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## A study on the risk analysis of ferries engaged in Yangtze River

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**WORLD MARITIME UNIVERSITY**

Dalian, China

**A STUDY ON THE RISK ANALYSIS OF FERRIES  
ENGAGED IN THE YANGTZE RIVER**

By

**Hu Wenchun**

**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)**

2015

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## 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):        Hu Wenchun

(Date):             2<sup>nd</sup> July 2015

**Supervised by:**

Fan Zhongzhou

Professor

Dalian Maritime University

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Secondly, I wish to express my profound thanks to my dissertation supervisor, DMU Professor Fan Zhongzhou, who gave me invaluable advice and assistance in the writing of my present dissertation.

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## **ABSTRACT**

Title of research paper: **A Study on the Risk Analysis  
of Ferries Engaged in  
Yangtze River**

Degree: **Master of Science**

Ferryboat, including passenger ferry and RORO ship, is the link between the residents along the river. On one hand, it makes people's traveling more convenient, contributing to the economic growth; on the other hand, the lack of security guarantee is still a problem in operation, resulting from the influence of the external environment, equipment and facilities on board and the quality of the crew.

The Yangtze river under the jurisdiction of Yangtze River Maritime Safety Administration flows from Chongqing to Anhui and extends more than 2100km with a total of 1,099 ferries and 1,022 ferry boats. More than 70 million people are transported by ferries each year. By analyzing the accidents happened from the past 20 years in the Yangtze River, it is found that the majority of the accidents are related with the ferries. According to the report of Yangtze River MSA there were 12 ferry-related accidents happened in 2013, and in which more than 2,000 people were in danger and 9 lost their lives(Chinese MSA, 2013).

It is reprovved by the accident security assessment. One is to upgrade the standard of ferry construction, building better ferryboats; the second is to improve the crew quality, and the third is to optimize the lines, to reduce the risks; and the fourth is to train and

educate the staff; the fifth is to examine the equipment on time; and the last is to cultivate the crew's quality and the sense of responsibility. Meanwhile, so effective steps can be taken to control and remove the apparent or potential source of risks, so as to make the ferry transportation in a good recurrent state and the secure traveling under control and improve the ferry order, the thesis also provides some suggestions for maritime institutions and related government departments.

**Key words:**The Yangtze River, Ferry, Risk Assessment, Safety Management

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## LIST OF ABBREVIATIONS

AIS	Automatic Identification System
CCTV	Closed Circuit Television
ETA	Event Tree Analysis
FSA	Formal Safety Assessment
FSC	Flag State Control
FTA	Fault Tree Analysis
GPS	Global Positioning System
HAZOP	Hazard and Operability Analysis
IMO	International maritime organization
LEC	Likelihood level Exposure values and Consequence
MMEM	Man/Machine/Environment/Manage
MSA	Maritime Safety Administration
MSC	Maritime safety Committee
RO	Recognized Organization
TSS	Traffic Separation Scheme
The US	The United States
VTS	Vessel Traffic Services

## Chapter 1 Introduction

### 1.1 Background of the Research

As a very important transport tool, ferry is the bridge of the people of both sides of the river and the emotional link of the people, it is also a common transport tool of the economical and cultural exchange of the water areas. Although some small ferries do not take much people in one time, but they are always located along the rivers and are the linkage of the roads and make the voyage of the public convenient. The safety of the ferries mean the happiness of the people and it is related to the development of the society and the economical issues(Li Shengquan & Hao Yong, 2008). So to ensure the safety of the ferries means a lot to the treasure of the people and the stability of the society and can improve the development of the area alongside the river.

Ferry is an old transport tool and exists for more than one thousand years in the world. With the development of the science and technology especially from 19th century, taking a ferry boat which is comfortable and modern way for the people who live near the river or lake especially along the Yangtze River. However, One thing we can not deny is that for the poorer economic fundamental investment of the west section of the Yangtze River and the influence of the poor support to the safety management of the ferries, there exist a lot of dangers to the ferries engaged in the Yangtze River, to avoid lives lost in ferry accidents is a very big responsibility for the local government. According to an analysis of the accidents happened in the Yangtze River for the past 20 years, the majority of the accidents has relationship with ferry boats. The safety of the ferry management is worrying due to the heavy risk and the challenging management. For ferry should be managed by the maritime authority ,officials should clearly know that the operation of ferries should be managed seriously and confirm it as a very dangerous area in maritime management(Hui liang,2007). So

how to distinguish and assess the potential risks of the ferry boats and its operation and how to control and make preventive measures to the danger of this field will be the most core work. And through the risk assessment of the management of ferries, the level and the feature of the risk can be confirmed and some suggestions and the direction of their work can be offered to the maritime authority, the government and the shipping companies.

## 1.2 Research Achievement

The core responsibility of the maritime authority is safety management, and the hardest and most important field is the safety management of ferries. How to control and decrease the possibility of the accidents related to ferry boats has a very important meaning to the safety of the people related. Based on the factual management of the Yangtze River, the paper will analyze the current situation of the ferry management and use Formal Safety Assessment and questionnaires and informal discussion to distinguish the risks of ferries, at the same time assess the risks and take preventive actions. It aims to totally change the current situation of the management of ferries and provide some suggestions and recommendations to the maritime authority and the related government.

## **Chapter 2 Present Situation of Risk Research**

### **2.1 Research of Risk Assessment**

Risk assessment is also called safety assessment and danger assessment. The objective of assessment is to invest better and achieve more safety management. It is obvious that risk assessment is related to the whole situation and a part of the systematic programme related to the safety management. In the 1930s, insurance was developed in the western countries, and the insurance agents charge the fees based on the risk he will undertake. Then comes to the question that how to estimate the danger and the risk, at the same time, some methods to assess the risk were created. Simply that risk assessment is the process of ensuring and measuring the risks. Therefore, risk assessment is called safety assessment and danger assessment.

In the early 1980s, many big companies and government department started to pay attention to systematic project of safety management, they started to use safety analysis by reference of the safety checklist and safety analysis methods in the developed countries in the world(Allant, 1997). FTA, FMFA, ETA, HAZOP and LEC etc, were introduced to the work group and the management level.

### **2.2 Risk Assessment Applied to Ship's Sector**

Nowadays, risk assessment is widely applied to safety of shipping. The corresponding procedure of this application is that using the method of distinguishing risk to identify the real risks and dangers, and make a corresponding action to eliminate the unsafe factors, to make sure to prevent danger from spreading. There are three phases in safety assessment which are risk identification, risk assessment

and preventive actions.

A study on the identification and assessment of risks of ships' transportation in Yangtze River which was conducted by Wang and Liu who are from Yangtze River MSA introduced a new idea of management based on the previous experiences, and suggested to build a 4R model which includes Risk, Rule, Resource and Response (Wang Peng, 2008). And the application of this model seems very effective when used in the safety management of the maritime authority during the past three years.

Du Dahai uses the fuzzy comprehensive assessment method to construct a comprehensive evaluation model of single ship's safety management. Subsequently, through questionnaires, interviews with experts and other ways to collect data, followed by two ships as examples, he checked the evaluation model by application testing. By evaluating, he identified the hidden dangerous factors in a ship's management, and then provided a reference to ship's safety management decisions (Du Dahai & Fu Yuhui, 2007).

### 2.3 Research and Application of FSA Methods in IMO

FSA (Formal Safety Assessment) is a systematic approach for the International Maritime Organization (IMO) to develop new rules and conventions which aim to improve the safety of ships. Using FSA method abroad started relatively early. British Maritime Authority started to apply the comprehensive safety assessment method in 1993. In 1997, the 68th MSC conference adopted the "interim guideline of FSA application" and with the practical needs of maritime safety, after the British proposed the FSA method for ship's safety, he continued to suggest that the FSA method should be utilized on bulk carriers in the session on the 70th conference of IMO Maritime Safety Committee (MSC) in 1998 (IMO, 1997). IMO, Japan, France,

Norway, Australia and some other countries jointly conducted the project together with UK(Chen Weijiong & Hao Yuguo, 2004).

#### 2.4 Research on the Safety of Ferries

Wang Jing studied the issue of human factors evaluation and control in roll-on and roll-off ships by the fuzzy comprehensive assessment method to evaluate the risks of the Bohai Bay and gave some recommendations to the control of the human factors.

In order to make sure the maritime authority perform well for its responsibility in the safety management of ferries, Zeng yue offered a proposal that every work should be done under the control of the government and the maritime authority and the captain of the ferry should take the responsibility of the ferry safety and, all these should be supervised by the mass. What's more, the related government department should also take the responsibility and strength the professional skill and the ethics of the officers of the ferries to ensure the work of the safety management of ferries to be better.

