

**Doctoral Dissertation:**

**Aspects of Maritime Transportation  
Risk: Bulker and Tanker  
Perspectives**

Written by: Sam P. Chacko

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## DETAILS

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Aspects of Maritime Transportation Risk: Bulker and Tanker Perspectives

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DOCTOR OF PHILOSOPHY  
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by  
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Houston, TX. USA  
June 2020

## Declaration

### **Certificate of Authorship:**

I hereby certify that I am the author of this dissertation and that any assistance I received in its preparation is fully acknowledged and fully disclosed. I have also cited any sources in the references from which I used data, ideas, theories, or words whether quoted directly or paraphrased. I further acknowledge that this dissertation was prepared by me specifically for this course.

**Candidates Name:**    **Sam P. Chacko**

**Date:**                    **25 December 2019**

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I hereby affirm that the attached dissertation is entirely my own, except where the words or ideas of other writers are specifically acknowledged according to accepted citation conventions. I have revised, edited, and proofread this paper.

**Candidates Name:**    **Sam P. Chacko**

**Date:**                    **25 December 2019**

**Advisor:**                John J. Hampton- DBA.

### **Abstract**

This study examines the operational and navigational risks present in the crude oil carriage via sea on the sea route between the Middle East/Africa to China. A survey was conducted of 30 experts including shipowners, shoreside managers, and seagoing officers who deal with general navigational risks in addition to the exposure from the Malacca Strait as a major yet narrow chokepoint along this route. Using a written questionnaire in a Likert 5-point scale format, responses addressed four major risk factors. (1) Key operational risks affecting bulkers and tankers on the Arabian Gulf/Africa to China voyages. (2) Risk management impact of automatic navigation and positioning systems. (3) Effectiveness of training programs on reducing the risk of human error in loading and discharging ports. (4) Degree of coordination among decision-makers responsible for safe and economical crude oil transport.

The findings confirmed the experiences reported in previous research adding depth to the nature of the risks. The written survey confirmed the exposures and the comments of five experts added richness to the perceptions. (1) Significant operational risks are indeed present on the voyage pattern. (2) Modern navigation equipment, particularly the use of a global positioning system (GPS) reduces the frequency and severity of collisions and incidents in Malacca Strait. (3) Companies that require high levels of training see major reductions from damage or other loss from human error in loading and discharging of cargo. (4) Respondents are satisfied with the existence of adequate coordination among decision-makers who must work together to be successful managing risk on this voyage pattern.

The findings are significant to discourage deviation from the mandatory and recommended safety rules and practices that can lead to major collisions or incidents with severe financial and other implications for ships, crews, and cargos.

The findings also encourage further research as change happens in cargo and shipping patterns, technology, and management practices. Finally, the findings guide and reinforce current practices of navigation and maritime regulatory bodies.

The limitation is the small sample size, a reality of the complexity of gathering data from individuals who are intensely engaged in maritime shipping in southeast Asia. This limitation is offset by the willingness of five active industry participants to answer detailed questions about the survey results.

An area for further research is to find risks from cultural and language barriers that affect maritime navigation along this diverse shipping route. Another promising area would be to survey government officials in China, the Middle East, and East Africa for their perspectives on maritime safety and risk management.

### **Dedications**

I dedicate this doctoral research to my wife, Mercy, and each of my children Jehosh (son) and Zinnia (daughter). Mercy was so supportive and encouraging since the beginning of my doctoral studies. Without her support, this degree would not have been possible.

I am hoping that Jehosh and Zinnia will build their educational base and eventually grow to be great professionals in their fields of choice. They should be destined to their goal which is becoming true citizens of the country they live in and at the same time, have respect for all which is the intention of God about mankind.

I dedicate this doctoral dissertation to my late parents. P.C. Chacko (father) and Mariamma Chacko (mother). Though they are not with me today, yet I am sure I have fulfilled one of their wishes about me.

I also dedicate this research to my late sister-in-law Mary (Rita) John who had a great desire to achieve a doctoral degree, which she shared with the family quite a few times. Unfortunately, she died young before having the chance.

Finally, I dedicate this research to my late grandfather Ponnathanath Ponnoose Chacko who was a great believer in “education for all” and planted that seed in me as well.

## **Acknowledgments**

I am humbled today as I am standing at a gate where I am going to end a specific journey soon that I have started a few years ago.

To begin with, I would like to acknowledge Professor Jack Hampton, my doctoral advisor, and supervisor who has provided invaluable insight and support right from the beginning of my study on this subject. His guidance was timely and to the point. Dr. Hampton was a true pillar of support from the beginning to the end of this research work. I am truly indebted to him for his tireless effort and desire for me to be successful in this expedition. I appreciate it very much, Dr. Hampton.

I also appreciate the International School of Management (ISM) community led by our Dean, Dr. Caesar Baena, and his team of faculty with whom I had the chance to attend, get to know and learn from. Besides, ISM's administrative team was incredibly supportive of this journey and I appreciate their invaluable support. A special thanks to the ISM Librarian, Judy Knight whose support and hard work in finding the right literature/information in time. She was there whenever I needed it the most. I appreciate your help and support so much Judy.

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**TABLE OF CONTENTS**

<b>CHAPTER 1: INTRODUCTION</b>	<b>15</b>
A brief history of maritime trade and development	15
The modern-day shipping industry	16
A brief history of crude oil carriage by sea and risks	17
The purpose of the study	20
Background to the Research Problem	21
Statement of a problem	23
The research question	25
Summary and expected outcomes	26
Summary	26
<b>CHAPTER 2: LITERATURE REVIEW</b>	<b>29</b>
Category 1. China’s Energy Demand: The Concept of Energy Security and Strategy	29
Historical Trends	36
The Malacca dilemma and the Chinese strategy	37
The oil trade and the risk of fluctuation in price	38
Challenge in achieving energy security and climate protection	44
Category 2. Crude Oil Transportation Safety and Security	48
Various risks at sea and its foundational analytics	50
Category 3. The Risk of Maritime Piracy	52
Category 4. The Regulatory Framework	69
Category 5. The Maritime Territorial Controversies	70
Category 6. Maritime Disasters and the Risk of Marine Pollution	75
Category 7. Operational Risks and the Human Factor	76
Summary	82
<b>CHAPTER 3: RESEARCH METHOD AND DESIGN</b>	<b>84</b>
Hypotheses	84
Hypothesis 1:	84
Hypothesis 2:	84

Hypothesis 3:	85
Hypothesis 4:	85
Data Collection	85
Tool:	85
Survey Respondents / Participants:	85
Data:	85
Preliminary findings:	85
Final Findings:	85
The Likert-Scale Questionnaires:	86
Likert-style questionnaire preparation, distribution and data collection	86
Research Design	87
The theoretical/conceptual framework	88
Identification of a phenomenon and development of a hypothesis	91
Summary	94
<b>CHAPTER 4: FINDINGS</b>	<b>97</b>
The operational risks affecting tanker ships	97
Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	97
Statement 1: There are many new and existing operational risk factors present in the Middle East and Africa to China voyages affecting tanker ships.	98
Statement 2: Operational risks are equally distributed among the origin, destination ports and during the voyage at sea.	99
Statement 3: Mistakes in operational activities is a high-risk area in international crude oil transportation by sea between the Middle East and Africa and China	100
Statement 4: It is important to identify and analyze key operational risk factors by the crude oil tanker operators to avoid maritime disasters while engaging in crude oil transportation between the Middle East and Africa and China.	101
Statement 5: Failure to identify and eliminate operational risk factors has a potential impact on the profit maximization of tanker shipping companies operating between the Middle East /Africa and China route.	102
Automatic Navigation and GPS and its significance in navigation	103
Analysis of Hypothesis 2: Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	103

Statement 1: Commercial trade route to and from Asia has significantly increased and chokepoints such as straits and canals in the sea-route are getting more and more congested.	104
Statement 2: Strait of Malacca, in particular, is becoming highly vulnerable to congestion and prone to accidents due to the high-volume of sea traffic.	105
Statement 3: China's oil security is highly dependent on crude oil ships and their safe passage through Malacca Strait.	106
Statement 4: Modern navigational aids are crucial for the safety of ships, it's cargo and crewmembers while passing through the Strait of Malacca.	107
Statement 5: Implementation of modern navigational aids such as automatic navigation and positioning systems significantly reduce the likelihood of accidents on tanker voyages through Malacca Strait.	108
Elimination of human error through quality training	109
Hypothesis 3: Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	109
Statement 1: The Maritime oil pollution from crude oil trade is both universal and regional. Regionally, in the Middle East and Africa or China, errors during load and discharge operations could result in significant marine pollution.	110
Statement 2: Oil spills during load/discharge operations are caused by human errors in the Middle East and Africa to China crude oil trade.	111
Statement 3: Human errors during port operations and subsequent oil spills, damage to personnel and property could result in a significant financial loss to shipowners.	112
Statement 4: Human errors at the load and discharge port in the Middle East and Africa and China are directly related to lack of employee training.	113
Statement 5: High level of training significantly reduces the risk of human errors at loading and discharging ports in the Middle East and Africa and China.	114
Importance of Decision-making in crude oil transportation	114
Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	115
Statement 1: Communication among decision-makers at shipping enterprises plays a crucial role in the efficient and safe transport of crude oil between the Middle East and Africa and China.	115
Statement 2: Shipowners, shoreside managers, and seagoing officers are part of the decision-making process at the shipping companies engaged in the sea-transport of crude oil from the Middle East and Africa to China.	116
Statement 3: To ensure the efficiency and safety of crude oil transportation between the Middle East and Africa to China, decision-makers should mutually agree upon adequate steps.	117
Statement 4: It is critical that decisions related to efficiency and safety be communicated to the employees at the operational level for adequate implementation.	118

Statement 5: Currently, shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of crude oil between the Middle East and Africa and China ports.	119
The Survey Respondents' Demography Analysis	120
Summary of Survey and Overall Respondent Opinions	126
1. There are significant operational risks present	126
Analysis of Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages	126
2. Modern navigation equipment such as GPS reduces accidents at Malacca Strait	128
Analysis of Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	128
3. Risk of human errors at load and discharge ports can be reduced by quality training	129
Analysis of Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	129
4. Coordination among decision-makers create efficient and safe transportation of crude oil	131
Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	131
Summary of findings and its theoretical and philosophical aspects	132
Summary	133
<b>CHAPTER 5: VALIDATION OF FINDINGS</b>	<b>136</b>
Importance of Expert Interviews	136
Ethical Attention	137
Interview with Captain Mohan Muppidi	138
Demographic Information	138
Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	138
Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	140
Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	141

Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between Arabian Gulf and China ports	141
Interview with Captain Kuldeep Singh	142
Demographic Information	142
Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	142
Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	143
Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	144
Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	146
Interview with Captain Christopher Desa	147
Demographic Information	147
Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	148
Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	149
Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	151
Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	152
Interview with Mr. Ashok Nigam	153
Demographic Information	153
Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	154
Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	155

Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	155
Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	156
Interview with Mr. S.V. Anchan	156
Demographic Information	156
Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.	157
Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.	158
Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.	160
Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.	161
Summary of expert opinions to survey findings	163
<b>CHAPTER 6: SIGNIFICANCE, LIMITATIONS, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH</b>	<b>165</b>
Significance of the Study	165
Limitations of the Study	167
Conclusions and Recommendations for further research	168
<b>APPENDIX-1</b>	<b>171</b>
<b>REFERENCES</b>	<b>171</b>
<b>APPENDIX-2</b>	<b>182</b>

## LIST OF FIGURES

Figure 1. Crude oil imports to the US from all countries	23
Figure 2. Crude oil imports to China from all countries.	23
Figure 3. Indicators for each acquisition stage and risks.	44
Figure 4 Theoretical Concepts / Framework	94
Figure 5. Statement 1 of Hypothesis 1 Many risks are present	98
Figure 6. Statement 2 of Hypothesis 1 Operational risks are present at ports and while at sea	99
Figure 7. Statement 3 of Hypothesis 1 Mistakes in operational activities is a high-risk	100
Figure 8. Statement 4 of Hypothesis 1 Identify and analyze operational risk factors	101
Figure 9. Statement 5 of Hypothesis 1 Operational risks impacts profit maximization	102
Figure 10. Statement 1 of Hypothesis 2 Straits and canals are congested in the China route	104
Figure 11. Statement 2 of Hypothesis 2 Malacca Strait is vulnerable and prone to accidents	105
Figure 12. Statement 3 of Hypothesis 2 China's oil security is tanker safety at Malacca strait	106
Figure 13. Statement 4 of Hypothesis 2 Technology does provide ship safety at Malacca Strait	107
Figure 14. Statement 5 of Hypothesis 2 Technology aids safe passage through Malacca Strait	108
Figure 15. Statement 1 of Hypothesis 3 Errors during crude oil load/discharge operation results in marine pollution	110
Figure 16. Statement 2 of Hypothesis 3 Human error causes oil spills during crude oil loading and discharge operation	111
Figure 17. Statement 3 of Hypothesis 3 Human errors bring financial losses to shipowners	112
Figure 18. Scale for statement 4 of Hypothesis 3 Lack of employee training leads to human errors at load/discharge ports	113
Figure 18. Statement 5 of Hypothesis 3 High level of training reduces human errors	114
Figure 19. Statement 1 of Hypothesis 4 Communication amongst decision-makers is key to the efficient and safe transportation of crude oil	115
Figure 20. Statement 2 of Hypothesis 4 Owners, managers, and seagoing officers are part of the decision-making process	116
Figure 21. Statement 3 of Hypothesis 4 Decision-makers should mutually agree upon adequate steps to ensure efficiency and safety in crude oil transportation	117
Figure 22. Statement 4 Hypothesis 4 Decisions to be implemented at the operational level	118
Figure 23. Statement 5 of Hypothesis 4 Bulker companies have adequate coordination among decision-makers for efficiency and safety in crude oil transportation	119

**LIST OF TABLES**

Table 1. China's Crude Oil Imports by Region. China's crude oil imports by region	34
Table 2. Sea routes and risk nodes	43
Table 3. Loss of trade on the East Asian trade route due to piracy	54
Table 4. Respondents' experience in the maritime industry	120
Table 5. Cargo respondents' experiences in the Industry, dealing with China and the Middle-East/Africa	121
Table 6. Finance respondents experiences in the Industry, dealing with China and the Middle-East/Africa	122
Table 7. Operations respondents experiences in the Industry, dealing with China and the Middle-East/Africa	123
Table 8. Operations respondents experiences in the industry, dealing with China and the Middle-East/Africa	124
Table 9. "None of these" respondents experiences in the Industry, dealing with China and the Middle-East/Africa	125
Table 10. Statements with respondent scales = There are operational risks affecting tanker ship voyages from Middle-East/Africa to China Voyages (Hypothesis 1)	127
Table 11. Statements with respondent scales - Automatic navigation and global positioning system reduces accidents at Malacca Strait (Hypothesis 2)	128
Table 12. Statements with respondent scales - High level of training reduces human errors at load and discharge ports (Hypothesis 3)	129
Table 13. Statements with respondent scales - Coordination among decision-makers create efficient and safe transportation of crude oil (Hypothesis 4)	131



## CHAPTER 1: INTRODUCTION

### **A brief history of maritime trade and development**

The international trade and transport of goods from one country to another have been a business that is on-going for thousands of years. There are several records in ancient religious texts that speak about the existence of international trade routes using ships as the mode of transport. Such texts give a glimpse of how the ships were built and navigated in ancient days. At one point, these ancient ships were built with two or more logs tied together and used as a raft to carry goods and people. Later, boats were carved out of wood, and paddles and oars were used to propel them. Furthermore, the first kind of sailing ships was introduced by Egyptians in 5000 B.C. (International Maritime Organization, 1998) These ships were used in riverways for fishing and movement of goods and people.

Sailing ships from the rivers to seas made people realize that there were more fish available in the sea than in the rivers. At first, the ships sailed slowly and cautiously in coastal waters, and sailors learned how seas can behave at times. Eventually, they became confident in sailing from rivers to seas which allowed people to venture out into open water and expand shipping trade. Despite the kind of dangers involved, humans became more adventurous and used ships and international trade to gather wealth and conquer lands. The finding of the new world (Americas) by Columbus was one of those challenges took by seafarers along with a new trade route to India by Vasco da Gama in 1498 (International Maritime Organization, 1998).

Over time, ships and sailors made the world grow smaller and humans established trade routes around the world. Trade routes were developed much faster than the ships themselves. It was only after the industrial revolution that ships were affecting international trade at a wider scale. During the end of the 19th century, the first time in the history of shipping, steel was used

to build ships instead of wood, and later steam was used as a power source to propel ships instead of coal (International Maritime Organization, 2012).

The sun and stars were used as the major navigation guides from the beginning of the ocean shipping. In 1569, Europeans started to use maps and charts to define the position of ships and for navigational direction. Later, the invention of radar and other modern gadgets onboard assisted ships in navigation. At the beginning of the 20th century, the shipping industry began to see enormous changes because of the developments around the world especially the Canadian and the US wheat, corn and lentils trade to Europe where shipping was found to be a cheap and efficient way of moving commodities in larger volumes for farmers (International Maritime Organization, 2012).

### **The modern-day shipping industry**

The maritime shipping serves both domestic trade of a country and the world trade in general. Since demands vary in parts of the globe, shipping needed to evolve to meet different demands. The sizes of ships were growing along with navigation technology. The number of crew members was reduced significantly to 13 to 20 to perform onboard functions such as engineering, shipboard communication, electrical department, and kitchen. As the demand for international trade increased, the supply of ships and space on ships grew to meet the demand. In 1983, the size of the world shipping fleet nearly doubled compared to 1971 along with the tonnage (Chrzanowski, 1985). There were three categories of ships which included oil tankers, ore and bulk carriers, and general cargo carriers.

The general cargo ships carried cargoes other than bulk and included a variety of commodities. These were not specialized ships and cargoes were dry. However, liquids in drums were also carried in general cargo ships. The ore and bulk cargo ships were built to carry ores in

bulk and considered as specific commodity carriers. The Ro/Ro (Roll-on/ Roll-off) ships were built to facilitate the movement of motor cars, trucks, and other vehicles around the world. In this specific type of shipping, the vehicles can be driven into the Ro/Ro ships using ramps without depending on landside loading equipment such as shore cranes. Furthermore, as part of bulk carriers, specialized industrial ships such as liquid natural gas (LNG), chemical carriers, and mineral carriers were also built and deployed as specific commodity carriers (Chrzanowski, 1985).

The ship sizes needed to be improved with safety measures to develop the capacity to carry crude oil in bigger quantities to refineries in the US Gulf Coast, Japan, and other parts of the world. This demand brought Very Large Crude Carriers (VLCCs) and Ultra Large Crude Carriers (ULCCs) into oil tanker fleets (Chrzanowski, 1985). In a nutshell, the shipping industry has evolved from its ancient-day wooden structure to the modern-day industrial marvels. Today, the industry responds to new maritime transportation needs with advanced technology and efficient equipment onboard. However, most of the traditional way of conducting business is going to be a challenge for the industry. There are a few critical areas where the author believes the challenges in the future will involve economics, security and risk management, governmental policies, and operations.

### **A brief history of crude oil carriage by sea and risks**

Within 10 years, a seaborne trade developed and was brought to Europe (Stopford, 1998). According to Stopford, the oil was first shipped as kerosene in 40-gallon drums or five-gallon tins using adapted wooden sailing ships. However, realizing the dangers and available volume of cargo and its demand, soon forced everyone to find alternative options for crude oil carriage. Instead of carrying in barrels, they used bulk carriage as an alternative option (Stopford,

1998). Later, using the available shipping technology, tanker ships were built to carry oil in bulk. Building tanker ships and using them to carry crude oil in bulk dictated considerable costs; however, it was more efficient and economical to carry in ships exclusively built for crude versus carrying in barrels in small quantities. Also, loading and unloading barrels was a labor-intensive, time-consuming, inefficient, and wasteful process. The barrels were not reused and often discarded (Stopford, 1998). In 1885, Armstrong's Low Walker shipyard embodied the idea of using the ship's hull as an oil container. From 1885 onwards for the next twenty years, shipyards in England built several tanker ships using its hull as an oil container to meet the international demand for carrying crude oil in the transportation industry.

The world oil industry is well-documented. In terms of economics, the market for oil is determined by the regions where it is produced and the regions where it is consumed, like the US, Western Europe, Japan, and increasingly in developing countries (Stopford, 1998). Middle Eastern countries, North/West Africa, etc., were the producers of crude oil. China and India were considered developing nations, but not the level they are depicted today. Besides, oil supplies in the past and even now are not well-distributed. Some countries are dependent on imports namely, Western Europe, Japan, the United Kingdom are entirely dependent on imports after World War II. The US became dependent on imports in the early 1970s (Stopford, 1998). After World War II, there was a significant shortage of energy in Japan, Western Europe and the solution was the newly found oil fields of the Middle East, Mexico, and North/West Africa, which was cheaper to resource as well as abundant in supply.

These developments put pressure on the shipping industry and weighed heavily on them to build more ships. Eventually, the traditional Middle East to USA trade route was developed where the world's 60% of the crude oil reserves were found (Stopford, 1998). At the time, the

Middle East was about 12,000 miles away from the consuming countries since the tankers must go around South Africa. Later, the construction of the Suez Canal created a shorter route to the US and Western Europe. Hence, these two regions became the world's largest crude oil tanker and merchant ship trading route. Also, consuming nations needed to build refineries to convert the heavy and dirty crude oil into usable petroleum and its byproducts. Hence, the US Gulf was established with many refineries to be intricately linked to the local markets rather than having refineries at the sourcing countries. Better technological advancement in the US brought more refined petroleum and the conversion of waste into useful chemicals during the refining process.

This investigation investigated crude oil as cargo, its characteristics and method of operations, and risks involved. Liquid petroleum has many byproducts ranging from raw crude oil to refined oils, bitumen, and related cargoes (Packard, 1985). All products related to the petroleum industry must be handled with care. Most products related to the industry are inflammable with a low flashpoint. Many are dangerous and emit toxic gases or by their chemical nature, can be corrosive. Most of the liquid commodities are pumped into tanker ships from shore-based installations which would take a few hours or days depending on the size of the ships or weather conditions. Crude oil is loaded from specified crude oil terminals called Single Buoy Moorings (SBMs) where the cargo loading will progress based on weather and tidal conditions.

Crude oil being a valuable product, the amount loaded by the shipper must be equal to the amount discharged to the buyer (Packard, 1985). Thus, the loaded amount must be measured by shore-based measuring machinery while pumping aboard. Ships stability and draft calculations must be measured during the loading process by ship officers. The same criteria are followed while discharging. During the laden voyage, great care must be taken to avoid inhaling toxic

gases, etc., along with fire hazards. Tank ullages must be used regularly to measure the levels and to ensure no leakages. Lighting cigarettes/open flames on the deck walkways is highly risky because the product is extremely flammable

The training and language barriers of the crew along with their cultural background, etc., are particularly important. Many tanker ships have highly qualified crewmembers on the traditional US trade route, mostly western crew. However, the new trade routes have a risk of hiring cheaper labor, and shipowners tend to reduce the number of crew members along with hiring cheaper labor to cut costs. There are many other measures to be taken in-transit such as temperature levels, especially when carrying waxy oils, as a certain heat level must be maintained to avoid difficulty pumping during discharge. Discharge of liquids also needs utmost care and the operation all the time will be performed by the ship's pumping system. Modern ships with higher power can finish larger ship sizes within 24 hours. Local safety regulations must have adhered to as well. For example, today, the US has the highest level of regulations for tankers concerning the pollution control and safety measure in its coastal waters.

### **The purpose of the study**

The purpose of this qualitative study is to identify numerous risks existing in maritime trade and the direct impact on tanker ships carrying crude oil from the Middle East and African countries to China by sea. The author's academic background and professional experience in the maritime industry have given him information on major incidences of the past that posed several minor and major risks affecting ships sailing at sea. Some incidences have resulted in major environmental disasters and subsequent financial drain as cleanup costs to shipowners and related associations. The author is convinced that such incidents are not just things of the past but will persist if the risks are not identified and managed. From the Middle East and African

countries to China, the oil tanker ships are passing through heavily congested chokepoints, unfriendly territories, pirate-infested waters, and so on. Thus, the purpose of this study is to bring awareness of the existing risks in this trade route.

### **Background to the Research Problem**

The American influence around the globe was unmatched after World War II and there was no other economic power that could influence governments to make changes in their policies to develop the economic sectors than the US. However, in recent years, the influence of American business leadership is slowly shifting and there is intense competition from Asian economic powerhouses, such as China and India. China's economic influence is especially rising around the globe and signifying itself as a close competition to the US to occupy the number one position in the world. Many changes are visibly stirring up and its political and economic influence is intensifying rapidly around the globe. Quite notably, China had grown pointedly in the manufacturing sector where the goods are cheaper to produce, and its consumers are seen both domestically in China and abroad including western matured economies/markets.

Discernibly, China as a country had chosen a path of labor-intensive production of goods for its economic growth and became the leading economy along with other Asian giants such as Japan and India. According to Zhao and Chen (2014):

China's economy has grown rapidly over the past three decades. The Gross Domestic Production (GDP) surged from 189,399 million dollars in 1980 to 7,318,499 million US Dollars in 2011. This has resulted in China surpassing Japan as the world's second-largest economy. (p. 270)

Besides, as an outcome of its economic achievements, the GDP growth of China is around eight percent and continues to grow since 2011. The country is also trying to keep

inflation below five percent, which is incredibly important for China to keep the social stability and security of the current government (Lee, 2012). Lee also advises that there is a link between energy security and maintaining rapid growth. Initially, the rapid growth in China was primarily credited to land reforms from 1979 to 1989 by which dramatic productivity was increased in the rural areas of China. However, the industrialization of China was instigated in the mid-1990s. From that point onwards a fixed-asset investment and exports replaced domestic consumption as the driver of China's economy. That means, until the mid-1990s, the domestic consumption was the driver of economic growth. Interestingly, now the fixed-asset investment is responsible for 50-60% of the Chinese economic growth.

Len and Lee (2015, 2012) show that the demand and dependence on energy are increasing in parallel with economic growth. The crude oil imports are incontestably playing a major part in China's energy demand and it is depending on the transportation of the crude oil by ships from the Middle Eastern nations/West Africa to China's shores. A study by Wang and Lu (2015) advises that China has experienced an increasing demand for crude oil in recent years due to its economic boom and is the second-largest energy consumer in the world next to the United States.

The US on the other hand, as depicted in figure 2 for the same period, China's imports increased by from 1,555 thousand barrels to 7,395 thousand barrels which in turn a positive variance of 5,838 thousand barrels per annum (US Energy Information, 2018). All over the world, countries have been exploring the possibilities of alternative energy sources. The American public's opposition to the dependence on foreign oil is also a key factor where Americans believe that drilling and refining are possible in the US Gulf Coast and in Alaska that may assist in less dependency on foreign oil. Thus, as shown in figure 1, US imports are



declining steadily (US Energy Information, 2017) and on the other hand, economic growth in China and its demand for additional energy is putting pressure on the Chinese government to source for crude oil from other countries. This is resulting in higher imports of crude oil from the Middle East to China as shown in figure 2.

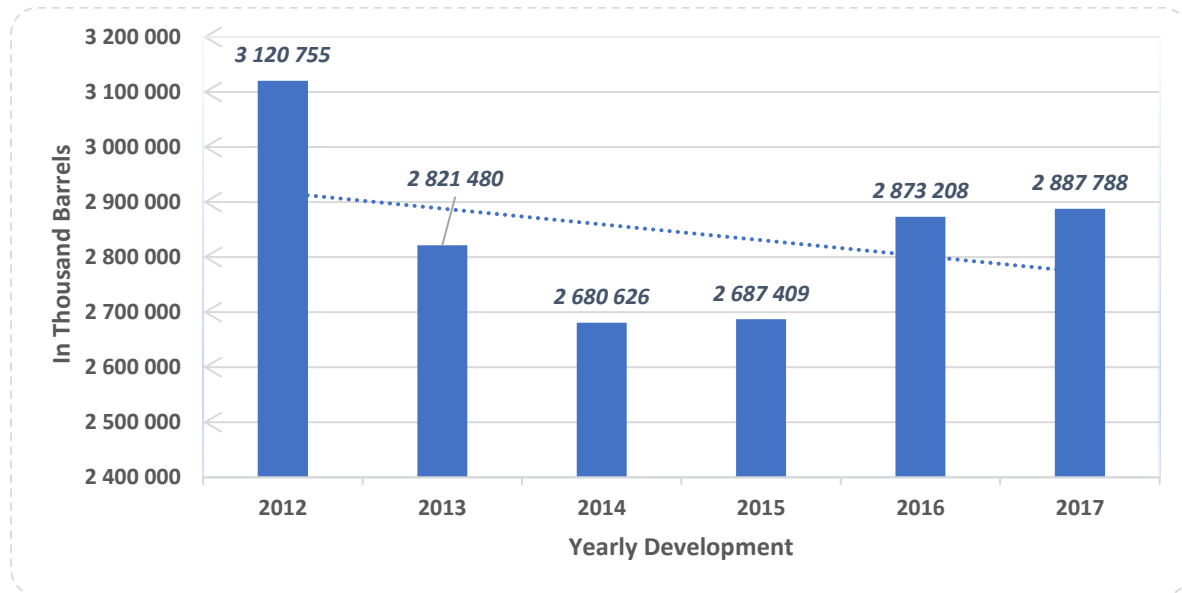


Figure 1. Crude oil imports to the US from all countries US Energy Information, 2017

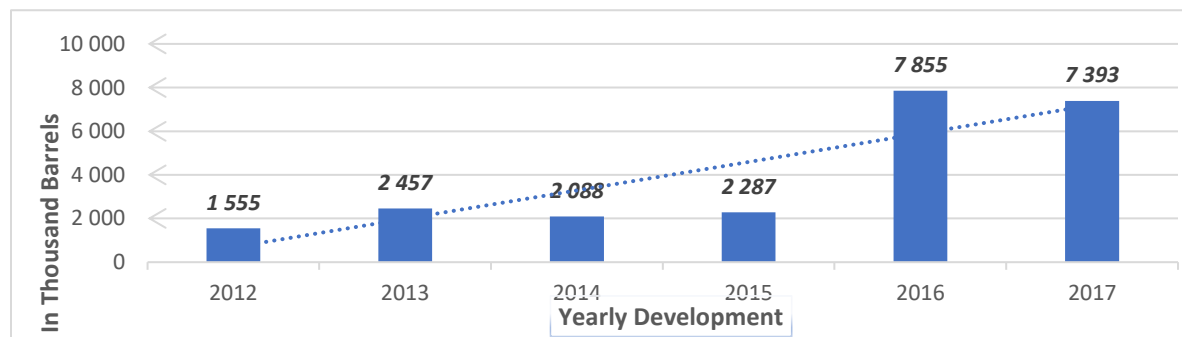


Figure 2. Crude oil imports to China from all countries. US Energy Information, 2017

**Statement of a problem**

Nations compete for successful sourcing of energy. The American influence in the world stage is diminishing slowly and at the same time, Asian powers such as China are growing in its

economic strength. It is also clear that the import of crude oil to the US is decreasing, but at the same time, it is not because of economic slowdown or financial crisis, it is simply because of change in the political environment, domestic policies and pressure to find alternative energy options. On the other hand, the Chinese economic growth had an opposite outcome where their economic growth demanded sourcing crude oil from other countries via tanker ships. The need for oil in China is increasing every year (Wang, 2015). To meet the challenge, the Chinese government has adopted policies encouraging Chinese national corporations to involve in mergers, acquisitions, and initiate projects internationally at resource-rich countries.

