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Supervision system for Chinese port safety and proposals for its improvement

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SUPERVISION SYSTEM FOR CHINESE PORT SAFETY AND PROPOSALS FOR ITS IMPROVEMENT

BY

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China

A research paper submitted to the World Maritime University in partial fulfillments of the requirements for the award the degree of

MASTER OF SCIENCE

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2016

Declaration

I sincerely declare that this master dissertation is under the guidance of my supervisor and it is finished by myself independently. Except the content which has already indicated that quoted from reference, other parts of dissertation are not plagiarized from any published material.

The people and community who contribute to my work is appreciated in the dissertation.

I fully understand the legal consequences that will be caused by this declaration and it will be undertaken by myself.

Supervised by

Professor SHI Xin

World Maritime University

Acknowledgement

First of all, I would like to show my greatest appreciation to Professor Shi Xin, Professor Shi offers so much help for me to complete my dissertation and he is so generous to share his professional knowledge with me, he is willing to answer my questions at any time, and also, he provided many valuable opportunities for me to look into my topic.

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Last but not least, I am showing my deepest love and heartfelt thanks to my parents, thanks for their unconditional support and encouragements when I am writing my dissertation.

Abstract

Title of Research paper: **Supervision system for Chinese port safety and proposals for its improvement**

Degree: **M.Sc.**

As the transport hub for city's waterway and sea transportation, port takes a very important position in the modern integrated transport network. Port safety is significant for port's operation, construction, development and Realization of the social function.

In this dissertation, I'm going to analysis the current situation of the safety management of the port and study the existing port safety supervision mode which is used by the port administrative department, thereby, I can put forward my own views on how to improve the regulatory system.

At the moment, China's port construction is in a stage of rapid development, the construction of a large number of petrochemical terminals, bulk cargo terminals and container terminals has brought heavy pressure for safety management.

Meanwhile, The revolution of port system brings new problems to the safety management of the port.

KEYWORDS: port safety, port safety management, supervision system problem, accidents

Catalogue

Declaration 2
Acknowledgement 3
Abstract 4
Catalogue 5
Chapter 1 Introduction 7
1.1 Background 7
1.2 Methodology 8
1.3 Outline of the paper 9
Chapter 2. Literature Review 10
Chapter 3. Significance of port safety management 12
3.1.World port safety statistic 12
3.2.Port safety statistic in China 16
3.3. The significance of port safety management 18
Chapter 4. General analysis of port safety management around the world 20
4.1. Theoretical analysis of threats and factors which have influence to port safety 20
4.1.1.Natural threats and factors 20
4.1.2.Technical threats and factors 22
4.1.3.Political threats and factors 23
4.1.4.Human threats and factors 24
4.1.5.Environment threats and factors 28
4.2. Analysis of positive tendencies inforeign port safety management 29
4.2.1. Shoreham port 30
4.2.2. Peterhead port 32
4.2.3. Canadian port 34
4.2.4. Common ways taken by foreign ports to ensure their safety operations 35

Chapter 5. Problems of and solutions to improve Chinese current port supervision system 37
5.1. Existing problems of Chinese port safety management 37
5.1.1. Weak supervision power and lack of supervisors 38
5.1.2. Incomplete specialized management system 39
5.1.3. Unclear boundary of the port safety management 40
5.1.4. Incomplete system of emergency response 41
5.1.5. Imperfect laws and regulations of port safety management 42
5.2. Solutions to improve supervision system of Chinese ports 43
5.2.1. Strengthen the supervision power 43
5.2.2 Publish safety manuals and constant monitor their realization. 44
5.2.3. Establish a systematic and standardized safety inspection system 44
5.2.4. Reclassification of responsibilities 46
5.2.5. Build up emergency response system 46
5.2.6. Improve employee's skill 47
5.2.7. Using of automated equipment 48
5.2.8. Using of remote operations 50
Chapter 6.Conclusion 51
References: 52

Chapter 1 Introduction

1.1 Background

Due to the convenience and high speed service that shipping brings to us, a growing number of cargos which are chosen to be transported by ships. Since port plays a very important role in shipping transportation, it has got rapid development. However, accidents start to occur in port because of the frequent actions, port safety management is highly required not only by shippers, but also charterers.

I did some research and found out that Chinese port safety management still has some defects. Also in recent years there were a series of accidents which had a dramatic effect not only on port personnel and infrastructure but also brought environmental threats, had a great economical impact and endangered well being of a common people. For example, the explosion of dangerous cargo in Tianjin Port caused giant losses on August 12nd 2015. Thus, from my opinion it is obvious that the development of Chinese port safety management is the question worth to be discussed.

In this work I am going to put forward a number of proposals for reasonable development of Chinese port safety management after I analyze three cases of foreign ports management.

The state's marine transportation system provides an effective means of carrying big numbers of cargo with the most economical and least environmental impact. For example, one average vessel can move the same quantity of cargo as 2800 trucks, or seven 100-car unit trains, which makes it the most efficient in fuel consumption, air emissions, and number of accidents, altogether it allows reduce transportation costs significantly in comparison with other transportation means.

With all these strong points of marine cargo transportation, a big number of safety issues

regarding labor and environmental impacts requires attention. And ports being the most important component of marine transportation industry, face the biggest challenges to provide safe operations and least impact on people's lives. The sharp increase of a number of cargo, transported by maritime means was adequately followed by the sharp increase of goods arriving, leaving and being (storaged) at ports. With the constant flow of cargo it is becoming more and more difficult for maritime transportation to keep safe record and remain the safest mean of transport. With competitors (such as airway, highway and rail) improving their own safe performance, the maritime industry is in need to follow the process of continual improvement of its safety strategies and to keep identifying new threats and hazards and also strengthen response to existing ones.

With all mentioned above, in my point of view port management and port personal have a unique responsibility to adopt relative practices and working system that is able to maintain adequate safety level while ensuring economic growth and development with preserving natural resources and environmental integrity at the same time.

I did some research and found out that Chinese port safety management still has defects. Also in recent years there were a series of accidents which had a dramatic effect not only on port personnel and infrastructure but also brought environmental threats, had a great economical impact and endangered well being of a common people. For example ... Thus, from my opinion it is obvious that the development of Chinese port safety management is the question worth to be discussed.

In this work I am going to put forward a number of proposals for reasonable development of Chinese port safety management after I analyze three cases of foreign ports management.

1.2 Methodology

This dissertation starts with the identifying risks and hazards for port safe operation and methods of adequate responses regarding those risks and hazards. Then it is followed by

cases of foreign port safety management, and learning from foreign management experience, it reflects the shortages which exit in Chinese port safety management. After analyzing the duties of different departments of the Chinese port authority for port safety supervision, and taking into account the usage of Publish security management theory and System management theory, consisting of Research proposal method and Experience summary method, I am going to discuss about the possible improvements for Chinese port safety supervision system.

1.3 Outline of the paper

Chapter 2, literature review, intends to overview the related researchrecourse and some problems existing in completing this paper. **Chapter 3**, **significance of port safety management**, I'm going to put forward statistics based on real data from internet and discuss it in this chapter to show the world port accident rate, statistics on Chinese port accident rate is followed after. The final part of this chapter is going to put forward the view that the port safety management is very important. **Chapter 4, general analysis of port safety management around the world**, this chapter includes the theoretical analysis of variable kinds of threats, risks, hazards and factors which have influence to port safety and preventive measures to avoid them totally or keep the effects of them on port operations as low as possible, as well as three cases of foreign port management from different countries of the world, and learn experience from the supervision measures which foreign port authority is taking to avoid to avoid serious casualties for port operation availability. **Chapter 5,problems of and solutions to improve Chinese current port supervision system**, this chapter can be divided into two parts, the first part is about the current situation of Chinese supervision system and the existing problems which cause the trouble of port authority' s work, I will also list several problems in this chapter, the next part is about solutions to improve supervision system of Chinese ports, I intend to talk about some executable solutions which I think can solve the problems above and make the supervision system more perfect.

Chapter 2 Literature Review

Research recourse on port safety management

First of all, the topic that I am going to analyze is the problems of supervision systemforChineseportsafetyandthe methods for its improvement, the articlewritten by Shi Jiangdong (2007) talked about the necessity for port security regulatory which can explain the meanings for me to study this topic.

Moreover, the factors that can influence the port safety is planned to be analyed, Huang Yong et al'sacrtical (2006) listed several factors which may cause the port accidents, it's very useful for me to form my view about this chapter.

The following is cases study, I plan to choose some foreign ports and analyze their common ways to deal with the port safety management in which Chinese ports are not doing so well. Shoreham Port (2010) and Peterhead port authority (2015) can support to complete my foreign port management study, as well as Xi Ou et al (2014), the article shared much abroadexperience about transportation of dangerous goods safety management.

Sun Guoxing'sarticle (2004) discussed about the current situation of port safety management and alsothe relevant solutions, and I learned more of this from Zhang Guangjing (2012) and Fu Zhaoming (2015)，while Sheng Shisheng (2014) talkedabout the problems existing in Chinese port safety regulation specifically and Wu Yiliang (2006) emphatically analyzed the methods can be used for the problem of unclear responsibility boundary for different departments. Since different authors had the different conclusions for problems and solutions, I can summarizedifferent opinions and get my own results.