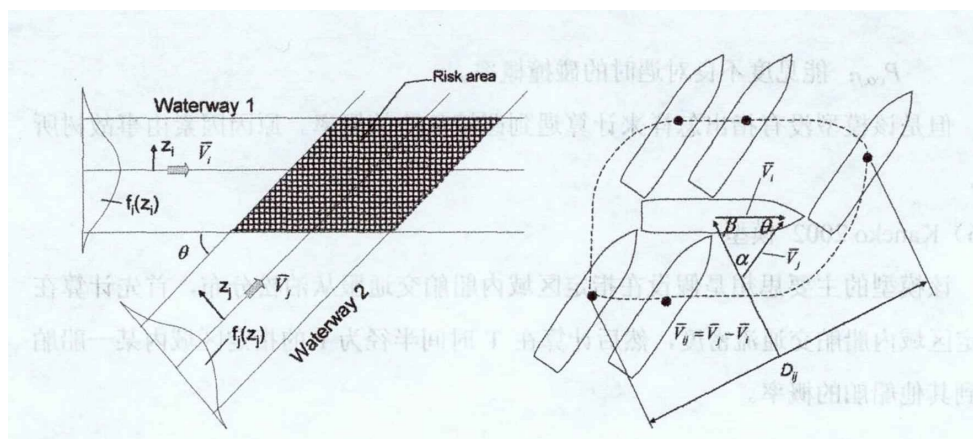
Hui Liang explains why the safety management of passenger ship in USA is so good They were supported by numerous officials, industry, technical committees and associations. Liu Guowen believes that in order to strengthen safety of the ferry management of ferries, authority and related government should eliminate the risks in advance of the accidents happened, and has to increase the capital investment, reconstruction and renovation of the ferries should be conducted. It is a good attempt to operate a ferry in a standard company in Zhongshan city of Guangdong, and the capital which invested into the reconstruction of the ferries will be addressed by the government and the companies(Liu Guowen, 2009). Foshan branch of Guangdong maritime safety administration classifies all the ferries and ferry piers with three levels based on the risk assessment. And they are supervising and inspecting the ferries with different standard. Meanwhile, in order to improve safety

of the ferry of management of the safety of ferries,they encourage the local government to take the safety management of ferries into its annual examination system to the related department .

In conclusion, risk assessment is developing fast and completely and referenced by several fields. The safety of ferries has been noticed by the maritime authorities in these years. Lots of scholars study the safety issue of ferries. But there are not so many papers which studied on the ferry boats engaged in the Yangtze River(Erik Vanem & Rolf Skjong,2006). So this paper tries to give some suggestions and recommendations to the maritime authority and the related organizations based on the researches on the construction of a risk assessment of ferries in the Yangtze River.

## 2.5 Two Models of Risk Assessment for Ferry Ships

### 2.5.1 Pedersen1995 model(Ren, Y.L., Mou, J.M., Yan, Q.X., Zhang, F., 2011).



**Figure 2.1: Crossing situation of ferry ships and other ships (Pedersen1995 model)**

**Source: Ye Feng, 2010.**

The relative speed of the ships:



$$V_{ij} = \sqrt{(V_i^{(1)})^2 + (V_j^{(2)})^2 - 2V_i^{(1)}V_j^{(2)} \cos \theta} \quad (2.1)$$

The diameter of the collision:

$$D_{ij} = \frac{L_i^{(1)}V_j^{(2)} + L_j^{(2)}V_i^{(1)}}{V_{ij}} \sin \theta + B_j^{(2)} \left\{ 1 - \left( \sin \theta \cdot \frac{V_i^{(1)}}{V_{ij}} \right)^2 \right\}^{1/2} + B_i^{(1)} \left\{ 1 - \left( \sin \theta \cdot \frac{V_j^{(2)}}{V_{ij}} \right)^2 \right\}^{1/2} \quad (2.2)$$

So the possibility of facing a collision is:

$$N_a = \sum_i \sum_j \int_{\Omega(z_i, z_j)} \frac{Q_i^{(1)} Q_j^{(2)}}{V_i^{(1)} V_j^{(2)}} f_i^{(1)}(z_i) f_j^{(2)}(z_j) V_{ij} D_{ij} dA \Delta t \quad (2.3)$$

Qi: the ship flow of the surrounding

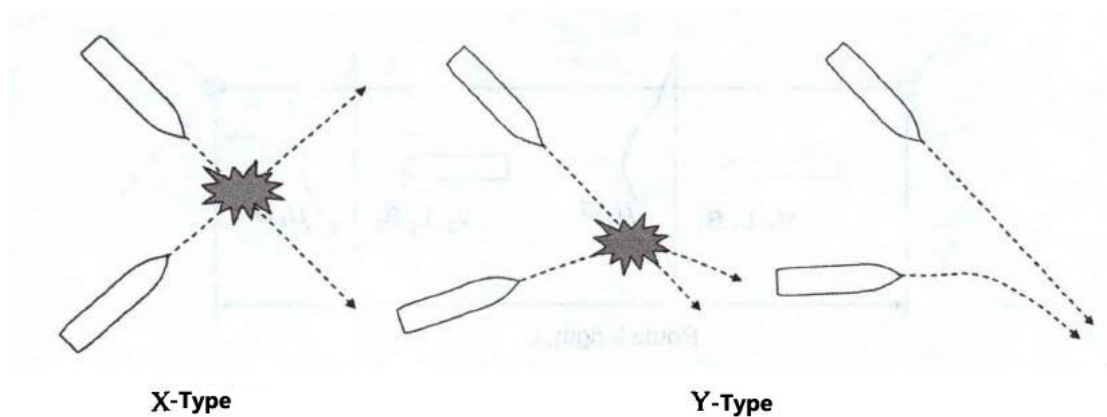
Dij: the diameter of collision

Fj: the distribution of ships in the jth level of the ferry ship

### 2.5.2 COWI 2008 Model

This model is created by professor Peter Friis Hansen and COWI enterprise while studying the risks of water traffic in Hormuz Strait.

The crossing situation: All the collisions except the collision between vessels collide in the same direction in the same water way are crossing collision(Li Bonian,2007).



**Figure 2.2: two types of crossing situation**  
**Source:Ye Feng, 2010.**

The calculation of the possibility of collision is decided by:

a:Type of crossing

b: The density of the ship flow in two directions

c: The length, breadth and the speed of the ships

d: The angle of collision

e: The possibility of causes  $P_c$ , for instance: the possibility of the collision while two vessels do not take successful actions to avoid collision.

f: The possibility of the crossing route of the two ships.

So the possibility of the collision :

$$P_X = P_1 \times P_G \times P_C \times k_{RR} \quad (2.4)$$

Here  $P_1$  means the possibility of the crossing route of the two ships.

$P_G$  means the geometrical possibility of collision (per year)

$P_C$  means the possibility of causes

And  $k_{RR}$  means the factors of reducing the risks. So

$$P_G = N_1 (1 - e^{-N_2 \Delta t}) \quad (2.5)$$

And

$$\Delta t = \frac{1}{|V_1 V_2|} \left[ B_2 \left| \frac{V_2}{\sin \theta} - \frac{V_1}{\tan \theta} \right| + B_1 \left| \frac{V_1}{\sin \theta} - \frac{V_2}{\tan \theta} \right| + L_1 |V_2| + L_2 |V_1| \right] \quad (2.6)$$

## 2.6 Approach and the Contents of the Research

This paper firstly studies the related researches and gets comprehensive knowledge of the theory and approach of risk assessment. Due to different approaches studying risk assessment, the author compared some related approaches and considers the feature of the ferries which could be influenced by various factors. So the

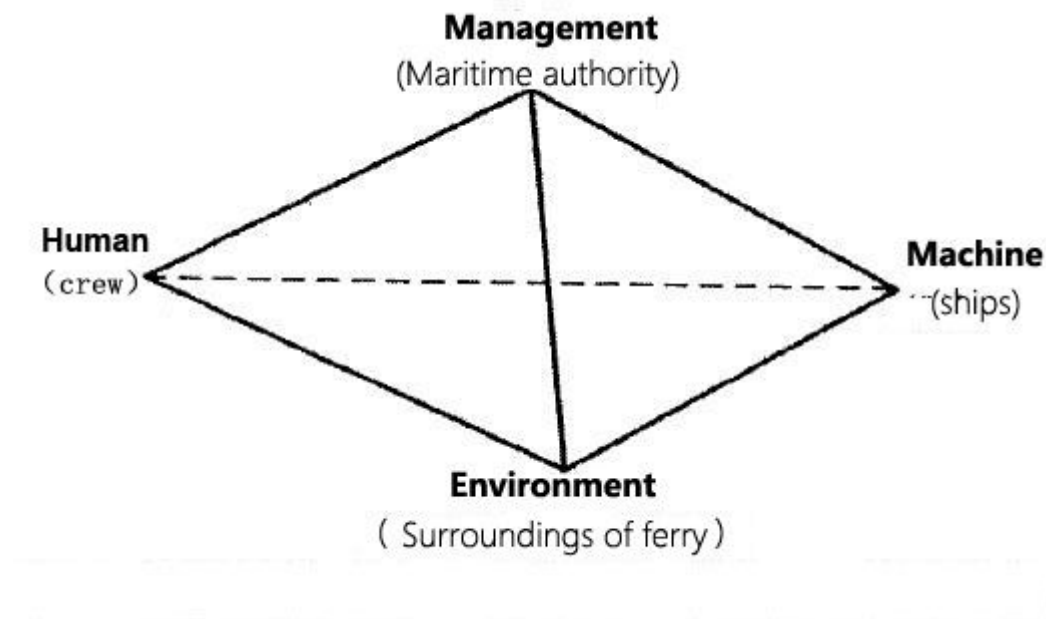
FSA(Formal safety assessment ) approach is selected to analyze risks of ferries, and then the author collect data on the internet, on-site investigations and questionnaires, interview with officials and their combinations to identify the major indexes of the dangers of ferries which sail in the Yangtze River. At last, the paper provides some safety management recommendations based on the conclusion of the assessment(Tan Zhirong,Wang Wanle, 2 004).