Experts have major concerns about maritime security, including threats from various elements namely, terrorism, risk of Weapons of Mass Destruction (WMD), sea route chokepoints, and bottlenecks. Also, risk of marine accidents and marine pollution, environmental catastrophes, soft risks such as human trafficking, and drug trafficking (Siddiqui & Verma, 2013). The risk of maritime piracy is also a major issue, especially in specific locations (Ronzi, 2013) such as the Somalian coast in East Africa, Gulf of Guinea, Malacca Strait, etc.

Territorial claims and border disputes between maritime nations are also causing concern. Major powers such as the United States, France, the UK., have their military presence in the West Pacific and the Indian Ocean to protect their interests in the region. Especially, the Indian Ocean is a major maritime access strip through which, nations in South East Asia and the entire Australian continent is served for their export and import needs. Therefore, all trading nations in this corridor and around the globe have a high interest in the safety and security of the Indian Ocean. Besides, India being a major regional power has a strong military presence in the Indian Ocean as well. Researchers in the past had pointed out that any dispute or misunderstanding between the US, India, countries of South East Asia, and China, on disputed

territories or navigational rights can lead to an all-out war. War and its impact on maritime trade in the region will be distressing.

The shift of the sea route is changing the risks. More ocean traffic is expected along this sea route creating havoc at narrow bottlenecks and chokepoints bringing the possibility for accidents and disputes, along with marine pollution due to major oil spills. China's response to such incidents outside of their territorial waters is still unknown. Also, this change calls for shipowners to take steps to avoid incidents which are an additional cost that would impact their profit margins. Border disputes in Southeast Asia and subsequent risks are going to disrupt oil movement and market price vulnerability for oil.

### **The research question**

There are a significant number of concerns for the tanker industry and the related maritime risks. Also, China is growing fast and a lot of positive changes are occurring for the past two to three decades, improving the lifestyle of its citizenry. The improved status has a direct impact on increased demand for energy, and consequently, dependence on foreign oil. On the other hand, the US imports of oil are diminishing. This has resulted in increased traffic and changing risks on the sea route where the tanker ships with high tonnage onboard are sharing the route with other maritime traffic. Therefore, the researcher asked: What are the key operational risks that affect decision making in the Middle East and Africa to China crude oil maritime shipments?

### **Summary and expected outcomes**

As in any qualitative research study, this dissertation also expects some of the key outcomes. The maritime industry is around for thousands of years and it is not a stranger to extreme risks. The trade route addressed in this study also has many risks and this study is expected to bring forward some of the key risks and its possible direct/indirect impacts on the shipping economics and operational aspects. This study is also expected to enlighten the beneficiaries/participants of the maritime industry especially tanker ship owners, exporters (the Middle East/African Countries), and the importer (China). The author's preliminary studies during the literature search and review, he did not come across a study that specifically addresses risks such as operational, financial, etc. However, there are specific topic related studies conducted by experts such as piracy, etc. Such studies have appeared to be fragmented. The author would like to inform in advance that some topics and related literature will be old since the industry has demonstrated both historical and modern aspects. In the end, the author is convinced that their major operational risks present in this trade that would affect decision-making in crude oil carriage.

### **Summary**

International trade by sea has been in place for thousands of years. It had a humble beginning where two or more logs tied together and used as floating objects to carry goods from one point to another by water. The industry had gone through various changes over the years and has resulted in the modern-day technological marvels. Besides, the ships are built as specialized cargo carriers including but not limited to container carriers, bulk, chemical, Liquid Natural Gas (LNG), crude oil carriers, and so on. When it comes to crude oil carriers ships of various sizes

have been built with different tonnage capacities including VLCCs and ULCCs with the highest technological options available onboard.

The crude oil production was initiated since 1859 and the oil trade has started internationally using drums and tins. Later, due to the heavy demand and volume that needed to be carried, such carriage methods became impractical and ships themselves have been built as specialized crude oil containers and from that, the modern-day oil tankers have been developed. The demand for crude oil as a primary energy source has increased exponentially and the supply of ships was needed to be increased as the demand for crude oil increased in international oil markets. As the number and sizes of ships increased, the safety of ships at sea, cargo onboard, and crewmembers have become primary importance in the international crude oil trade.

At the same time, major economies such as the US, European nations, China, Japan, India, and so on started engaging in exploring, recovering, refining, and distributing crude oil products. The oil prices were controlled by these economic giants. All-in-all, producing, importing, and hoarding petroleum products became the national security matter for many of the countries around the globe. Countries like China initially produced enough crude oil domestically, however, as their economy started growing, their population and industrial base needed additional energy source. Hence, China entered the international import market of crude oil and primarily, from oil-rich countries of the Middle East and West Africa.

Historically, the US was the major importer of crude oil by volume and had a well-established sea route for importing crude oil from the Middle East, and later the volume has reduced. This reduction is due to an increase in local production, and a change in domestic policies related to extreme dependence on foreign oil. As China increased its net imports, it became an important oil importer in the world. The researcher, in this case, found the route to

China from the Middle East and Africa is not as well-established as the US route and found a need for the risks to be studied. Risks such as the narrow canals, straits, and waterways along the route, political instabilities, territorial controversies mainly in southeast Asia, presence of major naval forces such as the US and Indian navies, etc., are found in this trade route. Numerous literatures have been reviewed, a survey has been conducted and expert opinions have been obtained to establish the presence of these risks.

## CHAPTER 2: LITERATURE REVIEW

There are many studies available outlining the risks in the maritime industry. Brits & Michelle (2018), Barrios (2005), Kosai & Unesaki (2016) are to name a few. The risks include operational, navigational, risks from lack of training of crew members and shoreside employees, and decision-making, and related risks. Today, international maritime crude oil trade is the largest it has ever been. Between 2010 and 2016 the global trade volume has grown by four percent (Statista, 2018). Most of the volume of crude oil moved to the US, Europe, China, and India. With such large amounts, tanker owners need to be aware of risks related to pirate and possible terrorist attacks, freedom of navigation in territorial waters of friendly or rogue nations, and ship's passage through narrow straits, chokepoints, canals, and so on. Since the focus of this study is about the transport of crude oil to China from the Middle East and Africa, China's border disputes with many of the surrounding countries, including claims on islands, maybe a serious threat to tanker ships and crude oil carriage to China. The researcher is confident that a significant body of work is present to identify each risk with crude oil transportation in this route and how it is currently managed. As much as possible, the researcher used recent literature, but it is important to note that, given the history of the industry, many relevant works are older as well.

### **Category 1. China's Energy Demand: The Concept of Energy Security and Strategy**

There is a close relationship between energy and social development (Wang, 2015). Also, Wang (2015) stated that due to scientific and technological limitations, humans can only use energies derived from coal, oil, and natural gas that can be fully exploited and widely used by the international community. The availability of this source of energy and extraction and utilization of it has also become a part of national security matters for many countries. Similarly, the Chinese government believes that there is a close relationship between national energy security

and national production and consumption and thus energy security has a direct link to the economic security of China. Wang (2015) also advised that the import of energy transportation safety becomes an integral part of the security of energy supplies and national energy security strategy of China. Zhao and Chen (2014) also added that the GDP of China surged from 189,399 million USD in 1980 to 7,318, 499 million USD in 2011, becoming the second-largest economy in the world and the second-largest consumer of oil.

The meaning of the word “energy security” varies from time to time, however, in essence, it is considered as a dynamic concept that is quintessential for the development of a country (Zhao & Chen., 2014). In the case of China, traditionally, the word “energy security” was meant as accessing and securing oil abundantly from national and international sources. Later, given the price volatility in the international oil markets, the political instability of oil-producing countries, etc., China has noted that abundant oil supply is unachievable. Thus, currently, the core concept of “energy security” has changed to an uninterrupted supply of energy than abundant oil supply (Zhao & Chen, 2014).

The government’s strategies to develop China into a maritime power started in 2012 when the Communist Party of China (CPC) called for developing the capability to safeguard the country’s maritime rights and interests (Len, 2015). This plan included diversifying employment of China’s armed forces, involvement in maritime security operations covering overseas energy and resources, strategic Sea Lines of Communication (SLOC), appointing Chinese nationals and legal advisors overseas; and provide vessel protection at sea (Len, 2015). This is the basis for supply-based energy security. In turn, there are some external circumstances the energy supply system confronts which includes a high level of uncertainty with regards to energy supply itself.



They are the logistical barriers and challenges along with the availability, accessibility, and affordability of energy resources (Zhao & Chen, 2014).

The People's Republic of China (PRC) and its rise in the ranking of world oil consumption was rapid. PRC is the second-largest consumer of oil behind the US (Taghizadeh, Yoshino, Mohammadi & Farboudmanesh, 2016). According to these authors, the country was a net exporter of oil until the year 1990 and since then, became the largest net importer and oil consumer by 2010. PRC's oil consumption growth in 2013 accounted for one-third of the world's oil consumption and further in 2014, PRC was responsible for 43% of the world's oil consumption growth (Taghizadeh, Yoshino, Mohammadi & Farboudmanesh, 2016).

According to Dannreuther, "The Chinese government has not been passive in responding to the energy demand and related challenges in the country" (2014, p. 1345). Accordingly, in response to energy demand and challenges, the Chinese national policy responded by encouraging major Chinese National Oil Companies such as CNPC (China National Petroleum Corporation), Sinopec (China Petroleum and Chemical Corporation), CNOOC (China National Offshore Oil Company), etc.; to establish ambitious offshoring and internationalization projects outside of China (p. 1345).

Making use of this freedom, the Chinese National Oil Companies (NOCs) became major international players and were involved in mergers and acquisitions of international oil and gas-related organizations resulting in spending US\$29.39 billion (Dannreuther, 2014). Thus, China became a major economic and political actor providing an alternative to the traditional dominant influencers, such as the US and European countries, and placed themselves as strategic investors in Iraq and Iran, established ties with Saudi Arabia, and other Middle East Gulf nations. To produce equity oil through such international projects the Chinese NOCs spent billions of

dollars. In 2008, the NOCs produced 45 million tons of oil and it is expected to reach 100 million tons in 2020 and started several loan-for-oil ventures with resource-rich countries internationally.

Encouraging the major oil companies is not the only response the Chinese government showed against the energy demand. Oil companies also encouraged and supported the expansion of the China Shipping Group company to develop and expand its tanker ship fleet operations. Accordingly, the fleet carries more than 70 million tons annually (Market Line Profile, 2013). China's crude oil demand is well-known to energy resource countries in the Middle East as well. The oil-exporting countries in the Middle East and Africa have taken the Chinese oil demand as a business opportunity and have responded to the call. For example, the Kuwait Petroleum company has responded by making agreements with China Petroleum and Chemical Corporation (Sinopec) to build a refinery and petrochemical complex in South China in 2011. At the same time, Kuwait City-Total signed a comprehensive Memorandum of Understanding (MOU) for establishing a refinery and petrochemical project in Zhanjiang (Kuwait Petroleum Corporation, 2014). These examples show that the response to the local demand for energy was not only from the Chinese government but also by resource-rich countries.

According to Cao and Bluth (2013), energy and security go hand in hand and involves engineering, politics, economics, energy environment, diplomacy, and military affairs. Energy security is often a common discussion point in all political and academic platforms. Besides, energy security has three major factors which include reliability, affordability, and environmental sustainability. Reliability in energy security includes a specific quantity by which energy is secured, affordability relates to the lowest price at which the energy can be secured, and ultimately, the usage of energy in the country should be following environmental safety rules.

Until recently, China was able to rely on energy supply domestically and the country was involved in the large-scale import of crude oil and the country prioritized energy security as a key factor for faster economic growth (Cao & Bluth, 2013). Thus, the Chinese government played a direct role in the securement of energy that is intrusive and pro-active when we compare to other leading economies of the world. The Chinese government's direct involvement ensured securing crude oil and other forms of energy such as natural gas. As far as China is concerned, there is no difference between energy security and national security and it is the same (Cao & Bluth, 2013). PRC is directly involved in identifying the core functions of economic systems, such as national defense, and decided that energy policy should be a long-term policy and should not be substituted by short or medium terms. Cao and Bluth (2013) stated that though China has no direct challenges in having a continuous supply of energy, the country is aware that its dependency on energy supply is increasing and it should take an active part in global financial and energy markets.

At the same time, China also identified its raising geopolitical issues concerning its role in the region as well as the relationships with Russia, Europe, and the US (Cao & Bluth, 2013). The US controls and protects international shipping lanes that are needed for oil transportation, while Russia has its control over its energy resources in Eurasia. Besides, the strategic conflict between the US and Iran, and its effects on the region where China has investments, has an overall impact on investing and diversifying energy security. The US and Iran conflict have connected to broader international issues, which may have an impact on China's energy supply (Cao & Bluth., 2013).

China's interests are no different than the United States, Japan, and EU in terms of its economic structure and energy dependence. However, it is to be noted that for the US and China

the energy policy is potentially a key trajectory for cooperation between the two major powers (Cao & Bluth., 2013, p. 382). If diversification of supply is becoming an indispensable part of energy security for China, then it must minimize geopolitical risks that may develop at oil resourcing origins and the supply routes (2013).

Moreover, the country's consumption of energy accounts for half of the growth of world oil consumption in the last 10 years (Cao & Bluth., 2013). This ranks China as the second-largest consumer of energy in the world and it is estimated that China's dependence on foreign energy will rise from 8.8% in 2008 to 25% in 2030. Much of the crude is coming from the Middle East (Table 1).

<b>Year</b>	<b>Middle East</b>	<b>Africa</b>	<b>Europe and Western Hemisphere</b>	<b>Asia-Pacific</b>
1989	41.3	0	0	58.7
1994	39.7	4.1	0.8	55.4
1999	46.2	19.8	15.4	18.7
2003	50.9	24.3	9.6	15.2
2004	45.4	28.7	14.3	11.5
2009	47.8	30.1	17.3	4.7

*Table 1. China's Crude Oil Imports by Region. China's crude oil imports by region (Cao & Bluth., 2013)*

Another challenge faced by China in its energy security policy is its negative effect on greenhouse gases. Recently, climate change is exacerbated by a vast accumulation of greenhouse gases in the earth's atmosphere, especially carbon dioxide (Cao & Bluth., 2013). No doubt, studies show that this massive accumulation of greenhouse gases in the earth's atmosphere is due to the use of fossil fuels.

No country, regardless of its economic status, can isolate itself from this global problem (Cao & Bluth., 2013). China currently plans to develop 15% renewable energy (such as solar, wind, and hydro powers) by 2020. However, the challenge is to take precautions against sudden fluctuations in energy supply as the current national oil reserve capacity is only 16.4 million cubic meters which are very small whereas, the US, Japan, and Europe have a reserve for more than 100 days (Cao & Bluth., 2013).

For the last 20 years, China relied heavily on imported oil solely because the country has taken it as an economic and security concern for the Chinese government and China's key international investors. By 2035, China will account for more than half of the world's oil consumption and must meet the need through importations. But so far, China has only been able to secure 10% of its future oil needs (Odgaard & Delman., 2014). Currently, China is attempting to link energy, economic growth, and political power at the national and international levels. Oil supplies are less secure than it desires to be due to instability in the regions from where China wants to acquire it.

The instability means conflicts with supplier countries or the US as a robust player in the energy sector (Odgaard & Delman., 2014). Though disturbances are expected, China is fully equipped to tackle temporary or mid-term disturbances without engaging in a military conflict. The country has well-developed energy diplomacy in place to establish a notion that China is a constructive global player and will not act as an adversary to any other powers or it will not chase after energy resources around the globe as a hegemon in disguise. However, conflicts cannot be ruled out due to territorial claims of China with its neighbors.

China is now the world's second-largest economy and concerns about energy security have become one of the core determinants of the communist party in Beijing (Leung, 2011). He

points out that the People's Republic of China has 1.3 billion inhabitants with 44,000 births every day. Despite the economic growth, the demand for energy in China is unquestionably large and it is accounted for three-quarters of the world's energy demand growth (Leung, 2011). All forms of energy sources are in demand, but oil is of the highest concern for the government and brought a sense of insecurity in the highest levels of the government.

Though traditionally oil has not taken up a dominant proportion in China's energy mix (17.9% of the energy needs in 2009), the concern is great since the country relies on imports for oil and the demand reached to 408.3 million metric tons in 2009. The oil consumption is grown rapidly from 114.9 million metric tons in 1990 to 408.9 million metric tons in 2009 (Leung., 2011).

### **Historical Trends**

After the Sino-Soviet split in the 1960s pulled the plug on the oil supply from the Soviet Union and Eastern Europe, which was the primary supply line, and left China on their own to secure the oil supply from other available sources (Leung., 2011). This vastly interrupted the daily training of military personnel, general transport, and the planning sector. Cars in Henan Province had to run on alcohol (Leung, 2011). China became self-sufficient in 1963 due to the development of Daqing Oilfield and other major fields. Despite this, in 1993, China became dependent on foreign oil due to increasing demands and energy security became a common term (Leung, 2011). In Leung's (2011) view, China's oil demand is not motor gasoline as in the US, but it is due to the voracious hunger by the nation's heavy industry sector (10.4% motor gasoline and 42.1% industrial demand in 2007).

China's acquisition of oil reserves abroad cannot guarantee a steady supply of oil at fewer expenses than the international markets as purchase equity interests oil resources cannot

protect Chinese consumers from a price shock (Leung, 2011). Oil produced overseas by Chinese companies shipped home is likely to face the same transportation risks as oil purchased by the Chinese company in the spot market. Also, the cost to produce oil in distant nations such as Africa is high, and it will be more profitable for them to sell it in the international markets than shipping to China. In turn, China should buy crude oil from the Middle East, which is in closer proximity. Thus, it is questionable what exactly is the contribution by the Chinese national oil companies to the energy security of China.

### **The Malacca dilemma and the Chinese strategy**

The heavy reliance on Chinese oil demand has caused high concerns as China's energy security depends on a single chokepoint, the Malacca Strait (Zhang, 2011). The smooth passage within the Malacca Strait is important, as any unexpected event can interrupt its oil trade flow and subsequent economic development and social stability. The Chinese leadership also has come to a view that the Strait of Malacca is a strategic vulnerability and feels that whoever controls the waterway has a stronghold on China's energy route. China has taken great efforts to handle the so-called "Malacca dilemma" to enhance its energy security such as controlling the growth of its energy demand. China has cut its per unit of GDP energy use by 20% which it considers an important step to build a harmonious society and scientific development. On the supply side, China has introduced policies to address the growing demand as well. It has taken initiatives to maintain domestic production at current levels and on the other hand, making significant efforts to support NOCs to diversify both sources and routes of its oil supply (Zhang, 2011).

One such initiative is to consolidate sourcing from the Middle East. China has also invested in adding new capacity to its world oil supplies via loan-for-oil deals or acquisitions

which in turn, positively affected the world consumer markets by stabilizing oil prices. Though China has a plan to indulge in Arctic oil and gas to circumvent the Malacca dilemma, it has limited options to diversify imports from the Middle East. Changing routes such as the Northern Sea Route (NSR) is slowly becoming a reality (Zhang, 2011). Zhang, at this juncture, alludes to the potential involvement of territorial disputes with neighboring countries especially, the East and the South China Sea where no clear picture of ownership exists though China has claimed its sovereignty and considers the territorial issue as bilateral (2011, p. 7614).

### **The oil trade and the risk of fluctuation in price**

There are two major exemplars in the international oil trade. One is the international oil trade market where the participants are faced with the risk of oil price fluctuations. Secondly, the global oil supply chain network in which physical disruption can be an important risk (Sun, Liu, Chen, & Li, 2017). Geopolitics has a direct impact on the oil independence strategy in both exemplars, triggering oil price volatility and aggravated instability in crude oil production and transport channel security. Predictably, the high dependence on oil imports makes China more vulnerable to risks, threatening its energy security overall. According to Sun et al. (2017), China's oil imports face more complex and variable risks and safeguarding it against all such risks are of primary importance.

Diversifying supply sources can reduce disruptions or susceptibility from specific sources; for instance, diversification significantly reduces key risk induced by events related to some supplier nations in the international markets (Sun et al., 2017). Diversification may also help in enhancing supply security, but other determinants should also be extensively studied to further improve international oil supply chain security specifically, concerning Chinese oil imports. Experts have used multi-attribute decision making (MADM) approaches and few



complementary tools to MADM approaches that have been used by different experts to measure oil supply chain security. For example, Sun, Liu, Chen, & Li (2017) assessed the relative vulnerability of 26 oil-importing countries in 2004 based on select eight indicators. Le Coq and Paltseva (2009) conducted an index based on four indicators to evaluate risks associated with energy supply to EU member states and so on.

The global oil supply chain refers to the entire process of sourcing from abroad and how and when it reaches the end-users (Sun et al., 2017). There are four risk factors at the demand and the market sides of the oil trade that portray the risks in different stages along the supply chain. These risks include the availability of suppliers, accessibility of transportation, accessibility of infrastructure, and affordability of the economy (Sun et al., 2017). Availability of suppliers pertains to supplier availability externally to meet the consumer demand; stability in acquiring the right transportation mode risk; the risk of accessibility to well-developed infrastructure such as ports and; finally, the risk of affordability of consumers to buy and use the imported oil which often influenced by the economy of the importing country (Sun et al., 2017).

Some of these risk factors are controllable and some are not especially when it comes to availability of suppliers, accessibility of transportation and affordability of economy is rather uncontrollable and importers need to evaluate these risks closely (Sun et al., 2017). Furthermore, a risk matrix including both internal and external risk factors to be established to study the oil import risks more comprehensively and accurately. When China is considered, availability risk is broadly distributed and the largest quantity comes from politically unstable regions, such as the Middle-East and Africa and in this area, there is little possibility for further diversification and China has to rely on these unstable regions for oil supply into a foreseeable future (2017, p. 450).

Saudi Arabia remains the largest and most stable supplier. Kuwait, Libya, Nigeria, Russia, and UAE are also relatively high and stable. Venezuela, Iran, and Iraq showed variable growth in resourcing by China (Sun et al., 2017). The relative increase from Iran is caused by its growing share in the world exports, and the decrease in Iraq is due to a drop in its share in the world exports. In short, the authors conclude that the political, economic, and financial stability or instability of a supplier nation will have a direct impact on the supply side of oil trade (Sun et al., 2017). The accessibility to transportation has multiple indicators. In addition to the transportation distance, one of the most dynamic risks related to maritime transportation is pirate attacks (Sun et al., 2017). The Middle East and Africa routes exhibit the highest risk of pirate attacks and the Southeast Asia route poses the lowest risk.

Concerning acceptability risk, ports play an important role in the transportation system. The capacity of ports and the number of berths has a significant part to play in China's Oil Supply Chain (OSC). The current ports (more than 30 big ports) can serve and satisfy China's oil import needs (Sun et al., 2017, p. 457). Finally, affordability moves in the same direction as oil volatility; affordability risks reach a higher level when volatility such as instability at resourcing origins occur (political instability, hurricanes, subprime conditions at major economy such as the US, etc.). Affordability risk increases with sharp fluctuations with oil prices and obviously, the GDP of the importing nation influences affordability risk as well (Sun et al., 2017). The greater the imported oil reliability, the higher the affordability risk will be.

External supply risk was an important aspect of energy security since the Arab oil embargo in 1973 to 1974 (Yang, Li, Sun, & Chen, 2014). Though such a crisis is unavoidable, China always is concerned about its energy security and it defines energy security as the availability of the regular energy supply at an affordable price. Fluctuations in price and supply

disruptions risk are measured using the “portfolio technique” where the oil supply risk is divided into systematic and specific risks (Yang et al., 2014).

The systematic risk is non-diversifiable and affects most suppliers, while specific risk affects only to few suppliers (Yang et al., 2014). In the oil business, countries have exceedingly small bargaining power, especially in the case of China, the country must passively accept the price as it is determined by the international oil markets (Yang et al., 2014). However, China can improve the supply risks due to disruptions at sourcing countries by diversifying sources of energy. Diversification is a model adopted from the financial markets and is commonly referred to as “don’t put all your eggs in one basket.” The Herfindahl and Hirschman Index (HHI) is commonly used to measure the oil market and its concentration and then decide how to diversify the oil resourcing process (Yang et al., 2014).

When oil suppliers are treated the same, China’s external oil supply risk is the lowest, and Japan is the highest according to the HHI (Yang et al., 2014). Also, some studies have paid attention to economic and sociopolitical instability that can influence the security of external supply, including risk in oil-exporting regions (Yang et al., 2014). Another key factor in the oil supply is production capacities and export policies are related to the physical availability of oil for importers. In this regard, with limited oil resources globally and consumption increasing, oil production is reaching its peak and the number of exporting countries are reducing in numbers (Yang et al., 2014).

Therefore, establishing a strong and respectable trade relationship with stable oil suppliers is crucial. In turn, China must rely on small suppliers because regular shifting from one to another supplier can cause instability in energy supply (Yang et al., 2014). It is also noted by the authors that oil security is best understood as an assurance of availability. In such cases, the

stockpile is important. For example, Japan has 169 days of supply available in its reserves whereas China has only 25 days of supply (Yang et al., 2014). In turn, although China has successfully diversified its oil imports in the past decades, they may face much greater challenges in the future as its oil dependence is growing.

Accordingly, China's oil import markets can be separated into five main regions: 1) the Middle East, 2) North Africa, 3) West and South Africa, 4) South America, and 5) Asia-Pacific (Sun, Gao, & Shen., 2014). Sixteen countries in these regions are determined by the proportion of oil exports to China for more than 1% in the past 10 years.

The transportation routes and the risks related to them in China's Oil Import Risk (OIR) is defined by the probability of disruptions caused by a failure in shipping routes. The risks of transport routes come from three aspects: 1) the amount of China's oil imports when larger the amounts carried on the route, higher the risk is borne by the importing country; 2) share in each shipping route in which larger the share in a route, greater the uncertainty and potential risks faced; and 3) probability of disruptions in risk nodes such as pirate attacks have to be taken into account (Sun, Gao, & Shen., 2014). Risk nodes indicate that the Indian Ocean, South China Sea and straits such as Hormuz, Malacca, etc., considering the number of average accidents or attacks between 2005-2007 where aforementioned straits and oceans have been detected based on the statistical data collected from International Maritime Bureau and International Maritime Organization (IMO) (Sun, Gao, & Shen., 2014, p. 607). Table 2 shows major sea routes for China oil imports and corresponding risk nodes.

<b>Major Route</b>	<b>Risk Nodes</b>
Middle East Route	Hormuz Strait, Indian Ocean, Malacca Strait, South China Sea
North Africa Route	Mandela Strait, Gulf of Aden, Indian Ocean, Malacca Strait, South China Sea
West & South Africa Route	Gulf of Guinea, Aden, Indian Ocean, Malacca Strait, South China Sea
South Africa Route	The Atlantic Ocean, Mozambique Strait, Indian Ocean, Malacca Strait, South China Sea
Asia-Pacific Route	South Sea, South China Sea

*Table 2. Sea routes and risk nodes. Sun et al. (2014), Energy Policy Vol 67 p.608*

China's OIR increases the cost of oil imports and it can reach 2237 million Yuan when the risk increases by 10% thus it will have a direct impact on the national economy and concludes that in any stage including oil purchase, transportation and distribution with problems creates disruptions to the supply chain and will have a direct influence on China's energy security (Sun, Gao, & Shen., 2014, p. 611).

From the beginning of the 20th century, oil has played a significant role in the energy sector due to an imbalance between the suppliers and consumers (Zhang, Ji, & Fan, 2013). According to Zhang et al., (2013) "it is predicted that the 'roof effect' of the world net oil-exporting may appear in 2028". Zhang et al., (2013) also stress the uncertainties due to dramatic

price fluctuation, political instabilities, economic environments, and shipping routes that are monotonous and dependent on chokepoints such as Malacca and Hormuz Straits.

There are three main stages in the external oil import process: external dependence stage, external supply stage, and external acquisition stage (Figure 3; Zhang et al., 2013). The external dependence stage is the consumer's dependence on external oil resources. The supply stage reflects supplier availability and distribution capability. The external acquisition includes economy and transportation.

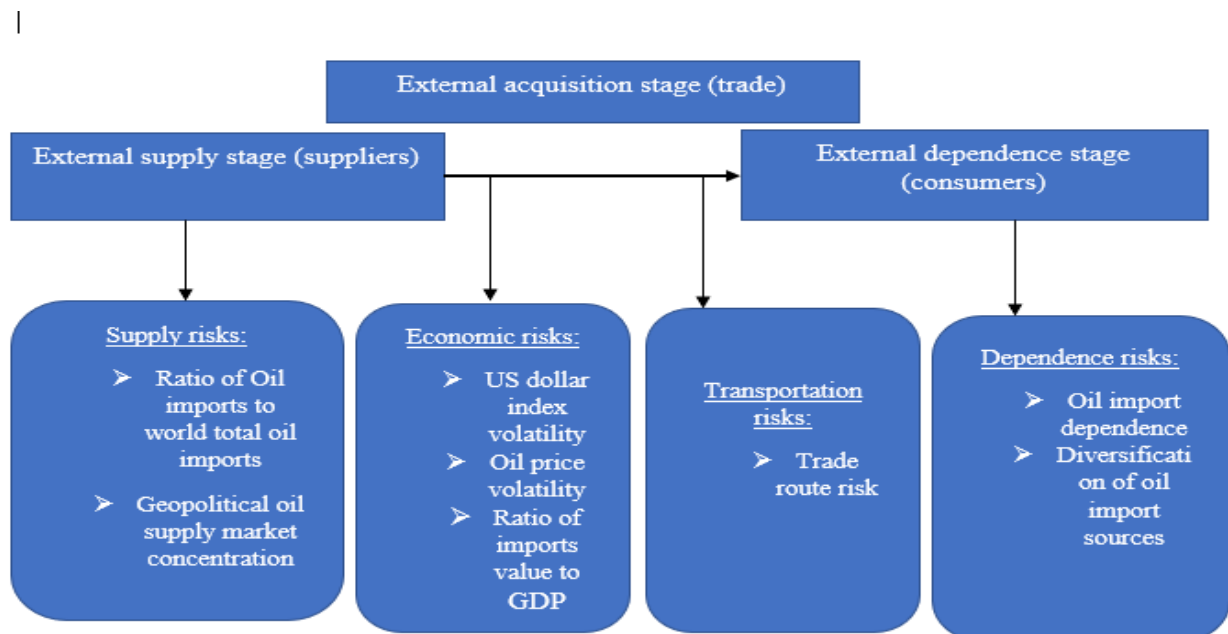


Figure 3. Indicators for each acquisition stage and risks. H.-Y. Zhang et al. / Energy Economics 38 (2013) 87-95

### Challenge in achieving energy security and climate protection

Climate protection laws and energy security were important for China to investigate how both can be managed simultaneously. One study stated that climate protection and energy security are the same, and both can be achieved through the same or similar policies (Wu, Liu, Han, & Wei, 2012). However, policymakers thought that climate protection and energy security could be traded off as two different policy objectives (2012, p. 157). This occurs when

policymakers choose the mix of individual technologies that reduce greenhouse gas emissions and enhance energy security. An optimal policy can be achieved when the cost of the additional use of each technology becomes equal to the value of the additional energy security that would lead to a successful reduction in CO<sub>2</sub> emissions (Wu et al., 2012, p. 158). According to the authors, the greenhouse gas emissions are costly and world leaders often engage in debates and seek ways as to how to mitigate CO<sub>2</sub> emissions.