Existing problems

I found quite a lot resources such as the articles from Sun Guoqing (2004), Zhang Guangjing (2012), and Fu Zhaoming (2015) which discussed about the problems of

Chinese current port supervision system and the methods which can be used to improve it, however, none of them talked about the methods in a practical way, they are lack of cases to illustrate.

Another problem that I met is the lack of date for Chinese port accidents rate, the only resource that I can find it from "Statistical analysis of traffic safety accidents" published by Safety Committee of the Ministry of transport (2016.5). By contrast, the world port safety date is easier to find, such as Rosa-Mari Darbra'sarticle (2004) and data from Port Skills and Safety (2014).

All in all, before I finish this paper, I still need to consult more information,the way is long to go.

Chapter 3. Significance of port safety management

This chapter is about statistics of accidents happened in seaports, factors which are leading to these accidents.

3.1.World port safety statistic

Statistics about port accidents are gathered and published by a lot of individual ports or special control organizations all over the world. I have gathered such statistics from different open sources (Port Skills and SafetyOrganization, Great Britain, West Gulf Maritime Assc, USA, Trade Supervisory Body, Germany,Rostransport, Russia).

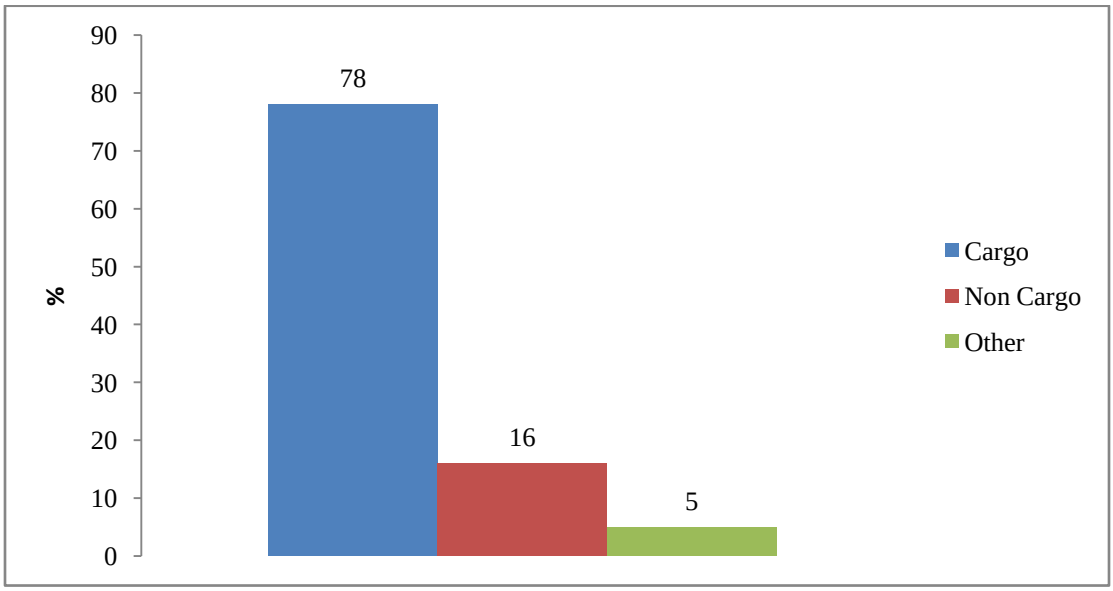

Figure 1. Graph of cargo and non-cargo handling area accidents.

Source: Port Skills and Safety, (2014.9), *Port Industry Accidents Statistics 2014 Half Year*

According to Figure 1 it is clearly seen that majority of port's accidents happen during cargo handling, with 78% (Port Skills and Safety, 2014.9)of all accidents happen during handling of operations related to cargo. It is quite understandable because the main purpose of port is receiving storage and sending different cargo, thus the majority of port operations are cargo related. At the same time 16% (Port Skills and Safety, 2014.9) of accidents

happen during execution non-cargo handling operations.

As it was mentioned above the main purpose of seaport is receiving and sending various goods which are being transported via maritime means. In general, every certain cargo which arrives or is about to be sent from seaport coming through several similar processes. Through these processes we can point out seven different categories to indicate the place or activity in which the accident occurred. These categories are transportations, storage, load / unload, process plant, warehouse, domestic / commercial and waste. On Figure 2 you can find the origin of accidents which happen in the seaport.

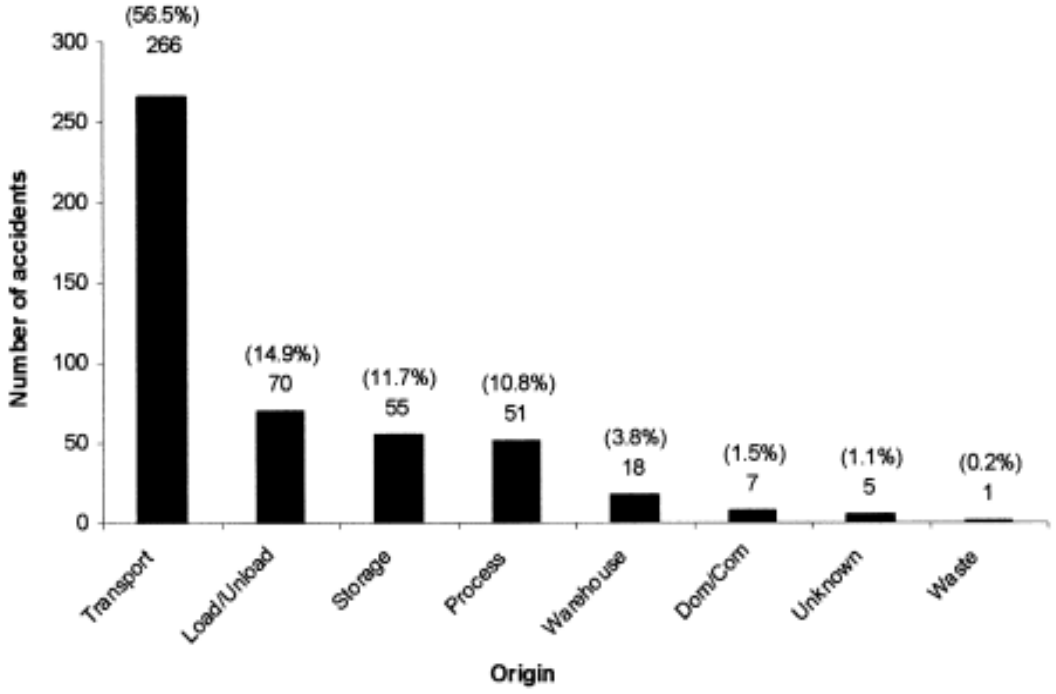

Figure 2. Origin of seaport accidents.

Source: Rosa-Mari Darbra, (2004), *Historical analysis of accidents in seaports*

From the Figure 2 you can see that majority of seaport's accidents happened during cargo transportation with the percentage of 56.5% of all cases. (Rosa-Mari Darbra, 2004) It should be noted that transportation category includes all accidents which happened during the moving of cargo while it is entering or leaving the port on board of the ship, as well as carrying it by trains and lorries during leaving or entering port facilities. Taking into account that the basic purpose of port is exactly the movement of goods it is no wonder at

all that the majority of accidents happened during execution of this process. For the same reason it is followed by load / upload category which has the percentage of 14.9% (Rosa-Mari Darbra, 2004)accidents happened during execution this kind of operations. In regard of port functionality loading and uploading goods are essential processes which involve lifting operations, so it is not a surprise that this category holds the second place in probability of accidents' origins. With lower but similar percentage come accidents happened in storage facilities and process plants both having slightly more than 10% percentage of occurrence. All other categories of risk origins have less than occurrence 5% rate.(Rosa-Mari Darbra, 2004)

For the purpose to indicate accident's location I have divided the port in seven major categories which are ship deck, ship hold, quay, store room, bulk facility, workshop and roadway. Majority of port operation happens in these seven locations.

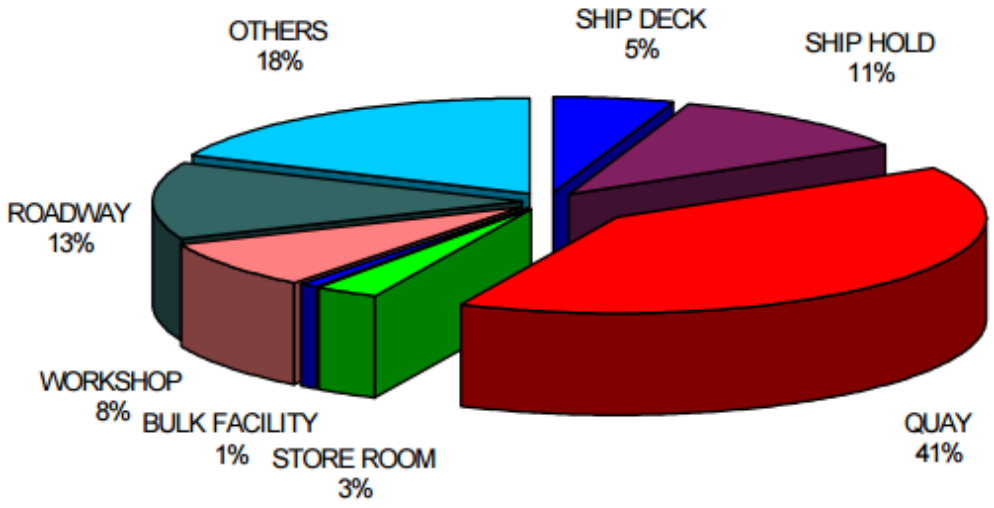

Figure 3. Location of accident.