### **Chapter 3 Determination of the Factors of Risk Assessment**

Before the construction of the model of the risk assessment, the dangerous factors of the ferries should be identified in advance. The key indexes of the risk assessment of the ferries will be ascertained by interviews and questionnaires in this part, and a risk index system will also be set up, and each of the index of the assessment will be introduced in the later part of this section.

#### **3.1 The Essential Factors of the Shipping Sector**

The safety of the water traffic includes many subsystem and these systems and its combinations comprise the complex system. So the safety assessment of the water traffic should be compliant with a systematic way, view and theory. In reality, almost every accident has relationship with human, machine, environment and management and their combination, and some incidents which contribute to disasters will happen unexpectedly. In order to reduce the possibility of the ships' accidents, the factors of human, machine, environment and management should be well controlled and coordinated.



**Figure 3.1: Factors impacting the safety of ferry ships**  
**Source: Handouts of MESM course by Jens Schröder-Hinrichs**  
**( Risk Management in the Maritime Sector )**

As the figure shows the essential factors of the safety of the ferries engaged in The Yangtze River are constituted by human(seafarers),machine(ships),environment(the surrounding environment of the ferries) and the management(maritime authority) which constitute a MMEM system. According to the analysis of the accidents happened in the past, the major reasons causing the accidents are two or more than two factors of the above four . So when assessing the risk of the ferries engaged in Yangtze River, all the factors should be considered and this paper tries to find the relationship of the factors which cause the accident, and finally provides reliable recommendations for the management of the safety of ferries.

### 3.2 Determination of the Essential Factors

#### 3.2.1 Interviews

In order to comprehend the major factors which impact the safety of the operation of ferries engaged in the Yangtze River and establish a system of assessment to the ferries' safety. The author conducted an interview outline for the seafarers on

ferries, ship management companies and the officials from maritime authority. There are 8 questions including 5 general and 3 specific questions. General questions can be answered by any one while the specific questions can only be answered by the designated people. General questions are listed as follows: How do you think the safety of the ferries in Yangtze River or in your jurisdiction? What are the poor and strong points of management of the ferries in your jurisdiction? Which do you think is the most important factor in terms of the influence to the safety of the ferries, human, machine, environment and management? How will you rank them in terms of the influence to the ferries? How are the safety status of the ferries in your jurisdiction and what can be done to improve the safety of the ferries? How are the surrounding environment of ferries and what is the main factor which impacts the safety and how it impacts?

The specific questions are how do you think the works related to the ferry management done by the maritime authority and whether there is something what should be improved (question for the officer from company, officials from local government and seafarer)? Who contributes the effects to the safety management of the ferries (question for the inspector from authority, officer from company and manager from the local government)? What are the most intractable issues confronted during the voyage (seafarer)?

During April 4th to 19th 2015, the author conducted several interviews and meetings in Yangtze River MSA and some related ship companies with the help of my friend Li Yin who is the leader of the ship's department of Yangtze River MSA. The author visited some seafarers who work on the ferries and managers of the ship companies, and talked with them about the safety management and risks of the operations of ferries. During the period, 4 meetings were held and 72 people from maritime authority, ferry company, ferry operator and seafarers took part in, and with the officials' accompany, the author inspected 4 ferry boats randomly.

The majority of the people who attended the meetings and interviews thought that the maritime authority and the related organizations have paid more attentions to the management of ferries and as well as the ship companies. They all gave safety the top priority. The situation of ferries tended to be better and the awareness of the seafarers has been improved in the past 3 years. However, there are also some shortages of management of ferries. For instance the ferries are not constructed so reasonable and the personal skill of the seafarers should be improved more and the ship companies should fully take their responsibilities for the safety management of ferries.

#### 3.2.1.1 Performance of Seafarers on Ferries

Among the four factors of human,ship,environment and management, the human factor has the most effective impact on the safety of ferries. This is mainly reflected by the following aspects: the seafarers' awareness of safety are relatively poor and they do not take the full responsibility for it, they do not complies with the operating regulations and the collision avoiding regulation, they do not pay enough attention to the watch and not use the VHF devices correctly. They do not broadcast their ship' trends to the other ships which is sailing along the river, even sometimes the seafarers do not comply with the notices and warnings of the maritime authority, they insist to sail even in a very poor weather conditions such as a heavy fog. And some of the seafarers are very poor when confronting a emergency situation, the majority of them are relatively old and do not have enough knowledge but just rely on their experiences, this contribute to lack of scientific guidance in terms of safety, the ability of learning is relatively poor, they do not have enough interest to accept the new devices such as the usage of AIS, most of them can just switch on and off but can not use it to avoid collision(Chinese MSA,2010). And some ship companies do not arrange enough seafarers on board to save money which contributes to the fatigue of the seafarers.

### 3.2.1.2 Performance of Ferries

The majority of people who attended the meeting and the interviews thought that the ferries were rebuilt and reconstructed with the help of the government and maritime authority. But there are still some shortages of the ferries to be improved: to change the single engine to twin- screw and twin rudder to reduce the risk in the real navigation environment under the complex conditions; for the usage of the passengers life jackets, it is not so convenient due to the wrong position, for the poor profits the companies earned, they do not have enough money to repair and maintain the equipment of the ferries and due to the lack of awareness of maintaining the equipment of seafarers, it is obvious that the problem of the maintenance of the ferries seems a big problem in recently years; What' more, the stability of ships is also a potential dangerous factor to the safety of ferries.

### 3.2.1.3 Assessment for the Surrounding Environment

It is well-known that the environment of navigation in the Yangtze River is relatively poor for the river crosses so many different areas which are not on the same sea level. So the water and weather condition effect the safety of navigation so seriously especially in the low water which starts form December to March the next year and in the flooding season which starts from June to October. And the ferries have to cross the river in some angle which leads to a cross situation with the other ships sailing along the river. With the developing of the south-west part of China, the volume of the ships sailing in the Yangtze River increased rapidly. So how to avoid collision with other ships is always a problem. There are some crossing areas near the ferry piers and some seafarers do not apply with the regulations when sailing in the crossing areas which leads t o a dangerous situation. Near half of the ferries are not constructed so well for there is little capital invested to the repair and maintenance of the ferries. All the aspects mentioned above bring some potential risks to the safety



of the ferries.

#### 3.2.1.4 Assessment for the Management of Ferries

Participants who attended the meeting and interviews felt that the maritime authority should pay more attention to the safety of ferries and check carefully, insisting on carrying out a detailed safety investigation which aims to figure out the hidden dangers every two years. Before holidays, officials should carry out on-line examination actively and hold a mobile classroom and night classes for training the crew. There should be some "one to one" training program including contents like bring safety culture and safety knowledge to the ferries directly to the crew. Any potential risks should be reported to the local government in time, the lifesaving and fire fighting equipment and communication equipment should be sent to the ferries periodically, and the maritime authority should try to help the owners of ferry boat or ferry companies to establish and improve the safety management system. The participants thought that it is very important for the authority and the government to do something for the safety of ferries, for the good management and control currently, it seems the management of authority has little impact on the risk of the ferry and it is not a majority factor which influence the safety of ferries.