Another study by Li, Huang, & Chen (2011) developed an Integrated Fuzzy-stochastic Optimization Model (IFOM) to mitigate CO<sub>2</sub> emission in association with the current greenhouse gas mitigation system (Wu et al., 2012). Yet another option was developing biofuel development in Asia from its existing status and have analyzed the key drivers, its impacts, and potential feedstock of biofuels in Asia. Some studies currently connecting climate change, energy security, and corresponding policy rather than climate protection and energy security by examining the role of several policy instruments in managing energy security and climate risks (p. 158).

In China, Wu et al., (2012) conclude that the energy consumption is rapidly moving at an average speed of 12% annually, bringing the highest pressure on the government for energy supply, the oil imports kept increasing and dependency of import oil exceeded 42% from unstable regions such as the Middle East and diversification trend index is showing a downward trend. The per capita energy consumption increased by 40% and in the international oil markets, the price is fluctuating and intensifying a risk in oil trades. These events positively affected the implementation of the energy-saving and emission reduction policy of China that was started in 2006. This policy is proving that China's energy security and climate protection can achieve a win-win result.

In recent years, oil prices in the international markets have experienced many ups and downs, sending shockwaves across the world (Wu & Zhang, 2014). In 2008, the price had reached up to \$147 per barrel at the same time, due to world economic downturn, the price has reached to \$30/barrel in February 2009 again, the price rebounded to \$100/barrel between 2010-2013 (Wu & Zhang, 2014). This proves that oil prices can play a crucial role in showing different economic variables such as GDP, inflation, unemployment, investment, stock price exchange rates, and fundamental industries. Specifically, the GDP is more stable when the oil prices are in a non-volatile environment than in a volatile environment.

In some instances, growth in the Chinese economy may have increased oil prices which had an impact on its export competitors due to China's large labor force (Wu & Zhang, 2014). In turn, oil price fluctuations are solely responsible for inflation and economic growth and prices (including aggregate commodities markets) raise in China. According to Wu and Zhang, the volatility of oil prices is driven by various factors, such as economic crisis, oil supply, and demand, OECD commercial inventory, OPEC behaviors, US dollar exchange rates, local military conflicts, natural hazards, and speculative trading activities.

Due to the rapid economic growth and expanding middle-class population, increasing motorization, and urbanization in China had increased crude oil consumption (Wu & Zhang, 2014). This consumption forced China to go to the international oil markets to obtain fossil-based energy and became the giant participant in the international crude oil market. Interestingly, due to the restrained crude oil policies, in China, its oil imports are negotiated on a cash basis (i.e. spot markets) than using derivatives like futures to resist weak capability and the extreme risk of international crude oil markets. This will lead to a special phenomenon where the crude oil imports increase to China when the oil prices are higher and on the other hand, when the oil



prices decline, China does not import much crude oil. For example, if the crude oil price surge of \$1 per barrel China's crude import enterprise had to pay 13 billion RMB more, however, market analysts say that China is often responsible for the increase of oil prices and volatility (p. 79).

During the 2008 financial crisis, Professor Krugman of Princeton University (Nobel Prize winner) argued that the price of oil increased due to emerging economies like China (as cited in Wu & Zhang, 2014). Wu and Zhang referring to a study conducted by Beirne et al., (2013) indicates that GDP growth in China had an impact on oil prices where they also argue that China's excessive growth adds a premium to the price of oil in the international markets (Wu & Zhang, 2014, p. 80). However, Wu and Zhang conclude with their opinion based on analysis that though there is demand in China is for a long time but blaming China and its influence on oil price has no foundational shreds of evidence. The largest emerging economies like China and India are using only one-eighth of world crude oil and so emerging markets cannot be blamed (p. 84). But they argue that fluctuation in US dollar exchange rates has a direct impact on crude oil prices, so it suggests paying close attention to US dollar exchange rates than connecting China's economic growth and oil prices in the international markets (p. 79).

According to Ge and Fan (2013), there are multiple risks faced by China in its oil imports and the primary one is supply failure. In 2011, when political turbulence started in the Middle East, North and West Africa, many oil exporters to China suffered due to the uprisings and thus it became clear to China that unstable conditions can harm its oil supply (2013). Fluctuating oil prices are also a risk to China's oil supply. When Japan, India, South Korea are competing with China for crude oil as these countries and their demand increases, it can bring competition in the international oil market. As a result, oil prices can increase, and consequently, it will have a direct impact on the Chinese economy.

Portfolio theory and diversification can also be used to minimize risk (Ge & Fan, 2013). Portfolio diversification normally produces a low risk of continuity in supply and can gain the highest expected return. Unforeseen fluctuations and changes in crude oil demand or events can result in actions taken by the crude oil-exporting nations where no specific strategies of an importing country can be applied. The only way to avert risk is by domestic actions such as enhancing and implementing energy efficiency methods/rules, building oil reserves adopting diversification strategy internationally where they can have more choices to import oil from.

In the case of China, diversification keeps crude oil imports steady when they are importing crude oil from more than 30 countries (Ge & Fan, 2013). Ge and Fan stated that “The world economy is becoming increasingly integrated and so is the crude oil market. Besides, crude oil trade is becoming financialized (p. 77).” In turn, the supply and demand are often becoming out of balance, and money is also speculated in the international oil market causing oil prices fluctuating low to high and vice versa. Seventy-six percent of the oil imports are handled from high-risk regions and China must have proper strategies both domestically and internationally. Ge and Fan conclude that oil prices, fluctuations, and volume imported are increasing constantly.

### **Category 2. Crude Oil Transportation Safety and Security**

Since realizing the fact that domestic production will not meet the extreme demand for energy, China’s dependence on oil imports has increased, and so have concerns related to maritime security. Threats include piracy, terrorism, drug trafficking, human trafficking, and the proliferation of weapons of mass destruction (WMD), pollution, and border and island disputes. It forces the Gulf Cooperation Council (GCC) countries to tighten the security of the oil trade and ships involved through augmenting of its naval capabilities and in April of 2012 naval

exercises held to establish that GCC countries are ready to build a naval force (Ronzitti., 2013, p. 12). At the same time, the dangers faced with oil tankers are not just in one region, but it is worldwide. Oil tankers and their valuable commodity have raised key questions on securities by many nations.

While there is such a huge quantity of crude oil that is shipped, it is not surprising to see any of the maritime transportation legs would lead to oil spills and intermittent accidents and maritime disasters that would result in economic, social and environmental costs (Siddiqui & Verma, 2013). The Exxon Valdez in the US and Prestige on the coast of Spain are some of the unpleasant memories of maritime disasters. These two accidents cost US\$2 billion and 100 million Euros respectively in cleanup costs. According to Tanker Owner Pollution Federation (as cited in Siddiqui & Verma, 2013), there were about 10,000 spills occurred between 1974 and 2008, and 43 active cases reported between 2004 and 2010.

These numbers prove that maritime disasters are costly and must be avoided at any cost. In response to different oil spills, the International Maritime Organization introduced the Prevention of Marine Pollution from Ships (MARPOL) regulations covering pollution of the marine environment from such operational disasters, the European Union also followed the suit by introducing the Erika legislative package for marine safety, in 1990 and the US introduced an Oil Pollution Act (OPA) and so on (Siddiqui & Verma, 2013).

The Arabian Sea, Indian Ocean, and the South China Sea are the major transit routes carrying oil from the Middle East and Africa to the major East Asian economies including China, about 80% of China's oil imports must pass through the Sea Lines of Communication (SLOC) since China has opened to the world economy (Len, 2015). The route passes through chokepoints, such as Strait of Malacca and Suez Canal, which are congested and prone to

accidents (Blunden, 2012). Blunden also suggests that by 2018, the world fleet will include about 100 thousand vessels with 500 DWT or more compared to 77,500 ships in 2008 (2012, p. 115-116).

China is also the number one manufacturer of finished goods and distributors to the matured markets, and in turn, is extremely vulnerable to sea traffic congestion through these chokepoints. Also, the sizes of ships are ever-growing and maneuverability of larger ships in narrow passages must be challenging for the navigators. The risk of heavy congestion and increased risk of collisions, the navigation of mega-ships should be done with the utmost care and precision, as there is not much room for error at such geographical ocean passage points (Blunden, 2012).

Ships with 200,000 tons capacity can only transit safely through the Malacca Strait. Besides, the strait is a disputed territory, which is cooperatively controlled by Malaysia, Singapore, and Indonesia (Zhao & Chen, 2014). On the other hand, the United States, India, and Japan expanded its authority on the waterway using the excuse of fighting piracy while China relies heavily on the strait as well for crude oil transportation. Whichever country controls the strait of Malacca, it can have a direct threat to China and its oil supply route. The leadership of China recognizes that the Malacca Strait dilemma is crucial for China's energy security (Zhao & Chen, 2014).

### **Various risks at sea and its foundational analytics**

Analyzing risk in maritime transportation is a growing field of study and has received a lot of interest in recent years (Goerlandt & Montewka, 2015). This is being recognized by international organizations and there are a heavy demand and endorsement using management tools to perform a specific risk analysis of cases/events. It has also given scientific and

environmental attention and related analysis and made it a part of the foundational analytics of risks in maritime transportation. Goerlandt and Montewka (2015) give an overview of applications that can be used for maritime transportation risks and conclude that there is a relationship between flow rate and frequency of collisions. In turn, as the flow of traffic in chokepoints increases the risk of accidents goes higher.

Yang, Yongchen, and Chen (2019) found that extreme weather events and piracy are two important considerations when it comes to safety. According to Yang et al., it is crucial for ships to avoid cyclones and tropical storms. Understandably, tropical cyclones are a prominent natural phenomenon present very often in the Indian Ocean and the South China Sea areas. Annually, about six to ten tropical storms develop in this area that would increase in its intensity and become cyclones. When these storms are forecasted, the tankers need to be rerouted to the nearest harbor for shelter. In addition to oceanic storms, equipment (ship's equipment) cargo safety and personal qualities are also important factors for the security of ships while transporting crude oil by sea. Moreover, piracy attacks have been noted by the authors as a serious threat to safety. In the South China Sea and the Indian Ocean are the areas of a high incidence of piracy where according to the International Maritime Organization report 172 and 143, piracy attacks happened respectively in these two bodies of water in 2013 and 2014.

Planning and carrying out operational aspects of oil tankers and crude transportation is important to the safety and security of the commodity. The tanker fleet and subsequent scheduling have played a significant role in the movement of oil between the supply and demand locations. In this process, a fixed but diverse fleet of long-term chartered ships is available for different grades of crude oil from different crude oil pick-up locations to different refinery locations that need specific pickup and delivery time windows (Hennig, Nygreen, Furman, Song,

& Kocis, 2011). Here, the crude quantities can be split among several ships. This task needs balancing supply and demand information. Matching the supply and demand includes aspects such as deterministic ship speed, quantity dependent pickup/delivery times and costs; restrictions on port access, ship weight and volume capacity, and time-window sizes of several days. This is a common problem faced by large industrial shipping activities and owners look for an optimal tanker route by which they can meet the pressure of timely pick-up and delivery functions.

The sailing speed of the ship is also a factor to be considered. A nominal sailing speed of the laden ship is usually less than a nominal sailing speed of an empty ship (Hennig et al., 2011). Besides, the fuel consumption is higher tons/day for ships sailing with cargo than that of consumption of a ship sailing with ballast. The consumption rate is higher at maximum speed and optimization of ship speed can only be avoided by scheduling and routing selections. The fuel and related costs can be reduced by knowing the route and voyages. Thus, for the Chinese oil trade to reduce the costs and meeting pickup and delivery windows, choosing the shortest and fastest routes is necessary rather than taking longer routes to avoid risks.

Moreover, the tanker route is often seen as a sequence of port visits. It is best to preplan and route in place before the start of the sailing than having to face the complexities of re-routing and it is better to determine when the final positions can be anticipated at destination in advance so that they can plan the next pick-up (Hennig et al., 2011). So, each routing decisions are made in advance so that each pick-up process can be planned for each sailing. Any hindrances along the sea route in between, to be avoided so that pickup of crude oil can flow seamlessly.

### **Category 3. The Risk of Maritime Piracy**

Though these characteristics of pirates are portrayed in films and works of literature, both ancient and modern-day piracy is nothing but banditry or armed robbery. Piracy has a long

history on oceans of the world and its origin dates back to Phoenicians more than 4000 years ago (Daxecker & Prins, 2015). The improvement in technology had allowed ships to sail away from the coastal waters and enters into high-seas where there was no policing available. Piracy was how individuals accrued wealth, and a tool used by states to show their political power in the olden days and modern days a tool to promote terrorism to some extent. The trade on the high-seas increased during the European colonization where cargo ships were laden by spices, silks, ivory, and precious metals and such ships became lucrative targets for pirates to attack and rob the cargo and taking the crewmembers hostage.

In recent years, the Somali pirates in East African waters had taken ships and crew under their control and demanded millions as a ransom for the crew release. Some crew had been killed and some had been rescued by the US Navy. This is a strategic risk to ships and crew, the threat is more structured and is riskier than ever. About one-third of the world's trade passes through two areas at extremely high risk, the coastal waters of Nigeria and Straits of Malacca in Asia. In the case of Malacca, the riskiest point is the narrowest point of the straight, the easternmost chokepoint (McGinley, & Berlinger, 2012). In the coastal area of Nigeria, the strategic location for the highest possibility of piracy will be the Shell Bony Export Terminal which is a major oil export terminal.

In 2009, the Somali Pirates hijacked 47 ships and taken 867 crew members as hostages (Bensassi & Zarzoso, 2012). The pirates completed about 217 violent attacks on ships to take control; to protect ships and commerce, the United Nations Security Council has ordered the maximum number of naval ships to the area. The studies made on data collected from reported incidents and subsequent findings, the effect of 10 additional vessels hijacked would lead to an 11% drop in export trades (including all commodities) and the international trade-related cost is

estimated at 24.5 billion dollars. Also, insecurity in commerce decreases opportunities in trade lanes as well (2012, p. 870). The following table 3 provides the percentage of hijacking by Somali and Malaccan pirates and the cost associated with it from 1999 till 2008. The countries like Indonesia, Malaysia, and Singapore are not a threat to marine traffic at this point and may cooperate in protecting it.

Percentage of Hijacking			Loss of Trade (Million USD)	
Year.	Somali pirates	Malaccan Pirates	Somali pirates	Malaccan pirates
1999	42%	58%	\$3,840	\$5,370
2000	13%	38%	\$1,390	\$4,170
2001	16%	68%	\$1,770	\$7,690
2002	11%	79%	\$1,210	\$8,870
2003	6%	72%	\$651	\$8,460
2004	0%	80%	\$0	\$10,600
2005	65%	35%	\$9,510	\$5,070
2006	38%	38%	\$6,490	\$6,490
2007	92%	8%	\$18,000	\$1,500
2008	91%	9%	\$19,000	\$1,810

Table 3. Loss of trade on the East Asian trade route due to piracy. Bensassi, S., & Zarzoso, I. M. (2012, p. 879)

Ships are re-routed to avoid areas of pirate attacks are present. Sometimes, shippers and consignees are considering other modes of transportation such as air, land, and pipeline options. Carriage of crude oil by land or air is not cost-efficient (Jones, 2014). Piracy, from a cost's perspective, could include additional charges/surcharges such as medical charges, war-risk surcharges, security personnel costs, etc. The recent estimates of pirates related matters costing the maritime industry ranged from 3.5 to 8 billion USD per year. Also, the effect of hijacking is costing the industry in the form of volume decline. This is also impairing worldwide trade very effectively costing the international trade with about 24.5 billion USD in trade destructions by effectively disturbing the maritime industry by pirates (Jones, 2014, p. 160).



Naval efforts are working to prevent piracy, especially in Somali waters. However, this positive result is offset by the growing number of pirate attacks in places like the African Gulf of Guinea where no naval efforts/patrolling are available (Jones, 2014).

Creating a piracy-free environment for international trade is a challenge for shipowners and governments including the United Nations. Piracy is just one of many incidents that can be faced by a shipowner while undertaking the carriage of crude oil to China, there are other issues such as illegal migration, drugs smuggling, marine resource management and so forth (Lehr, 2015)

Africa is the second-largest continent and is surrounded by oceans such as the Mediterranean Sea, the Red Sea, the Indian Ocean, and the Atlantic Ocean. Moreover, 38 of the 54 African states are either coastal or island states (Brits, & Nel, 2018). Traditionally, the concept of security matter was generally based on land-based conflicts and less attention was given on maritime security issues. In recent years, following the hydrocarbon exploration and crude oil transportation, there is a rapid climb in piracy on the east coast of Africa.

According to Brits & Nel, “there is no single accepted definition on the meaning of maritime security” (2018, p. 227). Proceeding this statement, the authors also state that the concept is not defined in the 1982 United Nations Convention on the Law of the Sea. In essence, the defining and concept of maritime security is not clear not only for the African continent but also an issue for the word ‘trade’ itself. So, in the researcher’s view, the unclear nature of the maritime security concept has an impact on trades worldwide. In this case, specifically on the African continent, should identify a shared risk to generate collective security prearrangement by the African states (p. 227). Thus far, according to the authors, African states not been able to establish a secure maritime environment despite global and regional support (p. 228).

However, in 2007, the African Union members in Nigeria adopted the Abuja declaration and plan of action on maritime transportation in Africa which ultimately accepted a revised African Maritime Transport Charter in 2009 (Brits & Nel, 2018). As a result, the charter became responsible to encompass maritime transport and related activities in the coastal, inland waterways, and territorial seas which included Exclusive Economic Zones (p. 229). With all the clauses for multilateral cooperation in developing mutual assistance and support between states, the charter also included a call for effective measures to combat piracy in the region. However, the charter does not address the illicit traffic or unregulated fishing. Besides, it also failed to address the dire state of port infrastructure across the continent.

The African Maritime Transport Charter calls member states to develop their security measures and the charter also addresses the development of maritime security and protection of the marine environment along with calls for fighting against piracy (Brits & Nel, 2018, p. 242). This charter's main focus is maritime transportation and advises states to use extensively the Djibouti code of conduct, the Yaounde Declaration as well as the Jeddah amendment to the Djibouti code of conduct that exclusively addresses the maritime security. However, in the authors' view, the Djibouti code of conduct and Yaounde Declaration and its implementation had little success in Africa as it addresses only maritime security and not the root cause which is the need of the human development (p. 242).

Struett, Nance, and Armstrong state that “Maritime Piracy is one of the oldest topics in international law and recently, piracy has reemerged as a serious threat to commerce and security” (2013, p. 93). This statement proved to be correct as, in recent years, the piracy threat to tanker ships increased significantly, especially in West and East African coasts. This is specifically true during the years 2006 to 2010 where the attack on ships was occurring at a rate

of one attack per day and the threat is not eliminated as of today (p. 93). The main target for pirates is the oil tankers as the reward would be much higher compared to other bulk cargoes carried by ships. This will significantly increase their (pirate) demands for hostage, ship, and cargo value negotiations with shipowners. Though the states have taken various measures to capture, punish, and prevent piracy, their efforts look to be poorly organized and too slow in developing an effective strategy so far (p. 93).

The International Maritime Bureau (IMB) established a piracy reporting center in 1992 as a division under the International Chamber of Commerce (2013, p. 97). This was an important move by the IMB and became an increasingly important part of the antipiracy regime complex. This establishment became the first point of contact for the shipmasters if they face an attack by pirates, in turn, IMB reports the pirate attack complaint to appropriate departments (p. 97).

The International Maritime Organization (IMO) an inter-governmental body, established in 1959 to create a regulatory framework for shipping addressing safety, environmental, legal, technical, and efficiency concerns (2013, p. 97). These objectives were achieved through international accords or combining and promulgating best practices in the industry. IMO is the highest authority when it comes to safety and standards in the shipping industry and it is an assembly of 169 member states that recommend treaties for adoption (p. 97). Having a membership with several powerful states, IMO is the place for intergovernmental dialogues between states on matters related to the safety and security of ships, cargo and crew happen. All-in-all IMO is the best place to discuss repressing piracy worldwide and has very much involved in piracy-related matters in recent years. However, IMO seems to make it an unlikely place to pressure states and other actors to make costly yet effective actions against maritime piracy (p. 97).

Piracy has been treated as a universal crime and not just secluded to one area of the world such as East/West African coasts but there are other spots in the world where Piracy is very much present. Erik Barrios says “roughly 45% of the world’s commercial shipping passes through South East Asia, so the maritime attacks in the region cause billions of dollars in economic loss each year.” (Barrios, 2005, p. 150) The states have long recognized these pirate attacks in the South East Asia region, however, these attacks have now gotten additional attention as these days, it is committed by terrorists. The commercial ships operating in the South East Asia region are particularly vulnerable to piracy as they pass through narrow waterways and countless small islands (p. 150). These attacks were massive as in 1990 when unemployment and political instability have plagued this region and in 2002, the shipping industry has counted approximately 140 attacks in the South East Asia region. The author says the attacks in this region are of great concern to the world shipping community as it caused an estimated \$16 billion in economic losses (p. 150).

It is important to note that the attacks in the region are unique as there is a link between local rebel groups and terrorist groups such as al Qaeda. The violent rebel groups existed in the region for centuries, however, the war on terrorism after September 11, 2001 attacks in the US, has significantly increased the attacks on ships in the southeast Asia region by the terrorist groups. This is mainly due to dissident groups in the Philippines, Malaysia, Indonesia, Singapore, and Thailand have attacked maritime targets using their links with al Qaeda (Barrios, 2005, p. 151).

The IMB organization considers piracy in South East Asia as a “new brand of piracy” where it is motivated by political agendas rather than traditional piracy and robbery in a maritime highway. Barrios states “Actual attacks by terrorists have thus far been limited to temporary

seizers of vessels and crewmen, but officials express concern over the ease with which large vessels such as oil tankers could be hijacked and used as weapons with which to block commercial waterways or attack one of southeast Asia's numerous harbors (2005, p. 151)". This point is very much a possibility that al Qaeda and related terrorist groups can easily target and attack oil tankers while passing through narrow passages, islands then seize them and use as an explosive weapon or use them for ransom for financing terrorist activities. This link between local dissident groups and militants calls for greater yet effective maritime law enforcement by UNCLOS, IMB, IMO, etc., to apprehend these groups and prosecute them (p. 155).

According to Kosai and Unesaki, "since the projected shift of future energy flow can significantly influence the transportation of energy commodity, the analysis on maritime security is of significant importance to evaluate energy security more comprehensively." (2016, p. 175) That means the authors are convinced that if there is no maritime security, then there is no energy security. Both maritime and energy securities go hand-in-hand and are reciprocally compensatory. As found in other security-related literature, maritime security is becoming an important part of policy creations and is referred by many governments of most of the energy importing and exporting nations (p. 176). This is particularly important for their efforts to secure sea lanes as part of the national interest and to enter into international shipping trade. According to the authors, the concept of maritime security came into existence since the end of the cold war, and traditionally, the concept was based on an idea called "good order at sea" (p. 176). Later, many major players/partners, governance and international security agencies created policies relating to maritime security to further enhance securities on the sea, threats to nations (terrorism for example), and threats to energy transportation by sea, etc., all as part of international security and especially, after September 11, 2001.

The authors also allude to piracy as a recent threat to maritime transportation of energy and its overall impact on energy security. They have pointed out that in the strait of Malacca and the Somali waters the piracy has increased between 2008 and 2011 that has contributed to many academic debates on geopolitical dimensions (Kosai & Unesaki, 2016, p. 176). Besides, as per the authors, “the term maritime security implicitly does depend on authors.” (p. 177) Some authors refer to it as a “threat” which is the most widely used term. However, the Center for International Maritime Security refers to it as “risk” and some have used the word “vulnerability”. Thus different analyses and studies have come up with its terms when referring to maritime security based on how they select the subset of these threats (p. 177).

Timothy Walker examines the maritime security issue based on situations developed in 2013 in West Africa especially, in the Gulf of Guinea. Accordingly, the author recognizes two major maritime security related issues one is piracy and armed robbery and secondly, illegal and unreported or unregulated fishing activities (2013, p. 85). Concerning the piracy matter, Walker also alludes to the fact that the Gulf of Guinea and West Africa, there is an integration of international exertions by various agencies to improve the situation. Certainly, there is an unstoppable increase in maritime piracy incidents reported from the region, however, Walker notices reductions in the armed robbery has been reported by analysts from 2011 to 2012 in the Horn of Africa (p. 85).

There were 275 ships attacked in 2011 and has been reduced to a mere 75 ships in 2012 in Somalian waters and the Gulf of Guinea became the new center of focus for various agencies and analysts (2013, p. 86). As per IMB, there is an escalation and increased risk of piracy in the Gulf of Guinea in 2012 and the annual report says there were a total of 58 recorded incidents in the West African Coast compared to 49 incidents in 2011 (p. 86). At the same time, we can also

view this matter as a persistent problem rather than an emerging one. This is mainly due to the oil boom in Nigeria since the 1970s. That means, in this region, there exists a long history of unprotected maritime waterways and ocean sector where the data available on the incidents may not be accurate as many such incidents are going unreported. Thus there are reasons to believe that the actual number of attacks may in fact, greatly exceed the currently reported totals (p. 86).

There is a difference in reported incidents in the past and now. In the past, the incidents/attacks were confined to the Nigerian waters especially around the port Lagos whereas, few contemporary attacks are happening near coasts of Benin, Togo, Cote d'Ivoire, and the Niger Delta (Walker, 2013, p. 86). One such incident had a lot of media attention where one tanker ship was attacked and its oil was stolen in Cote d'Ivoire. Also, not only China but also other international buyers are showing a lot of interest in the abundance of oil supply in the Gulf of Guinea and West Africa in general and this demands a high level of regional economic development and securities (p. 86). As the demand for oil from the Gulf of Guinea increases, the number of armed robberies of oil tankers will also increase. Tanker ships in specific will be targetted and attacked and the number of incidents reported so far will cause a pause on investors investing money in the region unless corrective actions are taken by the external actors and their agencies for the region to eliminate piracy attacks.

Walkers continue to point to the fact that interestingly, the spread of attacks beyond Nigerian waters has been reported as more sophisticated, and also the groups have shown increased audacity in committing such armed robberies (p. 87). Vicious and deadly attacks on ship's crew members and kidnapping have been reported and at the same time, illegal oil bunkering (tanker's oil is removed and transferred to another ship drawn up alongside) and robbery is a common occurrence in this region. The oil obtained by illegal bunkering is then

transported to the shore and sold. The activity of illegal bunkering causes a lot of environmental hazards while transferring as this activity is done in a hurry and no precautions are taken by the attackers to prevent oil spills and environmental damage (p. 87).

All such risks due to lack of security have a wider destabilizing effect concerning most needed humanitarian aid to the region and also increasing the ship insurance premiums and having a direct impact on the state customs revenues. Walker points out that Benin as a state is particularly susceptible to any deterioration in maritime security where the major revenues to the country are drawn from the port Cotonou means, 80% of the government's total budget is coming from this port's business (p. 87). Same way, attacks in the Nigerian coastal waters and waters in the neighboring states have an impact on transnational, regional, and global dimensions. According to the author, some vital steps have been taken to curb piracy and armed robberies of ships by local national and international agencies and tracking outcomes by analysts and reporting the same has vital importance (p. 87).

The piracy issue in Somalia has dominated maritime security as well as the maritime community for a long period in recent years. It was a major concern for the policy-makers in the industry as well as for government officials worldwide. Sporadic attacks on ships in the Somalian waters have occurred from time to time, however, in 2008 concerns for the security of ships across the Indian Ocean and especially, through the Gulf of Aden has grown exponentially as the pirate attacks, subsequent hijacking of the ships and demand for ransom became successive (Anyimadu, 2013, p. 2). The same year, there was a concerted effort taken place to stop piracy in the troubled areas of the world by the international shipping community as well. In May of 2013, the UN officials noted that there have not been consistent and successful efforts by the pirates to hijack ships in the Indian Ocean for a year or so (p. 2).



However, international attention was given to the Gulf of Guinea (a coastal range stretching from Senegal to Angola) where a high number of pirate attacks were occurring. The Gulf of Guinea provides an economic lifeline for landlocked West African countries and also got strategic importance for the rest of the world (Anyimadu, 2013, p. 2). The area is also crucial for the transportation of crude oil to support global energy needs. Especially, Nigeria and Angola are among the top 10 producers of crude oil. At the same time, the fishing industry is also important for the sustenance of the nations along the West African coast and its employment (p. 2). In 2013, the annual human cost of marine piracy report noted that more seafarers were attacked on the West African coast than the Somalian coast (p. 2).

There are differences in the maritime insecurities on the East Coast of Africa versus the West Coast. However, the Gulf of Guinea, its shoreline states, and other stakeholders can draw some key lessons from the experiences in combating piracy in the Somali waters and apply some of the strategies in combating piracy on the West Coast (2013, p. 2). Though piracy in the Indian Ocean is dominating, the attacks in the Gulf of Guinea can resonate in a variety of ways. In this region, the territorial waters and Exclusive Economic Zones (EEZs) at states such as Nigeria, Benin and Togo are known to be at the highest level of risk (p. 4). In the Gulf of Guinea, pirates launch attacks primarily from Nigeria intending to steal cargo, equipment, and valuables from the vessels or crew. The kidnapping of Crewmembers happens rarely compare to in the Indian Ocean. Also, violence is at high levels compared to East coast pirates as in the Gulf of Guinea, the pirates are less concerned about the well-being of the hostages (p. 4).

Undoubtedly, piracy has been given the most attention in the area of maritime security. In 2008, as per UN General Secretaries Report on the Ocean and the Law of the Sea, maritime

security can be subdivided per below and specifically, piracy is described as a contributor to potential disruption of energy shipments (Kosai & Unesaki, 2016, p. 177-178):

1. Piracy and armed robbery
2. Terrorist acts
3. The illicit trafficking of arms and weapons of mass destruction
4. The illicit trafficking of narcotics
5. Smuggling and trafficking of persons by sea
6. Illegal, unreported and unregulated fishing
7. Intentional and unlawful damage to the marine environment

The 2014 maritime strategy of the United Kingdom, describes potential disruption to vital maritime trade routes such as war, criminality, piracy, or even changes to international norms (Kosai & Unesaki, 2016). The European Union (the EU) included other concepts into the area of maritime security especially, it is considering conflicts between states as a potential threat to maritime security. The EU points out that the choice of alternative routing entirely depends on the geographical structure, and assessment of the route will be based on the level of vulnerability at the chokepoints (2016).