Source: port safety statistic from Internet

On the Figure 3 you can see location of the port accidents in statistical format. From the figure it is clear that almost half of accidents happens at ports' quays, 41% of all accidents occurred in this location. It is quite understandable because quay is the essential port

location where a lot of transportation, loading / unloading processes take place. 13% of accidents happen at the roadway, mostly during cargo transportation and 11% of accidents occurred in ship hold location mostly during load / unload operations. Thus it concludes that in general transportation and load / unload categories of port's operations require the biggest attention regarding past experience of accidents. At the workshop location occurred 8% of all accidents which mostly come to processing category. Other location have less accidents' rate with 5% of accidents happen at the ship deck and less than 5% percent of them happen at store room and bulk facility. It also should be noted that 18% of accident happen in locations other than seven main port's locations.

Based on the gathered information I divided the most frequently occurred in port incidents in six groups. These groups are tripped, slipped, fell on level related incidents, driving related incidents, handling, lifting or carrying related incidents, hit by moving, falling or flying object related incidents, falling from height related incidents, hitting something stationary or fixed related incidents. From the Figure 4 you can see the proportion of all these six categories of port incidents.

Accident group	Percentage of accident occurrence
Tripped, slipped, fell on level related incidents	27%
Driving related incidents	16%
Handling, lifting or carrying related incidents	16%
Hit by moving, falling or flying object related incidents	10%
Falling from height related incidents	9%
Hitting something stationary or fixed related incidents	4%

Figure 4. The most frequent accident categories.

Source: Port Skills and Safety, (2014.9), *Port Industry Accidents Statistics 2014 Half Year*

From the Figure 4 it is seen that the most frequently occurred accidents belong to tripped, slipped, fell on level related incidents, the proportion of such kind of accidents is 27%. (Port Skills and Safety, 2014.9) It is followed by driving related incidents and handling, lifting or carrying related incidents which have the same percentage of occurrence – 16%.

(Port Skills and Safety, 2014.9)Hit by moving, falling or flying object related incidents have the proportion of 10% and falling from height related incidents and hitting something stationary or fixed related incidents have proportion of less than 10% with 9% and 4% respectively. (Port Skills and Safety, 2014.9)It is worth to be noted that more than 18% of all accidents belong to other categories rather than six most frequent categories of port accidents but at the same time all of them have significantly lesser percentage. Also listed six most frequent accident categories remain the same for a long years time period of observation and during all that period maintain their high proportion compared with other categories. That is why in my opinion these categories must remain the center of attention regarding port safety actions and problems of reducing accidents rates should be mainly focused on these six categories of port incidents.

3.2.Port safety statistic in China

According to "Statistical analysis of traffic safety accidents" published by Safety Committee of the Ministry of transport in May 2016, it tells that in the first quarter of 2016, the number of accidents in port operations and the number of deaths has a 40% year-on-year growth and an 20% chain growth. (Chinese Department of Transportation, 2016.5)And with the increase of the port throughput, the number of port operation accidents isin a growth trend, especially the reasons affected by the aging of some port machinery and equipment and the violating operations of port operators are the main reasons which cause mechanical injury accident and it should rise the highly attention of the port enterprises and the relevant administrative departments.

In the first quarter, the number of accidents involving mechanical injuries and deaths accounted for 80% and 80% of the total number of port operations. (Chinese Department of Transportation, 2016.5)The number of transport ship accidents and the number of missing and death have29.8% and 29%year-on-year growth separately, (Chinese Department of Transportation, 2016.5)supervision for waterway traffic safety still needs to be strengthened.

Among the transport vessel accidents, the accidents for transporting sand increased significantly, the accident number and the amount of deaths are accounted for 25% and 32.8% separatelyof total transport ship accidents, they are increasing 42.8% and 81.8% respectively and the chain base growth rate is 66.6% and 17.6%, (Chinese Department of Transportation, 2016.5)the reason of this situation is the increasing demand for sand to develop the engineering construction projects, motivated by the high profit, some illegal behaviors such asoverloading, inadequate allocation, etc.,happened all the time which seriously threaten the safety of navigation.

The accident rate of inland transportation also has increased, in the quarter one, the number of inland accident as well as the number of death goes up 67.4% and 131.8% respectively in year-on-year growth, the chain growth is 30.9% and 21.4%, it occupies 90% and 83.6% of the total.(Chinese Department of Transportation, 2016.5)

And because of the poor condition of ship technical and the weak consciousnessof safety of the crew, the proportion of individual ship accidents remains high, the number of individual ship accidents and the death number of missing, accounting for 90% and 83.6% in one quarter of the total transport ship accident with year-on-year of an increase of 144.4% and 61.3% and with chain growth of 13.6% and 6.4%. (Chinese Department of Transportation, 2016.5)

The accident rate of port operation shows an upward trend, this situation asks to focus on promoting the construction of safety production system, carry out the risk management of safety production, and strengthen the power to exclude the potential dangers in order to achieve a smooth start of the production of traffic safety.

		The proportion of total number of accidents	Year-on-year Growth	Chain Growth
Transport vessel accidents	The number of accidents	80%	29%	-1.20%
	The number of death and missing	80%	29.80%	-18.70%
Sand transport	The number of accidents	25%	42.80%	66.60%
	The number of death and missing	32.80%	81.80%	17.60%

Inland transport	The number of accidents	90%	67.40%	30.90%
	The number of death and missing	83.60%	131.80%	21.40%
Individual ship accidents	The number of accidents	90%	61.30%	13.60%
	The number of death and missing	83.60%	144.40%	-6.40%

Source: Chinese department of transportation, (2016.5), *national port operations accident: a quarter of the port machinery injury and deaths accounted for 80%*

3.3. The significance of port safety management

From the analysis above, it can tell that there has many kinds of factors that will lead to the occurrence of port accidents, and now the port throughput is getting larger and larger, so the port accident rate is relatively high, this will not only affect the efficiency and safety of the operation of the port, cause the damage to the employees and port facilities, but also bring environmental pollution and other issues. And with the ports being major hubs of domestic and international trade even a slow delay of operations due to some accidents can cause significant economical losses.

With all being said the port safety management is a necessary prerequisite for the safety operation of the port, it can reduce the loss caused by the accident of the portand maintain the safety of the port work, only after the safety of the port is ensured, the safety of personnel and property in port can also be guaranteed. Also even though the world port accidents rate is reducing from year to year, but Chinese statistics clearly indicated that due to rapid development of Chinese maritime transportation system, influx of international trade and continuation growth of Chinese economy, all Chinese ports are under great pressure and accidents rate keeps rising from year to year. For reducing economic losses and maintaining good reputation it is essential for Chinese ports authorities to turn this rate down and in a coming years significantly reduce accidents rate. For this purpose Chinese port authorities should implement the best practices of port management from other countries which managed to significantly decrease accidents rate during recent years. In a next chapter I am going to introduce some examples of port management which in my opinion could be used for Chinese ports in future.

Chapter 4. General analysis of port safety managementaround the world

4.1. Theoretical analysis of threats and factors which have influence to port safety

Since accidents always happened inadvertently, andsometimesthe occurrence of accidents can be the result of many factors, it's very necessary to understand the factors which caused accidents clearly so that people can avoid it from the very beginning.

From my point of view, the factors can be divided into four kinds, and I'm going to analyze them one by one in detail.

4.1.1.Natural threats and factors

Natural threats are brought by the changes of weather, the extreme weather such as typhoon, thunderstorm, hail, snowstorm, etc., always cause large economic loss for the port, usually the handling job is done in the open air.

Since they cannot be completely prevented, port can only try to implement better detection and early warning systems and also figure out how to limit the loss.Also it is necessary for port authority to implement some measures to provide training for working personal,publish safety manual about safety measures during and after natural disasters, make sure all work personal is acquainted with it. In every department assign a responsible person for notifying department personal about safety measures.