#### 3.2.2 Questionnaires

##### 3.2.2.1 The Contents of the Questionnaires

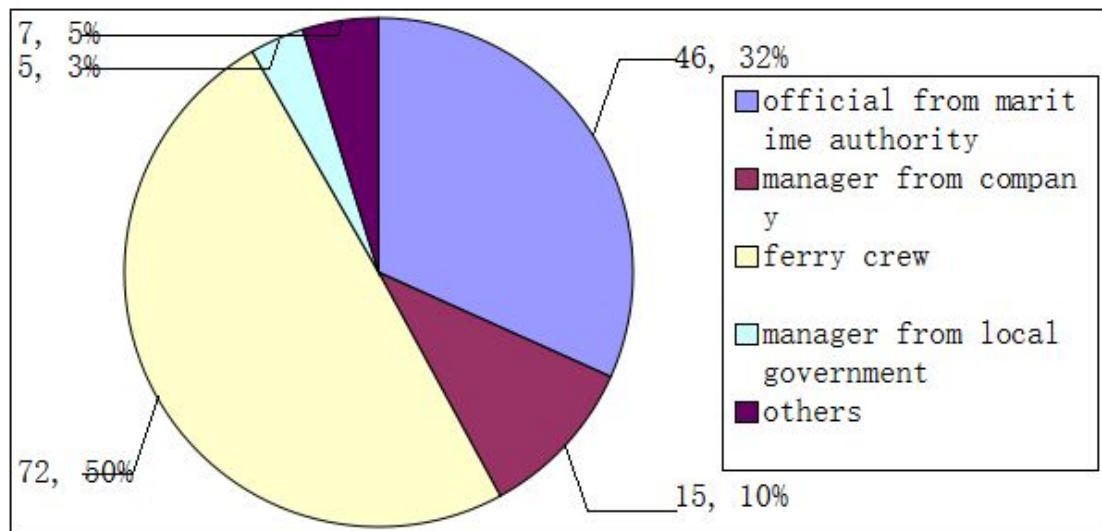
Because the classification of risks of the human, ship and environment involves many other factors, so in order to improve the accuracy and pertinence of the risks of ferries. The author decided to conduct a research with questionnaires based on the interviews, learning about the impact of opinions and suggestions of ferry crew, ship company, company personnel and maritime authority in terms of safety of ferries. After the results of the survey were quantified compared, three questions and some other requirements followed such as the position and title of the

interviewees ,and each question has no less than 4 options to choose.

The two basic requirements are to request the interviewees to write down their working position and title.

The three closed questions: 1.which do you think are the factors that influence the safety of ferries from the crew’s point of view? (multiple-choice) 2. Which do you think are the factors that influence the safety of ferries from the environmental point of view? (multiple-choice) 3. which do you think are the ships’ factors that influence the safety of ferries ? (multiple-choice)

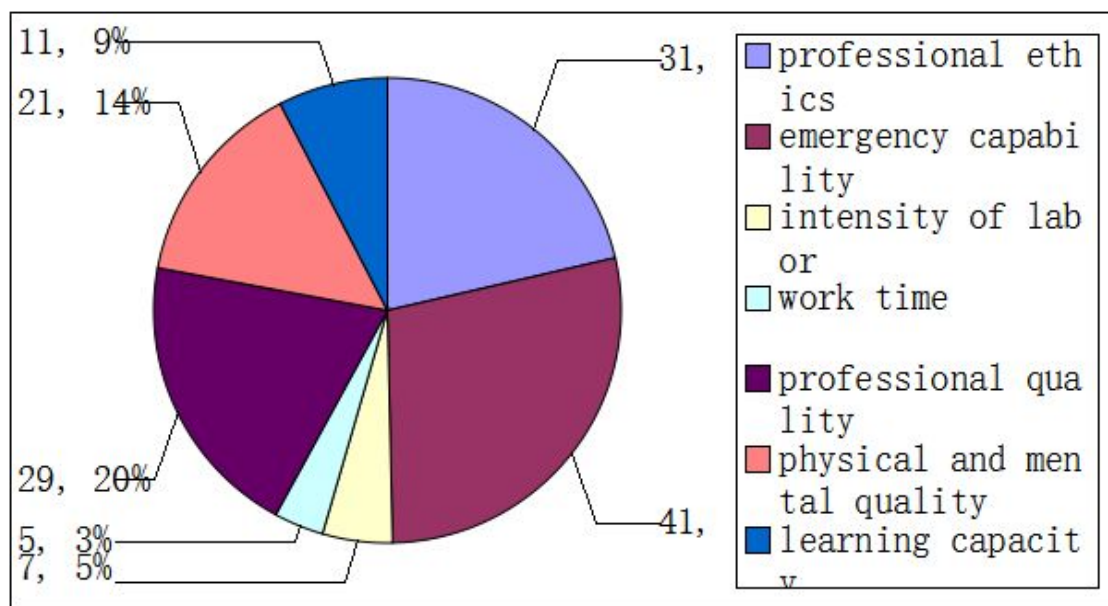
There are total 150 questionnaires released to the related persons and 145 out of 148 are successfully called back and valid. The rate of validity is 97.9%. Among the 145 questionnaires there are 46 from maritime authority, 15 from managers of the ship’s companies, 72 from the crew of ferries(including 42 from deck officers and 30 from engine room), 5 from managers of local government and 7 from the others.



**Figure3.2: Questionnaires distributed in terms of duties**  
**Source: Author, on the basis of data from questionnaires**

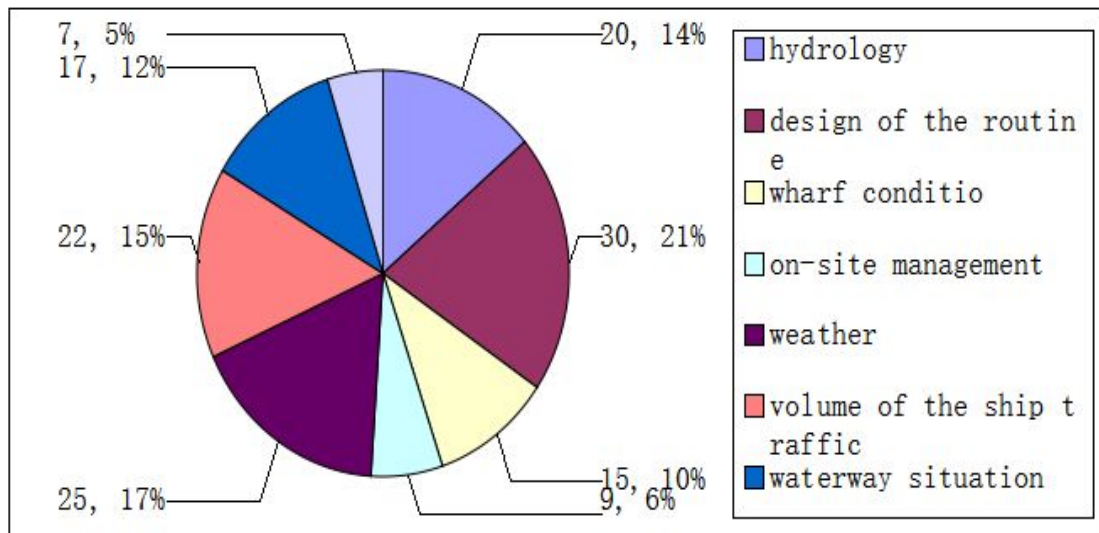
### 3.2.2.2 Findings of Questionnaires

For the first question "which do you think are the factors that influence the safety of ferries from the crew's point of view?" 31 people chose "A-work ethic"; 41 people chose "B- emergency capability; 7selected the " C-intensity of labor; 5 chose "D-work time; 29 people chose "E-professional quality "; " F-physical and mental qualities " is chosen by 21 people while 11 peoples chose" G- learning capacity" (the acceptance of new knowledge and new equipment for the crew ).



**Figure3.3(a): Crew's factors impacting the safety of ferry ships**  
**Source: Author, on the basis of data from questionnaires**

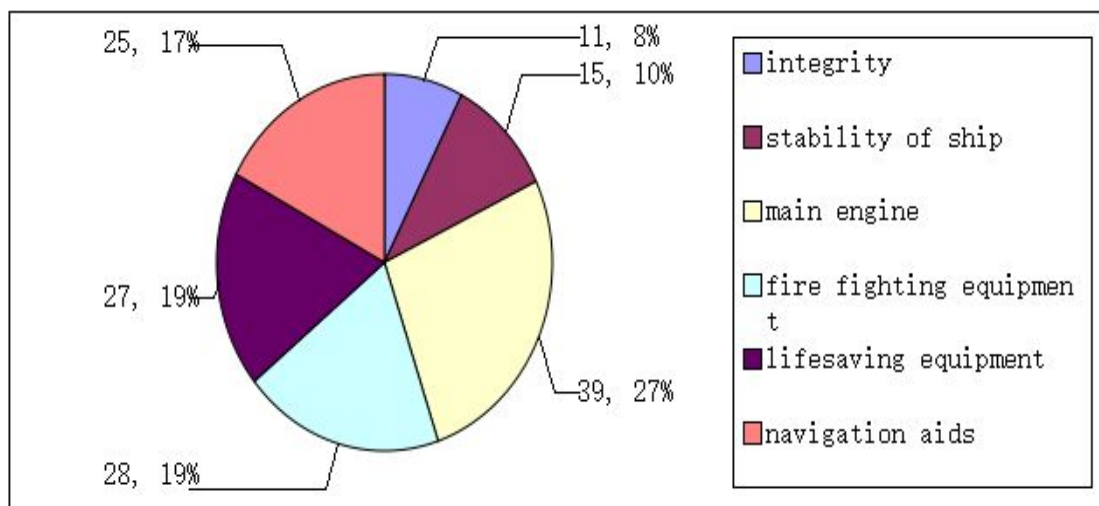
With regard to the question "Which do you think are the factors of environment that influence the safety of ferries?" 20 people chose "A-hydrology"; 30 people chose "B- design of the route; 15 choices of" C- wharf condition "; 9 people choose" D-on-site management "; 25 choices of" E-weather "; 22 people chose the" F-the volume of the ship traffic "; " G-waterway situation " was chosen 17 times and seven chose " H- traffic regulations".