The number of 'ships lost' cases in a geographical area would affect the maritime transportation system (Kosai & Unesaki, 2016). For example, the loss of Costa Concordia Cruise ship (sank in Italy January 2012) and Rabaul Queen (passenger ferry sank in the Solomon Sea February 2012) resulted in a global reconsideration on how the maritime security and its impact on transportation of commodities and passengers via the sea highways. The authors also list the causes of maritime incidents as follows:

- The collision involving vessels,

- Contact with harbor wall,
- Fire/explosion,
- Hull damage,
- Missing,
- Machinery damage,
- Stranded and miscellaneous (such as congestion, human error, weather), and
- Natural disasters.

Though China is a fast developing country in the world militarily as well as economically, it does not aspire to play supremacy or a superpower role (Penghong, 2015). Yet, the Chinese are thinking about the maritime dimension concerning Asian security in the Pacific and the Indian Ocean.

Strait of Hormuz not only a chokepoint for ships but also a vulnerable one for the world oil imports. It will most adversely affect China's economic development given its energy supply by sea. A disruption at the chokepoint can occur from several sources. Penghong (2015) points out some major sources that include:

- The waterway is very narrow between the Gulf of Oman in the southeast and the Persian Gulf in the southwest. At this narrow point, the strait is 21 miles wide, but the width of the shipping lane is for either direction is only two miles separated by a two-mile buffer zone making it a very confined area for navigation.
- A possibility of terrorist attacks cannot be ignored and there remains a deep worry of terrorist activity not just limited to the strait area but it is extended throughout the Indian Ocean. The Al Qaeda has always focussed on energy-related targets and such possibilities can not be undermined by China as a major oil importer.

- Knowing the fact that there were attacks in the past such as the Abqaiq attack (2006) and the Mumbai attack (2008). The most likely targets now and to the future will be Americans and their tanker and naval ships in the Persian Gulf.
- The Iranian nuclear issue can trigger a war between America and Iran and other Middle East nations will be dragged into the conflict. This will bring a disastrous, unnecessary strain onto China's energy security. The Middle-Eastern allies do believe that Iran is on the verge of or already produced a nuclear capability. If that is the case, conflict can erupt.
- A counter-attack by Iran is very well possible by closing/blocking the Strait of Hormuz and stopping the oil supply to the world. There is already a warning by Iran about this action if, US and Israeli forces attack their nuclear facility. Again, a blockade of any sort at this location would undoubtedly target oil traffic in and out of the Strait of Hormuz
- Hypothetically, another source can also be viewed here as well. It is nothing but a war between the US and China may be in the form of tensions raised between the two nations in power transitions. This is a possibility as we know all along that an existing power (United States) and an emerging power (China) cannot co-exist peacefully and war can erupt at the end. American interest in withdrawing from the Middle East (pulling troops from Iraq, Afghanistan, etc.) and shifting to Far East Asia where the US wants to establish its hegemony even strongly in the Indian and Pacific Oceans.

If there is a closure of the Strait of Hormuz or a war erupting in the Indian Ocean or Pacific, there will be a strong response by China because there is a likelihood that tanker traffic to China will be interrupted from the Middle East (Penghong, 2015). Otherwise, China has no option but to diversify the risks of overdependence on Middle-East oil imports. They must also

seek resources from nations other than Middle-East such as African, Central Asian, Russia, and South American nations and it is suggestable that China should develop close relations with oil-producing nations of Africa, the Middle East, and Central America alike.

Since China, with its energy diversification policies is also resourcing oil from west Africa, the risks (of piracy) to be also looked at this juncture. According to Katja Jacobsen, “ it is widely acknowledged that maritime security in the Gulf of Guinea is a highly complex phenomenon involving a variety of issues (legal deficiencies, inadequate military equipment, and challenges like corruption, political unrest, and youth unemployment) as well as a multiplicity of external responders.” (2017, p. 1) The possibility of building maritime capacity within a wide range of areas and at various levels especially, at military and civil institutional levels. In other words, the comprehensiveness that is unfolding is not fitting the criteria of the entire maritime activities and its security issues experienced in recent years in West Africa. There are a host of the root causes which also need to be addressed simultaneously while building maritime security capacity. In the Gulf of Guinea, multiple key dimensions need to be prioritized by the external actors who also is part of maritime capacity building. Now, the capacity building is not only failing to deliver comprehensiveness but also endeavors successfully influencing the security in the region. Gaps are seen here that little attention is given for productive effects where prioritization is given to certain aspects of a complex problem at the expense of marginalizing other key aspects.

In 2011, the United Nations Security Council (UNSC) passed a resolution probing on the issue of piracy in the region of Gulf of Guinea and condemned the act and UNSC called upon the regional bodies in West Africa and also a resolution was passed in 2012 urging the international community to assist the Gulf of Guinea in fighting piracy (Jacobsen, 2017). The United Nations

Office on Drugs and Crimes (UNDOC) also cited issues at the Gulf of Guinea along with experiences on the east coast of Africa (Somalian waters). However, all these capacity buildings were focussed on institutional capacities such as Interpol, etc., where tangible skills and procedures (conducting a criminal investigation, collecting evidence so on and so forth) have been addressed and promoted to add strength to legal and judicial aspects of criminal investigations. Besides, various UN agencies have also indulged in the capacity building on the west coast of Africa. The focus was not only to set the eyes on the piracy activities but also on other maritime security matters organized by groups that have engaged in criminal activities.

The key points ignored in the broad sense of maritime security build-up are onshore problems of poverty, corruption, and societal grievances. It is debatable that all these issues are translated into institutional security build-ups such as military capacities and legal institutions (Jacobsen, 2017). Reducing the effects of the so-called onshore influences is crucial for the successful fight against piracy in the Gulf of Guinea in West Africa. Involvement of different kinds of agencies such as the UN agencies, and their interventions are not only large-scale but also they will unfold across the borders where it needs some sort of corrective interventions as external agencies (Jacobsen, 2017). Such external agencies and their call for attention to the need for a broader conception of practices of interventions can add additional but important value to the aspects of a maritime security building in the West African region. So far, none of the capacity building actors seen addressing the issue of poverty, unemployment, social inequality, and corruption as a fundamental cause for maritime insecurity in the West African Region.

#### **Category 4. The Regulatory Framework**

The legality of carriage of crude oil is an important factor to be looked at. Many of the financial risks can be mitigated just by following some of the important rules and regulations by the tanker owners. Various laws and regulations cover a contract of carriage such as Hague/Visby Rules, Carriage of Goods by Sea Act (COGSA), Hamburg rules, Safety of Life at Sea, and so on.

The industry in question here is more than 2000 years old. In turn, the literature reviewed also has a foundation built from an older legal system. The risks and prevention of risks, regulations related to it today coincide with historical occurrences/premises. If a circumstance surrounding an occurrence today matches historical events in the industry, the court's decision on it becomes precedent for such occurrences today and in the future.

Legal matters help in the assessment of maritime security. This means that there is a legal environment that would either support or contest the security of ships passage through various sea routes (Ronzitti, 2013). Besides, there is a legal/regulatory framework yet to develop which would help to prosecute maritime crimes, such as piracy, WMD, and terrorism. The Persian Gulf countries are trying to create a WMD free zone in the Middle East (Ronzitti, 2013). Soft security would include drug and human trafficking needs to be given priority.

The United Nations Convention on Law of Sea (UNCLOS) in 1982 has been a driving force behind creating a regulatory framework. The UNCLOS is endorsed by various maritime nations and they became a signatory to it. Few nations are not a party to this convention and its provisions. However, even those states have accepted the main provisions of the convention as declaratory and customary international law (Ronzitti, 2013). These provisions include norms on rights of navigation on the high-seas, innocent passages through the territorial sea, and international strait passages (Ronzitti, 2013). The 1958 Geneva Convention and the 1982

UNCLOS provisions allow ships to have freedom of navigation through territorial waters if the intent is truly an innocent passage for conducting business and earning freight. To address maritime terrorism, the soft law instrument such as Proliferation of Security Initiative (PSI) is known to be a George W. Bush-era initiative to counter the transit of WMD by sea, air, land, and accordingly, all PSI states are party to the UNCLOS. Further Ronzitti (2013) advises that the PSI states should act in the sea areas such as internal waters which include ports of transshipment, the territorial sea, the contiguous zone, and the high seas.

Actions must be taken in contingent with the international law and based on the auspices of the UN Security Council resolutions (Ronzitti, 2013). Unless the foreign ship is a warship, an inspection of any ship will not pose a problem under the international law and PSI is specifically aimed at merchant ships since all warships take a prior notification from the territorial state before entry into their waters. If tanker ships are passing through enemy /not so friendly states of China and their waters, PSI statement of principles can particularly a nuisance for tanker ships that can be stopped and harassed for manufactured suspicions of WMD. This could be just to intimidate the flag state and China, the buyer. If the rules of PSI are contrary to innocent passage provisions and an innocent passage forcefully stopped under the rules of PSI and coastal states can use this rule arguing the fact that the stoppage is prejudicial to the peace, good order, and security.

#### **Category 5. The Maritime Territorial Controversies**

Territorial waters are an issue around the world, especially for neighboring countries. These controversies often linger around for a longer period without any resolution unless a third party helps in striking a deal between the countries. For example, both the UAE and Iran claimed territorial authority over Abu Musa Island. The island was occupied by the United Kingdom, in



1921 and later given to the Emirate of Sharjah. In 1971, Iran and Sharjah signed a Memorandum of Understanding (MOU) to establish a joint administration of the Island and waters surrounding the island and on equal sharing of the oil revenues (Ronzitti, 2013, p. 11). However, Iran diverged from the MOU, occupied the island, and raised antagonism from the UAE and other GCC members. Point to note here is that any conflict between Iran and members of GCC on the matter of Abu Musab island will have an impact on Chinese oil imports from the Middle East.

Such issues are also common in South East Asian countries as well. The issues between China and Southeast Asian countries like Vietnam, Indonesia, Malaysia, and the Philippines over the South China Sea territorial matters (Buszynski, 2012, p. 139). It is not just the fishing and territorial dispute but there are oil and gas drilling possibilities that exist where each of them has a claim. Also, it is a point of rivalry between China and the US in the Western Pacific. Since 2010, the South China Sea has become a focal point for US presence in the Pacific and Chinese claims on the territory. The dispute involves South East Asian countries in direct conflict with China on one hand and the US navy presence in the Pacific would make it more dangerous (p. 139-140). All Southeast Asian nations including Brunei put claims on the South China Sea as their territorial water and they feel bullied by China on the matter. For example, The Parcel Islands which is a combination of thirty islands is equidistance from the Vietnamese coast and is occupied by China. Vietnam is claiming that it is their territory. Besides, China is claiming the Spratly Islands that are close to the coasts of the Philippines and Malaysia. China's claim does not carry much weight in the international court of law (p. 140).

However, from a Chinese perspective, losing these islands and territories would downgrade their ancestral authority on these islands. At one point, Vietnam warned China not to continue the Exxon project in the South China Sea (Hirschberg, 2012, p. 1-2). The issue could

have dragged on without any acceptable solution forever or anyone having a claim on the territory. However, things have changed when the oil and gas reserves found in the disputed territory. China will push further for the claim to take advantage of the reserves. Also, if U. S. moves out of the area, the Chinese aggression over the South China Sea issue will escalate.

On the other hand, the US presence will agitate China as well. So, this is a complicated matter where any escalation of tensions between Southeast Asian countries and China occurs, the US must interfere along with India to save the smaller nations against a giant (Buszynski, 2012, p. 148-149). This is a major risk that needs to be looked at by all tanker owners while plying between the Middle East, Africa, and China. If a war breaks out, it will be a major one, and the merchant ships will be in extreme danger. Meanwhile, India also became a player in this which would complicate the scene where it has close ties with southeast Asian countries and causing resentment with China for various international issues (p. 142). India's rivalry with Pakistan and its longstanding dispute with the Kashmir territory is also a cause of concern for maritime trade conducted through the Arabian Sea.

Regions are naturally delineated by political structure, culture, or by geography. Each state within the given region naturally by default pursues its interests (The Maritime Executive, 2014). This may be part of a region-building process. Sometimes, it also entails a re-building process. In these processes of region-building and re-building, it would occur geographically or politically by a single state or a group of states and often the process will be contested by neighboring states or cultures (The Maritime Executive, 2014). For example, India and Brazil have tried to expand their maritime spaces within their respective territories to suit their interests. This often includes naval build ups, international cooperation, and revitalizing the zone. India is giving an extreme interest in this area by paying increasing attention to expand its presence in its

oceanic rims by providing security from Pakistan and the growing role of China in the region (2014). The Maritime Executive states that this is sort of a pre-emptive measure than using it as a platform for global power projection. However, there are opposing views from other scholars saying the Indian Ocean is a highly-globalized space, while others would call it a rather constitutive of regions in their rights by supporting the flow of ideas, goods, and things among societies along their perimeters (2014).

India is actively involved in region-building. It is a rising power involved in peacekeeping activities abroad through the United Nations. The country has expanded significantly in the Indian Ocean. The Indian economy had undergone a reform in 1991 providing significant liberalization to businesses domestically as well as for foreign investments. It had boosted regional cooperation agreements in Asia such as the South Asian Association for Regional Cooperation SAARC, Bay of Bengal Initiative for Multi-Technical, and Economic Cooperation (BIMSTEC). India has cooperation with its neighboring states on anti-piracy efforts. There are several challenges to India in region-building process. China recently established an operational presence in the India Ocean and India may view this as a threat. However, other countries in the region may view China's presence in the Indian Ocean as an economic opportunity. Both powers trying to have its presence in the Indian Ocean region especially India's effort of region-building might lead to conflict with China. Such incidents/conflicts may pose a severe threat to crude oil carriage to China and tanker ships passing through the India ocean route.

Iran can be a serious threat to oil trade from the Middle East Gulf area due to controversies surrounding the Strait of Hormuz. Even though Iran does not want foreign navies in the Persian Gulf waters and proposal by Iran to make it a zone of peace, it has been always

countered by the defense agreement made by the other Gulf States (Ronzitti, 2013). Since the seamless supply of oil is crucial for the world economy, and the world consumption of oil is rising significantly, the disruption at the strait of Hormuz will have a deleterious effect on the world economy (Zamora, 201). China's oil trade route includes the Persian Gulf waters. The controversial Strait of Hormuz and Iran's unhappiness about the US naval presence in the Persian Gulf and its attempt to irritate the US Navy in those waters have always been a security threat to tanker ships.

Kuwait's key business interests and projects in China and all trading ships in and out of Kuwait must pass through the Strait of Hormuz. In turn, there will be a serious impact if the Strait of Hormuz is affected by any warfare. At the same time, it is also worth noting that in the Indian Ocean also there is a heavy naval interest and presence from navies of the United Kingdom, the United States, and France. This presence is justified based on the right to use international waters for freedom of navigation for military and non-military purposes.

On the other hand, China is also building up relations in the territory as well. In addition to the buyer-seller of crude oil relations with Middle Eastern and West African nations, China is aware of the territorial controversies and is engaged with other nations to secure the sea routes. The marine security in Pakistan is of major concern for China as well and there is growing Pakistan-China bilateral interests. This is particularly true at Gwadar to achieve the geostrategic objectives of China-Pakistan Economic Corridor (CPEC; Chang & Khan, 2019). China's Strategic Belt and Road Initiative (BRI) interconnects the southeast Asia and Africa in a way that partners in close relations to work together and achieve their long-term goals. This will include designing roadways, railway lines, energy infrastructure, and marine routes. The studies show that the countries lying along the BRI constitutes 63 percent of the world's population and is

responsible for 29% of the world's GDP. There are two main components to the BRI where there is land-based "Silk Road Economic Belt" (SREB) and the "21<sup>st</sup> Century Maritime Silk Road" (MSR). Interestingly, the CPEC is both land-based BRI that would connect with the Ocean routes via the Gwadar port in southern Pakistan (Chang & Khan, 2019, p. 218). China Claims that Gwadar is located at a strategic location where the 21<sup>st</sup> Century MSR and SREB connects and they consider the Gwadar project as a key project for the success of China's "Belt and Road Initiative (BRI)" and the CPEC according to analysts as a game-changer for the region. Also, China has been connected to Pakistan from the western province of Xinjiang with the northern areas of Pakistan with Khunjerab (p. 218).

Going forward China may have an approach by using a faster route for its oil imports via Gwadar port and link to its Western province (Xinjiang) to the Indian Ocean using highways and networks of railways etc. (Chang & Khan, 2019). The plan will cut the current transit time via the sea route of 32 to 19 days through the suggested Bangladesh-China-India-Myanmar Economic Corridor (BCIMEC). China considers its maritime security as vital for its economic growth under CPEC and will be connecting to a unique route; i.e., connecting China to the Arabian Sea, the Middle East, and opening to the Indian Ocean. Therefore, for China, the development and the maritime security of Pakistan are of utmost priority especially, the movement of commodities through the Gwadar port (Chang & Khan, 2019).

#### **Category 6. Maritime Disasters and the Risk of Marine Pollution**

There is a narrow limit of waterways in the Middle East Gulf area and taking care of the vulnerable ecosystems is of high priority along with limiting marine pollution as much as possible (Ronzitti, 2013). Such steps need cooperation between GCC and other nations. Thus, the Arabian Gulf is the origin of many sea routes when it comes to oil trade and it is one of the

busiest sea-route locally as well. The oil spills have contributed to the increased levels of pollution.

In 1973, The London convention for the MARPOL endorsed by Arabian countries became a party to it as well (Ronzitti, 2013). Besides, the MARPOL convention has six annexes that would deal with special causes of pollution, and especially, Annexes 1 and 2 deal with oil and other dangerous substances (Ronzitti, 2013). The Exxon Valdez accident and marine pollution that occurred off the coast of Alaska in 1989 was the signature incident that brought forward many marine accident/marine pollution-related regulations. It is unclear if a marine accident at a scale of Exxon Valdez occurred how China would respond in terms of cleanup and financial accountability.

Publicly available datasets have information to track technical safety and regulatory changes over an indicated period. For example, the introduction of double-hulled tankers improved safety, but the associated accident records have not been identified.

### **Category 7. Operational Risks and the Human Factor**

The marine governance of oil transportation is complex due to difficulties in monitoring the written procedures effectively and not following the established regulations by ship crew and the port operations personnel at port of loading and discharge (Hassler, 2011). Oil spills, for example, it is always been argued that oil spills from ships occur due to human errors. However, we ought to realize the fact that there is a complexity in finding out what exactly caused the oil spill. That means, to what extent the oil spill occurred due to human error and what is the share of an accident. It is been established by experts that the accidental oil spills have been fundamentally met by the technical requirements on the vessel in combination with port state control, which attempts to have control over-restraint intentional pollution (2011). Vessels are

becoming larger and if major accidents take place, the oil spill is enormous and would cover a vast area of the surrounding body of waters. The oil spills pose a considerable threat to the ecological systems and marine flora and fauna (2011). For example, the spills are increasing in Baltic ports despite the technological improvement for safety on the modern tankers. This is particularly occurring during the cleanup process of the tanks or flushing the machine rooms of the ships during the voyage or in the port area by the crew or operations personnel by not giving enough attention to the oily waste created during the process. Such intentional pollutions are happening despite laws established through international conventions. The reason why these intentional pollutions are occurring only in the name of saving money (2011). Therefore, the governance of marine transportation and negligent or intentional acts that are causing pollution is difficult. Especially, such intentional pollution is done on the high seas. Thus there has to be a way to control at the same time a mechanism to be in place to differentiate between the intentional and accidental pollutions by the operators. According to the author, large scale spills can cause tremendous ecological, economic effects long-term to the local areas and is difficult to assess and will be very harmful in the long term. According to the studies, the institutional responses would vary depending on the environmental hazard that occurred due to an accident or during operational activities. On such differences in institutional responses, there are arguments for and against why such rationale exists. Ultimately, despite existing differences in institutional responses, we can learn how we could learn and improve safety and protect the environment by structuring specific problems and interact with the actors, the interests and results can bring effective and efficient outcomes (2011).

Hassler argues that stricter regulations on the crew and their working conditions onboard the ship can dramatically increase in the improvement of environmental safety (2011). Besides,

the operators make the routes longer which in turn can increase the harmful emissions from the vessel. Ultimately, whatever is decided by the International Maritime Organization on its framework on environmental safety can impact lower-level activities such as at regional and national levels (2011). This may be true in the case of China's imports of crude oil by sea from the Middle East and West Africa. Stricter regulations and adherence can improve safety standards produced by the crewmembers and operations personnel and avoid oil spills.

All countries have their agendas and priorities especially when it comes to economic interests and growth. However, they all share a primary interest which is protecting the environment (Hassler, 2011). It is also reasonable to expect how national interests play out and helps countries in realizing the economic development and if we motivate them to invest in increasing environmental safety and lobby for stricter regulations the effect will be more than desirable at the end. The bi-geographical characteristics of a problem will have a direct impact on national interests (2011) and the kind of institutional response emerges from the states to tackle the matter will have to be stressed.

Though there is a similarity in accidental and intentional spills, the response from institutions has been quite different in addressing the pollution issue. The accidental responses are quite strictly enforced and requirements on vessel construction, equipment quality, onboard safety installations, etc., are enforced stringently (Hassler, 2011). Such responses and related regulations have made the campaign against accidental spills observed closely however, despite the improvements, the vessel construction, on-board safety installations remain quite a concern to the enforcers (2011). According to Hassler, overall, the flag-state control, port-state control and human error factors which are the main three important areas of concern and are



substantially related to each other and should not be viewed in isolation but addressed all three in combination if the objective is to reduce or eliminate the threat of marine pollution (2011):

Marine pollution and the governance thereof can be divided into major four areas:

- Precautions in vessel design (double hulls, protected areas, and traffic separation).
- Monitoring (example, surface, aerial, and satellite surveillance by port -state control).
- Enforcement (flag-state control, No Special Fee System, and Coast Guard patrols).
- Remedial actions (Pooling equipment in case of large spills and joint exercises to combat oil pollution).

These four categories are mutually exclusive and when considered in unison will protect against oil spills.

Carrying non-indigenous species (e.g., harmful aquatic organisms and pathogens) across the world in the ballast water of ships were identified and addressed by one of the International Maritime Organization's (IMO) resolutions in 1973. Eventually, IMO worked towards finalizing the International Convention for the Control and Management of Ship's Ballast Water and Sediments (BWM) and adopted in 2004 at a diplomatic conference on London (Matej, Elliot, Wiley & Gollasch, 2015). This convention was aimed at eliminating the risk to the environment, human health, property, and resources that would ascend due to the transfer of ship's ballast water and sediments that could carry harmful aquatic organisms and pathogens. In total there are 15 guidelines put forward by the convention and already been adopted by the Port-State -Control where convention guidelines define how to properly conduct a detailed inspection of the ships and its ballast water management. Overall, the uptake of ballast water onto ships should include mainly the following precautionary methods and should avoid below uptake under below conditions where practical:

- Avoid areas identified by port-state-control and if there is guidance by the port is in place.
- In the darkness, the organism concentration is high at the upper level of the water – so avoid ballasting in darkness.
- Avoid areas, where there were outbreaks, infestations, or known populations of HAOPs, is present.
- Avoid very shallow water where organisms will be pumped from the sediments or below the water.
- Propellers may stirrup sediments and avoid such waters.
- If dredging has taken place recently and water from the dredged area should be avoided.
- Avoid pumping from near sewage outfalls.

Besides, vessels and their crewmembers should also implement precautionary practices by avoiding ballast water discharge unnecessarily. They should think in such a way that if it is necessary to discharge and uptake ballast water from the same port or not to have a safe cargo operation (Matej, Elliot, Wiley & Gollasch, 2015). There is a requirement of treatment of ballast water on board the ship is essential before discharge and onboard crew should be able to do such treatments before the discharge of ballast water in a specific port is done.

As the environmental concerns started to undergo institutional and infrastructure reforms, there were pockets of responses from ports especially by the multinational terminal operators on the west coast of Africa (Dabban, Koppen, & Mol, 2017). This is mainly due to the response by states and providing incentives to the economic actors such as ports so that a specific target of ecological modernization can be achieved in West African ports, such as Abidjan, (Ivory Coast), Douala (Cameron) Lagos (Nigeria) and Tema (Ghana). The West African economy is dependent

on international trade and out of that, 90% is maritime routed trade (Dabban, Koppen, & Mol, 2017). This calls for efficient ports and subsequent shipping service are the key factors for their economic sustenance. To overcome the inefficiencies, many of the ports had to undergo institutional and infrastructure upgrades. Globalized economic liberalization attracted private investments resulting in new equipment installations and providing more autonomy to ports from state governance (Dabban, Koppen & Mol, 2017).

The operation of or the process of transferring crude oil from the port terminal to the ship or vice versa and also the internal recirculation of crude oil during loading and discharging is also a key area where there is a possibility of an oil spill can occur. One of the major causes of the oil spill is pressure upsurge inside the pipelines as a hydraulic hammer's consequence (Roszkowska & Sarnecka, 2018). That means, the pressure surges can cause by many factors that would directly influence the liquid velocity to rise in a pipeline. These factors may include sudden valve closures, pump trips, emergency shut-down, etc. Especially, when and where sudden valve closures occur, it can increase the packing pressure and quickly allows the velocity of the oil in the pipeline to change/increase causing an oil spill. The stages of oil transfer include:

- Loading cargo at the low rate initially
- Laboratory tests of exported crude oil
- Loading cargo with full rate
- Loading cargo with a reduced rate
- Unloading cargo with an initially slow rate
- Unloading cargo with full rate
- Unloading cargo with a reduced rate
- Terminal idle mode means there will be no transfer of cargo

- Lastly, an internal recirculation process

When a tanker ship comes for loading or discharging to a specific port terminal, the ship will be moored properly and then the ship's crew and terminal representatives should discuss all technical processes and procedures before the operations begin (Roszkowska & Sarnecka, 2018). Overall, during the loading and discharging process, the ships and terminal operations crew must work in harmony and both should be highly trained to handle the operations without meeting with any incidents that would result in oil spills. The same process applies to the discharging of crude oil from the ship to the terminal as well and a high level of training is needed to avoid oil-spills in the marine terminal areas.

### **Summary**

The literature review provides key information on oil tanker/bulker transportation from the Middle East to China. The researcher reviewed the literature in connection with operational risks and human factors at load and discharge ports along with navigational aspects. The researcher identified at least six to seven key matters to support the current study, including China's energy security, strategy and subsequent pressure to import crude oil through outsourcing; the safety, and security of crude oil transportation; and key risks involved in this area and avoidance. The maritime piracy in key points of the navigational route such as Somali waters and other points of North and West African coasts, it's bearing on ships, cargo, and the crewmembers' and their safety is been noted. The regulatory framework of maritime trade and its international nature and loopholes can have problems in finding justice against criminal and tort claims in an international court of law. Additionally, territorial controversies between nations (e.g., the South China Sea and territorial claims of China with neighboring countries) can

escalate into regional conflicts and closures of sea routes. Potential marine accidents and dangers to marine life due to oil pollution can have major financial risks to shipowners.

### CHAPTER 3: RESEARCH METHOD AND DESIGN

China is growing fast and a lot of positive changes are occurring for the past two to three decades. As a result, China's financial rank improved along with the luxury lifestyle of its citizenry. This improved status of the Chinese population has a direct impact on increased demand for energy and consequently, dependence on foreign oil. This has resulted in increased traffic in the sea route where the tanker ships with high tonnage are sharing the route with other maritime traffic.

On the other hand, US imports of oil are diminishing, and tanker owners deployed their ships to a route where more business opportunities exist which happened to be the Middle East and Africa to China route. Therefore, some of the existing risks from US trade have shifted to this new trade route. The research question for the study asked: What are the key operational risks that affect decision making in the Middle East/West Africa to the China crude oil maritime shipments?

#### **Hypotheses**

##### ***Hypothesis 1:***

Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf/West Africa to China voyages.

##### ***Hypothesis 2:***

Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.

***Hypothesis 3:***

Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf/West Arica and China.

***Hypothesis 4:***

Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf/West Africa and China ports.

**Data Collection*****Tool:***

A written questionnaire using Likert scale responses has been created and sent to participants.

***Survey Respondents / Participants:***

Shipowners, shoreside managers, and seagoing officers.

***Data:***

Collected from responses to the questionnaires. Supporting data was collected from available sources of information in the industry.

***Preliminary findings:***

Developed from survey responses and supporting research data from the industry sources.

***Final Findings:***

Preliminary findings have been shared for comment and enrichment with five carefully selected maritime experts and converted into final findings.

***The Likert-Scale Questionnaires:***

The surveys are used to collect data from experts currently working in the field. The survey answers from this sample population were analyzed to generate firm conclusions concerning this study as well as to add new information to the body of knowledge. Answers were given to statements in what is known as the Likert Scale of: ‘strongly disagree’, ‘disagree’, ‘neutral’, ‘agree’, ‘strongly agree’ (Holmes & Mergen, 2014). Having a five-point scale allows the respondent more options than solely answering either agree or disagree, known as the neutral or mid-point.

**Likert-style questionnaire preparation, distribution and data collection**

The researcher designed the survey questionnaire to specifically understand the operational factors and risks in tanker ship voyages with crude oil from the Middle East and African ports to China destinations. To obtain expert views, the researcher designed a Likert-type scale questionnaire containing four categories of key identified risks. Each category included five statements totaling twenty statements per questionnaire. Though the respondents' identity was not requested by name or other personal information, the researcher included a demographic information section within the questionnaire as an option to be completed. The researcher used the five-point questionnaire with the mid-point or neutral option.

The four categories of identified operational risks including:

1. Key operational risks affecting tanker ships from the Middle East and Africa to China;
2. The use of automatic navigation and global positioning systems to reduce the likelihood of accidents of tanker ship voyages through the Malacca Strait.



3. The use of training to reduce the risk of human errors at loading and discharging ports in the Middle East and Africa and China; and
4. The importance of coordination among decision-makers at shipping enterprises to create efficient and safe transport of crude oil.

The questionnaires were sent to industry experts via e-mails and the responses were low. However, the researcher attended the Sub-Saharan African Oil Conference in Houston, TX where industry experts were in attendance from various parts of the world. The arrangers of the conference allowed the researcher to present the research topic at the conference, distribute questionnaires to the attendees, and collect the responses on the same day. In total, the number of responses received was 30, which was sent to industry experts. Since the responses were submitted by professionals, the researcher has proceeded to conduct the analysis based on these 30 expert responses.

### **Research Design**

The research design is the process of collecting the data and deciding on the method in which the data are collected. Considering the international nature of this study involving different nationalities, cultures, and languages along with small sample sizes, it was necessary to choose an appropriate design. In turn, a mixed-method design was used for this dissertation.