N	Threat	Chance of happening	Preventive measures

1	Earthquake	Low	In earthquake endangered areas it is necessary to use enforced structures and buildings so that in order of earthquake to minimalize casualties Follow earthquake warning announcements, closely work with earthquake warning centers in high risk areas.
2	Water freezing	Seasonal in northern regions	Constantly control weather forecasts, in case of temperature drop make a possible water freezing warning. In case of freezing water in time arrange ice breaker ship to make safe passage.
3	Typhoon	Seasonal in southern regions	Pay attention to weather forecast, make a typhoon warning. Offshore vessels and staff shouldnotice the dynamic condition of severe tropical storm and the change of climate carefully, and return to the port's shelter as soon as possible, and ensure the safety of water traffic: Strengthening all port facilities, prevention of ships anchor, grounding and collision.
4	Thunderstorm	Quite high	Take preventive measures before thunderstorm coming: build up enough tubes to drain away the water on the port, fix all ships, make sure they won't turn over.
5	Heavy snow	Seasonal in northern regions	In order to prevent the accumulation of snow, snow should be cleaned up in time, and main haulage roads should be unblocked.
6	Hail	Seasonal in all regions	Pay attention to the weather changes, prepareto prevent hail, protect the high value cargo on the ships, staff on board should stop working and find shelter immediately.

4.1.2.Technical threats and factors

The port operations are becoming more and more automatic at present including the vessels entering and leaving the port, cargos loading and unloading, obstacleseliminating, navigation etc. Altogether modern ports have a lot of high technology mechanical and digital equipment which are necessary to maintain.

Terminal production is closely connected withmechanical equipment, modern port loading and unloading operation are basically completed by mechanical equipment, it much faster than the original human handling operation mode. Modern production mode increasethe production efficiency dramatically.

It all depends on the high speed development of technology, high technology brings the convenience to the port operations, but at the same time, the failure of technology also will cause the bad consequences to the port and influence the port safety. Sometimes, technical threats can be lethal. That is why for a normal port operation it is essential to maintain all equipment in a good state. With the modern frequency of operations even a small malfunction can lead to consistent casualties which would result in delays and huge losses. It is not less important to constantly maintain the normal functionality of software equipment as to maintain hardware equipment. Modern automation level of all operations dramatically increased the productivity of all processes but at the same time it increased dependence of those processes from normal functionality of software equipment. Even small malfunction in software can lead to very serious consequences.

N	Threat	Chance of happening	Preventive measures
1	Mechanical breakdown	High	Constant maintenance of all mechanical equipment. Implement a schedule to check equipment's operational capabilities. Regularly check mechanical equipment according to schedule, timely fixing or changing malfunctioned equipment.

			Regularly check whether equipment guarantee working period has not expired. Timely exchange expired equipment. Hire professional repairman to fix the machineproblem in time. Possess the standby machines to ensure port operations can keep working. Train all employees who work in the port, make sure they have the ability to deal with the mechanical failure.
2	Software breakdown	High	Implement a schedule to check software operational capabilities and updates. Regularly check the software, make sure all software is updated. Train the employees to use the software practically. During introducing new software organize training for personal, make sure that personal is familiar of using it

4.1.3.Political threats and factors

Political threats is involved with the actions of the government, the alteration of country's policy will affect the port production.

For instance, if the country is in a war, it is very dangerous to transfer the cargo in that country's port, thus, many ship owners will choose not get close to that area, and it will cause the low production of the port.

It is important that port authorities should be ready to such kind of challenges and make all their best efforts to prevent them from happening and minimalize the casualties in case such accidents would take place. Working personal also have to be acknowledged of what actions to take in case of such accidents.

N	Threat	Chance of happening	Preventive measures
1	Terrorist attacks	Low (recently is higher)	Strengthen the internal and external monitoring, alarm system. Make sure that unauthorized persons cannot enter port territory. Strengthen security of high risk areas such as storages and warehouses. Take collision prevention measures to limit the loss if terrorist attack happens. Establish an specialized surveillance office. Train the employees, make sure everyone have the ability to escape and self-saving.
2	War	Low	Build up enough shelters for all staff. Establish an air defense warning. Train the employees, make sure everyone have the ability to escape and self-saving.

4.1.4.Human threats and factors

On account of the importance that people have in all kinds of work, human is a very significant factor in port safety, because usually people make the crucial decision, and any change of the conditions of people like physical condition, age, ability, and also the consciousness of safety, can affect people's actions, that's why human factor must be paid attention to.

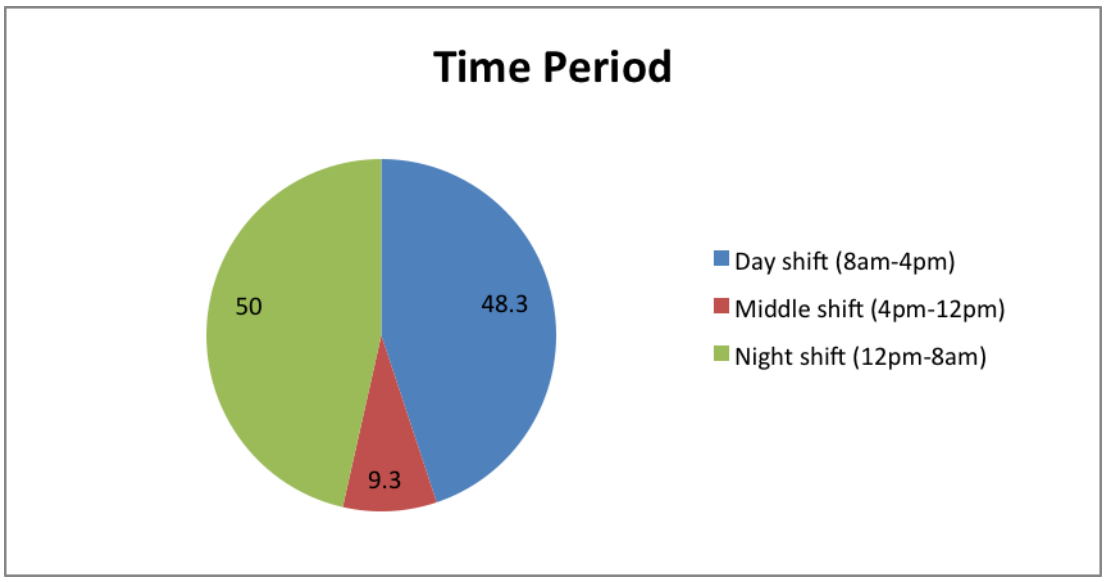

Figure 1 – Accident rate in port based on different time period

Source: HUANG Yong, MAO Bao-Hua, (2006), *Port safety management system, P12*

From the graph showed above, we can tell that the port accident rate from day shift and night shift is higher than the accident rate from middle shift. Because of the working condition in the daytime is much better than the condition at night, most of the time, a plenty of works are done during the day shift, workers pay more attention to the speed of work, but neglect the quality of service, thus, accidents happen quite often and port safety is not guaranteed.

However, the working condition at night is so poor, the working place is lack of light, and tiredness starts to take over workers thoughts after midnight, under this circumstance, workers can be negligent and errors in operation might increase, that's why the accident rate is higher.

In general speaking, physical condition has very important effects on port safety.

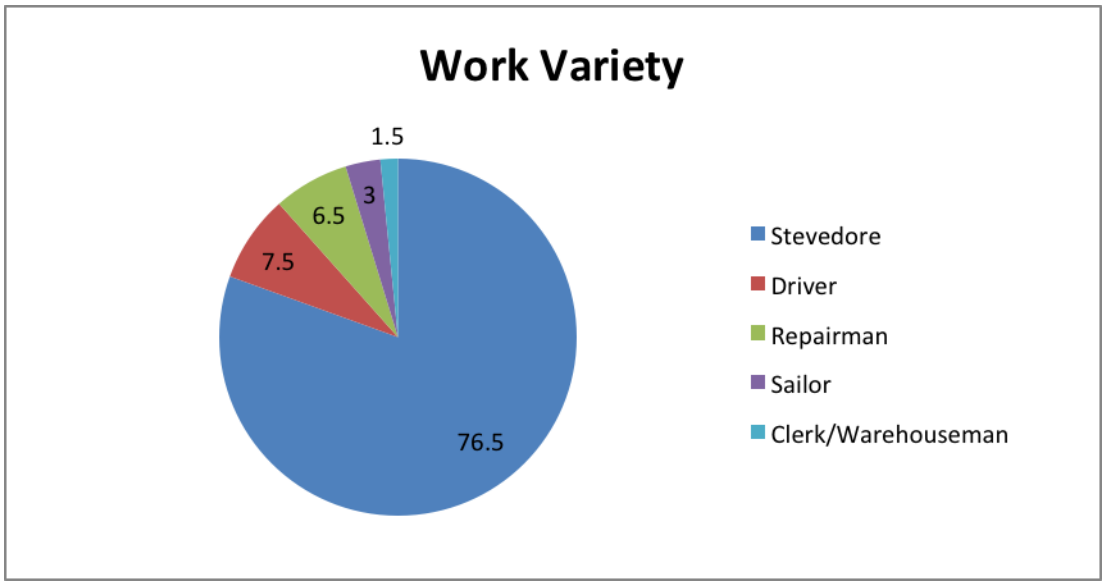

Figure 2 - Accident rate in port based on work variety

Source: HUANG Yong, MAO Bao-Hua, (2006), *Port safety management system, P12*

Different varieties of work cause different rates of accident. It can be seen from the graph that the overwhelming majority of accident rate is brought by stevedore.

Stevedore always needs to get in touch with hazardous cargo according to their job requirements, and any inappropriate transportation for hazardous cargo can cause serious accident in port, so the rate of accident which caused by stevedore is the highest.