**Figure3.3(b):Environmental factors impacting the safety of ferry ships**

Source: Author, on the basis of data from questionnaires

For the question "which do you think are the ships' factors that influence the safety of ferries ?" 11 people chose "A- integrity"; 15 people chose "B- the stability of ship"; 39 choices of "C-main engine";" D- fire fighting equipment was chosen 28 times and 27 times for choices of "E-lifesaving equipment"; 25 people selected "F-navigation aids ".



**Figure3.3(c): Ship's factors impacting the safety of ferry ships**

Source: Author, on the basis of data from questionnaires

### 3.3 The Evaluation of the Basic Key Factors of the Safety of Ferries

#### 3.3.1 Ship Condition

With the help of the local government and the maritime sector, a number of old ferries gradually retired from the ferry industry. so far, the standardized reconstruction of ferry ships has developed fast . Since 2008, the cumulative number of updated ferries has been 136 which accounts for 75% of all the ships, of which 114 passenger ferryboats have been updated which accounts for 85.7% of the total passenger ferries(Chinese MSA,2013)), and all the ships which were propeller-hanged type have been replaced with standardized ferries. It provided a solid foundation for the safety of ferries due to the replacement in the Yangtze River through reconstruction.

##### 3.3.1.1 Main Engine and the Lifesaving Facilities

The wheel and the main engine of ferries should be used frequently while navigating and especially in storms and other bad weather and in case of urgent situation. It needs to have better capacity to maneuver than other type of ships(Huang Zhi,2007). However the majority of the ferries in Yangtze River are single engine ships. From the perspective of the type of the main engine of ferries under the jurisdiction of Wuhu MSA, 330 out of 493 passenger ferries have only one main engine(Yangtze River MSA, 2013). And it is relatively hard to ensure the safe navigation for the this kind of ferry. For example, January 29th 2009, the main engine of the passenger ferry Chang Du 4004 which belongs to the Yang Chang ship company of Gong An county suddenly failed to work in the voyage, and on September 8th 2009, the incident of the ferry Jing Hui drag 2 which belongs to He shun ferry Co., Ltd related to the failure of the single engine(Chinese MSA, 2013). Although both of the two accidents did not cause any casualties and loss of ships, it reflected the risks of this kind of accident still exists, and should arouse more attentions .

**Table 3.1: The type of the main engine of ferries in jurisdiction of Wuhu MSA**

Type of main engine	Numbers	Rate
Single engine	330	66.9%
Double engine	163	33.1%
Total	493	100%

**Source: Yangtze River MSA Annual Report of Safety for Ferries**

### 3.3.1.2 Navigational Aids

The navigational aids mainly refers to the global positioning system GPS, automatic identification system and VHF equipment. From the investigation , almost all the ferries in operation were installed with the above equipment at present which ran relatively well. But because the navigational instruments required to be powered by battery supply, while the ferries berthed and the main engine stopped running, and sometimes due to the lack of corresponding ship battery charging device, the capacity of battery is relatively small while the navigation aids consume greatly, all the above will impact the enthusiasm of using these facilities for the crew who fail to ensure 24-hour's working, which will seriously affect the real-time supervision on the ferries.

### 3.3.2 Condition of Crew on Ferries

#### 3.3.2.1 Work Ethic

The work ethics of the crew is different from other works of life, it requires special work ethics for the crew besides the general requirements. The overall performance is relatively good through training and education and the safety awareness and sense of responsibility have been greatly improved. But there are still some shortages of the crew when operating the ferries.

#### 3.3.2.1.1 Poor Safety Awareness

These problems are mainly embodied in the overconfidence, wrong estimate for the situation and fluky mind, all the above results from the poor safety awareness of the crew. Currently part of the ferry boats which do not belong to formal companies are managed by local government or private enterprise. At present, the supervision and management of the maritime sector mainly depends on "on-site supervision", "GPS monitoring", "first and last report", "ferry spot inspections," and inspection on the ships "etc to prevent hazardous sailing .

#### 3.3.2.1.2 Poor Sense of Responsibility

These problems are mainly embodied in the negligence of watch, not giving the right signal while confronting emergent situation, and failures with navigational devices and so on. The lack of the sense of responsibilities of the crew is the root reason . The crew will be apathetic for the sailing because they sail in the same waters year by year with several times a day and they think they are so familiar with the conditions in the sailing area.

#### 3.3.2.2 Capability of Emergency Response

Because of the particularity of the ferry ships, the crew will face complex situations and various unforeseen risks during the operation. In most cases, the crew need to take right actions in the shortest time as soon as possible while in a emergent situation. And it is the last door of defense for the safety of ships for the crew to protect the safety of human life and property on ships. In recent years, maritime authority has obviously improved the crew's capability of emergency response through various training and exercises. According to statistics, in 2012 a total of 183 emergency drills in which involved 530 ships and more than 1900 people were involved(Chinese MSA, 2013) .

It is known that a few crew are not familiar with the alarm signals on board and the wrong actions are chosen during the emergency drills, and the cooperation of the crew sometimes is relatively poor due to lack of cooperation. What's more, it was recorded that some crew do not hang any signals and sound alarm signals in a real accident rather than a drill, even sometimes they do not take any actions to avoid the dangers or reduce the possible loss. What they do is just to call the maritime rescue sector and wait for help.

### 3.3.2.3 Professional Quality

Because of the low level of economic development in the Yangtze River area especially in the upper reaches of the river, most of the crew are from rural areas alongside the Yangtze River, and the officers are trained in a very traditional way. The crew's age are from 30-50 years old and the level of educational level are not high but just graduate from junior high school and even below. Although the manning of the crew is in accordance with the national laws and regulations, the crew prefer to rely on the experience for maneuvering the ships, this results in a lack of sense of science and safety (Chinese MSA, 2010). The majority of the crew were not familiar with the legislation and regulations such as "*Inland water traffic safety management regulations of the people's Republic of China*", "*Inland regulations for preventing collisions of the people's Republic of China*" and "*The knowledge and skills for crew on inland-water ships*". All the above mentioned results in unregulated operation on ferries and cause risks and dangers to the ships.



**Table 3.2(a): The ages of crew in different jurisdiction of the Yangtze River**

Age of crew Jurisdiction	30-	30-40	40-50	50+	total
Shishou MSA	9	48	35	13	105
Gongan MSA	2	6	14	8	30
Jianglin MSA	1	4	2	4	11
Shashi MSA	1	23	17	11	52
Total	13	81	68	36	198

**Source: Yangtze River MSA Annual Report of Safety for Ferries**

**Table 3.2(b): The educational experience of crew in different jurisdiction of Yangtze River**

Educational level Jurisdiction	Junior college	High school	Junior middle school	Primary school	total
Shishou MSA	10	78	14	3	105
Gongan MSA	4	9	10	7	30
Jianglin MSA	0	0	6	5	11
Shashi MSA	0	12	32	8	52
Total	14	99	62	23	198

**Source: Yangtze River MSA Annual Report of Safety for Ferries**

### 3.3.2.4 Psychological Factor

According to statistics, human factors in all kinds of water traffic accidents accounts for about 80%, and the majority of human factors are psychological factors of the crew, especially in relation with the nervousness, self-control ability, straining capacity, ability of resisting interference and Labile moods. Accidents are inevitable and unexpected during the operating process, this needs the crew to be stable and calm and make right judgments and take the most effective actions. According to

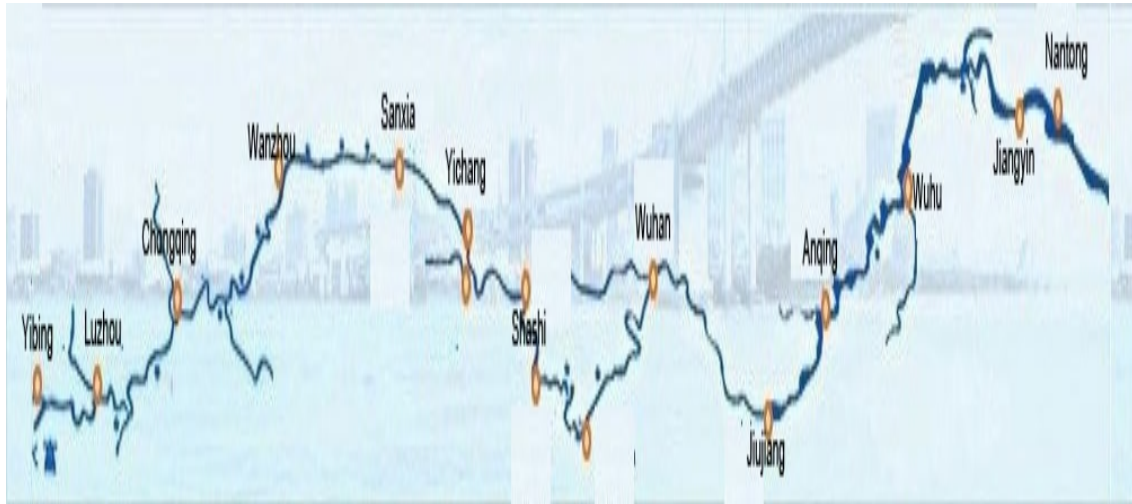
statistics, the ferry crew ages from 30-50 and accounted for 88.5% of all the crew market, most of them have worked more than 10 years and have good experience of sailing (Yangtze River MSA, 2013). They have strong professional adaptability and are more familiar to the routes and the environment. Their psychological qualities are relatively good and have the abilities to take the right actions to avoid accidents when unexpected events occur. While it is so difficult for the crew who are under 30 to handle with emergency because they are not so familiar with the navigation environment and the professional skills. Although the crew on ferries in the Yangtze River is relatively old, the health conditions well meet the requirements of the competence for seafarers.