A mixed-methods design uses both quantitative and qualitative data (Wright & Sweeney, 2016). This approach is also beneficial where multiple data approaches are needed to fully understand a topic (Johnson, 2015). The mixed-method research design approach allowed the researcher to obtain observations on multiple variables from participants and helped develop a

theory using different viewpoints (e.g., shipowners, navigation officers) for this specific qualitative study (Wright & Sweeney, 2016).

### **The theoretical/conceptual framework**

A thesis is a labor-intensive process where the researcher must put an incredible amount of time and effort to achieve his/her goal in finding the intended answers, at least, that was sought (Osanloo & Grant, 2016). The theoretical framework is one of the most important aspects of the research process and is also an often-misunderstood area in a case study process. The authors further point out that theory-driven thinking and acting must be emphasized in the selection of a topic, development of research questions, the conceptualization of the literature review, the design approach and the analysis plan of the dissertation study. Without a theoretical framework, the structure and the conclusion of the study being conducted remain unclear. In other words, a dissertation plan that includes a theoretical framework gives a strong basic edifice to the study and allows rational yet pedagogic thoughts to flow from one chapter to another in a structured way. This basic framework should be mapped out from when the study being initially conceptualized, and the scholar must realize that it has a direct insinuation on every decision we make during the construction/building of the dissertation.

A 'theory' as an organized and systematic set of interrelated statements (concepts) that would specify the nature of relationships between two or more variable with a purpose of understanding a problem and concepts (nature of things) that would symbolically become a statement or a class of phenomena (Green, 2014). According to Green, the theoretical framework should be specifically used when the research is grounded on one theory; however, the conceptual framework draws on concepts from various theories and findings with which the research is guided. According to Green, the frameworks (theoretical or conceptual) are nothing

but a map for the dissertation, where it gives some key rationales to the development of research questions or a hypothesis. It has key importance in assisting the researcher, focusing on the work he/she is trying to achieve. Also, the conceptual framework gives the diagrammatic representation of the study being conducted. Green also points out that the development of both theoretical and conceptual frameworks can be undertaken as an outcome of the research, however, it may be unlikely that one will be considered as part of the design. Projects using theoretical frameworks do have a philosophy or an epistemology on which the research is based upon. For example, the grounded theory methodology is based on the epistemology called the symbolic interactionism where it will not possess either theoretical or conceptual model in the design of a specific study being conducted.

The theoretical conceptual framework provides a frame of reference for a study being conducted (Hymovich, 1993). It provides the researcher with a definite path to follow and guide him or her in developing a firm basis for research questions or hypotheses and in establishing the relationships among the inconstant that are being studied. The theoretical framework also gives the researcher an ability and a basis to interpret the results. Besides, it will help in averting the inaccessible collection of facts by enabling the assignment of new conclusions into broader areas of already existing knowledge. Hymovich believes that the process of linking theory to research is often difficult because there is no best approach for developing a theoretical or conceptual framework and there are no right or wrong ways to conceptualize a study. Thus, the work of research is purely a creative one using the process of induction, deduction, and retroduction.

In the past, because of the increasing rate in qualitative research studies, various fields especially in the social sciences field, special attention and at the same time, a concern was raised about its central issues such as the importance of an innate theory within the study that is

being conducted (Tavallaei, & Talib, 2010). As it is well-known, a researcher uses a qualitative method of research when a study needs to be grasped in a detailed yet complex way. In this method of study, the researcher makes every effort to understand the participant's context and settings that are related to the phenomenon. Interestingly, qualitative work will be designed when there is an inadequate theory that exists through which a new theory can be developed by the researcher (p. 570).

There is an enormous difference between receiving knowledge from an expert versus making it on our own. As we know, a lecture from an expert can deliver content to a group of people at once. A textbook in print along with a lecture is even more advantageous than just a lecture alone. Though this is one way to impart an expert's knowledge to a group of learners by delivering content in a short period, like any learning model it has its limitations (Ellet, 2007 p. 7). According to Ellet, the lecture model is good at transferring information, however, it has severe delimitations when it comes to encouraging listeners to think about content and apply it. This means concepts that are meant to be applied need opportunities to put it in realism.

Mariene Sinclair compares a theoretical framework to a map or a travel plan. She says, "when planning a trip to an unfamiliar country, people seek as much knowledge as possible about the best way to travel, using previous experience and the accounts of others who have been on similar trips." (2007, p. 39) A travel plan includes survival advice and top tips enabling the traveler to ascertain the abilities, expectations, and equipment that may help to finish their journey pleasingly (2007). Same way, the theoretical framework takes a researcher for a journey giving him/her the desired advises and tips to an adventure that is challenging yet sustainable and reaches the final Safehaven exultantly. Considering the theories that are underpinning the knowledge base of a phenomenon is the first step in all the research adventures (Sinclair, 2007).

Thereafter, the researcher will address underlying questions and by doing so, he or she can start building a theoretical framework in a loosely structured manner. Such a loosely structured theoretical framework will provide much-needed guidance to the researcher to carry-on with his/her project. The questions can include as below (2007, p. 39).

- What do I know about the subject matter that I want to study?
- What sort of empirical, non-empirical tacit, moral, ethical intuitive knowledge are available for me to conduct this study?
- What theory will guide me throughout my research adventure?
- Is this theory been proved before through specific theory-linked study/s?
- What other theories can be applied for this study?
- For this specific research, how can I apply these theories and findings in practice?

By considering the questions and, reviewing the appropriate literature, Sinclair believes that a researcher can build a meaningful, yet artistically pleasing and methodically sound conceptual framework for the study being conducted (2007). In the end, the framework must possess a clear practical outcome that will become his/her findings on the phenomena and its ability to display as a knowledge that is newly instituted.

### **Identification of a phenomenon and development of a hypothesis**

While contemplating to embark on the dissertation project, the researcher, had some initial thoughts based on his years of experience in the maritime industry and its influence on the world economy and trade. Further, he had a specific interest in crude oil transportation and risks thereof surrounding its operations, geopolitical issues, legal framework and consequences for non-compliance, trade routes and its specific yet hidden dangers, and so on.

When the thought was yet in its infancy stage, the researcher conducted a preliminary examination into this precise sector of the maritime industry and to his surprise, the quantity of literature and the abundance of information related to the sector was enormous and overwhelming. So, the researcher's intuition gave him the uncontested truth that this specific sector is as vast as the maritime industry itself. Undertaking a project covering the entire crude oil transportation industry in the world and studying the risks with it; is impossible. Besides, based on the enormity of literature and information available, it was not an easy mission to bring a specific theory in other words, creating a theoretical and conceptual framework for this massive area of study will be a traumatic task.

By giving further thoughts into this subject matter, the researcher understood that the growth of the Chinese economy in recent years and China's endeavor to become the number one economic force in the world found to be an interesting fact. Quarrying deeper into this matter, the researcher also found that the living standard of China's citizenry is also improving along with their economic status. Also, there was an interesting phenomenon that was emitting with all these signs of progress in China, the researcher through scanning some of the literature, found that there is a close relationship between economic growth and energy demand. Besides, an interesting aspect was noticed that China was not self-sufficient in domestic energy supply and was highly dependent on oil imports and sourced it from the Middle East/Africa to meet its domestic demand. These oil imports were highly dependent on the sea carriage using tanker ships. This high demand had deployed a high number of tanker ships of various sizes and tonnage capacities including VLCCs/ULCCs into this trade route.

Based on the conclusions drawn from kinds of literature reviewed on this subject, the theoretical framework is nothing, but a logically structured representation of the concepts,

variables, and relationships involved in a study with the purpose to identify what will be explored, examined, measured, or described. To this end, there are few concepts, factors, and corresponding variables (intermediate or dependent) that would give a theoretical structure to lead my study to its completion.

Two primary concepts are proven through the literature review (US crude oil import reduction and Chinese energy demand) that lead to the second concept (i.e. an intermediary variable) which forced the country of China to take the energy demand as a national energy security matter. There is one “factor” which I believe has influenced the energy security matter and steps taken by the Chinese government which is the domestic economic growth and subsequent financial status followed by the living standards' improvement of its people. Concept 3, the intermediary variable made the government seek crude oil from internationally from the Middle East and Africa to China.

On the other hand, the US Imports reduced for various reasons, and the tanker shipowners, taking the advantage of Chinese prosperity and demand for oil deployed their ships into the Middle East and Africa to the China Route. This shift has had increased risk to the exiting risks from that of the traditional route (Middle East to the US). Three major dependent variables are supporting this concept of increased risk. Firstly, general maritime risks (piracy, congested canals and straits, the possibility of terrorism, collisions, and maritime disasters, etc.). Secondly, the Geopolitical issues (territorial claim issues in southeast Asia, China Sea, military presence primarily the US, etc.). Lastly, the regulatory environment and related risks (IMO safety regulations, COGSA, UNCLOS, other local national and international legal framework and compliance, etc.). The researcher was confident that by exploring these theoretical concepts/frameworks, he could copiously identify the existing and new risks contemporary to

this trade route. Below figure 4 (flow chart) shows how the theoretical/conceptual framework is constructed for this study and following it will assist the researcher to finalize this qualitative research project.

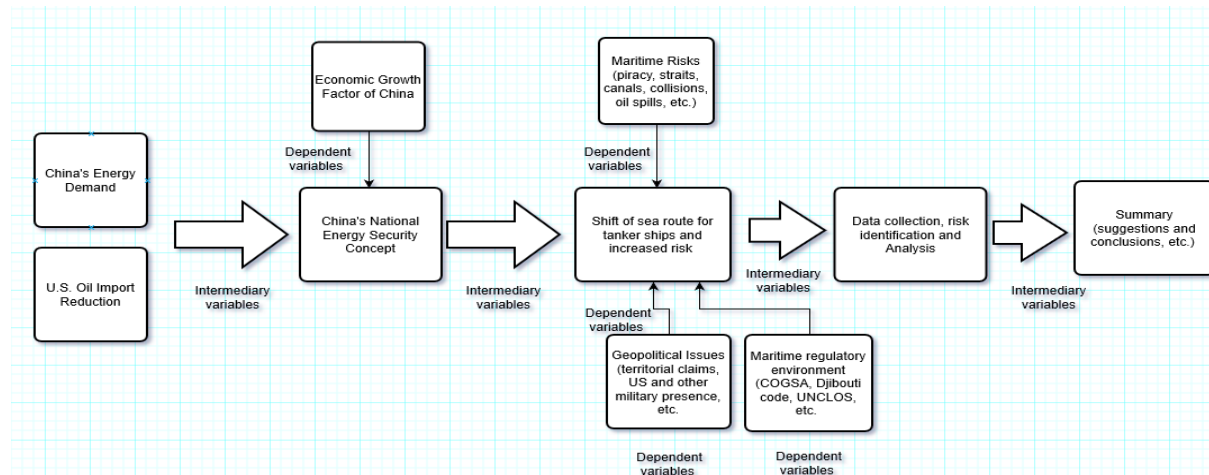


Figure 4 Theoretical Concepts / Framework

## Summary

As delineated in this chapter, the US became the leader in exploration, production, importing, and refining the crude oil since the end of World War II. Its economic status and technological knowhow had a direct impact on this process. The discovery of fossil fuel in the Middle Eastern countries permitted the US to use its leadership in the process of exploration, production, and carriage of crude oil to its refineries in the US-Gulf Coast. The US navy in cooperation with its European allies had given protection to crude oil carriers concerning ship and cargo safety along the sea route from the Middle East to the US. As it is seen, it is obvious that there is a reduction in crude oil imports by the US in recent years. This is due to various changes in domestic and international policies regarding foreign oil dependency. Also, the US successfully initiated and explored fossil fuel domestically and now it became the number one net exporter of energy in the world.



On the other hand, the growth in the Chinese economy increased the demand for energy domestically. The amount of energy produced (supply) domestically in China was not sufficient to meet the real requirement (demand) for its day-to-day operations. Thus, China had no option but to rely on crude oil imports from the Middle East and Africa to meet its domestic demand. This crude oil import decision by the Chinese relied heavily on oceangoing tanker ships. Alternatively, taking this immense opportunity, the shipowners deployed more and more tanker ships of various sizes in this route to increase their participation in the crude oil carriage.

While planning a research project, the researcher needs to understand and develop an idea of the research topic in their mind. It is equally important to have a research design that matches the questions that are being asked and the topic that is addressed (Eriksson & Kovalainen, 2014). Research planning includes many decisions ranging from the selection of the topic itself for the research, determining the work plan, designing a preliminary/conceptual framework, and analyzing the data.

In this study, the researcher chose the Likert-style questionnaires as a method used to collect the data for analysis. Due to the international nature of this industry and the difficulty to get experts for face-to-face discussions (interviews), the Likert -scale questionnaires were the best option for data collection for this study. Moreover, a mixed-method research design was chosen to allow for a wider breadth of data to be collected.

The maritime industry has many risks that can affect shipping economics and operations. This study is expected to enlighten on major risks such as operational, navigational, human errors, and its consequences, and the effects of decision-making in crude oil transportation by sea. The target addresses to this research paper are the tanker owners, exporters, or traders in the Middle East and Africa, and importers of crude oil in China. Besides, per the researcher's

understanding, there was no study conducted specifically addressing this subject in the past.

Hence, the researcher is expecting to bring this new information as a contribution to the body of knowledge.

## CHAPTER 4: FINDINGS

### **The operational risks affecting tanker ships**

Waterborne transport is considered to be one of the cheapest and most competitive ways of transporting goods. Though the movement takes longer, it is still the preferred mode of transport utilized by traders to move cargoes in volumes or bulk. However, the transport of bulk commodities, such as crude oil has come under attack for unacceptable safety and environmental performance. Due to the low cost of transportation, shipping has a relatively low standard of safety (Kristiansen, 2013).

When it comes to safety and operational risks, it is the shipowner's and cargo owner's responsibility to ensure safety. The cargo owner has been given considerable authority to instruct the master of the ship concerning the operation of the vessel (Kristiansen, 2013). This is significant where all parties involved are recognizing the fact that safety is usually compromised at the operational aspects of ships specifically, in this case, the crude oil carriers. Considering the importance of operational risks and its relation to the safety of ships and crew, this hypothesis became the primary point of investigation for the researcher:

**Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf/Africa to China voyages.**

***Statement 1: There are many new and existing operational risk factors present in the Middle East and Africa to China voyages affecting tanker ships.***

To the above statement, there were 29 responses received. One respondent strongly disagreed with this statement and also one respondent disagreed with this statement. There were 14 responses to the scale neither agree nor disagree and 11 agreed and 2 strongly agreed to the statement. Therefore, 3 percent of the 29 responses were strongly disagreed, 3 percent disagreed, 48 percent neither agreed or disagreed with the statement, 38 percent agreed, and 7 percent strongly agreed to this statement (Figure 5).

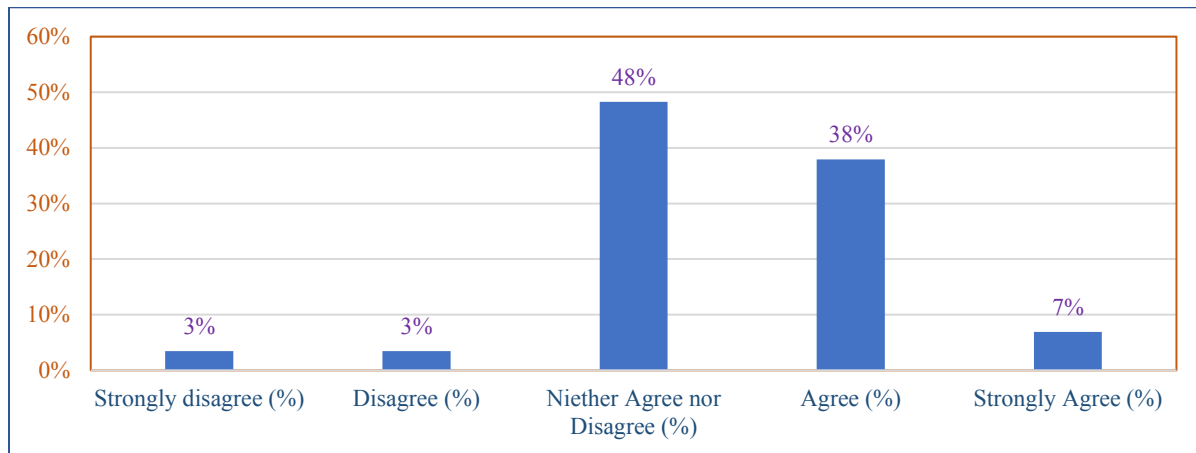


Figure 5. Statement 1 of Hypothesis 1 Many risks are present

***Statement 2: Operational risks are equally distributed among the origin, destination ports and during the voyage at sea.***

To this statement, there were 30 responses. The response to scales such as strongly disagree was 2 and 7 for the scale disagree. There were 9 responses to the scale neither agree nor disagree and 9 agreed and 3 strongly agreed to the statement. Therefore, 7 percent of the 30 responses were strongly disagreed, 23 percent disagreed, 30 percent neither agreed nor disagreed with the statement, 30 percent agreed, and 10 percent strongly agreed to this statement (Figure 6).

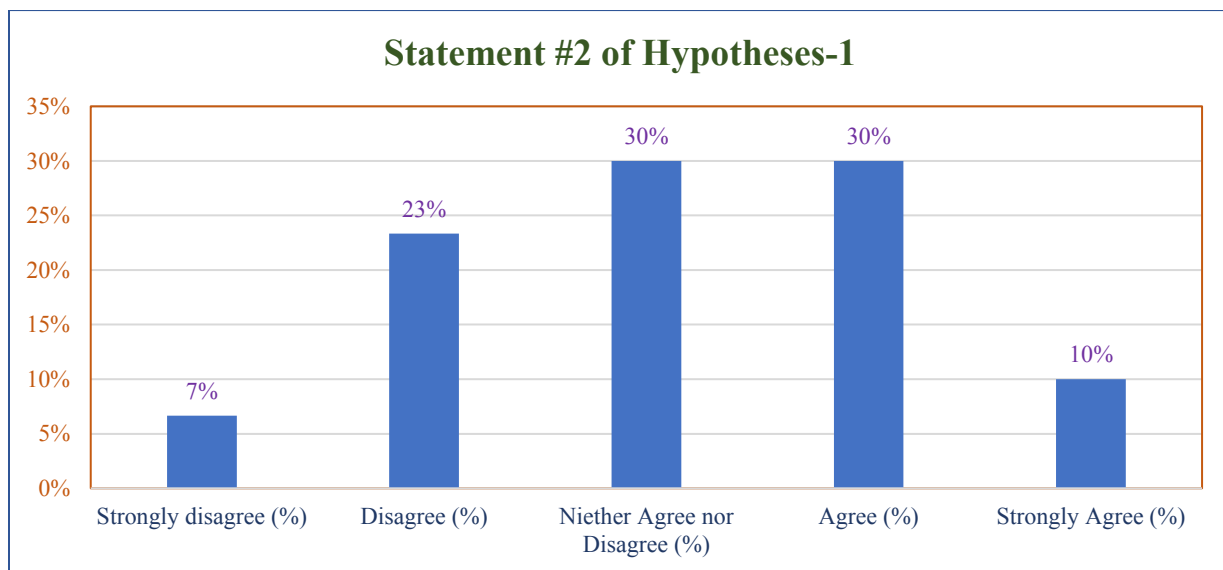


Figure 6. Statement 2 of Hypothesis 1 Operational risks are present at ports and while at sea

***Statement 3: Mistakes in operational activities is a high-risk area in international crude oil transportation by sea between the Middle East and Africa and China***

To this statement, there were 30 responses. The response to scales such as strongly disagree and disagree are zero respectively. There were 5 responses to the scale neither agree nor disagree, 20 agreed and 5 strongly agreed to the statement. Therefore, 17 percent neither agreed nor disagreed with the statement, 67 percent agreed, and 17 percent strongly agreed to this statement (Figure 7).

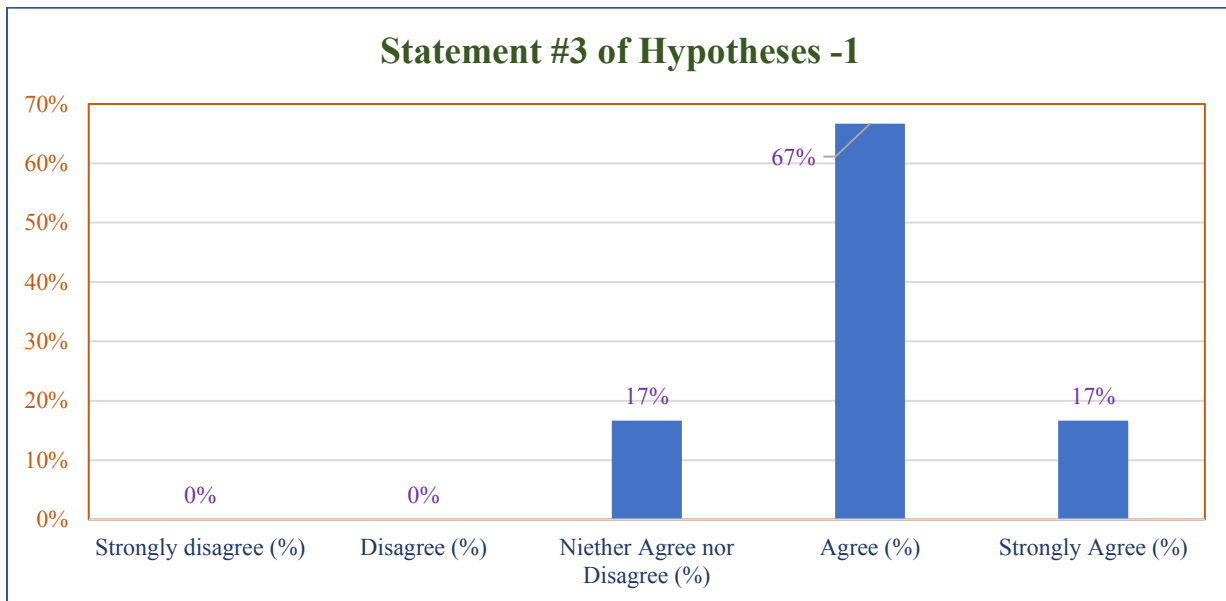


Figure 7. Statement 3 of Hypothesis 1 Mistakes in operational activities is a high-risk

**Statement 4: It is important to identify and analyze key operational risk factors by the crude oil tanker operators to avoid maritime disasters while engaging in crude oil transportation between the Middle East and Africa and China.**

To this statement, there were 30 responses. The response to scales such as strongly disagree was 1 and disagree is zero. There were 4 responses to the scale neither agree nor disagree and 6 agreed and 1 strongly agreed to the statement. Therefore, 3 percent of the 30 responses were strongly disagreed, 13 percent neither agreed nor disagreed with the statement, 20 percent agreed, and 63 percent strongly agreed to this statement (Figure 8).

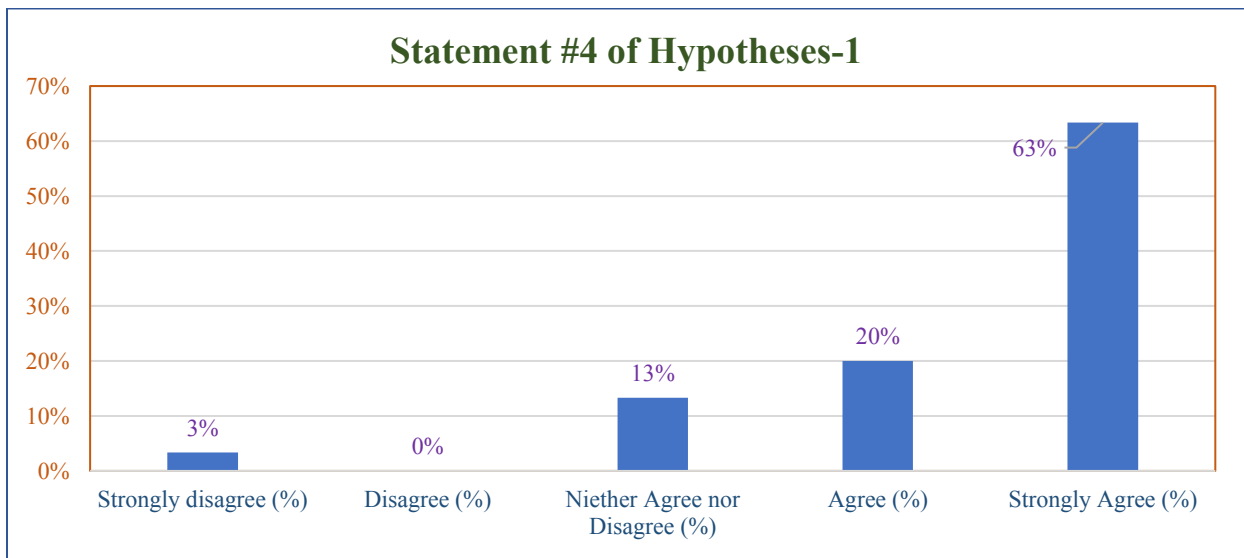


Figure 8. Statement 4 of Hypothesis 1 Identify and analyze operational risk factors

***Statement 5: Failure to identify and eliminate operational risk factors has a potential impact on the profit maximization of tanker shipping companies operating between the Middle East /Africa and China route.***

To this statement, there were 30 responses as well. The response to scales such as strongly disagree was 1 and disagree was zero. There were 4 responses to the scale neither agree nor disagree and 8 agreed and 17 strongly agreed to the statement. Therefore, 3 percent of the 30 responses were strongly disagreed, 13 percent neither agreed nor disagreed with the statement, 27 percent agreed, and 57 percent strongly agreed to this statement (Figure 9).

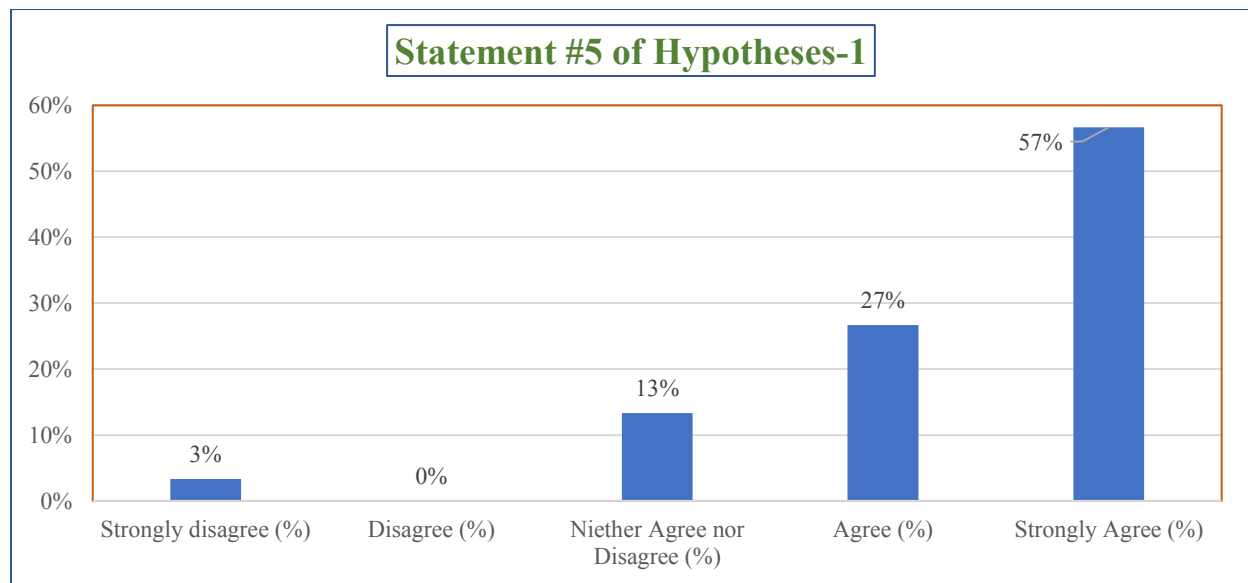


Figure 9. Statement 5 of Hypothesis 1 Operational risks impacts profit maximization



### **Automatic Navigation and GPS and its significance in navigation**

As the world's commercial trade continues to grow, China has become the world's factory producing all sorts of General Department Store Merchandises (GDSM) and other industrial products. This demand for Chinese products in the Western Hemisphere and within Asia has put pressure on shipowners to deploy ships. The researcher's extensive experience with the world's major container shipowners gives firsthand information that ships with more than 20,000 Twenty Equivalent Unit (TEUs) have been deployed in the US, Europe, and Intra-Asia trades to meet the demand. Chokepoints such as canals and straits, like the Malacca Strait, have become more congested and prone to maritime accidents.

The researcher's discussions with maritime experts such as Christopher Desa and Captain Mohan Muppidi, the Malacca Strait is getting congested. In some areas, draft (depth of water) is also a concern and bigger ships have to wait for high-tide to assure safe passage. Also, piracy attacks on ships are an issue. The researcher felt having modern navigational equipment such as a global positioning system (GPS) and other navigational apparatus may ensure safety.

**Analysis of Hypothesis 2: Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.**

**Statement 1: Commercial trade route to and from Asia has significantly increased and chokepoints such as straits and canals in the sea-route are getting more and more congested.**

To this statement, there were 30 responses. The response to scales such as strongly disagree and disagree is zero. There were 11 responses to the scale neither agree nor disagree (37%) and 17 (57%) agreed and 2 (7%) strongly agreed to the statement (Figure 10).

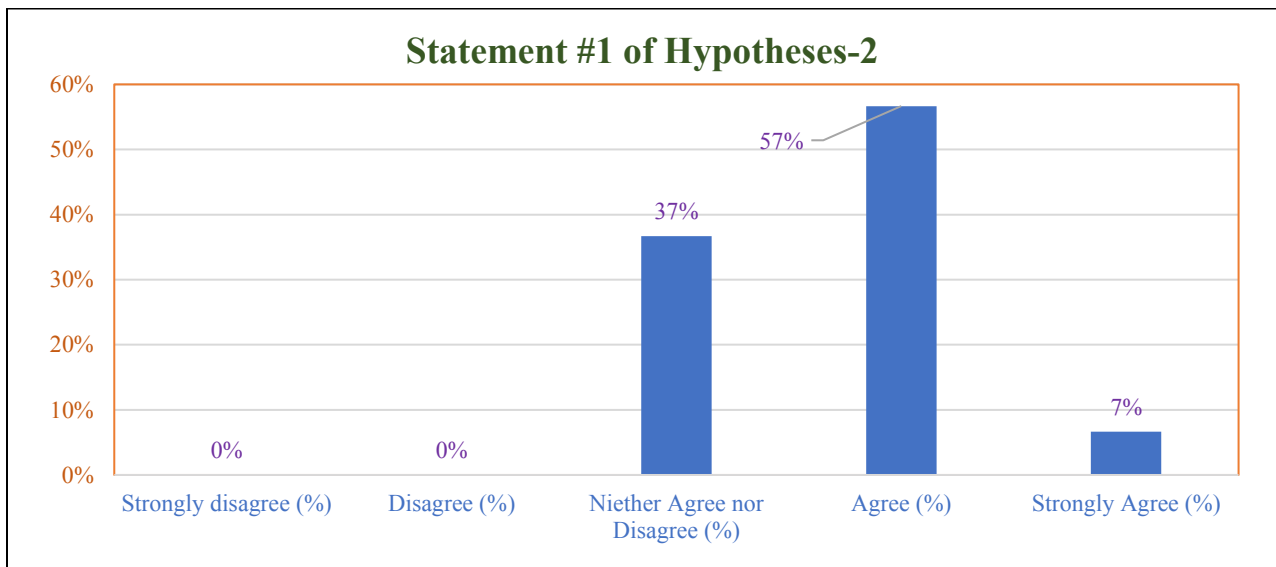


Figure 10. Statement 1 of Hypothesis 2 Straits and canals are congested in the China route

***Statement 2: Strait of Malacca, in particular, is becoming highly vulnerable to congestion and prone to accidents due to the high-volume of sea traffic.***

To this statement, there were 30 responses. Again, the responses to scales such as strongly disagree and disagree was zero. There were 12 responses to the scale neither agree nor disagree and 17 agreed and 1 strongly agreed to the statement. Therefore, 40 percent neither agreed nor disagreed with the statement, 57 percent agreed, and 3 percent strongly agreed to this statement (Figure 11).

