

THE CAUSES OF ACCIDENTS IN WATER TRANSPORTATION IN THE CHAO PHRAYA RIVER

Phichet Netsawang, Phranakhon Si Ayutthaya Rajabhat University

ABSTRACT

The aims of this study were 1) to study causes of accidents in water transportation in the Chao Phraya River, 2) to study factors affecting the water transportation system in the Chao Phraya River. The research methodology was qualitative research. The sample groups consist of 3 groups: 1) 52 operators and personnel of shipping companies, 2) 30 ship workers, and 3) 18 freight managers and other involvers. The instruments were Ishikawa Diagram (Fishbone Diagram) and Pareto Chart. Data were collected by reviewing from related documents and using in-depth interviews with the involvers. Data were analyzed by using descriptive analysis. The results of the study were as follows:

The causes of accidents were from various factors including from workers (e.g. ship sailor and boatswain), ship structure, physical condition of the ships, ship equipment, and shipping method. The factors affecting the water transportation system were external environmental incidents including weather, current, high and low water level, downstream routes, and the wide and devious appearance of the Chao Phraya River. These were factors that caused the risk of accidents in water transportation in the Chao Phraya River.

The significant guidelines for accident prevention and reduction were workers training on working process, ship physical condition check, loading weight control for both persons and cargo, safety equipment installation and ship tracking system, and external environment check including weather, current, water level, downstream routes, and the risk areas in the Chao Phraya River. These processes will effectively result in the improvement of water transportation accident prevention and reduction in the Chao Phraya River and further result in the improvement of the overall economic system of Thailand.

Keywords: Bulk Ships, Water Transportation, The Chao Phraya River, Accident in Water Transportation, Accident Cause

INTRODUCTION

Water transportation is an activity to transfer persons and cargo using a variety of freighters or carrier ships in terms of size and transportation process in water surface such as river, canal, sea, lake, and ocean. The objectives are of transportation and commercial shipping. In the past, boats or rafts were sculpted from logs to use for crossing rivers. Then, water transportation was developed, and passenger ships were used for transporting and shipping goods over canal, river, sea, and ocean.

In the past, water transportation in Thailand took place on rivers. Nowadays, water transportation in Thailand is done by using bulk ships or freighters and plays a significant role in the economic system of Thailand because it is a low cost shipping method with higher capacity and heavier load when compared to air and land shipping that have more limitations. The goods that are mostly shipped by using freighters in Thailand are sugar, chemical fertilizer, sand, soil, coal, and so on. These items have heavy weight and need bulk cargo loading shipping.

In 2007 – 2018, there were lots of water transportation accidents. (Marine Department & Ministry of Transport, 2018). The recent accidents were of the Muslim passenger ship, sugar cargo ship, and other goods that sank in the Chao Phraya River. The accidents affected the economic system, people who used passenger boats, freight companies, and the environment in rivers that connected to the Chao Phraya River.

Therefore, the study to analyze causes of accidents in water transportation is needed as it is the problem that must be solved urgently. The scope of the study was the Chao Phraya River area covering Angthong, Phra Nakhon Si Ayutthaya, Pathum Thani, Nonthaburi, Bangkok, and Samut Prakan Province at the estuary to the Gulf of Thailand. The objectives of the study were to study causes of accidents and factors affecting the water transportation system. The significance of the study was that it can improve and develop the water transportation system in the Chao Phraya River to be more effective and further improve the economic system of Thailand. Other involvers also get advantages including passengers, Freighter Company, and the environment of rivers and canals that are connected to the Chao Phraya River.

The Objectives of the Study

- 1) To study causes of accidents in water transportation in the Chao Phraya River
- 2) To study factors affecting the water transportation system in the Chao Phraya River.

LITERATURE REVIEW

Theories and Related Studies Concerning Accidents in Water Transportation

Department of Protection & Welfare (2000). mentioned 3 theories concerning accidents in water transportation as follows:

Heinrich (1950). created Domino Theory with the main principle of dangerous effect order. To illustrate, the dangers can happen in order - when the first incident happens, it affects the other processes until the end of the effect namely getting hurt. It is similar to the domino - when the first piece of domino falls down, other pieces also fall down too. The key is that if you don't want the fourth piece to fall down, just take the third piece out. That is action should take place in a dangerous condition or situation so that hurt or damage will not happen.