### 3.3.3 Navigational Environment

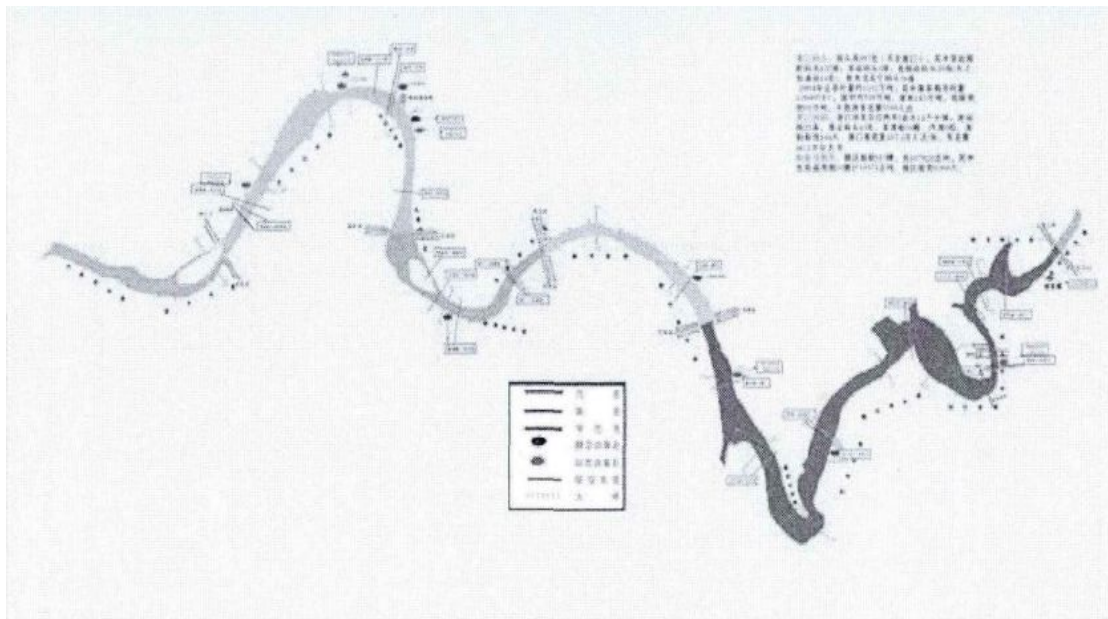
#### 3.3.3.1 Waterway Status

The Yangtze River under the jurisdiction of Yangtze River maritime authority runs from Chongqing to Anhui and extends to 2100 kilometers and has about 1000km branches and 19 lakes. There are a total of 1099 ferry piers and 1022 ferries navigating in the Yangtze River in 2012 and 70 million people safely cross the river by ferries.

The Yangtze River looks like a letter “W” on map in the middle of China. The depth of the water is from several meters to more than 50 meters in different section of the river and widens from 20 meters to more than several kilometers in the lower reaches. There are lots of areas which are very narrow and bending. The flow speed of the water in the Yangtze River currently is about 3m per second on average after the construction of Three Gorges Dam. But it flows more than 10 meters per second sometimes in summer in some part of the river. There are more than 60 bridges across the Yangtze River in 2012 and numerous anchor places and crossing areas.



**Figure3.4: The Yangtze River on map**  
**Source: Front Page of the Website of Yangtze River MSA**



**Figure3.5: The Jurisdiction of Wuhu (a section of Yangtze River)**  
**Source: Wang Junru & Liu liang, 2010.**

### 3.3.3.2 Volume of Ship Flow

**Table 3.3(a): The ship flow in different observation station in March 2014**

Number	Location of ships' flow observation	Ship's flow (Both direction)
1	Jiang jin station	68
2	Chaotianmen station	236
3	Wanzhou station	244
4	Wushan station	193
5	Sanxia dam station	349
6	Zhicheng station	220
7	Jinzhou station	168
8	Chenglinji station	314
9	Wuhan bridge station	353
10	Yangluo bridge station	336
11	Huangshi bridge station	352
12	Jiujiang bridge station	570
13	Jiujiang Hukou station	738
14	Anqing bridge station	891
15	Tonglin bridge station	1021
16	Wuhu bridge station	1332

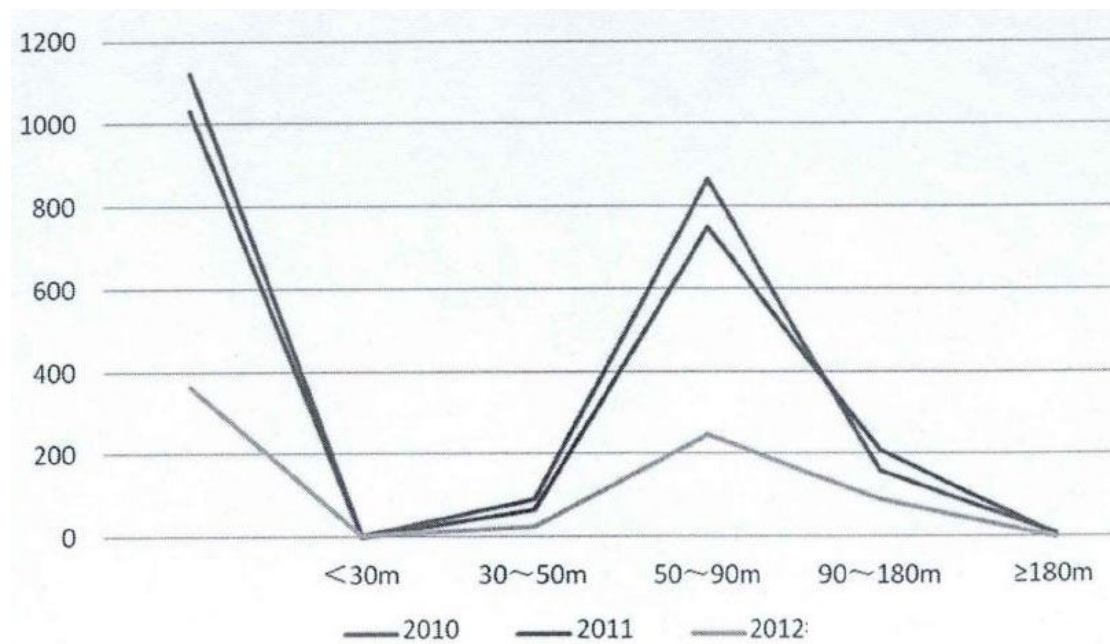
**Source: Ship flow statistic and analysis system of Yangtze River MSA**

**Table 3.3(b): The ship flow in different observation station in March 2015**

Number	Location of ships' flow observation	Ship's flow (Both direction)
1	Jiang jin station	93
2	Chaotianmen station	249
3	Wanzhou station	205
4	Wushan station	86
5	Sanxia dam station	334
6	Zhicheng station	215
7	Jinzhou station	135
8	Chenglinji station	1266
9	Wuhan bridge station	336
10	Yangluo bridge station	225
11	Huangshi bridge station	298
12	Jiujiang bridge station	519
13	Jiujiang Hukou station	701
14	Anqing bridge station	815
15	Tonglin bridge station	1073
16	Wuhu bridge station	1467