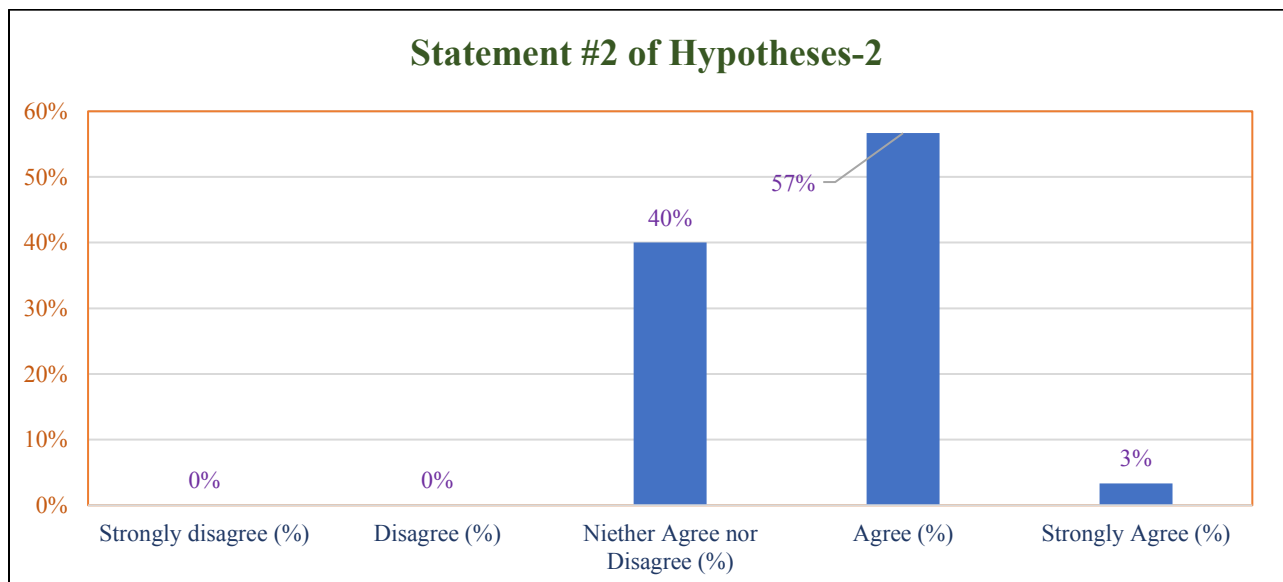


Figure 11. Statement 2 of Hypothesis 2 Malacca Strait is vulnerable and prone to accidents

**Statement 3: China’s oil security is highly dependent on crude oil ships and their safe passage through Malacca Strait.**

To this statement, there were 30 responses. The response to scales such as strongly disagree was zero and disagree is 2. There were 9 responses to the scale neither agree nor disagree and 13 agreed and 6 strongly agreed to the statement. Therefore, 7 percent disagreed, 30 percent neither agreed nor disagreed with the statement, 43 percent agreed, and 20 percent strongly agreed to this statement (Figure 12).

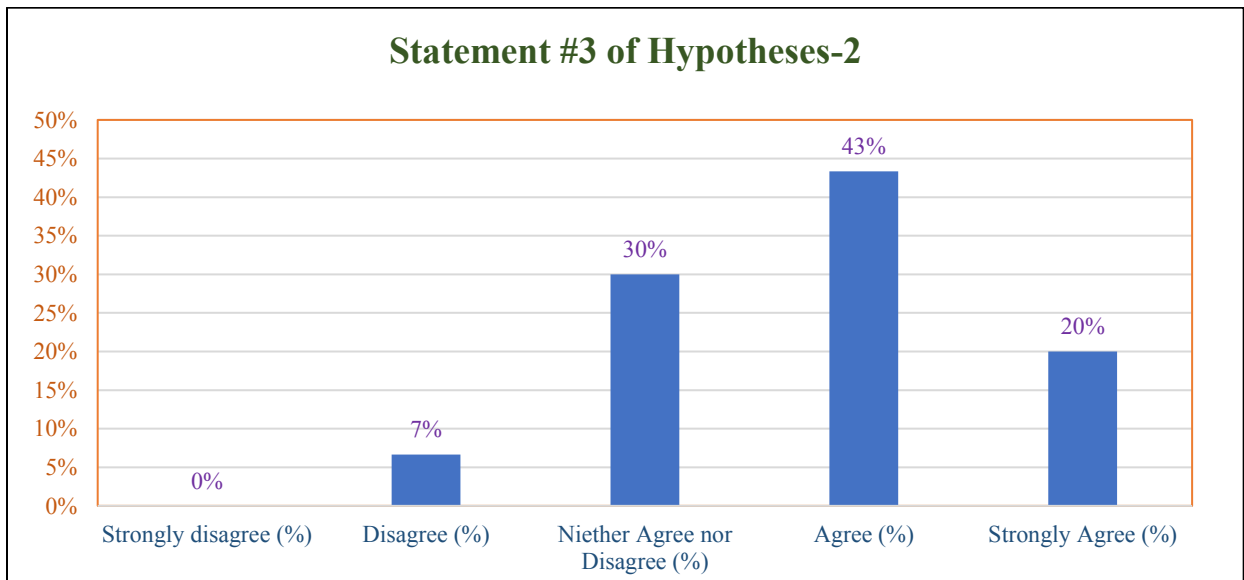


Figure 12. Statement 3 of Hypothesis 2 China’s oil security is tanker safety at Malacca strait

**Statement 4: Modern navigational aids are crucial for the safety of ships, it's cargo and crewmembers while passing through the Strait of Malacca.**

To this statement, there were 30 responses. Response to scales such as strongly disagree was zero and disagree was zero as well. There was 1 response to the scale neither agree nor disagree and 17 agreed and 11 strongly agreed to the statement. Therefore, 3 percent disagreed, 3 percent neither agreed nor disagreed, 57 percent agreed, and 37 percent strongly agreed to this statement (Figure 13).

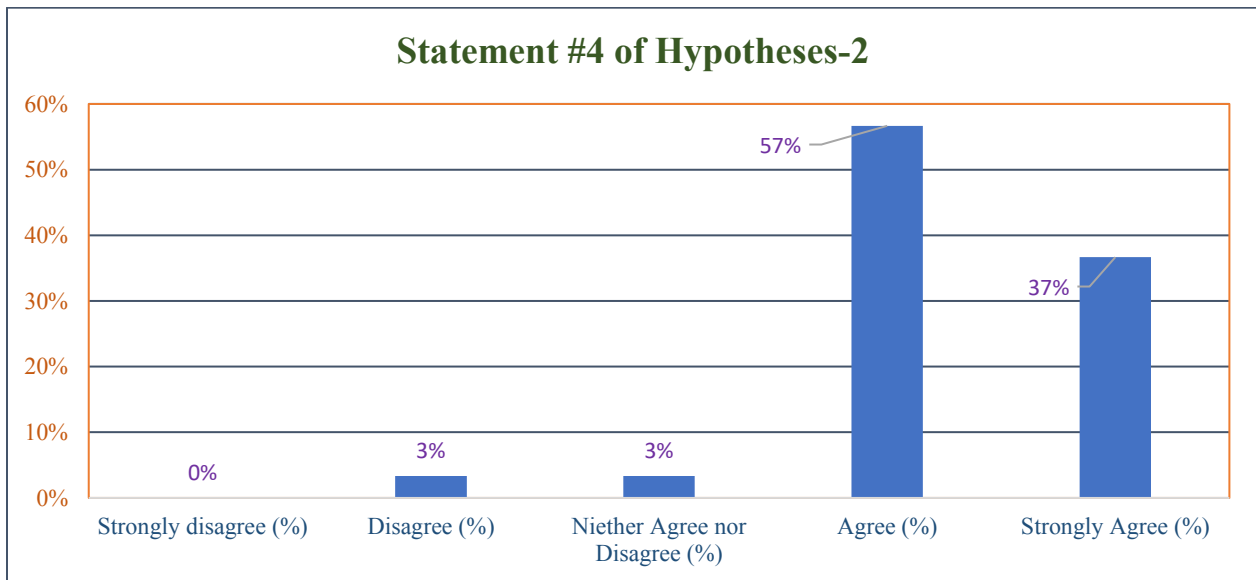


Figure 13. Statement 4 of Hypothesis 2 Technology does provide ship safety at Malacca Strait

***Statement 5: Implementation of modern navigational aids such as automatic navigation and positioning systems significantly reduce the likelihood of accidents on tanker voyages through Malacca Strait.***

To this statement, there were 30 responses. The response to scales such as strongly disagree and disagree is zero. There were 5 responses to the scale neither agree nor disagree and 16 agreed and 9 strongly agreed to the statement. Therefore, 17 percent neither agreed or disagreed with the statement, 53 percent agreed, and 30 percent strongly agreed to this statement (Figure 14).

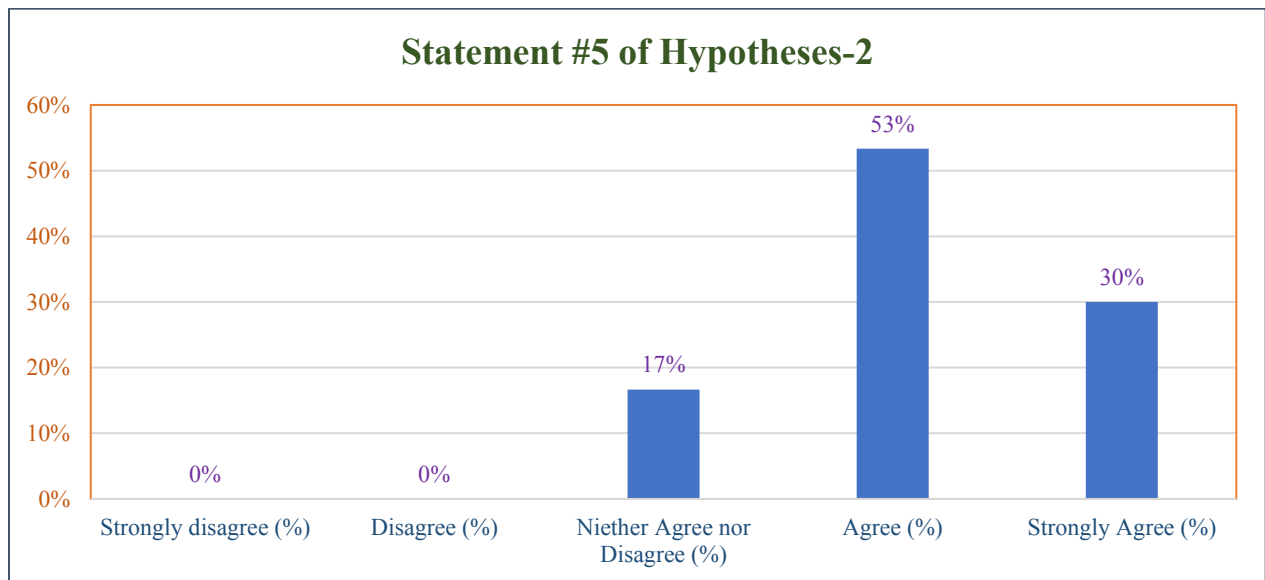


Figure 14. Statement 5 of Hypothesis 2 Technology aids safe passage through Malacca Strait

### **Elimination of human error through quality training**

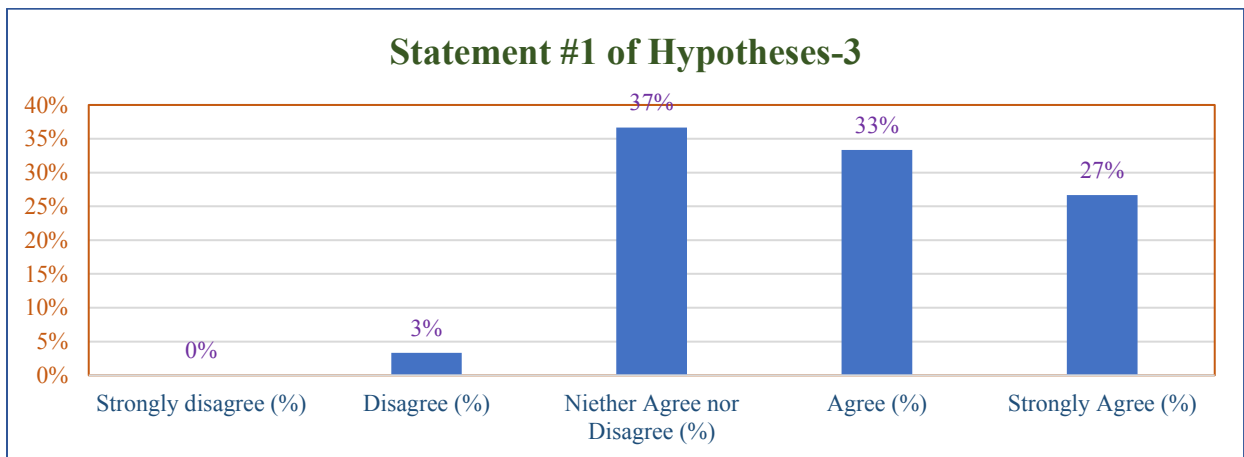
There is a correlation between the human factor and operational risks (Hassler, 2011). Marine governance of oil transportation is becoming more and more complex due to difficulties in monitoring the written procedures effectively and failure to follow the established regulations (Hassler, 2011). Also, there is a high level of complexity in identifying the cause of the oil spill during loading and discharge operation or major crude oil pollution caused on the highseas due to an accident. However, experts such as Captain Desa advised that about 90 percent of the time, oil spills are caused by irrational human errors. Authors such as Hassler argue that the working conditions and stricter regulations on the ship as well as on the shore would dramatically increase safety (2011).

There are three types of incidents that lead to oil-related accidents, including oil leakage, overflow, and oil spill (Roszkowska & Sarnecka, 2018). All such incidents can be prevented through quality training and strictly implementing the current written regulations. Thus, the researcher noticed that a high level of quality training is required to reduce risks.

**Hypothesis 3: Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.**

***Statement 1: The Maritime oil pollution from crude oil trade is both universal and regional. Regionally, in the Middle East and Africa or China, errors during load and discharge operations could result in significant marine pollution.***

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree is 1. There were 11 responses to the scale neither agree nor disagree and 10 agreed and 8 strongly agreed to the statement. Therefore, 3 percent disagreed, 37 percent neither agreed nor disagreed with the statement, 33 percent agreed, and 27 percent strongly agreed to this statement (Figure 15).



*Figure 15. Statement 1 of Hypothesis 3 Errors during crude oil load/discharge operation results in marine pollution*



**Statement 2: Oil spills during load/discharge operations are caused by human errors in the Middle East and Africa to China crude oil trade.**

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree was 1. There were 13 responses to the scale neither agree nor disagree and 14 agreed and 2 strongly agreed to the statement. Therefore, 3 percent disagreed, 43 percent neither agreed nor disagreed with the statement; 47 percent agreed, and 7 percent strongly agreed to this statement (Figure 16).

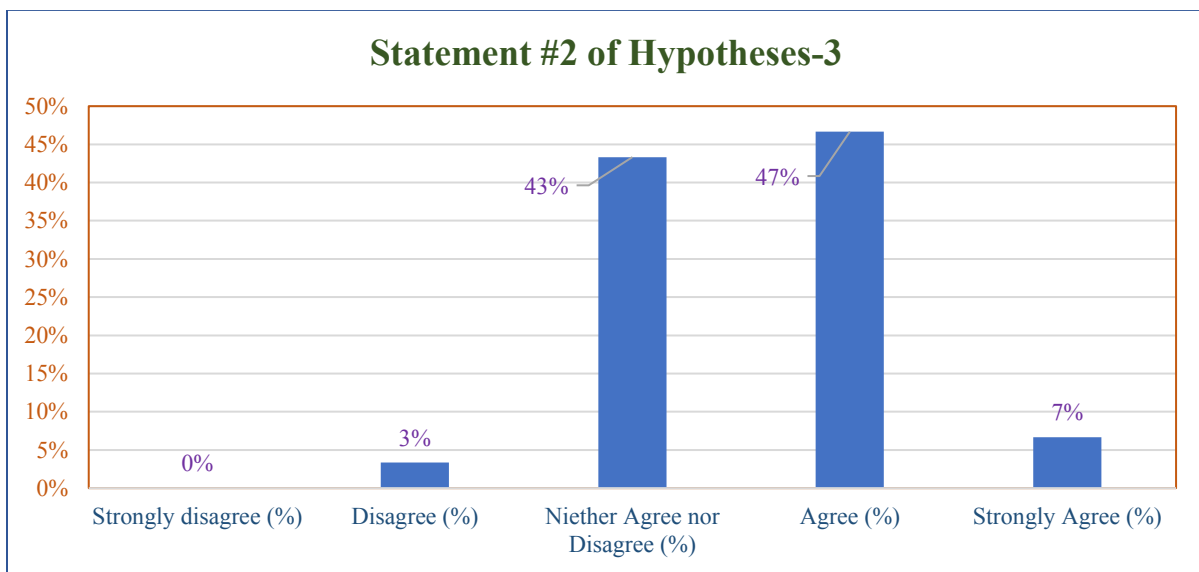


Figure 16. Statement 2 of Hypothesis 3 Human error causes oil spills during crude oil loading and discharge operation

***Statement 3: Human errors during port operations and subsequent oil spills, damage to personnel and property could result in a significant financial loss to shipowners.***

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree and disagree was zero. There were 8 responses to the scale neither agree nor disagree and 15 agreed and 7 strongly agreed to the statement. Therefore, 27 percent neither agreed nor disagreed with the statement, 50 percent agreed, and 23 percent strongly agreed to this statement (Figure 17).

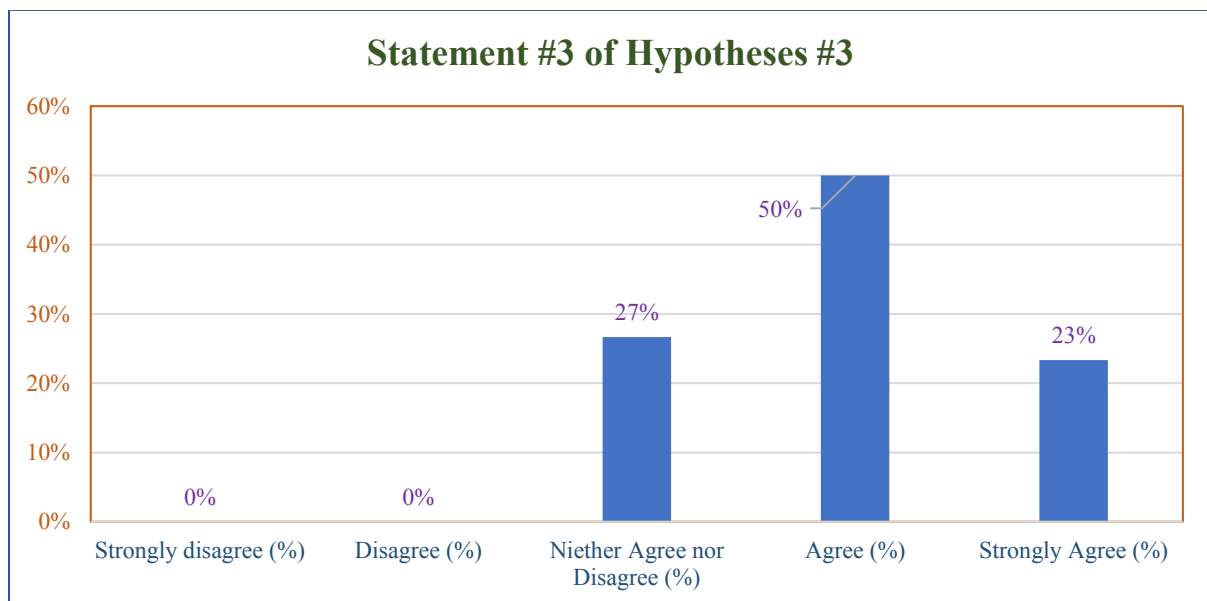


Figure 17. Statement 3 of Hypothesis 3 Human errors bring financial losses to shipowners

**Statement 4: Human errors at the load and discharge port in the Middle East and Africa and China are directly related to lack of employee training.**

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree is 3. There were 11 responses to the scale neither agree nor disagree and 12 agreed and 4 strongly agreed to the statement. Therefore, 10 percent disagreed, 37 percent neither agreed nor disagreed with the statement, 40 percent agreed, and 13 percent strongly agreed to this statement (Figure 18).

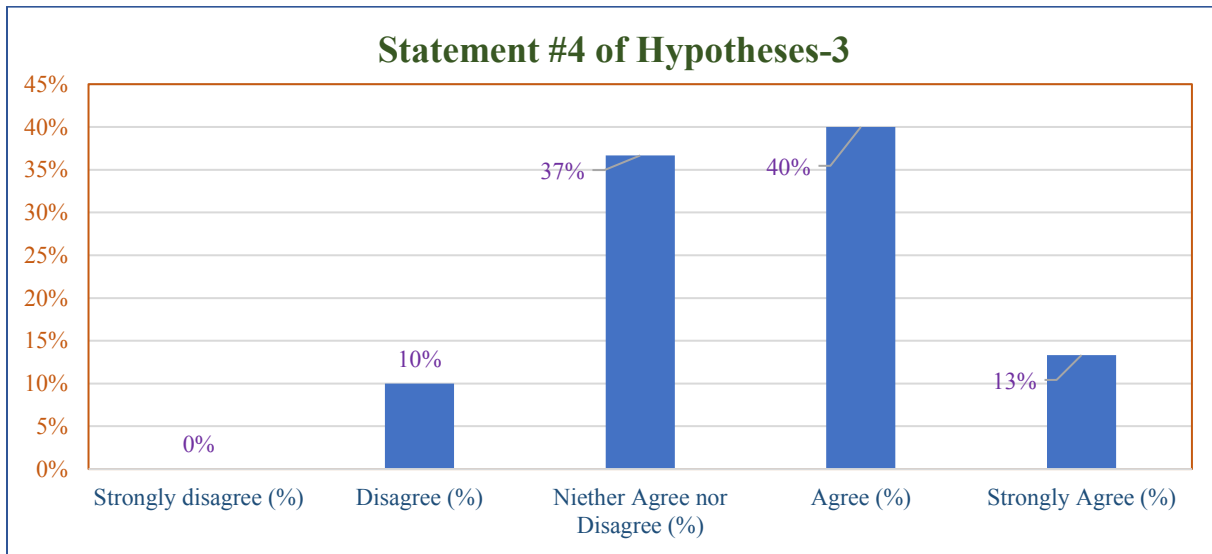


Figure 18. Scale for statement 4 of Hypothesis 3 Lack of employee training leads to human errors at load/discharge ports

***Statement 5: High level of training significantly reduces the risk of human errors at loading and discharging ports in the Middle East and Africa and China.***

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree and disagree is zero. There were 3 responses to the scale neither agree nor disagree and 17 agreed and 10 strongly agreed to the statement. Therefore, 10 percent neither agreed nor disagreed with the statement, 57 percent agreed, and 33 percent strongly agreed to this statement (Figure 18).

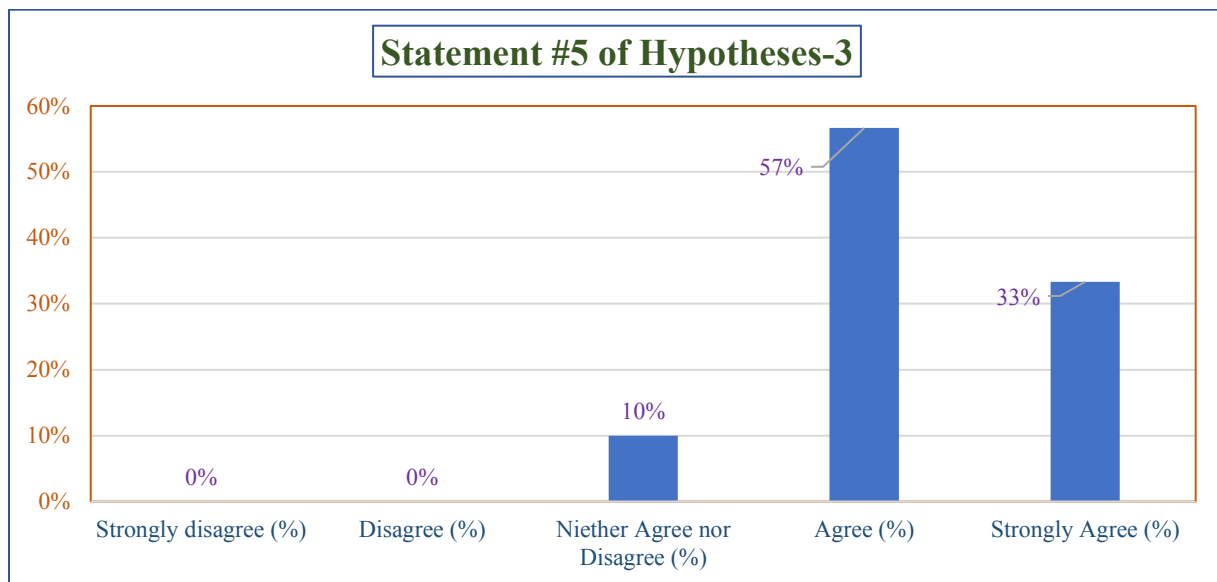


Figure 18. Statement 5 of Hypothesis 3 High level of training reduces human errors

### **Importance of Decision-making in crude oil transportation**

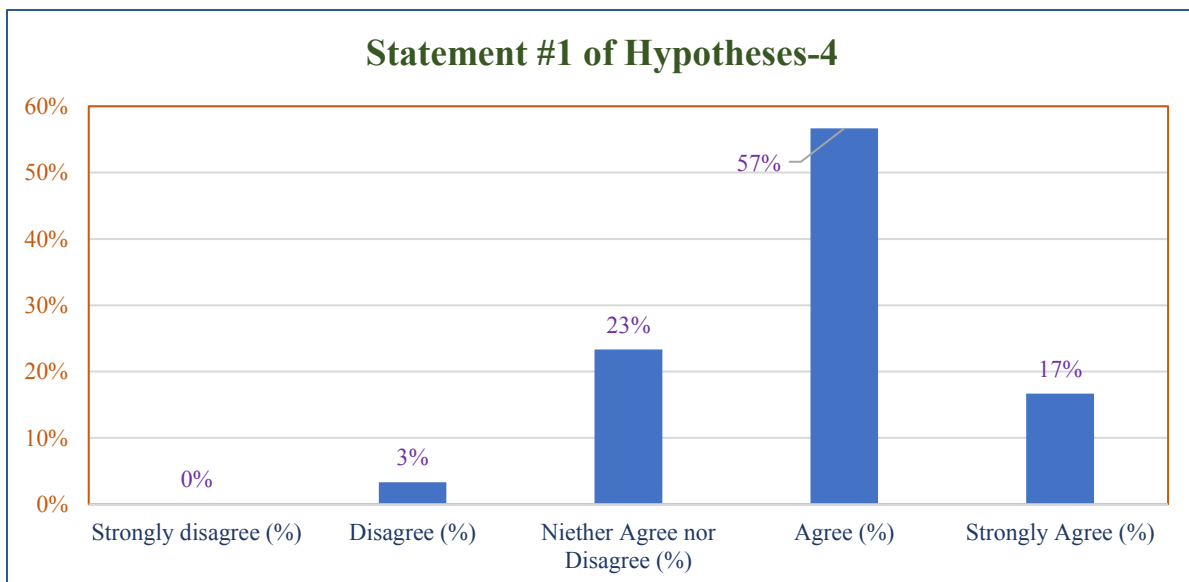
Communication and coordination between the decision-makers at shipping organizations are of high importance. Shipowners make key decisions that have a profound impact on safety. Besides, the majority of the risks can be avoided if the decision-makers work in unison. Communication among the decision-makers (e.g., shipowners, shoreside managers, and seagoing officers) is crucially important. The researcher also felt the importance of mutual agreements on

decisions related to safety rather than the top-level management finalizing on a decision resulting in a top-down approach. Also, the implementation of those decisions is equally important.

**Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.**

***Statement 1: Communication among decision-makers at shipping enterprises plays a crucial role in the efficient and safe transport of crude oil between the Middle East and Africa and China.***

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree was 1. There were 7 responses to the scale neither agree nor disagree and 17 agreed and 5 strongly agreed to the statement. Therefore, 3 percent disagreed, 23 percent neither agreed nor disagreed with the statement, 57 percent agreed, and 17 percent strongly agreed to this statement (Figure 19).



*Figure 19. Statement 1 of Hypothesis 4 Communication amongst decision-makers is key to the efficient and safe transportation of crude oil*

***Statement 2: Shipowners, shoreside managers, and seagoing officers are part of the decision-making process at the shipping companies engaged in the sea-transport of crude oil from the Middle East and Africa to China.***

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree is 2. There were 8 responses to the scale neither agree nor disagree and 13 agreed and 7 strongly agreed to the statement. Therefore, 7 percent disagreed, 27 percent neither agreed nor disagreed with the statement, 43 percent agreed, and 23 percent strongly agreed to this statement (Figure 20).