Firenze System Model describes a safety system model to study the causes of accidents in the whole system as the components in the system are linked together. Those linked components are Man, Machine, and Environment. Moreover, these components also influence and affect Task (*i.e.* decision making) and Accidents as well.

U.S. Military applied accident prevention system to use for safety management. The safety system was improved by integrating advanced technology together with developing production technology.

In conclusion, the causes of accidents and dangers in water transportation were Man, Machine and Equipment, and Environment and Natural Disaster.

Pareto Chart

Pareto (1848), created Pareto Chart to show the relationship among causes of defects and the consequent damage. This process can figure out the critical factor of the problem from other factors. The results of the investigation can be confirmed by comparing “before” and “after” incidents. Then, determine the problem to be fixed and find out the solution by operating the problem solving process step by step. This process will show the proportion of the

seriousness of each problem by presenting it in form of a chart. The chart can easily convince researchers without complicated calculations. The chart consists of a bar chart and line chart of information on Y axis and X axis together with percentage and accumulated percentage on the most right columns of the chart. The bar chart will show the highest to the lowest number from left to right except the “other” information that will be presented in the last row. To conclude, the process of making Pareto Chart are 1) determine problem to study and what data to be collected, 2) determine data collection methods and time, 3) design record form, 4) data collection, 5) place data in order, and 6) draw the Pareto Chart from the collected data.

Ishikawa Diagram (Fishbone Diagram)

Ishikawa (1943), created Ishikawa Diagram (fishbone diagram) that shows the problem to study on the most left or most right of the diagram with the main line going through the center from left to right as a backbone. Then, draw other lines of sub-bone to mention 3 to 6 related problems and do the skew angle from the main line. In each sub line, also name factors that can cause the sub problems. It is possible to draw more sub lines within the first level sub lines. If there are more levels of factors that can cause problems. Normally, the sublevels can reach 4 to 5 levels. The complete diagram will show the overall picture of the factors affecting problems. The advantage of the Ishikawa Diagram is that we can save time to categorize the ideas as all ideas are well organized in the diagram. Moreover, we can notice the main causes of the problem easily with their sub causes that might be the consequences of the main causes. The disadvantage of the Ishikawa Diagram is that the fish bone will control the overall idea and avoid members to think freely on their own. Therefore, it is needed to be used by skillful people especially when it is applied with brainstorming processes.

The aforementioned theories concerning accidents in water transportation were applied into this study. First of all, the scope of the causes of accidents in water transportation consisted of Man action (*i.e.* personnel, workers, and involvers), Machine, Method, and Environment. Ishikawa Diagram was used for analyzing the causes of accidents in water transportation in the Chao Phraya River, and Pareto Chart was used for summarizing results of the study for the clearer conclusion and discussion.

CONCEPTUAL FRAMEWORK

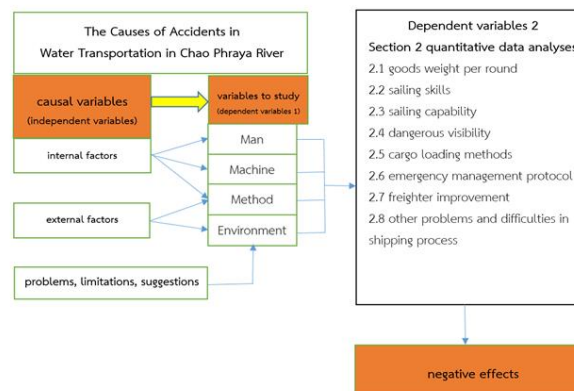


FIGURE 1

CONCEPTUAL FRAMEWORK OF THE CAUSES OF ACCIDENTS IN WATER TRANSPORTATION IN THE CHAO PHRAYA RIVER ANALYSES. (NETSAWANG. P. 2019)

RESEARCH METHODOLOGY

The study of the causes of accidents in water transportation in the Chao Phraya River was qualitative research. In order to collect data to be covered all causes of accidents, the procedure was as follows: making research operation plan, retrieving basic information in the scope areas, determining participants, studying related studies, reviewing how to get to the areas, developing interview form and testing the interview form, getting to the scope areas to collect data by using in-depth interview with the key informants who were selected by purposive sampling method, analyzing data, making data report, interpreting the data by using content analysis, and presenting the results in descriptive analysis (Figure 1).