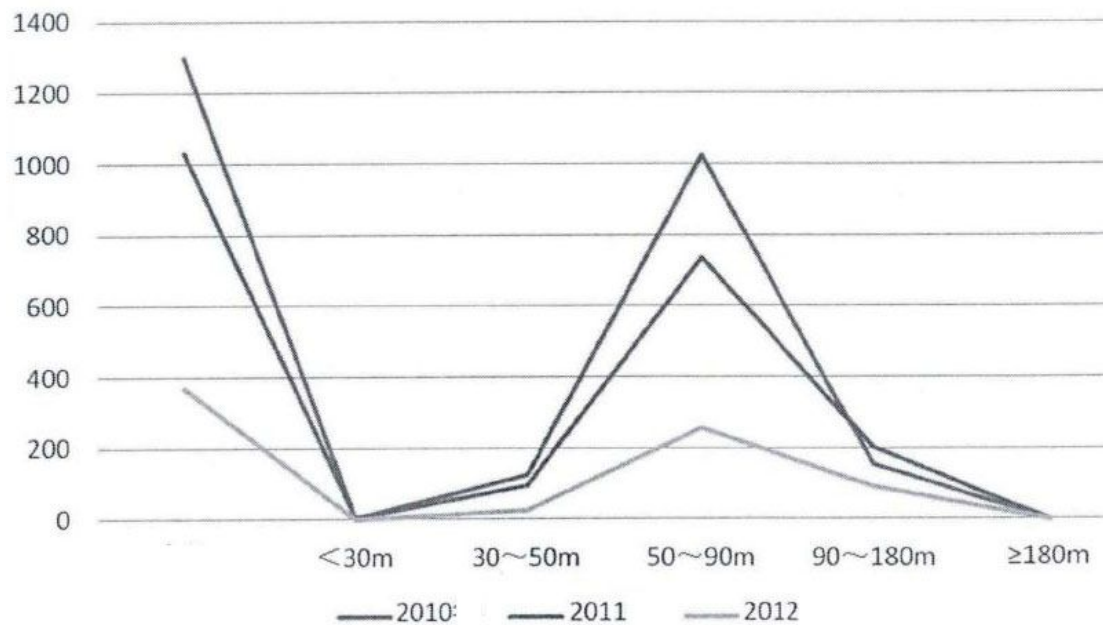
**Source: Ship flow statistic and analysis system of Yangtze River MSA**

View from the observation of ship flow in different sections of the river , the daily average vessel flow is about 580 of which the upward ships accounted for 48.13%, downward ships accounted for 51.87%. View from the size of the ships, ships with 50-90m length account for 70.27% of average ship traffic flow. Ships with 90-180m length accounts for about 17.36% of the average ship traffic flow(Wang Junru & Liu liang,2010). The ship volume of flow at the lower reaches is apparently large than that at the upper reaches of the river. From the total flow of view, the volume in 2015 April is roughly at the same level.



**Figure 3.6(a): Ship's size observed at the Jinzhou station in three years (up-bound vessel)**

**Source: Ship flow statistic and analysis system of Yangtze River MSA**



**Figure 3.6(b): Ship's size observed at the Jinzhou station in three years (down-bound vessel)**

**Source: Ship flow statistic and analysis system of Yangtze River MSA**

The flow of ships sailing in the Yangtze River will experience a gradual increase with the development of those area during the 5-10 years in the future and the ship's size will become more and more big. In some parts of the Yangtze River such as Chongqing and Wuhan sections ,there will be more than one ship sailing through the observation stations and this will result in the increase of crossing situations of ferry ships and the other ships. The inevitable risks of the navigation of ferry ships is the collision situations caused by ferry ships when leaving the wharves in the busy traffic(Kiyoshi,Hara Shiny&Nakamura,1995).

### 3.3.3.3 Condition of Wharves

Due to the imbalance of economic development, ferries are often constructed in remote areas or villages which are far away from the downtown. Still some ferry wharves are natural ramp due to the poor investment on constructions of infrastructures and some wharves has no ship facilities and safety facilities, even no rest place for passengers. According to the statement of the director of Wuhan MSA,

there is no staff to maintain the order on-site. All the conditions mentioned above bring hidden dangers and inconvenience to passengers .

Of course, with the development of the economy in these areas, many ferry wharves have been reconstructed relatively modern and safe for passengers and the maintenance of the ferries and the related facilities tends to be better and better(Ge wang, John Spencer, 2002).

**Table 3.4: The wharf conditions in several jurisdictions under the Yangtze River MSA**

	<b>Barge wharf</b>	<b>Concrete slope</b>	<b>Natural slope</b>	<b>Total</b>
<b>Shashi MSA</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>8</b>
<b>Gongan MSA</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>8</b>
<b>Jianglin MSA</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>4</b>
<b>Shishou MSA</b>	<b>0</b>	<b>2</b>	<b>12</b>	<b>14</b>
<b>Total</b>	<b>3</b>	<b>17</b>	<b>14</b>	<b>34</b>

**Source: Author, on the basis of data supplied by Yangtze River MSA**

## Chapter 4 The Existing Risks of Ferries

### 4.1 Human Factors

The educational experience and the safety skill are relatively poor for the crew. More than 70% of the crew who work on the ferries just have a junior school education, and most of the ferry crew are farmers who live alongside the Yangtze River. So a number of the crew members are illiterate and semi literate, while in the busy farming time, they pay more attention to their farming rather than the ferry work. Due to the poor management and supervision in the past, some of the drivers who works on ferries did not receive any formal training and professional education.

There exist some illegal sailing behaviors . Some of the crew members did not comply with the traffic separation scheme and the related regulations because they thought that was not convenient for them. For pursuit of economic profits, they sometimes drive the ferry boat directly from one place to the destination without any operations for avoiding collision(Wan Yi, 2009). In spite of the forbidden orders from the maritime authority, some of the crew still sail under a very bad weather such as heavy fog and in the mid-night (the ferries in Yangtze Rive are not permitted to work at mid-night according to the national law and regulations).

The safety awareness of the ferry crew is relatively weak. The ferry crew market is not so stable due to poor efficiency of the operation of ferries and the low income of the crew. So the safety awareness of the crew is relatively weak, the poor safety awareness and self-protection awareness of the passengers accelerate the growth of the bad behaviors of the crew.



## 4.2 Ships' Factors

There exist some risks on the ferries due to the weak design and constructions and poor technology. The outdated of equipment and the aging of ships are relatively prominent. There are about 60% of ships engaging in the Yangtze River have operated more than 10 years more than 80 passenger ferry vessels have worked for over 30 years (Yangtze River MSA, 2013). Some ferry ships which were constructed before the 1990s are relatively small and not be supervised by the ship classification society(Wang Junru & Liu liang, 2010). So the structure, watertight and stability were difficult to meet safety requirements. The operating performance and the ability of resistance of wind and wave are relatively weak and can not meet the safe requirement of navigation in the Yangtze River.

There is no regulation to standardize the types of the passenger ferry ships and the equipment on the ferries is relatively simple. Because the ferries belong to individuals, the owner designed the ships' type and size based on the economic profits and the market of requirements of traffic. Therefore, almost all of the passenger ferry ships have different size and the type design is complex. From the perspective of the type of the main engine of ferries in the Yangtze River, 493 passenger ferries have the main engines in the cabins, of which 330 ships have only one main engine and there are 108 passenger ferries (accounted for 24.8%) which were designed hanging the propeller at the aft of the ship (under the jurisdiction of Wuhu MSA )(Wan Yi, 2009), these type of ships have poor performance of maneuvering. Some passenger ferries lack of necessary facilities such as high-frequency telephone, fire fighting facilities and life-saving equipment , some light signals corrupted and the color of the hull does not meet the requirement of the regulations. The officials from maritime authority usually inspect the ferries twice a year (refer to the requirement of FSC). According to the FSC report in 2012, there are more than 6 deficiencies on one ferry on average in the Yangtze River. However, the owner seemed not to be voluntary to rectify the deficiencies due to the economic

reasons.

With the rapid development in recent years, bridge construction and rural highway have developed fast in the area of Yangtze River. More and more people choose to take bus or railway instead of passenger ships. This results in the sharp decrease of passengers(Sun Wencheng,2006). Most of the ferries built 10 years ago have the problem of excessive capacity of transportation, which means a ferry takes less passengers than in the past and the owner and the ship company do not have enough money to maintain and improve the safety status of the ferries.

#### 4.3 Environmental Factors

There are lots of Whirlpools in the upper reaches of the Yangtze River due to the construction of the Three Gorges Dam. The hydrology is unstable because of the water level of the river especially in the intersections of the Yangtze River which has more complex ship flow. 80% of the ferries are not constructed by human but nature. Bad weather such as heavy wind and fog happened frequently after the construction of the Three Gorges Dam(Yang Yadong, 2010). There are lots of waste logs and other corps floating on the river which can easily cause damages to the propellers of the ferry ships. All the above are potential risks to the ferries.

The water level changed frequently in the lower reaches of the Yangtze River and there are frequent bad weather. In the low water period, the channel is narrow, shallow and bend, especially in Zhijiang and Taiping waterways(Zuo xiaoqing, 2000). In the flood period, the water floods fast is disorder. There are lots of heavy fog in winter and spring season, while heavy winds and waves in summer. The waves last for a long time while it meets and keeps pace with the waves generated by the ships, it is very dangerous to the ferries if confronting heavy rains at the same time. Another aspect is related to the strong wind which is not easy to be forecast by the meteorologic bureau, an initial report revealed that the disaster of the Eastern Star

which sank in the middle of the Yangtze River near Jianli county caused more than 400 lives lost was due to the heavy wind and rain.