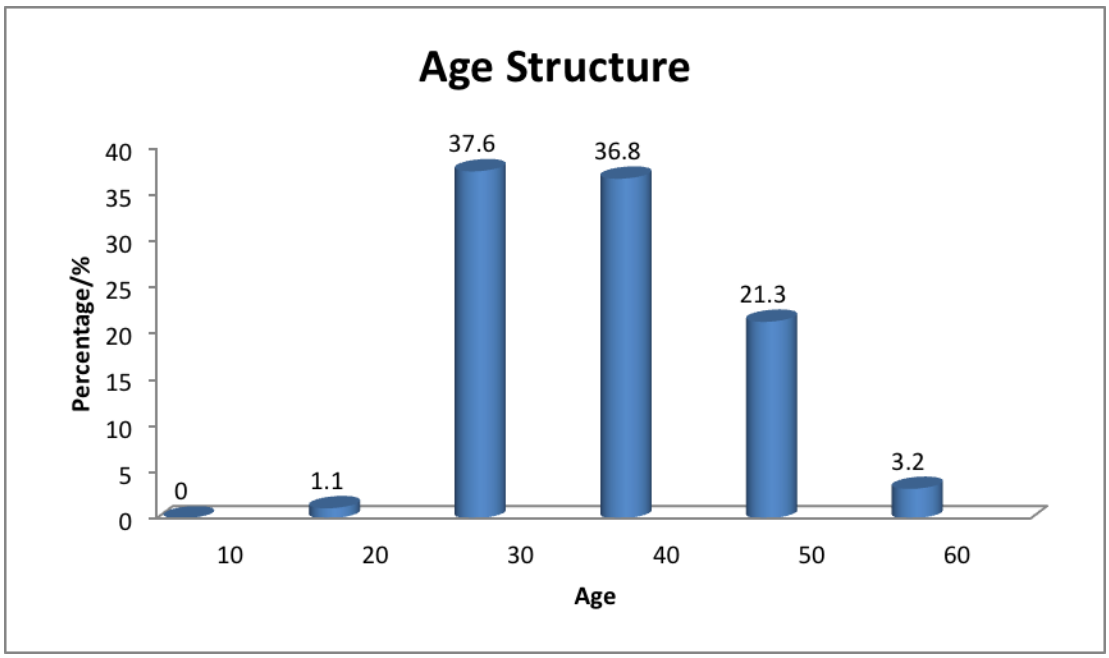

Figure 3 - Accident rate in port based on age structure

Source: HUANG Yong, MAO Bao-Hua, (2006), *Port safety management system, P12*

Usually elder people is assigned to do paper work, it's very rare to have accident in the office, and most of the handling job is completed by youngsters, therefore, it showed in the bar charts that the accident rate caused by the people aged between 20 years old and 40 years old is the highest, it's constituting almost 75% of all. (HUANG Yong, MAO Bao-Hua, 2006, P12)

In addition to the factors which has already been mentioned, lack of safety coconsciousness and weak capacity of operation are also the human factors which lead to the rise of accident rate in port.

N	Threat	Chance of happening	Preventive measures
1	Physical condition	High	Increase the quality of service in the daytime, Improve the working condition at night.
2	Work variety	High	Stevedore should be well trained and the work of stevedore should be managed emphatically.
3	Age structure	High	Pay more attention to the young workers at

			port,improve their safety consciousness and capacity of operation.
4	Safety consciousness	High	Give the necessary information to allemployees,let them realize the importance of keeping the port safety.
5	Capacity of operation	High	Train the employees, improve their capacity of operation.
6	Management fault	Media	Use Classification management for different kinds of cargo and variety of work, dangerous cargo should be managed emphatically.

4.1.5.Environment threats and factors

Port should attach importance to protecting the environment, serious accident can occur because of the environment pollution, such as the leakage of oil, it is caused by the crash of the vessels, the explosion can easily happen because of a little fire when the oil is floating on the cover of surrounding water of the port, it is a big threat to the port safety operation.

Poisonous gas is another factor that have bad influence on human's health such as CO, CO2, SO2 etc. It comes from the navigation of the vessel when the vessel doesn't use clean energy and Cargo loading and unloading operations and other activities can also produce poisonous gas. Also, the noise can cause the bad emotion of employees.

The change of environment such as the rise and fall of temperature, the change of the humidity will easily rise the explosion of dangerous cargo, Once the explosion happened, it will endanger the safety of the port employees and damage port facilities.

N	Threat	Chance of happening	Preventive measures
1	Leakage of oil	Low	Examine the vessel before sailing.

2	Poisonous gas	Medium	Monitor the vessel's navigation route. Command the vessel operation when it is entering the port area. Improve employees' working ability. Require all vessels to use clean energy. Install the converter which can purify exhaust gas on the vessel.
3	Noise	Medium	Reduce the loudspeaker's voice if it is needed to command the port operations. Build up the acoustic panel to reduce the noise.
4	Explosion of dangerous cargo	Medium	Monitoring the status of dangerous goods constantly. Report any changes no matter how small it is. Use advanced equipment which can reach the high demands to store the dangerous cargo, and keep the stability of the environment.
5	Spread of epidemics	Medium	Make sure that all cargo and ship crew members entering the port are checked accordingly state medical standards. Infectious disease control officers should inspect all arriving cargo. Ships coming from high risk epidemic areas should be quarantined according state medical norms. Medical examinations should be performed on crew members.
6	Spread of invasive species	High	Control officers should inspect all arriving cargo whether it contains any invasive species.

4.2.Analysis of positive tendencies inforeign port safety management

This chapter is about the measures that foreign ports take to supervise port safety and

ensure port operation safely and efficiently, three cases will be analyzed separately, and after the discussion, the experience can be learned from foreign port.

4.2.1. Shoreham port

Shoreham port is one very successful port from Great Britain, it devoted itself to developing and regulating the operations at sea in order to keep the safety of all the port area as well as all users in port and public environment. It also makes efforts to comply with all law requirements and the Port Marine Safety Codewhich is the UK national standard for all harbor authority, at the same time, trying its best to meet the variety requirements of different port users. Thegoal of Shoreham Port is protecting the benefit of all users and the safe, high efficient, cost-effective operations of wider communityand also keep the port work to run sustainably.

Shoreham port commits itself to making sure that all employees are informed and have sufficient knowledge and skill to complete the port operations and follow the Port Marine Safety Code, Shoreham port has the point of view that the safety of the port is not only decided by the high technical equipment, but the supervisors of the port and the positive safety management culture. Safety is the prior to anything in port and everyone in port has the responsibility to keep the port safe.

Risk recognition, risk assessment and records of accidents are very important to port Shoreham, because employees can learn experience from happened accidents so that they have basic knowledge about how to handleemergencies.

All stakeholders are welcomed by Shoreham portfor maintaining the participation and improving the awareness of safety of all workers in port. Shoreham port has different authorities for supervising its port safety, but the responsibilities for each authorities are very clearly divided, everyone do their own job without interrupting others.
The Board at Shoreham port is one of the duty holders, Board members are asked to understand all standards in Port Marine Safety Code**.** Port authority of Shoreham port is responsible for the management of port security and efficient operation.Board of directors

at Shoreham port has the responsibility to ensure the executionofduty of port authority, also the board should make sure port authority follows the Port Marine Safety Code.

The main duties for Shoreham port authority are as follows: (Shoreham Port, Safety Management System, 2010)

1. Administrate port's assets
2. Maintain port equipment to reach the industry standards
3. Perform the duty for offshore operation
4. Recruiting and training the operators to the competitive level
5. Make sure that all staff are well trained for dealing with any accidents

In order to perform all above duties, the port authority has appointed the port master to help safety operation officer to complete their jobs. Safety operation officers are responsible for: (Shoreham Port, Safety Management System, 2010)

1. Make sure all risks are under the assessment, and limit the risk to the reasonable level
2. Investigate, record and report all happened accidents, ensure that all relevant staff can search and learn experience from these data
3. Carry out the routine inspection for all marine operating equipment, and assess the risk for them
4. Build up the safety committees, examine relevant marine business regularly and feedback the results
5. Replace the board of directors every 3 years

Harbor superintendent is nominated by port authority, the duty of harbor superintendent is keeping the port running safely and efficiently, and its particular tasks are: (Shoreham Port, Safety Management System, 2010)

1. To make sure that all workers at port can work safely;
2. To promote the methods of safe navigation, maintain the access to sail to the port;
3. To provide and maintain all available port facilities;
4. To supervise all regular port activities, and ensure that the law can be complied when it is necessary;

5. To formulate the relevant pollution treatment and nature protection methods to protect and maintain the environment;
6. To examine and correct the port's plans, policies and procedures every five years.

The port authority of port Shoreham consider itself as a body which has the duty to guarantee the safety of all its employees and all vessels and properties when they are in the port area. The duty also includes the safe use of port facilities, protecting the surrounding environment and dealing with the accidents when it happens.

4.2.2. Peterhead port

Peterhead port is the easternmost deep water port which based on the mainland of Scotland, and it is one of the largest fishing port in Europe, the inner port offers modern bay facilities to deal with all aspect of fishing industry and the facilities are distributed to several bays. It's a challenge for Peterhead port authority to keep the port operating safely.