The Results of the Study

The Causes of Accidents in Water Transportation in the Chao Phraya River

The data were analyzed by considering mutual variables of the causes of accidents in water transportation in the Chao Phraya River such as strong current, hitting other ships, hitting objects, and so on. The data were retrieved from the Marine Department, Ministry of Transport, consisting of accident information in the Chao Phraya River and Pasak River in Phra Nakhon Si Ayutthaya Province during 2007 to 2018. The results revealed that the causes of accidents in water transportation the highest frequent cause was the ship control problem including losing control and losing balance because of the current or the other ship passing by. The other causes of the accident were the strong current, leaking, hitting objects, hitting bridge piles, and overloading passengers. These factors cause various levels of accidents including sinking or hitting other ships. The results of the causes of accidents in water transportation in the Chao Phraya River were shown in Table 1 as follows:

Table 1
THE CAUSES OF ACCIDENTS IN WATER TRANSPORTATION IN THE CHAO PHRAYA RIVER 2007 – 2018

Causes	Year												Total (number)	Percentage	Accumulated Percent
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018			
Ship Control	0	0	0	1	2	2	0	0	1	1	0	0	7	41.18	41.18
Strong Current	1	1	1	0	0	0	0	0	0	0	1	0	4	23.53	64.71
Leaking	0	0	0	0	0	1	0	0	0	0	0	1	2	11.76	76.47
Hitting objects	0	0	0	0	0	0	0	1	0	1	0	0	1	5.88	82.35
Hitting Bridge Pile	0	0	0	0	1	0	0	0	0	0	0	0	1	5.88	88.24
Overloading	1	0	0	0	0	0	0	0	0	0	0	0	1	5.88	94.12
Other (Bollard Off)	1	0	0	0	0	0	0	0	0	0	0	0	1	5.88	100
Total (per year)	3	1	1	1	3	3	0	1	1	2	1	1	17	100	

The statistics of accidents in water transportation in the Chao Phraya River were retrieved from Marine Department, Ministry of Transport, during 2007 to 2018, and the data were presented in Pareto Chart in Figure 2 as follows:

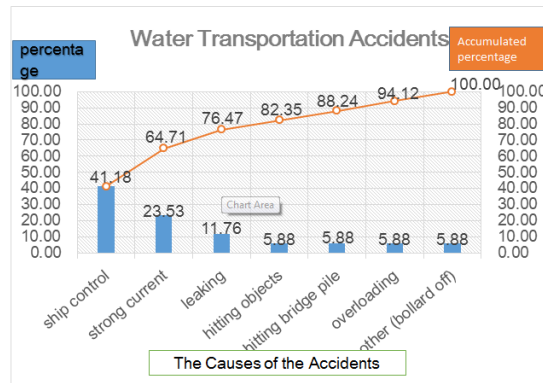


FIGURE 2
THE STATISTICS OF WATER TRANSPORTATION ACCIDENTS IN THE CHAO PHRAYA RIVER PARETO CHART

(PARETO V. F. D (1848))

Figure 2 revealed the causes of accidents in water transportation in the Chao Phraya River during 12 years (2007 - 2018). The statistics of the causes of accidents in water transportation in the Chao Phraya River were analyzed by using percentage and accumulated percentage. The results showed that the most serious causes of accidents were ship control (41.18%) followed by strong current (23.53%), and leaking (11.76). The other 4 causes consisting of hitting objects, hitting bridge piles, overloading, and other (bollard off) were similar in percentage of occurrence (5.88%). That made the accumulated percentage up to 100%.

These aforementioned causes affected water transportation in the Chao Phraya River in various aspects including late shipping, higher cost, affecting the environment, and causing water pollution.