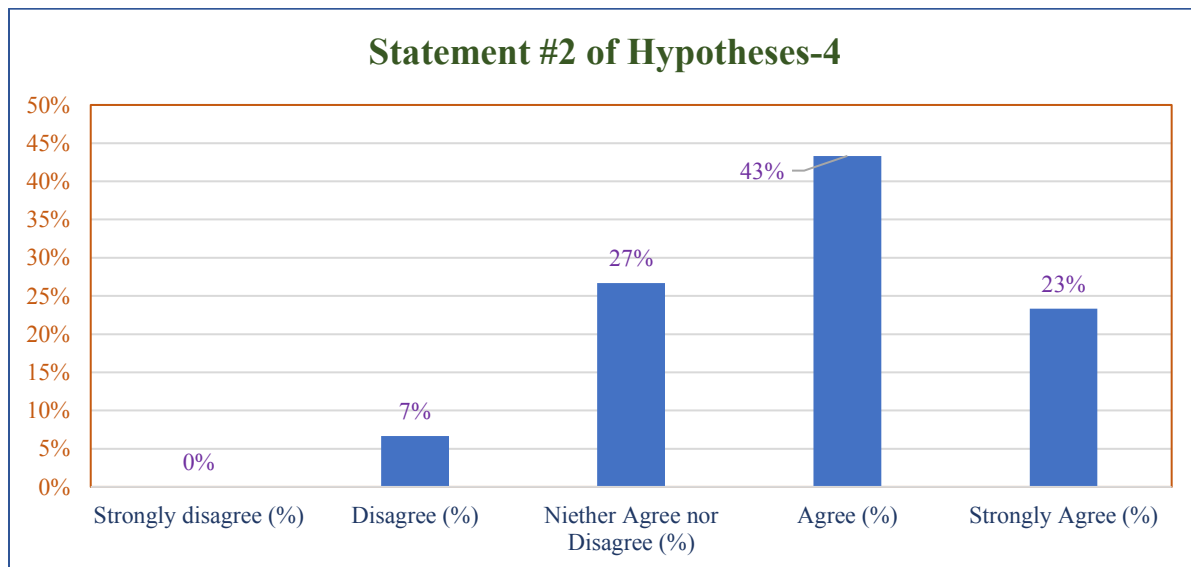


Figure 20. Statement 2 of Hypothesis 4 Owners, managers, and seagoing officers are part of the decision-making process

**Statement 3: To ensure the efficiency and safety of crude oil transportation between the Middle East and Africa to China, decision-makers should mutually agree upon adequate steps.**

To this statement, there were a total of 30 responses. The response to scales such as strongly disagree was zero and disagree is 1. There were 2 responses to the scale neither agree nor disagree and 17 agreed and 10 strongly agreed to the statement. Therefore, 3 percent disagreed, 7 percent neither agreed nor disagreed with the statement, 57 percent agreed, and 33 percent strongly agreed to this statement (Figure 21).

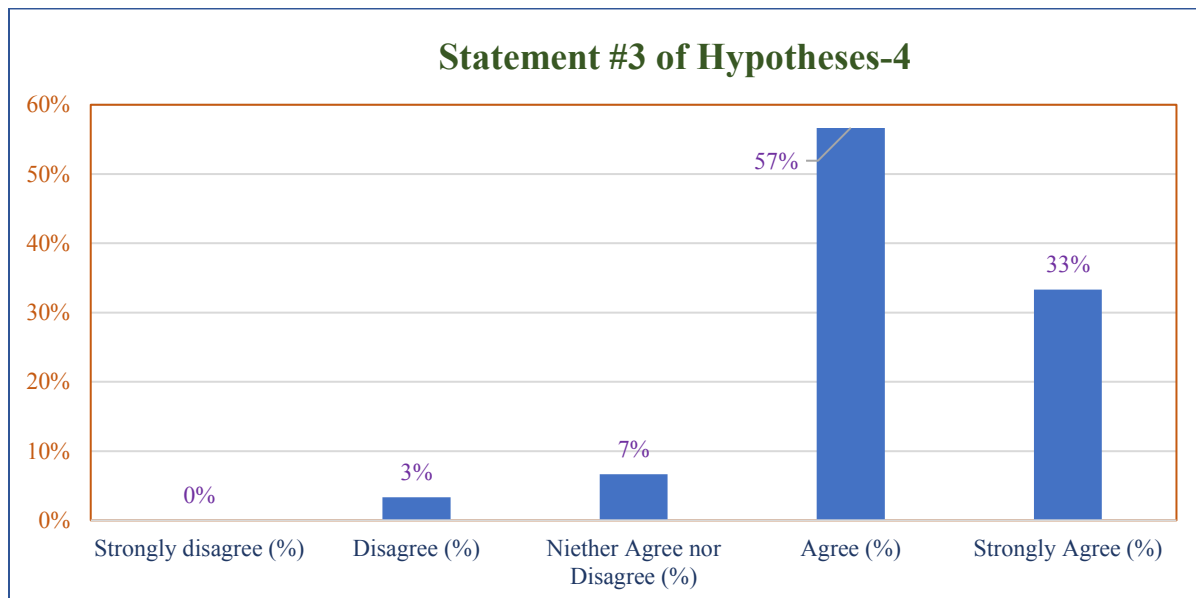


Figure 21. Statement 3 of Hypothesis 4 Decision-makers should mutually agree upon adequate steps to ensure efficiency and safety in crude oil transportation

***Statement 4: It is critical that decisions related to efficiency and safety be communicated to the employees at the operational level for adequate implementation.***

To this statement, there were a total of 30 responses as well. The responses to scales such as strongly disagree and disagree is zero. There were 5 responses to the scale neither agree nor disagree and 14 agreed and 11 strongly agreed to the statement. Therefore, 17 percent neither agreed nor disagreed with the statement, 47 percent agreed, and 37 percent strongly agreed to this statement (Figure 22).

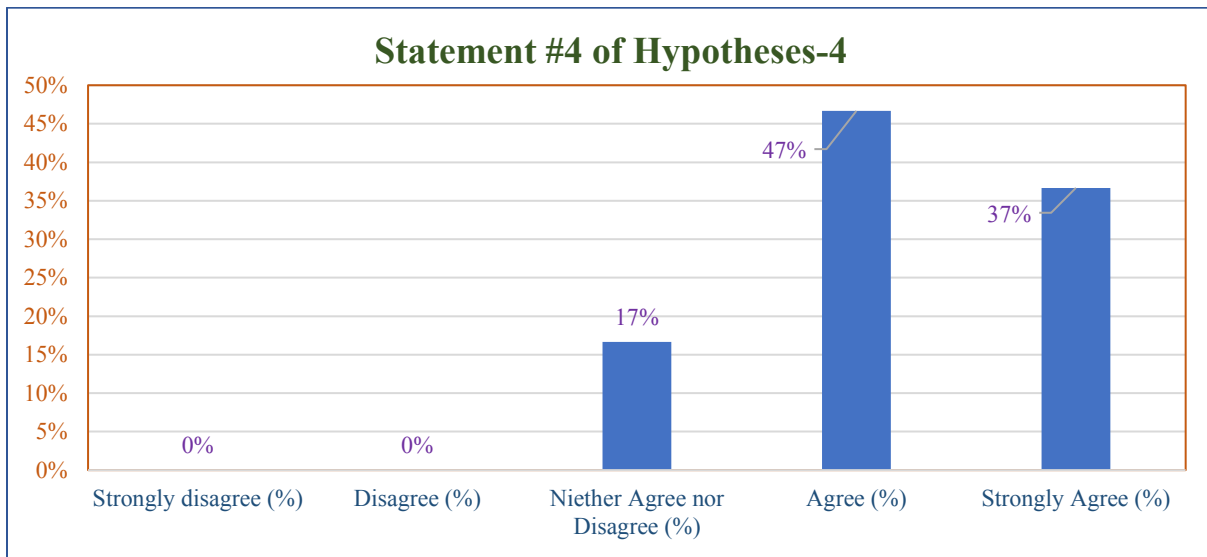


Figure 22. Statement 4 Hypothesis 4 Decisions to be implemented at the operational level



**Statement 5: Currently, shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of crude oil between the Middle East and Africa and China ports.**

To this statement, there were a total of 30 responses. The responses to scales such as strongly disagree were zero and disagree is 2. There were 10 responses to the scale neither agree nor disagree and 12 agreed and 6 strongly agreed to the statement. Therefore, 7 percent disagreed, 33 percent neither agreed nor disagreed with the statement, 40 percent agreed, and 20 percent strongly agreed to this statement (Figure 23).

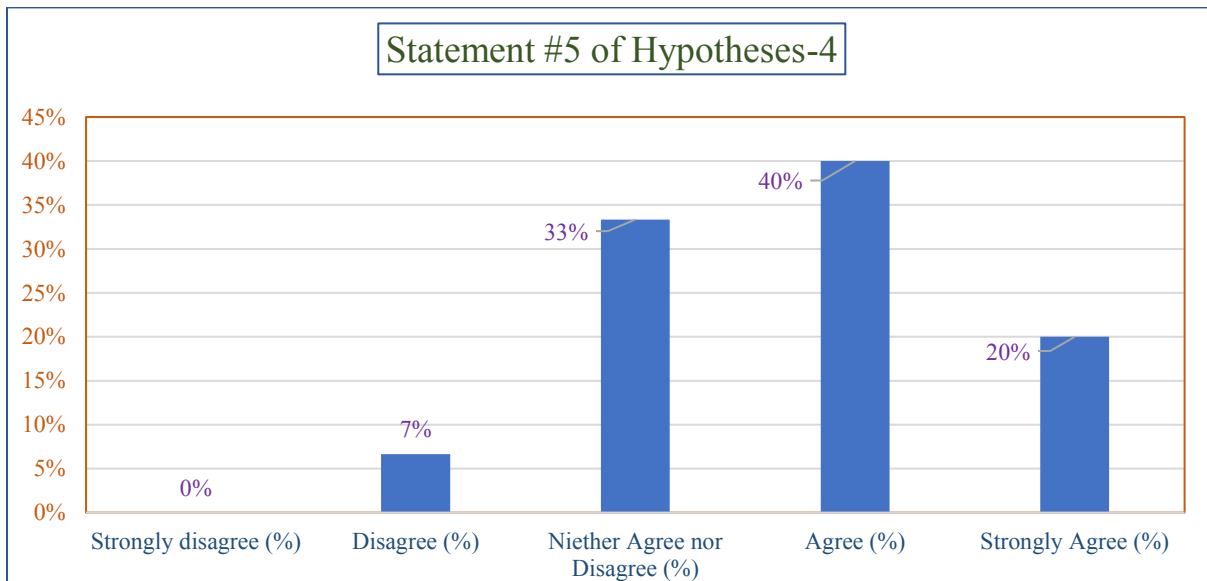


Figure 23. Statement 5 of Hypothesis 4 Bulker companies have adequate coordination among decision-makers for efficiency and safety in crude oil transportation

### The Survey Respondents' Demography Analysis

The survey questionnaires had a demographic page that included five statements. The first question inquired about the participant's area of expertise. The other four statements asked questions to gather information on years of work experience:

1. in the maritime industry (0 to 2 years, 3 to 10 years and 10 years or more);
2. in the Middle-East/Africa to China trade (0 to 2 years, 3 to 10 years and 10 years or more);
3. dealing with the Middle East and Africa (0 to 2 years, 3 to 10 years and 10 years or more); and
4. dealing with China (0 to 2 years, 3 to 10 years, and 10 years or more).

Out of the 30 respondents, the bulk of experience in the maritime industry statement, the respondent's contribution was divided as shown in Table 4. The "none of these" option means they have experience in the industry, but not in the specified fields such as cargo, finance, operations, and shoreside.

Area of experience	Number of participants	Percentage
<b>Cargo</b>	3	10%
<b>Finance</b>	1	3%
<b>Operations</b>	10	33%
<b>Shoreside</b>	11	37%
<b>None of these</b>	5	17%
<b>Total</b>	<b>30</b>	<b>100%</b>

*Table 4. Respondents' experience in the maritime industry*

Table 5 shows the years of experiences of 3 survey participants from the cargo sector with a percentage section. All 3 respondents from the cargo division had experiences from 3 to 10 years in the maritime industry. Two of the respondents had up to 2 years of experience in dealing with trade from the Middle East and Africa to China and one had up to 10 years of experience in dealing with the same trade. As far as dealing specifically with the Middle-East/Africa goes, all three of the participants from the cargo division had up to 3 years of experience. About China specifically, two respondents had up to 2 years of experience and one had up to 10 years of experience.

Respondent	Area of Experience	Maritime Experience (yrs.)	Middle East and Africa to China Experience (yrs.)	Dealing with the Middle East and Africa (yrs.)	Dealing with China (yrs.)
1	Cargo	3 to 10	0 to 2	0 to 2	3 to 10
2	Cargo	3 to 10	0 to 2	0 to 2	0 to 2
3	Cargo	3 to 10	3 to 10	0 to 2	0 to 2
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Years of Experience</b>	0 to 2 yrs.	0	2	3	2
<b>Years of Experience</b>	3 to 10 yrs.	3	1	0	1
<b>Years of Experience</b>	more than 10 yrs.	0	0	0	0
<b>Years of Experience -%</b>	0 to 2 yrs.	0%	67%	100%	67%
<b>Years of Experience -%</b>	3 to 10 yrs.	100%	33%	0%	33%
<b>Years of Experience -%</b>	more than 10 yrs.	0%	0%	0%	0%

Table 5. Cargo respondents' experiences in the Industry, dealing with China and the Middle East/Africa

Table 6 shows the years of experiences of one survey participant from the finance sector with a percentage section. The respondent from the finance division had an experience of up to 2 years in the maritime industry and more than 10 years of experience in dealing with crude oil trade from the Middle East and Africa to China. In reference specifically with the Middle-East/Africa, the participant from the finance division also had more than 10 years of experience and, the respondent had at least 3 years of experience specifically with China.

Respondent	Area of Experience	Maritime Experience (yrs.)	Middle East and Africa to China Experience (yrs.)	Dealing with the Middle East and Africa (yrs.)	Dealing with China (yrs.)
<b>1</b>	<b>Finance</b>	0 to 2 yrs.	more than 10	more than 10	0 to 2
<b>Total</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
<b>Years of Experience</b>	0 to 2 yrs.	1	0	0	1
<b>Years of Experience</b>	3 to 10 yrs.	0	0	0	0
<b>Years of Experience</b>	more than 10 yrs.	0	1	1	0
<b>Years of Experience -%</b>	0 to 2 yrs.	100%	0%	0%	100%
<b>Years of Experience -%</b>	3 to 10 yrs.	0%	0%	0%	0%
<b>Years of Experience -%</b>	more than 10 yrs.	0%	100%	100%	0%

Table 6. Finance respondents' experiences in the Industry, dealing with China and the Middle East/Africa

Table 7 shows the years of experiences of 10 survey participants from the operations sector to include a percentage section. One respondent from the operations division had up to 2 years, four had up to 10 years, and five had more than 10 years of experience in the maritime industry. Eight of them had up to two years of experience in dealing with trade from the Middle East and Africa to China and two had up to 10 years of experience in dealing with the same trade. As far as dealing specifically with the Middle-East/Africa, eight participants from the operations division had up to 2 years and two had up to 10 years of experience. About China specifically, eight participants had up to 2 years and two had up to 10 years of experience.

Respondent	Area of Experience	Maritime Experience (yrs.)	Middle East and Africa to China Experience (yrs.)	Dealing with the Middle East (yrs.)	Dealing with China (yrs.)
1	Operations	3 to 10	0 to 2	0 to 2	0 to 2
2	Operations	more than 10	0 to 2	0 to 2	0 to 2
3	Operations	more than 10	0 to 2	0 to 2	0 to 2
4	Operations	0 to 2	0 to 2	0 to 2	0 to 2
5	Operations	3 to 10	0 to 2	0 to 2	0 to 2
6	Operations	more than 10	0 to 2	0 to 2	0 to 2
7	Operations	more than 10	0 to 2	0 to 2	0 to 2
8	Operations	3 to 10	3 to 10	3 to 10	3 to 10
9	Operations	more than 10	3 to 10	3 to 10	3 to 10
10	Operations	3 to 10	0 to 2	0 to 2	0 to 2
<b>Total</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>
<b>Years of Experience</b>	0 to 2 yrs.	1	8	8	8
<b>Years of Experience</b>	3 to 10 yrs.	4	2	2	2
<b>Years of Experience</b>	more than 10 yrs.	5	0	0	0
<b>Years of Experience -%</b>	0 to 2 yrs.	10%	80%	80%	80%
<b>Years of Experience -%</b>	3 to 10 yrs.	40%	20%	20%	20%
<b>Years of Experience -%</b>	more than 10 yrs.	50%	0%	0%	0%

Table 7. Operations respondents experiences in the Industry, dealing with China and the Middle East/Africa

Table 8 shows the years of experiences of 11 survey participants from the shoreside sector and includes a percentage section. Nine respondents from the operations division had up to 2 years of experience, one had up to 10 years, and one had more than 10 years of experience in the maritime industry. Eight of the participants had up to 2 years of experience in dealing with trade from the Middle East and Africa to China, two had up to 10 years of experience and one had more than 10 years in dealing with the same trade. In reference specifically with the Middle-East/Africa, eight of the participants from the shoreside division had up to 2 years of experience, two had up to 10 years of experience and one had more than 10 years of experience. About China specifically, eight of the participants had up to 2 years of experience, two had up to 10 years, and one had more than 10 years of experience.

Respondent	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
1	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
2	Shoreside	0 to 2	more than 10	more than 10	more than 10
3	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
4	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
5	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
6	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
7	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
8	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
9	Shoreside	0 to 2	3 to 10	3 to 10	3 to 10
10	Shoreside	3 to 10	3 to 10	0 to 2	3 to 10
11	Shoreside	more than 10	0 to 2	3 to 10	0 to 2
<b>Total</b>	<b>11</b>	<b>11</b>	<b>11</b>	<b>11</b>	<b>11</b>
<b>Years of Experience</b>	0 to 2 yrs.	9	8	8	8
<b>Years of Experience</b>	3 to 10 yrs.	1	2	2	2
<b>Years of Experience</b>	more than 10 yrs.	1	1	1	1
<b>Years of Experience -%</b>	0 to 2 yrs.	82%	73%	73%	73%
<b>Years of Experience -%</b>	3 to 10 yrs.	9%	18%	18%	18%
<b>Years of Experience -%</b>	more than 10 yrs.	9%	9%	9%	9%

Table 8. Operations respondents experiences in the industry, dealing with China and the Middle East/Africa

Table 9 shows the years of experiences of 5 survey participants selecting the “none of these” specified sectors. Four respondents choosing “none of these” section responses had up to 2, and one had up to 10 years of experience in the maritime industry. Three of them had up to 2 years of experience with trade from the Middle East and Africa to China, two had up to 10 years of experience in the same trade. In dealing specifically with the Middle-East/Africa goes, three of the participants from this division had up to 2 years of experience, two had up to 10 years of experience. However, all five had up to 2 years of experience working with China specifically.

Respondent	Area of Experience	Maritime Experience (yrs.)	Middle East and Africa to China Experience (yrs.)	Dealing with the Middle East and Africa (yrs.)	Dealing with China (yrs.)
1	None of these	0 to 2	0 to 2	0 to 2	0 to 2
2	None of these	3 to 10	0 to 2	0 to 2	0 to 2
3	None of these	0 to 2	3 to 10	3 to 10	0 to 2
4	None of these	0 to 2	0 to 2	0 to 2	0 to 2
5	None of these	0 to 2	3 to 10	3 to 10	0 to 2
<b>Total</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Years of Experience</b>	0 to 2 yrs.	4	3	3	5
<b>Years of Experience</b>	3 to 10 yrs.	1	2	2	0
<b>Years of Experience</b>	more than 10 yrs.	0	0	0	0
<b>Years of Experience -%</b>	0 to 2 yrs.	80%	60%	60%	100%
<b>Years of Experience -%</b>	3 to 10 yrs.	20%	40%	40%	0%
<b>Years of Experience -%</b>	more than 10 yrs.	0%	0%	0%	0%

Table 9. “None of these” respondents experiences in the Industry, dealing with China and the Middle East/Africa

## Summary of Survey and Overall Respondent Opinions

### 1. There are significant operational risks present

#### *Analysis of Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages*

In reviewing the data (responses) concerning the key operational risks (Hypothesis 1), the researcher can conclude all 5 statements under this Hypothesis. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker ships from the Arabian Gulf/Africa to China voyages, provide some extremely important data. Of the 149 responses received on this Hypothesis (operational risk), there are only minimum disagreements (either strongly or just disagree). However, many of the respondents either agreed or strongly agreed to statements raised on the Hypothesis (Table 10). Of the total number (149) of responses, the disagree choice was minimal (i.e., 3 percent strongly disagree and 5 percent disagree), and 24 percent of the responses were at the midpoint indicating neither in the agreement or in disagreement with the statements/queries. However, 36 percent agreed and 31 percent strongly agreed to the statements on the identified operational risks. Essentially, the researcher can conclude from these responses that the crude oil trade between the Middle East and Africa to China route has some significant risks suggesting the stakeholders need to pay close attention to:

- New and existing operational risks present in the Middle-East/Africa to China voyage that would affect tanker ships, safety, and potential financial outcomes.
- Operational risks that are equally distributed among the port operations at both ends (origin/destination) and during the voyage of tanker ships at sea.
- Any mistakes occurring in operational activities between the Middle East and Africa to China should be considered as a “high-risk area” in the international crude oil trade.



- Operational risk factors between the Middle East and Africa to China to avoid grave maritime disasters and related expenditures (i.e., destruction of the environment, marine fauna and flora, and socio-economic costs and compensations, etc.) attached to it.
- Maximizing profits will be a challenge to the shipowners if the operational risks aren't identified and eliminated. Thus close attention should be given to identify risks and avoid them as much as possible so there will not be any financial risks caused by operational risk.

Scales	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Total Responses by Scale	Total Responses to all Statements	Scale Percentage all Statements
Strongly disagree (%)	1	2	0	1	1	5	149	3%
Disagree (%)	1	7	0	0	0	8	149	5%
Neither Agree nor Disagree (%)	14	9	5	4	4	36	149	24%
Agree (%)	11	9	20	6	8	54	149	36%
Strongly Agree (%)	2	3	5	19	17	46	149	31%
<b>Total Responses by Statement</b>	<b>29</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>149</b>	<b>149</b>	<b>100%</b>

Table 10. Statements with respondent scales = There are operational risks affecting tanker ship voyages from Middle East/Africa to China Voyages (Hypothesis 1)

## 2. Modern navigation equipment such as GPS reduces accidents at Malacca Strait

*Analysis of Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.*

Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait (Table 11). In this case, of the 150 responses received on this Hypothesis (2), only 2 percent disagreed, 25 percent remained at midpoint indicating no agreement or disagreement with the statements. Fifty-three percent agreed and 19 percent strongly agreed.

Scales	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Total Responses by Scale	Total Responses to all Statements	Scale Percentage - all Statements
Strongly disagree (%)	0	0	0	0	0	0	150	0%
Disagree (%)	0	0	2	1	0	3	150	2%
Neither Agree nor Disagree (%)	11	12	9	1	5	38	150	25%
Agree (%)	17	17	13	17	16	80	150	53%
Strongly Agree (%)	2	1	6	11	9	29	150	19%
<b>Total Responses by Statement</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>150</b>	<b>150</b>	<b>100%</b>

Table 11. Statements with respondent scales - Automatic navigation and global positioning system reduces accidents at Malacca Strait (Hypothesis 2)

Thus we can conclude with below points:

- The commercial trade with China has increased significantly in recent years and especially, the chokepoints have been heavily congested as well.
- Malacca Strait is becoming highly vulnerable to congestion and prone to accidents due to the high volume of sea traffic passing through it.

- Malacca Strait and safe passage of crude oil ships through the strait has a direct relation with China's oil security.
- Using modern navigational aids will play a crucial role in the safety of ships, it's cargo and crewmembers while passing through chokepoints like the Malacca Strait
- In essence, using navigational aids such as automatic navigation and global positioning systems significantly reduces the likelihood of accidents while passing through the Malacca Strait.

### 3. Risk of human errors at load and discharge ports can be reduced by quality training

*Analysis of Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.*

The results suggest that a high level of training significantly reduces the risk of human errors, only 3 percent of the participants disagreed with this point (Table 12). Thirty-one percent of participants remained at mid-point of neither agreement nor disagreement. However, 45 percent agreed and 21 percent strongly agreed to the statement.

Scales	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Total Response	Total Response	Scale Percentage - all Statements
Strongly disagree (%)	0	0	0	0	0	0	150	0%
Disagree (%)	1	1	0	3	0	5	150	3%
Neither Agree nor Disagree	11	13	8	11	3	46	150	31%
Agree (%)	10	14	15	12	17	68	150	45%
Strongly Agree (%)	8	2	7	4	10	31	150	21%
<b>Total Responses by Statement</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>150</b>	<b>150</b>	<b>100%</b>

*Table 12. Statements with respondent scales - High level of training reduces human errors at load and discharge ports (Hypothesis 3)*

Considering the above survey findings we can conclude with below points on this hypothesis

(#3)

- Maritime oil pollution is a regional and universal issue, and errors during the loading and discharge operations could result in significant marine oil pollution.
- The oil spills during load and discharge operations are caused by human errors and this applies to the crude oil trade between the Middle East and Africa to China route.
- All human errors during loading and discharge operations could lead to oil spills, damages to personal property and lives, and ultimately financial losses.
- Quality training significantly reduces human errors at loading and discharge ports

#### 4. Coordination among decision-makers create efficient and safe transportation of crude oil

***Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.***

The final hypothesis (4) relating to coordination between decision-makers at shipping organizations and its impact on the safe and efficient transportation of crude oil has shown the results as follows. Overall, only 4 percent of responses disagreed on the statements (Table 13). Twenty-one percent of respondents could neither agree nor disagree. The agreement was (agree or strongly agree) 49 percent and 26 percent respectively. This suggests that co-ordination and cooperation between decision-makers are crucial to protect ships, crew, and cargo.

Scales	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Total Response	Total Response	Scale Percentage -all Statements
Strongly disagree (%)	0	0	0	0	0	0	150	0%
Disagree (%)	1	2	1	0	2	6	150	4%
Neither Agree nor Disagree (%)	7	8	2	5	10	32	150	21%
Agree (%)	17	13	17	14	12	73	150	49%
Strongly Agree (%)	5	7	10	11	6	39	150	26%
<b>Total Responses by Statement</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>150</b>	<b>150</b>	<b>100%</b>

*Table 13. Statements with respondent scales - Coordination among decision-makers create efficient and safe transportation of crude oil (Hypothesis 4)*

Therefore this hypothesis (4) can be concluded with below points

- Communication among the decision-makers at shipping enterprises plays a crucial role in the safe and efficient transportation of crude oil.
- The owners, shoreside managers, and seagoing officers are part of the decision-making process at shipping organizations engaged in transporting crude oil.

- All decisions must be mutually agreed upon by all participants before taking adequate steps to confront safety-related matters.
- Critically, decisions related to efficiency and safety must be communicated to employees of all levels throughout the shipping organization who is engaged in affecting crude oil transportation in this trade.
- Shipping companies are currently showing adequate communication and coordination between decision-makers.

### **Summary of findings and its theoretical and philosophical aspects**

This study is grounded in the researcher's own work experience in the shipping industry especially dealing with Asia to the US, Europe, and intra-Asia trades and having first-hand experience in observing China's strong presence in the maritime trade. China's economic growth and the positive change in the standard of life of its citizenry was also observed by the researcher over the years. This created an interest in exploring the energy imports and the risks present in the Middle East and Africa to the China sea route. The researcher's educational qualifications are also in line with the maritime industry and have written quite a few research papers relating to the shipping industry as part of his educational pursuits/aspirations.

The researcher is confident that, the data collected and studied in this research project has given a new insight into where we can say that China and its exhilarating economic growth are commendable. The Chinese government is working to satisfy the energy need to cope up with the change in the luxury of its people. The steps taken by the government are substantial especially its decision to outsource crude oil. However, the process of importing crude oil created a curiosity in the researcher to explore the risks that are present in this sea route. The

development of the Likert-style scale questionnaire and statements presented to participants revealed that there are many risks especially operational/navigational risks in the trade route.

### **Summary**

In this chapter, the analysis of the survey responses has brought forward some key findings. Each hypothesis and its rigorous analysis of data used from the survey have agreed with the existence of some major risks. Shipowners, shoreside managers, and seagoing officers agree that the operational risks are present in the trade route studied by the researcher. It is found here that the operational risks affect tanker ships operating in this trade route and those risks are equally distributed when the ships are at the origin or destination port or while at sea. It was also found that all minor or major mistakes made by any employee can lead to major incidents in the international crude oil trade. Therefore, it is important to avoid all such mistakes to load, carry, and discharge crude oil safely. The experts in the field, through their survey responses, did agree that all parties involved in the crude oil transportation by sea must identify and analyze key operational risks so that there will not be any major accidents and subsequent catastrophes involving tanker ships at ports or while at sea. The results of the survey also suggest that failure to identify and eliminate all operational risk factors will have a direct impact on the financial profit of shipping companies.

Technology plays a key role in the navigation of ships at sea, especially, while passing through narrow waterways such as straits and canals. It was evident from the study that the shipowners, shoreside managers, and seagoing officers agree that the automatic navigation and global positioning system significantly helps in reducing accidents in general. Also, it assists the passage of tanker ships through the Malacca Strait. The respondents did agree that the commercial trade route to and from Asia is getting busier with sea traffic volume and canals and

straits are getting congested significantly. The Strait of Malacca is becoming highly vulnerable to accidents and is heavily congested due to the high volume of traffic that is passing through the strait. It was also found through data analysis that the oil security of China is highly dependent on the security of tanker ships at Malacca Strait. Therefore, modern navigational aids are playing a key role in the safe navigation of ships through Malacca Strait and do help in reducing the likelihood of accidents.

One of the key findings in this chapter was the human errors and its serious negative impacts on crude oil transportation. This research shows that the shipowners, shoreside managers, and seagoing officers do agree that quality training significantly reduces human errors in loading, discharging operations, and helps in avoiding marine pollution. Oil trade/carriage by sea is a worldwide operation and both universally and regionally, the same rules apply when it comes to oil pollution. All the time, oil pollution does occur due to errors made in cargo operations by port and ship's crew. Unquestionably, oil spills caused by human errors bring damage to personnel and property, and end-up in significant indemnification payments resulted from lawsuits. Subsequently, it was found that the only way to avoid such incidents is by providing quality training to employees.

It is an important note from this study that it weighs heavily on the importance of decision-making by the parties involved in the crude oil transportation process. One of the key findings is that the decision-makers at shipping companies play a crucial role in the efficient and safe transportation of crude oil in this trade route. That means, survey respondents weighed heavily on the point that communication amongst the decision-makers is important to ensure safety. Especially, it was found that the owners, managers, and seagoing ship officers must be part of the decision-making process and they all should mutually agree before finalizing on all



adequate steps. The field experts also agreed that decisions related to efficiency and safety must be communicated to all employees involved in the crude oil transportation process.

## CHAPTER 5: VALIDATION OF FINDINGS

### Importance of Expert Interviews

While researching a subject related to business, consulting with experts from the industry is one of the instruments often used by researchers. Alshenqeeti (2014) advised that a good qualitative interview has two key features. First, they flow naturally, and second, the expert's deliberations will be rich with details. To attain a quality interview, the researcher needs to know that he or she is there to listen from an expert and not to express their views on the subject matter (Balxter, 2006). As cited by Alshenqeeti (2014) points out that interviews offer researchers the opportunity to uncover information that is probably not accessible using techniques such as questionnaires and observations.