The authority of Peterheadport follows the Health and Safety at Work Act 1974 in order to provide a safe and healthy working environment for all port employees. The aim for authority is minimize the accident rate and try to build up the non-accident working environment to let the employees feel at ease when working. And the port authority will accept and guarantee to perform their duty to protect marine personnel, ship crew members, passengers andall other people who have the right to use the harbor or getting into the port area.

Under the premise of the port authority, it will try its best to keep the safety of all port employees, the authority puts forward an opinion that each individual person who is related with marine operations have the responsibility to take care of the welfare of their own as well as others, and to report any situation that may cause a threat to the port.

In order to achieve the goal, all employees in Peterheadport will be well trained so that all of them have the skill to operate all port facilities and have knowledge on how to supervise and deal with the accidents.If the employeeis not sure about how to perform a specific task

or feeling it's a risk to perform the task,it is required for employee to report the situation to the port master or harbor superintendent. An effective marine operating system needs continuous communication between superior leaders and subordinates.

And it is the responsibility for employees to report all potential dangers for port operation no matter how small the danger is to harbor safety officer so that every hazards can be recorded and learned at the next time. It has to be mentioned that Peterhead port has a marine health and safety system, it requires everyone involved to record and report any threats or any accidents to the system, thus, the employees ought to report dangerous actions immediately.

The board of Peterhead port is the duty holder, it consists of 10 members who are assigned by the port authority, the board members are appointed to do the following jobs: (Peterhead port authority, 2015)

1. Maintain all aspects of strategic supervision and direction of port operations, including the safety of maritime;
2. Responsible for developing port policies, port plans, and safety of navigation systems and procedures;
3. Ensure that all assessments and examines are according to the port needs, in order to maintain and improve the safety of Marine;
4. Make sure that the port authority is seeking and using the appropriate power for executing laws and regulations, and setting the level of the fee which can be the funds to fulfill all the duties.

Risk assessment is a very important task for the port authority of Peterheadport,it can help the port authority to recognize the risks which will influence the safety of port personnel, port users and the public environment. The risk assessment can identify the causes of risks and the results risks would bring. This information will be used to decide how to manage these risks and make decisions under a sensible, rational and structured manner, and the actions can be taken in an appropriate way.

The risk assessment is done and learned by employees who are trained for assessing port risks, and after that, the employee should decide whether a further study should be taken to learn more details about the risks. The risk assessment methods which Peterhead port adopts are as followed: (Peterhead port authority, 2015)

1. **Recognize the risks**: identity the risks as soon as it appears;
2. **Estimate who may be injured and how**: in order to learn better about the risks, the people who may be injured should be identified, it can help to lower the damage when the risk really happens;
3. **Assess the risks and decide preventive measures**: evaluate the possibility of risks happening, the way of risk appearing and the results that risk could bring, then the preventive measures should be considered;
4. **Record the investigation and bring them out**
5. **Review the assessment and update it when it's necessary:** review the former assessments to learn experience from happened risks, new risks are asked to be recorded in time when it arises.

4.2.3. Canadian port

The experience about dangerous goods transportation management also can be learnt from foreign ports, the safety of waterway transport of dangerous goods has attracted great attention from all over the world since the dangerous cargo is the main factor that influence the safety of the port.

In Canada, in order to strengthen the management of the transport of dangerous goods, safety supervision authorities have formed a relatively complete system of laws and regulations, andthe laws and regulations which applied for Canadian ports are consistent with the requirements of the international dangerous goods transport regulations, "Canadian dangerous goods transport regulations" also refers to the main content from "international dangerous goods transport rules" and "international maritime dangerous goods rules", (Xi Ou, Zeng Yamei, 2014)it makes the domestic dangerous goods transport management become both unified inland and highly connected with the international rules.

The safety managementof dangerous goods taken by Canadian port is fully reflecting the safetyand responsibility's principle which says the enterprises are responsible forfollowing the rules while the government is responsible for supervising, the safety of the transportation of dangerous goods should be completely guaranteed by the enterprise, the boundary of liability of the government and enterprises is very clear.

In order to increase the management efficiency tothe enterprises, the Canadian port authority adoptsadministrative punishment system for dangerous goods transport. The way of punishment is described as the separation of supervision and punishment, when the port authority found out that the enterprise or the individuals have involved in violations, it has to be submitted to the court to monitor the investigation report, and then decided by the court on how to execute the punishment. According to the "Canadian dangerous goods transport regulations", (Xi Ou, Zeng Yamei, 2014)the offender can be sentenced to a fine of five thousand to one hundred thousand Canadian dollars, since the amount of penalty is quite large, the effect of this rule can also be deterrent.

In the process of dealing with dangerous cargo accident, accidents are investigated by the Canadian Federal Bureau of transportation accident investigation and safety rather than investigated by transportation department, but when the accident happens, it allows the transportation department to send the inspection division or technical experts to provide technical advice, help, operation inspection and analysis instruments etc. on the spot.Department of transportation can also check outwhether the unit or the relevant personnel are in violation of rulesbased on"Canadian dangerous goods transport regulations". (Xi Ou, Zeng Yamei, 2014)When the accident occurred in the waterway,the local authorities should be notified in addition to notify the Canadian Federal Bureau of transportation accident investigation and safety and transportation department.

4.2.4. Common ways taken by foreign ports to ensure their safety operations

First all of, the boundary of responsibilities for each port department is well defined, there

has no problem such as duties overlap, however, the responsibility overlapping problem is very common at Chinese ports. Secondly, each port has unified rules to follow, for example, Shoreham port followsthe UK national standard which calledthe Port Marine Safety Code, and this standard is used for all British harbor authority, on the contrary, in Chinese port safety management, each department has their own standard for enterprise, it confuses the enterprise which standards to follow. Once more, each port which was analyzed above requires every port employees to be well trained, all of them must have enoughknowledge and skill no matter on the port operations or dealing with accidents, Chinese port safety management is always lack of employees so that usually employees are not trained so well before officially working, some of them even don't have any port relevant knowledge. Lastly, foreign ports attach great importance to information timely updated, like Peterhead port, the risk assessment work requires every risk no matter how small the risk is to be reported and recorded as soon as it is found, this always can be learned by Chinese port.

Chapter 5. Problems of and solutions to improve Chinese currentport supervision system

After analyzing foreign cases of foreign seaports safety management and data about current situation with supervision system of Chinese seaports I have listed some problems of Chinese supervision system which in my point of view prevent to improve general safety level of Chinese seaports. After it I put forward solutions which can lead to a significant modification of supervision system and safety of seaports in China.

5.1. Existing problems of Chinese port safety management

Currently, the port construction in China is in a stage of rapid development, under the threats brought by different factors which are discussed above, port safety is strongly affected, and the fast construction of petrochemical industry terminal, dry bulk terminal and container terminal, as well as the automation trend of machinery and equipment, has led to large pressure of port safety management.

Under the current supervision system, a majority of the port accidents have been avoided before it happens, so in general, the situation of Chinese current supervision system can meet the port safety production needs, however, some serious accident still occurs during the port operation because of thedefective of supervision system, and usually it comes with huge damage and loss to the finance of the port. And as it is seen from statistics of Chinese ports the accident rate is keeping its rising from year to year. This is one of the major problems which ports authorities are facing these days.

For example the explosion of hazardous goods warehouse of Rui Hai company is one case of extraordinarily serious accident happened in Tian Jin port which happened very recently, it caused huge economic and property losses: 165 people were killed, 8 people were missing, 798 people were injured and 7533 containers were damaged in this accident, it

also caused the bad pollution to the ocean due to the expand of harmful chemical. This disaster exposes the shortages of safety assess of current supervision system, supervision system is badly in need of improvement.

Port safety production is very closely related to port supervision, it claims the necessary of strengthen the port security supervision for port authority, and before the discussion about the improvement of Chinese current supervision system, the problems should be clearly understood, so the existing problems will be analyzed from different aspects in the following chapter.

5.1.1. Weak supervision power and lack of supervisors

Although almost all of the ports have already built up port authority, there are still some ports have not set up special administrative departments of ports and the amount of supervisors is not enough so that the supervision work is lagging. Unlike the above mentioned examples of foreign ports where authorities pay a great attention to a sufficient number of supervision power at each port areas, in China the lack of professional supervisors is also very serious problem, with the expansion of the scope of the safety supervision of the port and the increase of the supervision matters, there is a conflict between the limited law enforcement resources of the safety supervision department of the port.

What makes it worse isquite a few workers are not professional in port supervision, some of the supervisors haven't involved into port safety management before or they have very little knowledge about port enterprise.Due to a rapid and fast development of Chinese maritime transportation system and its port infrastructure, it is always in need of fresh labor force, but new coming supervision personnel is not always quite ready for port duties from the beginning. That is because the establishment modes of port authoritiesare quite different, and employees come from different departments, some are from roads and traffic authority, some are from port enterprises, and others are from other relevant industries to join in this port administrative department, the work can be very tricky for those employees who haven't involved in port management before and have very little relevant knowledge,

also most of them are lack of port working experience. The work position like safety management is highly technical, it puts forward very high requests for employees' knowledge and skill, at the same time, the significant changes have taken place to the modes, objectives and methods of safety management, employees have to adapt to the new working environment.