#### 4.4 Management factors

The laws and regulations related to the management of ferries are not unified, and policies are not fully implemented. There are more than one government departments which have the responsibilities to supervise the safety of ferries such as the Maritime Authority, Waterway Bureau and the Administration of Work Safety (Shi Yi & Peng Ke, 2011). There exist some overlaps related to the management of ferries in China. It is hard for the local government to exert the responsibilities which can result in the vacuum of management of ferries. For instance, some county of Hubei and Hunan province have local protectionism for the approval of the setting of ferry places. There are many ferries operated jointly by the companies from Hubei and Hunan province, but when the ships belong to Hunan withdrawn from the business, some governments along the Yangtze River in Hunan would abolish the right of operating ferries which have been recognized to avoid the responsibilities of supervising the safety of ferries, or the ferries without local ships will not be recognized by the local government.

The on-site supervision can not cover all the aspects of the safety of ferries at present. Currently, the supervision model of the ferries for the Yangtze River Maritime authority is from top to bottom while the implementations of local governments is designated by territorial management. This results in some overlaps of the responsibilities (Ward S C, 1999).

The quality of supervision should be further improved. Through the interviews and on-site inspections, some of the managers from the companies and local governments are not familiar with the relevant laws and regulations, the sense of responsibilities and the implementation of legislation are not strong enough. All the problems

mentioned above directly influence and restrict the performance of implementation.

The means of supervision is relatively backward. Currently the supervisions of the safety of the ferries rely on human apart from the ships which have been equipped with GPS. It needs many officials to patrol and on-site control especially in holidays when there are lots of people who need to cross the river(Wangjin, 2008). The model of management seems to be unique and the punishments of violations and the rectification of defects are hard to be achieved.

## **Chapter 5 Recommendations and Suggestions for the Improvement of Safety**

A good risk management is the cornerstone for improving the safety of ferries . Based on the experience of supervision, the following are some recommendations and countermeasures.

### **5.1 Countermeasures for Human Factors**

The managers from the companies and all crew on ferries should be retrained and given special training and education for free due to the lack of professional knowledge and skills. Meanwhile, the related authority should train the crew periodically and explain related regulations and norms to the managers, crew and passengers . The regulations and related codes should be published and issued to the crew to learn(Ye Feng,2010).

For the illegal sailing of passenger ferries, the authority should frequently check the ferries especially confronting a bad weather. The officials from the local governments and maritime authorities should implement on-site inspections while there is heavy fog and wind to forbid the sailing of the ferries, and issue the notification for safety information in time.

Sending some safety culture related to the safety of ferries to the school every year. Government should require the schools alongside the Yangtze River to open some courses in relation with safety of ferries and educational activities, and send officials to the schools to explain the accidents of ferries and make some card on which there are some safety information and the lesson schedule to the pupils. In an other words, safety knowledge about ferries should be spread on campus.

Some safety information about the ferries should be sent to the crew members and the passengers, and the information can be made into a disc to play on the ferries and the ferry piers to remind the crew members and the passengers to pay attentions to the countermeasures.

## 5.2 Countermeasures for Ship-based Factors

Due to the poor conditions of part of the ferry ships which are relatively outdated, the related authorities should strengthen the reconstruction of these ferries and optimize the routes of the navigation. In accordance with the requirements of Ministry of transportation and Safety Supervision Bureau, the government should gradually eliminate the ferries which do not fully meet the standards of the regulation and construct some new ferries with advanced equipment. The capital needed should be addressed jointly by the local government, the ships companies and the ship owners. Such as the "Wuyun 1", "Wuyun 3" and "Shuhe 1" passenger ferries which are the examples of this solutions (Ye Feng, 2010).

The government should mandatory eliminate the ferry ships which were constructed with hanging propellers and single engine and encourage to construct new ferries with double engines. For most of the passenger ferries are operated by individuals, the private interest should be also considered. The local government should increase the subsidies of the fuel consumed on passenger ferries and solve the capital problem for the ship owners and the companies (Washington Ship Company, 2009).

Meanwhile, the initial stability of the ferry should be strictly controlled by the related RO such as the ship survey sector.

### 5.3 Countermeasures for Environmental factors

The influence on the safety of ferries by nature is objective and can not be changed in a short time. However, people can subjectively and positively reduce the risks to the minimum with countermeasures so as to ensure the safe navigation of the ferries.

The officials from maritime authorities should positively take actions to the bad weather, and check and inspect the conditions of the ferry piers and ferries periodically. Ferries should be banned to sail in a very bad weather such as heavy fogs and winds.

The maritime authorities should strengthen the co-operations with the local meteorological department, do more researches on the analysis of winds and heavy fogs and other inclement weather of the Yangtze River, to increase the capacity of monitoring bad weather, forecast weather information to master by alternative ways in advance(Xiao Xiliang, 2007). For instance, October 6th 2007, strong winds occurred in the jurisdiction of Wuhan MSA, the VTS center received a warning on the evening of 5th, by monitoring the weather information, officials released the warning to the ferries in advance and suggested the masters of the ferries to take countermeasures against the strong winds.

### 5.4 Countermeasures for Management-based factors

All the governments and authorities in relation to the safety supervisions of ferries should do their best to take the responsibilities and to establish a harmonious forum for addressing the problems. The maritime authorities should designate an official to one each ferry. The local government should encourage and support the manager from the government to strengthen the management of the safety of ferries including offer enough time and capital. The upper government should designate only one department to take full responsibilities to the safety management

of ferries rather than several departments to avoid overlapping. The related authorities and organizations should strictly approve the setting of ferry places and to make sure every aspect related to the safety complies with the legislation and mandatory regulations.

The maritime authority should increase the frequencies of on-site supervision especially on holidays when there are plenty of passengers crossing the river by ships. Patrol ships should check the navigational environment every day and request the ferries to report the conditions in the first voyage each day. The phenomenon of overload is the major risks for passenger ferries and this should be strictly banned. Each phenomenon of overloading must be addressed before the voyage and it is suggested that a auto-counting system should be built at the ferries to limit the number of passengers on ferry ships.

For improving the ability and the quality of the officials and the managers from maritime authority and local government, the training and education should be further strengthened. The government or the maritime authority should carry out a training lesson every year for the crew and the officials to improve their safety awareness and ability of supervision. The related regulations and legislation such as the “*manual for the crew in the Yangtze River*”, “*the latest code for avoiding collision*” and “*regulation for the in-land water penalties*” should be well acknowledged .

The maritime authority should accelerate the construction of systems of GPS, CCTV and VTS for monitoring, and encourage and offer capital support to the installations of modern equipment such as the devices mentioned above. For the ferries with GPS installation the authority can conduct 24-hour supervision and offer emergency services. This can improve capacity of the dealing with emergency for both the crew and the maritime authority.



## **Chapter 6 Conclusion**

This paper provides a systematic method of risk assessment based on the major factors of human, machine, environment and management, recognizes and analyzes the potential risks which impact the safety of ferries engaged in the Yangtze River through interviews, questionnaires and data from the related authorities. The research of the safety of ferries is a systematic programme in relation with the safety of the society and other related fields. Safety management is defined as risk management as well, which is a new science of studying related to the law and the control of the risks . To optimize the management skills and measures through the achievements of risk recognition, risk calculation and risk assessment and take various countermeasures to control the risks and minimize the influences of risks, only do like this can the safety of the ferries in Yangtze River be improved.

In conclusion, this paper firstly introduce the related research method of risk assessment and the current situation of risks of ferries in Yangtze River, then analyze major factors of risks through MEM theory and finally provides some recommendations and suggestions for the improvement of the safety of the ferries sailing in the Yangtze River.

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## **Appendix A: Outline of the Interview**

1. How do you think the safety of the ferries in Yangtze river or in your jurisdiction?
2. What are the poor and strong points of management of the ferries in your jurisdiction?
3. Which do you think is the most important factor in terms of the influence to the safety of the ferries, human, machine, environment and management and how will you rank them in terms of the influence to the ferries?
4. How are the safety status of the ferries in your jurisdiction ?
5. what can be done to improve the safety of the ferries?
6. How are the surrounding environments of the ferries ?
7. what is the main factor which impacts the safety and how it impacts?

## **Appendix B: Questionnaires related to the ferry ship's safety status in the Yangtze River**

For a comprehensive assessment of the safety of the ferries which engaged in the Yangtze River, the author has to identify the major factors which impact the safety of the ferries and establish a index system for assessment based on the helps of yours.

Here is a specific questionnaire for you. Please fill the blank and write down your suggestions according to your knowledge and experiences. Thanks for your time.

The basic data of informants:

Occupation:  maritime officials  manager from ship company  deck crew  
 engine crew  officer from local government  others

Duty:

Questions:

1. which do you think are the factors that influence the safety of ferries from the crew's point of view?

A- professional ethics

B- emergency capability

C- intensity of labor

D- work time

E- professional quality

F- physical and mental qualities

G- learning capacity (the acceptance of new knowledge and new equipment for the crew)

2. Which do you think are the factors of environment that influence the safety of ferries?

A-hydrology

B- design of the route

C- wharf condition

D- on-site management

E-weather

F-the volume of the ship traffic

G-waterway situation

H- traffic regulations

3. which do you think are the ships' factors that influence the safety of ferries ?

A- integrity

B- the stability of ship

C-main engine

D- fire fighting equipment

E-lifesaving equipment

F-navigation aids