Problems and Difficulties of Water Accidents in the Chao Phraya River

The results from the in-depth interview with the key informants namely involvers who were public sectors and private sectors including freight companies were plotted in Ishikawa Diagram (Fish Bone Diagram). The problems with the causes and consequences were analyzed in the diagram to show the relationship between Problem and Possible Cause (Figure 3).

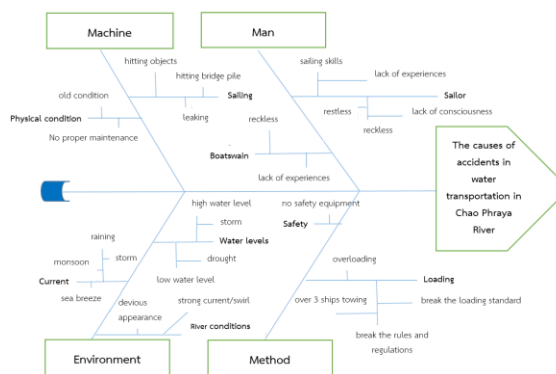


FIGURE 3
THE CAUSES AND RESULTS OF WATER TRANSPORTATION ACCIDENTS IN THE CHAO PHRAYA RIVER ISHIKAWA DIAGRAM (ISHIKAWA, 1943)

Factors Affecting Water Transportation System the Chao Phraya River

The results from the data analyses of the causes of accidents in water transportation in the Chao Phraya River can divide problems and difficulties of water transportation in the Chao Phraya River into 4 factors (*i.e.* both internal and external factors) as follows:

- (1) Man: The problems that were caused by Man were from the lack of experiences and skills of the sailor, the unfamiliar to the route in the river, the lack of consciousness, reckless, the inability to making decision, and restless that made the personnel not ready to work.
- (2) Machine: The problems concerning Machine in this study referred to the ship itself that was not ready before the operation. The problems were caused by improper maintenance, the old physical condition of the ship, non-registered ship, no annual check, no safety equipment, and the safety equipment had no maintenance and made them not ready to use without fixing or changing.
- (3) Method: The method problems were overloading both goods and passengers that easily caused accidents. In the flood season, the problem of hitting bridge piles easily occurred. Therefore, the process of connecting to the near port should be prepared so that the ship would not block the route or intrude into the residences around the river.
- (4) Environment: The problems that were mostly found were due to weather including storms, strong current, high and low water levels that caused difficulties in ship control. Therefore, the sailors should consult the Meteorological Department to increase safety in shipping. The sailor should also avoid facing natural disasters in order to reduce the accidents in water transportation.

These factors were the internal and external causes of accidents in water transportation in the Chao Phraya River that affected the economic system, investment, fishery, environment, and ecosystem in all rivers that connected to the Chao Phraya River.

Guidelines for Accident Prevention and Reduction of Water Transportation in the Chao Phraya River

The guidelines for accident prevention and reduction of water transportation in the Chao Phraya River were as follows:

- (1) Traffic surveillance systems and communication systems must be improved in order to take control over traffic in the river and increase safety in the areas. For example, there should be radio communication systems among ships that pass by each other on the curve of the river so that in case of an accident occurs, the ships will be able to contact the security sector immediately. Moreover, surveillance camera systems should be installed at the risky areas or the important ports.
- (2) There should be patrol boats and more investigators in the risky areas. Moreover, the freighter and ships should follow the rules and regulation strictly and cooperate on the inspection at the ports. Safety equipment should also be installed to be ready for rescue in emergency cases.
- (3) Ship quality control and personnel qualification measurement should be more strict to the rules and regulations. Goods and passengers overloading must be strictly punished in order to reduce the risk and reduce the level of the accidents especially in flood season. There should be publicizing and training for personnel and workers to raise their awareness in safety and increase their knowledge about safety practice in water transportation.
- (4) Security equipment should be installed; for example, a control system for getting on and off port, signs or publication that show direction of the route and explain practice during taking the ships such as always wear life jacket at the port.
- (5) Personnel or workers should get continuous training on sailing, towing, and goods carrying to increase their skills and capability. They should also study the route for towing and shipping and study the behavior that leads to accidents so that they can avoid doing it. The practice for emergency cases should be held so that personnel and workers can rescue victims in time following the correct protocol from the Marine Department, Ministry of Transport.