The management team can be set up, the establishment of the team will decide the quality and effect of port management, so it is ought to be constituted with a group of professional supervisors, otherwise, it will cause bad consequences.

Compared with the fast development of port, the supervision system cannot be guaranteed, rather than having more time to deepen this work, so it's highly required to strengthen the supervision power. Also in my point of view it is very important that every supervision departments should have some experienced personnel which can share their knowledge with fresh employees and in present situation there is some lack of such practices. In order to this exchange programs could be implemented when experienced personnel from move to another port.

5.1.2. Incomplete specialized management system

A it was mentioned in examples about foreign ports supervision system, all of them have a very well developed system which is able to supervise the whole area under the port's authority. At present situation in China, due to the various factors such as the improper structure of management system and insufficient allocation of personnel, thefunction of the port administrative department for supervising and inspecting the enterprise security management has not performedvery well, it is not effectivesolved and decided on what part of port enterprise safety should be supervised and the way that the port administrative department should use to supervise. So the incomplete port safety management systemlimits the effect of port safety management.

Besides, in the opposite to foreign seaports which operates under the authority of national safety standards which overview the whole volume of port's operation and duties,Chinese

management system is not incomplete because there has no management standards for different kinds of cargoloading, unloading and storage, it's very threateningfor the safety of port, especially the liquid dangerous goods such as oil, bulk liquid, chemicals, liquefied petroleum gas etc., can easily bring the danger to the port because of the inflammable and explosive nature of liquid cargo. However, the distance between warehouse and residential area is too close which can be regarded as a potential risk, the arrangement is not reasonable for storing dangerous cargo.

Classification management should be used for different kinds of cargo depends on their characters and also different standards for port authority to follow. Incompletemanagement system will only bring the great risk to the port safety production and potential accidents may not be discovered and solved.

5.1.3. Unclear boundary of the port safety management

As it was said in the case of foreign ports the boundary of responsibilities for each port department is well defined, there has no problem such as duties overlap.At the same time in China the boundary of responsibilityfor Port administration department and other relevant safety managementdepartmentsis not clearlydefined, the division of responsibilities is not clear, The overlapping of management responsibilities seriously restricts the effect of the administrative departments of the port on exercising the safety management responsibilities,the overlapping problem is quite prominent in many cases, local safety supervision and management department, the administrative department of port, the port enterprises, the Marine Department, fire department are allexercising the management responsibility to terminal safety operations.

At present, Shanghai customs is responsible for supervising the administrative licenses of domestic waterway transportation, the main task for customs is to accept and examine the previous business of companies, and also to monitor the subsequent business, it also needs to guarantee the qualification of enterprises, besides, the customs need to examine the management behavior of waterway transportation company. Shanghai port management center is in charge of supervising, managing and maintaining the safety operation of inner

port and land. The safety supervision for shipping out of outer port is under the charge of the maritime safety administration, for example, Shanghai maritime safety administration takes the charge of the shipping on the Huang Pu River.

Through the survey of Shanghai port authorities, it can easily find out that some aspects are supervised by different authorities, and this problem will bring drawbacks to the supervision work.

First of all, different authorities have different safety standards for supervisees even in the same aspect, it's rarely possible for supervisees to follow all these standards, so it will cause the demurrage of the work probably, but the demurrage should be tried to avoided in shipping. Secondly, due to the different goals that administrative departments follow, the decisions made by department will tend to their goal unconsciously, for instant, when a conflict happens between production and safety, the department who purchase high production will pay more attention to the throughput of containers but neglect the safety, however, the department who attach importance to safety will always put the safety at the top place, in other words, production is not that important anymore. Thirdly, because of the lack of information exchange between different authorities, usually they have different data bases, they cannot response to unexpected accident in time when it happens. The fourth point is the different extent of punishment, on account of the different standards, the penalties for supervisees are also different, it will come out the problem that the punishment is not fair for everyone. Last but not least, it's very hard to formulate the unified safety standards not only in safety managing, but also in training staff, rather than implementing them, it influences theimprovement of level of safety management for the overall shipping industry.

5.1.4. Incomplete system of emergency response

The port supervision system of emergency response is quite vulnerable, it does not work very well in risk recognizing, risk assessing and also risk monitoring, the system cannot give the early warning in time and react very slowly to deal with the emergency including recording and investigating the accident. As you can see from the examples of foreign ports'

safety management, they have an adequate systems to identify risks in each working areas, which Chinese ports not always have.

The capability of port authority for emergency supporting is weak when the accident happens, deficiencies exists in many aspects. First of all, the establishment of theemergency response team is still incomplete,because the amount of employees cannot meet the requirement of all work, no additional personnel can be assigned to do the emergency response work.Next, the distribution of emergency supplies and equipment is uneven, emergency supplies and equipmentcannot be distributed to every area evenly, that's why not all accidents were disposed in time. Once more, the safeguard from emergency funds is not reliable, the emergency funds are not always abundant, and port authority hasn't paid much attention to the funds reserve. Last but not least, the support from emergencytechnique is deficient, the risk assessment and accident disposition cannot leave without technical support, out dated technology is not reliable when accident happens.

Some port authority hasn't had any contingency plans, the rescue work carried out without arrangement when the accident happens. It causes the larger loss to the port facilities. The others although have already established emergency agencies, emergency rescue teams and contingency plans, the feasibility of the plan is not strong, the rescue capabilities is weak, and there still has many problems in the overall comprehensive coordination ability.

5.1.5. Imperfect laws and regulations of port safety management

The chief of the Shanghai terminal management center once indicated during the investigationthat the design of dangerous goods management system has defects, the design cannot match with the actual situation, so the system need to be revised.

As it was mentioned in cases about foreign ports, there they have safety regulations which fully cover all seaport operations. Safety management rules and regulations are the basis for the administrative departments of the port to exercise safety management responsibilities. In recent years, Chinese government has carried on the fruitful work in the

safety management legislation, the state has promulgated the "safety production law", "dangerous chemicals management regulations" and other laws and regulations,(Sun Guoqing, 2004)the Ministry of communications also has done a lot of work in the construction of laws and regulations on the safety management of the port. However, the loading and unloading operation specificationfor different types of cargo is lack of proposed standards, especially the safety management laws and regulations in liquid dangerous goods handling and storage, such as oil, bulk liquid chemicals, liquefied petroleum gas are imperfect. The safety management rules and regulations of the port enterprises are based on the enterprise's own situation, which is not compatible with the current port security management system. Therefore, it is an urgent task for the port administration department to formulate regulations to adapt to the management of the port administration according to law. The potential accident may not be discovered and handled in time because of the imperfect laws and regulations, no laws or rules for port safety management to follow, or the absence of safety management, and this willfinallybring great risk to the port.

5.2. Solutions to improve supervision system of Chinese ports

5.2.1. Strengthen the supervision power

More professional supervisors who hold enough knowledge and skill about port safety management should be hired, and it’s required to train the new staff to perform regulatory responsibilities. Training programs should be implemented with all supervision personnel participating in them and sharing their knowledge. After that, a professional team should be organized to perform the safety management responsibility, the establishment of the management team should follow the requirements and duties from the relevant rules, all safety management personnel are asked to be strictly trained with the professionalknowledge and technicalskill, so that the team can be guaranteed with very high quality.

5.2.2Publish safety manuals and constant monitor their realization.

Authority responsible for port safety should publish safety manuals for every factor, which can lead to the accident (according to Chapter 2.3). These manuals should contain explanation how these factors can affect port safety, which measures should be taken to reduce the possibility of affecting port safety and which measures should be taken in case accident happened.

Every port staff member should acknowledge these manuals and every department should have responsible person who have to ensure that every department personnel member is familiar with content of safety manuals. To ensure this process every stuff member should participate in specially designed examination. In case new information is added to the manual, responsible person should make sure that every department personnel is acknowledged with this new information.

In purpose to monitor the procedure of safety manuals' implementation, safety supervision management should edit schedule of periodical examinations for every port department, responsible person in every department should make sure that every personnel participates in periodical examinations to test their awareness of safety measures and risk factors (once every year or with other intervals according to department rules).

Every new hired personnel should be acknowledged with all safety manuals before starting to perform working duties. Afterwards they also should participate in periodical examination according to schedule for their departments.

5.2.3. Establish a systematic and standardized safety inspection system

Using different inspection standards for different work varieties. In waterway transportation, the accident caused by the dangerous goods always has very disastrous influence,it leads to personal injury, property damage and environmental pollution, sohazardous cargo is the key target to monitor.

The technology for dangerous cargo vessel is backward in China, some ship owner chose to transfer their dry bulk vessel to dangerous cargo vessel in order to earn higher economic interests, this makes the dangerous cargo vessel could not fully meet the standard requirements. Chinese port authority should join in the relevant international conventions actively such as MARPOL and SOLAS, both of them have made specific provisions on the aspects of the safety management of dangerous goods and the management of oil pollution. And under the premise of complying with the international convention, Chinese port authority should formulate safety management rules based on the port practical situation.