DISCUSSION

The results of the study showed the causes of accidents in water transportation in the Chao Phraya River and guidelines for accident prevention and reduction of water transportation. The results revealed that the causes of accidents in water transportation were from various factors including from workers (e.g. ship sailor & boatswain), ship structure, and physical condition of the ships, ship equipment, and shipping method. Moreover, there were external environmental incidents including weather, current, high and low water level, downstream routes, and the wide and devious appearance of the Chao Phraya River.

The guidelines for accident prevention and reduction of water transportation were by providing personnel or workers continuous training on the operation and method, checking ships continuously, controlling weight of cargo and passengers, installing safety systems and tracking systems. For external factors, the personnel or workers should check weather, current, water levels, and the wide and devious appearance of the Chao Phraya River to avoid accidents in water transportation.

This results were consistent to the previous study on the risk analysis of accidents in water transportation in the Chao Phraya River and Pasak River, Phranakhon Si Ayutthaya Province (Reantongchai, 2015), safety management of personnel: case study of a crossing ferry company (Kuntee, 2016), and the study of safety model scheme in water transportation in the Chao Phraya River and Pasak River, Phranakhon Si Ayutthaya Province (Yamuang, 2016). The results of the studies also influenced the economic system of Thailand and the investment in industries and services. Furthermore, it helps reduce water pollution in the Chao Phraya River as well.

Body of Knowledge (Diagram with Description)

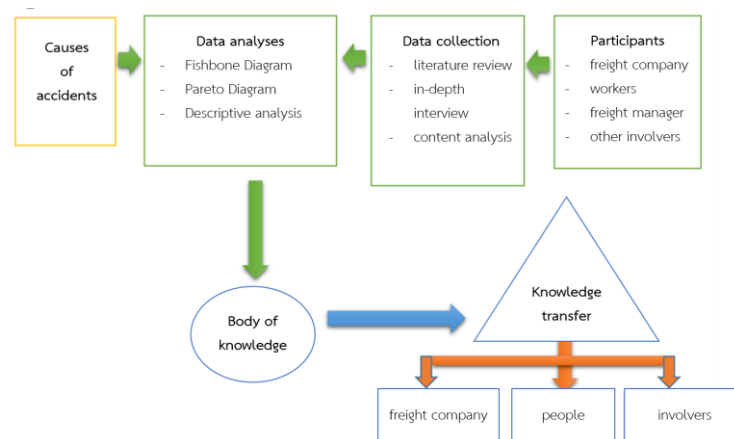


FIGURE 4

BODY OF KNOWLEDGE FROM THE STUDY OF THE CAUSES OF WATER TRANSPORTATION ACCIDENTS IN THE CHAO PHRAYA RIVER DIAGRAM (NETSAWANG. P. 2019).

The body of Knowledge from the Study of the Causes of Water Transportation Accidents in the Chao Phraya River focused on the cooperation between the involvers including freight company, personnel and workers, freight managers, and public and private sectors. The body of Knowledge of this study was retrieved from lesson learning, experiences, and related studies and presented in the Fishbone Diagram and Pareto Chart. The results were described by using descriptive analysis so that it can be further easily transferred to the freight companies, people who receive water transportation services, and other involvers. Additionally, it will raise the

safety awareness in water transportation and notify the process of shipping preparation to prevent and reduce accidents in water transportation in the Chao Phraya River.