Risk identification is the basis of risk control, the main solution is to determine the existence, the nature and the consequences of the risk. As long as there has production activities in the port, the risk is existingeverywhere. So it's very significant to make sure all risks are under the assessment, but human monitoring is not enough to supervise all the risks, technical support should be used.

Video surveillance system can be set up in the port to inspect all port operations, any dangers will be found in time.Digital images with setting position according to where they were taken can be stored and constantly analyzed for the purpose to improve efficiency and review any internal or external port security threats or accidents occurred. Modern technologies and progress of digital image technologies today makes it easier to capture, storage, transmit and analyze large amounts of information by recording and operating digital images of high quality. High resolution ofphoto and videos and improved ability and speed of personal computer allowto deal with a lot of digital image contained in the big storages of data. Intelligent software has been created to operate with the images and videos to get the relevant and important information, which can then be stored or transmitted by different means when it is needed.

For example, the construction of the video surveillance system of Shanghai port terminal management center including Video surveillance center at the terminal, and another 4 surveillance stations, it changes the terminal center service mode, break through the single means of supervision, and improve the efficiency of supervision.

The accidents which has already happened should be recorded and reported, and also the data base should be built up to analyze the cause of accident and learn the experience from them.

5.2.4. Reclassification of responsibilities

With regard to the problem of unclear boundary of responsibilities, the chief of the Shanghai terminal management center also indicated that it does exist in the present work, at the same time, he put forward his views and opinions about this problem. He said “the responsibility in loading and unloading in port and the management of liquid gas is not clear for theterminal management center and the safety supervision departments”, “it is clear that Huangpu River is a river, it is in the management scope of terminal management center, the maritime bureau should hand over all the responsibilities to theterminal management center”.

To realize the separation of the government responsibility and the enterprise responsibility, duplicate parts should be eliminated, currently, the administration of the port authority is integrated with both the government responsibility and the enterpriseresponsibility, so the government part can be divided from the administration of the port authority and build up the local port authority to perform industry management functions, and port group is asked to take charge of the enterprise part and operate independently.

5.2.5. Build up emergency response system

Crew members in the port should be well trained on how to make the fast and correct response when accident happens. The team which specially for dealing with the emergency accident should be organized and the team is asked to be prepared at any time and examine the accident immediately when it occurs.

Complete the rescue network, make sure it can react at the first time, when the accident happens during the transportation of dangerous cargo, if the rescue is not timely or the

rescue method is not proper, it's very easy to cause the expansion of the danger, resulting in unexpected consequences, so the establishment of the rescue network can minimize losses of the port.

Using the modern management information system to track dangerous goods every second during the whole trip such as the RFID tags are used on the containers to track the physicallocation, and make sure the storage environment in the vessel can meet the requirements for dangerous cargo,once the storage environment changes, the system can send an alarm to remind the staffin time.

Establish complete contingency plans for emergencies. The port operator should formulate emergency plan for dangerous goods accident, passenger emergency evacuation and rescue plan for major production safety accidents as well as the pre-arranged plan for prevention of natural disastersin accordance with the laws and regulations, and make sure the plans can be implemented smoothly. The plans which port operator formulated for emergency have to be reported to the administrative department of the port and the local maritime institution of the port. Therefore, the port enterprises should not only pay attention to ensure the safety of production, but also to establish a corresponding emergency rescue management system to prevent accidents, emergency preparation and recovery work should be prepared in order to reduce the losses caused by disaster and prevent the secondary disasters.

The contingency plans should follow thetheoretical knowledge about safety system engineering, disaster prevention and reduction, safety management,as well as accident analysis and processing. Analyzethe occurrence, development and evolution of the accident based on research data and real information. Finally found the documentof the port enterprise emergency rescue plan.

5.2.6. Improve employee's skill

The supervision work cannot proceed very well because supervisors are lack of professional knowledge and skill on how to achieve the management responsibility, thus,

training for supervisors are highly requested. The port authority supervisors and enterprise producers are both needed to be trained to improve their safe consciousness as well as their working skill, well trained employees can be a competitive advantage to the port, because equipment malfunctions need to be fixed extremely fast when it occurs, it is the premise for punctual cargo handling, skilled employees are the guarantee for fast and safe work.

Since more automatic equipment are used in the port in order to reduce the accident rate caused by human factor, port employees are highly required to take the training courses, all of them should be taught by how to operate all kinds of equipment for safe handling and the procedure on monitoring, reporting, and recording accidents by using the graphics and video scenes, English courses also very important for those employees whose mother language is not English. All recorded data should be available for every personnel, and employees should learn to cooperate and communicate with each other.

Improve the treatment in the port, such as providing specialized program on health and safety and offer assistance for port workersif it needs toincrease the retention rates of old crew members, since it takes long time to cultivate an excellent staff.
Modern emergency response software should be installed to enable more efficient use of seaport emergency response system.

5.2.7. Using of automated equipment

With the rapid development of modern technologies automated equipment is more and more commonly used for all port operations. Further development and increased usage will lead to reducing of human factors in accident causing which would altogether reduce accident rates. For example more frequent usage of automatic vehicles would lead to reducing of accidents during cargo transportation, usage of automatic twins locks would improve personnel safety and reduce accidents rate for loading / uploading operations.
Although capital costs for new generation automated equipment is much higher than the cost of traditional equipment, these unmanned systems require fewer workers on the waterfront and in the operations yard. Downtime not often goes beyond the maintenance or technological problems, and unlike personnel, automated equipment do not require meal

breaks or rest periods, working period can reach 24 hours per day if it is necessary. A continuous schedule is achievable which can greatly increase seaport performance. Also using automated equipment can lead to the elimination of salaries, allowances, expenses on training programs and so on. From the point of view of labor personnel the new environment eliminates driver fatigue and reduces the risk of the employee.

The current trendin automationis focused onautomationof processingequipmentand production processesfor ports andterminal operators. As for equipment,there are solutionsfor yardcranes andhorizontal transportvehicles.For example there were developed revolutionarynew programs for quay cranes which allow fully remote operation of them.

Altogether,automated processing equipmentis becoming moreand more developed whereasthe market competitionhelps to move forward limitswith automaticsafety functions, performanceand management.The resultismore focused on decisionsupportsoftware tools which are ableto improveequipmentschedulingand dispatchingefficiency.These tools helpmaximize productivityand equipmentuse, increase the safety level of operations, reduce the dependence from human factor, and all thiswhile reducingcurrentoperational costs at the same time.

Automationcan helpto improve the efficiencyof cargo movementin and outof the terminal.Changing frommanualtoautomated processes, automationcan speed up the movement of cargoand decrease the percentage of errors during the handling of cargoand containers.Additionally,it can lead to moresustainableterminalinitiatives, less spending onfuel costs and reduceemissions, while consistently improvingsafety of all operations.

Thanks to the automaticidentificationof containers, equipment items,and personnel,cargo flowsbecome lesssensitiveto the error of personnel and mishandling of equipment, thus less dependent from the human factor as a whole, whichmakes them more efficient and productive. Automated emergency response systems can detecterrorswhich furthermore can be solved in aremote,centralized manner.

Altogether automated operations intended to ensure consistency of operations and improve their safety level. A seaport fully installed with automated equipment is able to provide much better and safer performance than old styled seaport mostly operated by labor forces. Modern equipment, technology and software are able to provide simple, reliable and efficient working process, thus ensure positive handling in every difficult and nonstandard situation such as accident occurred.

5.2.8. Using of remote operations

Other measures to improve safety system and reduce the risk of port personnel are the use of remote operations. This alternative apart from using fully automated equipment does not exclude the personnel participation in the port operations, just change the working position making it more remote from the operation undertaken. Such methods require staff with more advanced technical and computer skills. Technologically, such operation provides the division of personality and activity, which minimize the danger of port personnel in the midst of loading and uploading cargo. In addition it also speed up the working process thus enabling to undertake bigger number of operation per working shift.

Chapter 6.Conclusion

Port accident cannot only harm the safety of port employees and damage the port facilities, but also influence the port businesses, cause the financial losses to the port, for the purpose of ensuring the safety of port personal and port property as well as keeping the high profit of the port, accident rate must be reduced.

The accident rate of port is still very frequent in the current situation, in order to reduce the accident rate from the very beginning, supervision power must be strengthened and supervision system is ought to be completed. First of all, the defects of supervision work should be analyzed from differentperspectives, then, actions can be discussed on how to make up for the defects.

When the accident really happened, the emergency response system should be implemented in time to deal with the bad consequences brought by accident, limiting the losses is the basic requirement, the top task is to ensure the safety of port personnel and facilities, besides, the accident should be handled timely so as to ensure the cargo handling work will not have delay.

Supervision system is the guarantee for port safety operation, it’s necessary for port safety management, it also meet the requirement from the increasing number of port throughput. Any defects of supervision system will affect the normal work of port safety management, the safety of the port cannot be ensured in the meanwhile. So the supervision system has to be improved and completed.

Since the defects of Chinese port has already discussed above, it’s the time for Chinese port authority to take measures to improve the supervision system.

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