CONCLUSION

The causes of the accidents were analyzed from various factors that affected accidents in water transportation. The results of the study showed that there were various factors that caused accidents including the lack of experiences and lack of skills and capability in operation. There were also uncontrollable and unexpected causes such as unstable weather, strong current, and downstream routes that were wide and devious resulting in the ease of accidents occurring in the Chao Phraya River. Some accidents were so serious as they took huge damage to properties and lives such as sinking, sticking to shallow areas, hitting river banks where there were people around, and so on. Sometimes, it intruded into the personal household or responsible areas of the Marine Department. Consequently, the ship cannot move on and block the shipping route. Therefore, there should be safety protocol to deal with the emergency cases that can always happen. The safety protocol in water transportation can include the determination of the effective safety measurement such as always checking and maintaining facilities and safety equipment including warning systems such as alarming systems, life jacket, loops, and so on. The safety rules and regulations should be more strict especially in the high risk areas with the continuous training to raise the safety awareness in water transportation for public and private sectors to prevent accidents in water transportation in the Chao Phraya River. For the accident reduction, there must be up to date plans for accident prevention and solution. Moreover, traffic tracking and communication stations should be developed to effectively control traffic in water transportation and increase security in the areas. Patrol boats and more investigators in the risky areas should be added for the more effective investigation on ship and personnel quality control. Overloading ships should be punished to reduce the risk and the levels of damage. Personnel or workers should get continuous training. The freight company should raise the safety awareness by installing safety equipment and facilities and showing signs to publicize directions and practice during the operation. The operators and workers should follow the safety rules and regulations such as always wearing a life jacket, use the rescue equipment correctly, and even make marks or signs to show where safety equipment is placed at the risky areas such as at the curve or narrow route.

SUGGESTION AND RECOMMENDATION

Suggestion and Recommendation for this Study

Workers, namely sailors and boatswains, should check the readiness, physical condition, and ship structure before the shipping operation in order to reduce the risks of accidents in water transportation in the Chao Phraya River.

The ship controllers should study water routes, check weather, water level, and current thoroughly before the shipping operation.

In order to improve safety in water transportation in the Chao Phraya River, there should be a concise measurement for checking passenger and cargo loading to avoid overloading that is considered the most serious risk of accidents in water transportation.

For the safety in water transportation, there should be clear traffic signs to support the mutual use for many ships together in the Chao Phraya River. Moreover, surveillance cameras should be installed in all risky routes.

In case of emergency or dangerous situation in water transportation, it must be immediately informed to the involvers. Communication system and tracking system must be installed in the freighter properly for the highest safety.

Suggestion and Recommendation for the Future Study

The accident in water transportation can be focused case by case as a case study to get in-depth information for the clearer picture of each case.

The towage process of bulk cargo or freighter should be studied and analyzed, and the guidelines for problem solving developed from sailor and boatswain skills and capability.

Proper ship design, structure, and equipment should be studied to improve the highest safety in water transportation.

REFERENCE

- Jamornman, A. (1995). A guide to choosing statistical techniques for analyzing social sciences data bangkok.
- Kijpreedaborisoot, B. (2000). *Including research articles, measurement and evaluation (2nd Edition)*. Bangkok: Srianunprinting.
- Chinokun, C. (2005). *Supply chain management and logistics (1st Edition)*. Bangkok: vjprinting.
- Detroit, M. (2008). Water transport management of exchange membrane fuel cell.
- Georgios, I., & Zekos. (2000). Safety sea and Air transport under EU Law.
- Ishikawa, K. (1943). *Quality management*. The University of Tokyo.
- Hirunrut, N. (2010). The customer' satisfaction of the chao phraya express boat users. *RMUTP Research Journal*, Thailand.
- Academy. R. (1995). *Royal institute dictionary (6th edition)*. Bangkok: Auksornjaroentas AGT Co Ltd.
- Statistical Analysis Group, Office of the Harbor Department, Ministry of Transport (2018). The Chao Phraya River passenger boat report: Thailand.
- Audomtharak, S. (1979). *The water of transport*. Silpakorn University: Thailand.
- Poojindatrakool, S. (2011). Satisfaction with marine transportation service by lighter: A case study of M&T Logistics Co. Ltd. Rajamangala University of Technology Thanyaburi: Thailand.
- Boonlar, B., FCILT, & CMC. (2008). *Seminar on logistics and supply chain*. Bangkok: Mr.copy (Thailand) Ltd.
- Boonlar, B., FCILT, & CMC. (2008). *Logistics assessment guide, (1st Edition)*. Bangkok: Activeprint (Thailand) Ltd.
- Pareto, V.F.D. (1848). Political scientist and philosopher, Italy.