Rigorous data collection is an integral part of qualitative research and it is mainly conducted by a survey-based quantitative study and interviews that introduce the interviewee to the topic and questions (Ranney et al., 2015). The introduction part acts as an "ice-breaker," making it easier for the participant to understand the subject being studied. Also, the interviewer should be careful not to make controversial statements which will create a sort of uneasiness to the participant in sharing information (Ranney et al., 2015). In an interview, the moderator's viewpoints and opinions adding into the data collected after an interview should be limited. In other words, the researcher's own opinions should not flow into the interview process.

The interview process was considered in this study to strengthen the findings from the survey conducted for this research study. For this purpose, the researcher selected five seasoned industry experts where they had experiences in various segments of the crude oil transportation industry. The researcher contacted all of them through emails initially and followed by a phone call to get appointments for a phone interview. Out of the five selected, three sailed as ship

captains for crude oil tankers and specifically had experience in navigating oil tanker ships from the Middle East and Africa to the China route. One of them was a chief engineer who sailed on tanker ships for 13 years. One other had shoreside experience in chartering, operations and is the Managing Director of a shipping agency in New Jersey. He had time-chartered as well as owned and operated tanker ships to carry crude oil. Their input with regards to findings through the survey was specifically discussed in addition to their views about the transportation of crude oil.

During the introduction, the researcher carefully yet clearly explained the purpose of the study with the experts and was careful not to make any controversial statements during the introduction stage. The researcher found no hesitation from the experts in sharing their perspectives about the research and in almost all cases, they have agreed with the findings from the survey as well. Throughout the interviews, the researcher was principally a listener after giving open-ended questions and allowed the experts to express their views. The interviews were conducted over the phone. There was no electronic recording of the conversation instead, extensive notes taking were in progress during the expert's discourse. Each interview lasted 45 minutes to one hour.

### **Ethical Attention**

It is important to consider ethical issues, especially while conducting interviews to protect the person's identity. If the researcher would like to disclose a statement made by the respondent in the research paper, the participants should provide their informed consent.

Alshenqeeti (2014) points out that an ethical challenge to researchers would be the openness and intimacy of the interview situation as it may lead respondents to disclose information that they may later regret. Besides, there exists a risk that the interaction may become a quasi-therapeutic relationship for which most researchers might not have been trained. Thus, it is the researcher's

responsibility to protect the rights of a participant and avoid any harm that may come up in the forthcoming days. In these interviews, though no written consent was taken from the participants, they have agreed verbally to use their name and views in the research paper.

## **Interview with Captain Mohan Muppidi**

### ***Demographic Information***

Captain Mohan Muppidi was a seagoing crude oil ship captain currently residing in the state of Connecticut in the United States. He works for a ship management company called Fleet Management Limited. The company manages more than 450 ships and is the second-largest ship management company in the world. Ranging over 45 years of experience, Captain Muppidi's areas of expertise in the industry include operations, safety, quality management, business development, and technical support. Besides, he has experience in dealing with crude oil carriage between the Middle East and China.

### ***Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.***

Captain Muppidi advises that operational risks need to be viewed very seriously, which can cause accidents, maritime disasters, and consequentially, it could impact the marine environment through marine pollutions. More importantly, it can cause extreme financial losses to the tanker owners. In general, the Somali pirate issue was a serious matter and currently, it has subsided due to various strict actions taken by export and import countries, the United Nations, and the shipping communities overall.

Another specific concern he raised was the instability in the Middle East, especially, Iran's recent actions on tanker ship attacks/arrests near the Strait of Hormuz. Otherwise, he is not seeing any major issues impacting ship safety in this voyage at this point. That means if a Very

Large Crude Carrier (VLCC) leaving the Middle East and Africa to China, once she safely passes the troubled areas such as Somalian waters or Middle East Gulf (especially, Strait of Hormuz), the rest of the voyage is free of major incidents that can bring operational dangers to crude carriers. Once the ship gets to the Arabian Sea and then to the Indian Ocean, the passage is smooth. Occasionally, the ships may face certain weather-related issues in the Indian Ocean. Otherwise, current voyages are safe and free of any major operational hazards.

He agrees with the findings to all five questions where either agree or strongly agree to the statements. He agrees with the fact that there are many new and existing risks present in the Middle East and Africa to China voyages that may have a direct impact on tanker ships. Also, operational risks are equally distributed among the origin and destination ports and during the voyage at sea. In addition to specific risks during voyages, he alluded to the risks at the port of origin and discharge. Loading and discharge operations are especially vulnerable to oil spills/pollution by malfunctions of valves, line bursting, someone disconnecting supply line from one end without ample notice, and so on. In turn, the risks are distributed quite evenly at seaports and while at sea. Furthermore, he strongly agrees with the fact that the operational activities and mistakes are considered high-risk sections of crude oil transportation.

Captain Muppidi also agrees strongly that identifying and analyzing the key operational risk factors by tanker owners is crucial to avoid maritime disasters in this trade route. For example, with the Somalian pirate issue, shipowners and insurance companies work together to identify and analyze risks very often. Some tanker owners have armed guards on board as a precautionary step as and when they have identified pirate risks. He noted that traders, in this case, the buyers (in China) and sellers (in the Middle East and African countries) do not engage in voyage risk analysis, but shipowners do need to identify, analyze and take steps appropriately.

Brokers are the agents for the tanker owners and where they present risk factors and their analysis to the traders on behalf of the tanker owners. That means the traders are not concerned about the risks to the ships, cargo, crew, and their safety. It becomes the duty of the broker to identify, analyze, and convince traders of such risks during tanker voyages. Overall, he strongly agreed that any failure to identify and eliminate potential risks will have a direct impact on the profit maximization of tanker operators.

***Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.***

Captain Muppidi confirmed that there is a variety of modern navigational technology available onboard to use. Especially, using the paper charts to assist navigation is the method from the past and is not used anymore. Instead, crude carriers are using electronic charts just like we use on any modern-day road vehicles. Automation is used and the technology is advancing by the day. He agrees with the survey participants that the commercial trade route to and from Asia has significantly increased and the chokepoints in the China sea route are getting more and more congested.

Regarding the Strait of Malacca, he agrees that it is a highly vulnerable chokepoint where the depth for navigation needs to be proper and if no depth (draft) is available, the ships have to wait for the high-tide for a safe passage. Another risk that is often faced by navigators here is the increasing traffic that would include ships of various types and sizes passing through the canal all the time. Thus, it is highly prone to accidents and ship navigators must be extra vigilant. The pirates of Indonesia are also something to watch out for in the Strait of Malacca.

His expert opinion also lines up with the researcher's findings on the fact that China's oil security is highly dependent on the security of Malacca Strait. In other words, the stronger the

safety and security at Malacca Strait, the better the oil security of China will be. The usage of modern navigational aids reduces accidents during tanker voyages through Malacca Strait.

Autopilot systems help steer the ships. A system called Electronic Chart Data Indicating System (ECDIS) is immensely popular. This package includes a radar system, GPS, and other navigational aid technologies. ECDIS is one of the modern navigational aid packages available for ships today and helps in the safe navigation of ships through Malacca Strait as well.

***Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.***

High level of training and subsequent reduction in human error at ports (load and discharge) is one of the reasons for maritime oil pollution. He agrees that human errors could cause significant maritime oil disasters and pollution. According to Captain Muppidi, 80 percent of the time, accidents occur due to human error, and 20% of the time due to malfunction. Any human error at load ports or discharge ports especially during loading and discharging operations of crude oil can cause serious risk of oil pollution. This can lead to significant personnel and property damage that could result in financial losses to the shipowners. Training is required and it is provided all the time to people involved in operations at load and discharge ports. Thus, there is no lack of training, but what matters is the quality of training that is provided.

***Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between Arabian Gulf and China ports***

Communication is the key to the successful and safe operation of tanker ships especially, a route where there are a lot of risks present. He strongly agreed to the fact that shipowners, shoreside managers, and seagoing officers must be part of the decision-making process and all decisions once made should be communicated to employees of all levels. Adequate steps to be

taken to avoid risks and those measures must be based upon mutual agreements between all parties involved. He agreed that there is an exceptionally good communication system in place and is constantly occurring as the modern-day ships have the internet onboard. Thus, communication between shipowners, operations managers, navigation officers, crew onboard, and onshore should be part and parcel of crude oil transportation.

## **Interview with Captain Kuldeep Singh**

### ***Demographic Information***

Captain Kuldeep Singh sailed as a captain of crude oil tanker ships around the globe and performed the loading and discharging of crude oil. Captain Singh's years of experience in the maritime industry constitutes 46 years working both on shoreside operations and, onboard ship as Captain. Captain Singh is currently working as Vice President for Technical Services at Gallagher Marine Systems LLC in Houston. Gallagher provides full-service regulatory compliance to more than 400 global shipping companies, representing over 4,000 tankers and non-tankers trading to the US, Panama, and Canada. They have developed thousands of spill response and contingency plans, facilitated scores of drills and training programs, and provided in-depth consulting services for facilities, major and independent oil companies, marine terminals, and government agencies (Gallagher Marine Systems, n.d.).

### ***Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.***

Concerning the operational risks statements and survey findings, Captain Singh agreed that there were new and existing operational risk factors present on the sea route to China and that the operational risks are equally distributed among the origin, destination ports and voyage at sea. Mistakes made during operational activities are the cause of maritime disasters. However,



he pointed out that there are two causes of oil spills. One is a quite common occurrence where spills happen during the bunkering of ships and primarily due to human error. The second is accidents and succeeding maritime pollution due to crude oil spills. This occurrence is exceedingly rare and once it happens, the consequences are severe. In both cases, human errors are to blame.

When it comes to the oil spill during the bunkering operation, we see a high number of such incidents happening around the globe. In short, the severity of the maritime oil spill as an operation's risk depends on the volume of cargo or bunker spilled due to a maritime accident or mistakes caused by humans. He also agreed on the importance of identifying and eliminating operational risks and that it does have a direct impact on the profitability for shipowners and all parties involved. He counsels that in the crude oil transportation and operational process, there are risks hidden in the entire voyage and his opinion, all such risks need to be identified, analyzed, and addressed.

***Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.***

Captain Singh does agree with the researcher's finding that the commercial traffic to and from China sea route has increased significantly and congestion is present at Malacca Strait. However, at the strait, there are dedicated deepwater routes available for bigger ships such as oil tankers which helps to avoid the regular volume of traffic and related congestion. Also, ships are provided with pilotage service while passing through the strait. Piracy is a factor in Malacca Strait, but not as big of an issue compare to piracy seen in the West African waters. With the respondents, Captain Singh also agreed to the fact that China's oil security depends on the safe passage of oil tankers through the Malacca Strait. However, he stated that it is not just the safety

at Malacca Strait, but it depends on the passage of ships through the entire leg of the voyage from the origin port to the destination port is to be considered and observed thoroughly.

Certainly, modern-day navigational aids do assist in avoiding accidents. He cannot see adequate improvements that occurred for the last few years in navigational equipment. However, the position fixing of ships is not an issue and is a useful technology. The accuracy provided as far as the positioning of ships may not be at a high degree. However, it is to be noted that the ship's position accuracy is not required especially while passing through Malacca Strait. In his view, whatever navigational aid available today is appropriate and helpful. Nevertheless, it is not the lack of the navigational aid that matters much, it is the user of the equipment that matters the most. In turn, the knowledge and training provided to the user do matter much. He agrees that modern navigational aids do help in reducing accidents significantly. The ECDIS and other related equipment are aiding the navigation through Malacca Strait. Also, it is to be noted that navigational aid does not mean that it is just the modern equipment present internally on board the ship, but the ships do get external support such as pilotage and positioning of ships via a satellite that would assist ships safe passage as well.

***Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.***

According to Captain Singh, human error is the main cause behind accidents, but he felt the question was subjective because the root cause analysis has never been done by the bodies such as International Maritime Organization (IMO). Thus, in his view, it is commonly concluded as an accident caused by human error in the operational process without quarrying in and finding the root cause. He admits to the fact that quality training is essential to reduce human errors. The oil spills during the bunkering process or by the cargo spill due to maritime accidents, regardless

where the location of the ship is (whether at ports or sea), the human factor is always there behind such incidents.

He does agree that human errors during cargo operations can lead to damage to personnel and property and subsequently financial loss to shipowners via oil spills. However, we must also consider the involvement of the Protection and Indemnity Club (P&I Club) where shipowners pool funds and pay for the costs. So, it is not on the financials of the shipowner who caused the spill gets impacted, but the cost is covered by the P&I Club and other such owner's clubs/associations. According to Captain Singh, not everything is about the loss of lives, cargo, and the ship, but the process involves saving of environment, ecosystems, marine flora and fauna, indigenous people, and their protection.

Concerning the provision of high-quality training and lack thereof, the impact is seen either positively or negatively. Quality training does help in avoiding accidents (positive impact) and lack of training becomes one of the causes of accidents (negative impact). However, when we speak about the quality of training, the trainers must understand that the selection of the right people for the job matters. Shipowners must try to select people with the right skills for the job. Most importantly, the recruiters need to check the attitudes of people during the selection process. Onboard a ship, the job is very demanding. That means, the person who gets selected for the job, may have all the good skills, education, brilliance, and so on but if they do not possess the right attitude and passion to perform the demands of the daily job then, he/she is not trainable. Even if, they are given quality training, and they lack the passion to perform the job, the training has no meaning. In his view, such employees can cause more harm than good when it comes to the safety and security of the ship, cargo, and crewmembers onboard.

With the matter of training, Captain Singh also advised that information overload is causing a lot of negative impact on the process. Technology is expanding and the human brain is becoming almost incapable of keeping up with the technology as the changes are just too rapid. Thus, it is the International Maritime Organization's subject where they should create training as a quality yet simple product/package. It should only be relevant to the job the employees are performing daily rather than overloading them with new and unnecessary information that would lead to confusion. Also, the training involves a lot of international regulatory matters and all such regulations are politically motivated. Sometimes, the regulations become too rigid and though quality training is provided, it is hard for employees to function in a highly regulated environment.

***Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.***

Decision-making is a daily process in the crude oil transportation operations. Captain Singh agreed that coordination and communication processes should be involved in decision-making at shipping enterprises. In turn, shipowners and seagoing officers including the master of the ship and shoreside managers should be part of the decision-making process. All decisions must be mutually agreed before implementation as well. These days effective communication is seen across the board among the decision-makers. Besides, as the regulations change, the management interference is more with the shipmaster and his team onboard.

The onboard team is susceptible to such interference from management now than before. The master's command and control power are often to be shared with management onshore and the management is asking more questions with navigation officers now than before. Due to such interference from the management side, there is a sort of erosion occurring in the decision-

making process onboard. The onboard teams these days can handle any situation, as the members are knowledgeable, skillful. They know the policies and regulations with regards to operations, safety, and security of the ship, cargo, and crew. Also, they are knowledgeable about all the local requirements when the ship is at a certain point in time on the globe.

However, the ship captains are asked questions by management which was not a normal occurrence some twenty years ago. He feels that corruption in the system is one of the causes of this sort of one-sided management process. Thus, the result is that the higher the management involvement, the lesser the decisions the captain and his team can make. However, he is certain that there is no compromise when it comes to safety and adhering to international regulations. No matter what, when it comes to safety, the master's word is the final.

## **Interview with Captain Christopher Desa**

### ***Demographic Information***

Captain Christopher Desa is currently working as an independent consultant stationed at Savannah, GA in the US. His total experience working in the industry is 47 years. The area of expertise includes shore-side (ship chartering, planning, etc.), operations, and sailed as a captain of a Very Large Crude Carrier (VLCC). His major expertise is in navigating/mastering crude oil tanker ships, especially he worked once as a master for India's largest tanker ship. Also, Captain Desa is a representative of the P&I Club and is also a flag state representative for the Liberian flag registry. Furthermore, he worked for Chevron oil company ships as well. He sailed as captain from the Middle East to China route and knowledgeable about the operational risks that exist in this trade route.

***Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.***

Captain Desa agrees with the operational risks identified, surveyed, and analyzed by the researcher. He said there are risks in some parts of the operation more so than others, especially the in-transit risks. For example, piracy is still a major risk seen in this trade lane. In this route, West African waters, Somali waters, and Malacca Strait has a high risk of piracy exist. It is to be noted by all parties involved in crude oil trade involving tanker ships that piracy is still a threat in modern-day shipping, and we can see pirate activities even in the Gulf of Mexico. Regarding piracy at the Malacca Strait, it is quiet for a while due to the active monitoring of the Malaysian and Singaporean Navy.

He admits to the fact that mistakes made during the operational activities are a high-risk area. Besides, he agrees that it is incredibly important for the parties involved especially, the crude oil tanker operators to identify and analyze the risk factors to avoid maritime disasters. If not identified and eliminated, it can cost a substantial amount of money to shipping organizations, traders, and P&I Club in the clean-up process and paying out damages to victims. In turn, the elimination of risks in the crude trade from the Middle East to China trade is especially important to maximize profits.

When it comes to operational risks, we immediately think of risks that are physical such as accidents, collisions, maritime disasters, oil spills, etc. However, the industry does not identify the risks that are nonphysical, such as regulations and fines levied on ship operators for non-compliance. There are hundreds of safety-related regulations set forth by the International Maritime Organization and there will be penalties if not complied with the IMO regulations. There are also local regulations from coastal countries or ports with which ship operators should follow and slight deviation will cost them money in the form of penalties.

The sanction by the US government and its European partners on doing business with specific countries where ship operators will end up paying heavy penalties/fines. For example, in this case, China has excellent relations with Iran and is the buyer of oil from Iran. However, due to US sanctions on Iran, Chinese ship operators and oil corporations came under scrutiny by the US government for violation of US sanctions and carrying Iranian oil to China. According to Captain Desa, operators, traders, and agents of crude oil transportation need to identify and understand the details of these nonphysical risks and avoid them.

***Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.***

Automatic navigation and global positioning system are a useful aide while transiting through Malacca Strait. Pilotage service also available to navigate the ships through Malacca Strait. Pilots are knowledgeable with the local waters and navigational channels and once the ship arrives at a certain location where navigation becomes difficult, pilotage services provide pilots to navigate through local waters. At this point, the ship's master transfers command and control to the pilots to navigate the vessels through such waters. In this case, the Malacca Strait and its narrow passage, the ships do use pilot services. However, the master is still monitoring the pilot's actions in navigating his ship. At any point, the master can overrule the pilot's decisions if it compromises the safety of the ship, crew, and cargo. At any point, irrespective of who is navigating the ship, the captain is the ultimate authority when it comes to matters related to safety.

Besides, Captain Desa also alludes to the fact that the dedicated deepwater ship lanes where the bigger ships such as oil tankers get priority. These dedicated lanes help in saving time by not waiting to share the channels with other smaller ships for passage through Malacca Strait.

Further, about navigational aide, Captain Desa added that the Global Positioning System (GPS) and Electronic Chart Data Indicating System (ECDIS) are useful and are required as a navigational aid to assist for the safe passage. GPS goes into the ECDIS. Therefore, ECDIS combined with the radar provides excellent navigational assistance while passing through canals and straits. All the new ships are fitted with the ECDIS system and for older once, it is mandatory to have ECDIS onboard for ships with a tonnage capacity of twenty thousand and above.

The Malacca Strait is particularly an important passage for China and its oil imports. Also, Captain Desa points out that the South China Sea and China's claim on this body of water as its territorial waters is not welcomed by other Southeast Asian nations such as the Philippines. These challenges and subsequent blockades from other neighboring countries can also bring a sort of instability to China's energy security for the short term.

Overall, on the risks connected with the Malacca Strait and passage of oil tankers through this chokepoint, he summarizes with four major points. First, dangers from the high volume of traffic passing through the strait and the possibility of collisions are a constant threat to the ship's safety. Second, there is always a need for deeper water, especially for oil tankers with higher tonnage capacities such as VLCCs and ULCCs and sometimes need to wait for high tides even if, dedicated lanes are available. Next, is the piracy issue faced by ships, which is not just stealing, but attacking and injuring ship's crew especially, by the Indonesian pirates. Lastly, is the problem/possibility of terroristic activities where terrorists can take hold of a ship while passing through the narrow points of the strait and bargain for ransom or even destroy a port and surrounding waters by blowing up a chemical or crude oil tanker. The waterways are shared between Southeast Asian states, and accordingly, the waterway is not owned by any of the



surrounding states. However, the responsibility of monitoring the waterway is undertaken by Malaysia and Singapore.

***Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.***

Captain Desa agrees that maritime disasters and subsequent oil spills is a universal issue and regionally for Asia, it is an existing threat/risk. Most of the oil spills during cargo operations occur due to human error which is in line with the researcher's findings. He agrees that human errors and subsequent costs related to spills will have a direct yet negative impact on the financial books of the shipowner. He advises that it is not the lack of training that is causing spills, but it is the adherence to what is learned during training and display it on their daily job that matters. He also advises that it is not the "high level of training" the right word to use here the word should be "quality training".

According to Captain Desa, no amount of training is enough training for seagoing personnel. Crewmembers are supposed to validate their certificates often and update themselves with the new and changing regulatory environment. Especially, the crew working on tankers are to be certified and should get a qualified rating endorsement on their merchant marine credentials (MMC). This is a standalone credential that is usually endorsed by the Standards of Training, Certification, and Watchkeeping (STCW). These endorsements should be attained by navigational officers, deck or engineering officers, and stewards working on tankers carrying liquid cargoes (such as crude oil) and liquid gas cargoes (LNG). Tanker captains are specialized professionals in operating liquid tank ships. Captains from other types of ships are not allowed to work on tank ships unless they get specialized certifications and related experience.

All accidents and spills that occur in the port area are caused by simple yet nonsensical mistakes of human error. Thus, training should be an ongoing process in the field of crude oil operations and the knowledge of members should be constantly improved/updated. Accidents during cargo operation can occur sometimes with the back pressure on the manifold, high pressure on pipelines after the ship leaves, or while testing the ship's pump (positive pressure testing), heavy line blocks, and pipe bursts do occur during these processes.

It is also crucial for shipowners to pay attention to the retention of knowledgeable personnel onboard the ships and at ports. Losing experienced hands needs to be circumscribed and should take every step to preserve those trained talents. Today, officers change jobs very often for various reasons. Every time the operator puts a new talent with lesser training would lead to mistakes and oil spills. Thus, quality training is a must to foresee the possibilities of ongoing risk factors and avoid oil spills. The International Maritime Organization has many training programs provided to sailors on safety regulations. However, it is important to note that there is not enough quality/standard training available or given to crewmembers by local, national, or international regulatory bodies.

***Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.***

The discussion on the decision-making process at shipping organizations to create efficient and safe transport of crude oil between the Middle East and Africa to China, Captain Desa agrees with the findings on communication among decision-makers is a must for safe transportation of crude oil. He also agrees that the owners, seagoing officers, and shoreside managers should be involved in the decision-making process and all decisions, especially safety-related decisions must be mutually agreed before implementation. He admits that there is a

certain level of coordination between decision-makers that exist at ship organizations especially after the advent of the internet, e-mail, and satellite phones, this is occurring very often.

According to Captain Desa, in the modern-day crude oil operations, the parties involved in the decision-making are usually the commercial operations department, shipmasters, and their team onboard the ship. Additionally, some traders and charters fix the ship for crude oil transportation from origin to destination.

One of the major decisions to be made is a description of crude that is going to be loaded onto the tanker ships. The lighter the crude is, the easier the handling going to be. In his view, 31.2 American Petroleum Institute (API) gravity or higher is a desirable crude to carry. The lesser the gravity, thicker the crude going to be and hard to do the cargo operation such as loading and discharging using pumps. Also, cleaning of tanks will be even a bigger challenge when thicker crude is carried. Cleaning is needed when the same ship is used to carry lighter crude for the next sailing. This is going to incur an additional cost to the shipowner. Besides, there will be a need of maintaining the temperature onboard (165°F) to keep a certain level of liquidity to the crude onboard while in-transit. This makes the delivery operation harder since the crude is coming in too hot to pump it out of the ship to the receiving terminal. The selection of the right crude for carriage itself is a major decision to make. Therefore, handling characteristics of the crude oil is a major factor and that should be part of the decision-making process.

## **Interview with Mr. Ashok Nigam**

### ***Demographic Information***

Ashok Nigam is a marine chief engineer by profession and sailed as a chief engineer on board ships for 13 years. He sailed all over the world on crude oil tanker ships and has significant experience sailing. Ashok has 40 years of experience in the maritime industry,

especially in the crude oil transportation sector. His area of expertise includes operations and technical side of maritime shipping. Currently, he is doing an independent consulting business in Houston, TX.

***Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.***

Mr. Nigam agrees that there are new and existing risks present in the Middle East to China Route. He specifically mentioned that he is not a navigation officer or a captain, but he was a marine engineer sailed on crude oil ships and was a member of the onboard management team. As far as the operational risk distribution goes, he agrees that the risks are equally distributed between ports of loading and discharging and, at sea.

In short, he said the risk is all over not just concentrated only on certain stretches of the voyage. However, there are standard risks specifically related to the port area and some are voyage related. He also added that operational risks at Malacca are unique to the area which cannot relate to risks that are present in ports or other segments of the voyage leg. He agreed to the point that mistakes in operational activities are a high-risk area in international crude oil transportation and it will be true to the Middle East and Africa to China sea route as well. Identifying and analyzing the key operational risk factors by the crude oil transportation-related organizations is a must-have process to avoid maritime disasters and he fully agreed with the statement like other respondents did for this survey. Finally, in the operational risk category, he is also in agreement that the shipping organizations surely should have the process not only to identify and analyze the operational risks but also to have a process in place to eliminate them. These processes are crucial for the shipping companies to maximize their profits.

***Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.***

Mr. Nigam agreed that the increased commercial trade of China with the rest of the world, the chokepoints such as the Malacca Strait is getting congested. His firsthand knowledge of the traffic, he stated that the traffic around Singapore and Malacca Strait is high in volume and is prone to accidents if close attention is not given.

Piracy at Malacca Strait is also a concern but is currently less active due to some actions are taken. The navigational equipment such as radars, GPS, etc., are helpful for the safe passage of the ships through the strait as well. The statement on oil security of China and its relation to the safety of ships at Malacca Strait, he agreed to the statement and also insists that the security of ships for the entire leg from West Africa or the Middle East to China route should be taken into consideration.

***Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.***

Quality training is useful for crewmembers and port operations personnel when it comes to crude oil operations. Mr. Nigam says that very often, human errors are to blame for the accidents, collisions, and oil spills in the crude oil transportation process. This causes personal injuries, damage to properties, and worst of all, the maritime disasters where severe environmental damages and corresponding consequences are faced. All accidents and subsequent costs to correct the mistakes involve serious financial expenditures on shipowners and related associations such as P&I Club. According to Mr. Nigam, he believed there is plenty of training out there, but what matters is how useful it is. In his view, this is the root cause of human errors.

***Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.***

Coordination of decision-makers and its importance are concerned he agreed that it plays a crucial role in the efficient and safe transport of crude oil. Communication between decision-makers in a shipping organization is also an important factor for the seamless movement of crude oil. The shipowners, shoreside managers, and seagoing officers are to be part of the decision-making team. He adds that the Vessel Management Team (VMT) onboard the ship is primarily responsible for voyage related decisions especially when it comes to safety. The VMT includes onboard technical teams such as the marine engineer and his team. The shoreside managers are in touch with the VMT regularly and they always work as a team. In his view, there is adequate communication among the decision-makers is in place and implemented with the operational level employees. He agreed that currently, shipping companies do have a system of adequate coordination among decision-makers to create an efficient and safe transport of crude oil in the China route

#### **Interview with Mr. S.V. Anchan**

##### ***Demographic Information***

Mr. S.V. Anchan is a maritime expert and is in the industry for about 24 years. He had experience in chartering ships for a major bulker shipping company in India. The experience in chartering crude oil, petroleum, and chemical tanker ships for moving these products around the globe are the highlights of his career. Currently, as Managing Director of Safesea Group, he had also owned and operated crude oil tankers to move crude from the Middle East to various parts of the world. He has experience in managing tanker ships as well as owning and operating them. His experience specifically focused on the Middle East to China, and the USA. Within the

Middle East area, the operations involved moving crude from one point to another where refineries are available. He also moved Iranian crude oil at the time when there was no US embargo placed on Iranian oil. His experience in moving crude from West Africa is truly little. His major experience is chartering and operating ships of various sizes including VLCCs for the largest shipowner and trader in the world called Bakri Navigation in Saudi Arabia.

***Expert opinion on Hypothesis 1. Shipowners, shoreside managers, and seagoing officers agree on the importance of key operational risks affecting bulker and tanker Arabian Gulf to China voyages.***

Concerning the operational risk category and statements, he agreed on every statement but one. He strongly disagreed that there are many new and existing operational risk factors present in the Middle East and Africa to China voyages. The risk is more of a geopolitical nature than purely operational. Once ships leave the ports from the Middle East to China, operationally if the navigators follow all the set rules, the risks are not severe. Even marine pollutions are truly little during voyages unless there is a need for transfer of cargo between ships at high seas and in such cases, the oil spill may be a possibility. He did agree that operational risks are equally distributed among the load/discharge ports and high seas. According to him the only difference in risk he can see that if an oil spill occurs in a port area, we have more control and could be able to limit damages quickly than it happens in a mid-voyage at high-seas. Mistakes are limited at ports if the port crew follows all the guidelines and undergo all the operational checks systematically. On the other hand, mid-voyage operations at high-seas, mistakes can be extremely dangerous and these days many such mistakes are made during mid-sea operations and are becoming a high-risk area.

Concerning identifying and analyzing the risk factors, he agrees to the statement and considers the process as an important element when it comes to tanker operations. He further

adds that identifying and analyzing occurs each step of the way and all parties are well-aware of what risks are out there and what additional risks to look for. However, in his view, sometimes the disaster can occur due to oversight and overconfidence. Overconfidence causes accidents more so than an oversight. Sometimes, handing the navigation over to inexperienced (junior officers) hands by the captain can also lead to accidents.

Regarding the elimination of operational risk factors and its direct impact on profit maximization, he agrees with the statement. However, in his view, if the shipowner has the right insurance, it covers most of the losses from the disaster and the P&I Club is involved in sharing the costs. In turn, the financial impact as an owner of the ship or charterer is minimal. However, the major impact comes when there is a loss of hire in which the ship may not be able to sail further and cannot be delivered for the next voyage. Otherwise, as per the charterparty (contract between the charterer and the shipowner), the charterer has to prove that the ship had a technical fault, and that is why the accident occurred subsequently, the ship could not be delivered back to the owner for the next sailing. This becomes a major cost for the charterer if he could not carry out the next voyage or he could not deliver back the ship to the owner for his next contract with another charterer. Either way, he is liable to pay the losses to the owner for not delivering the ship on-time or he loses the business with his trader for not carrying cargo which was planned for the next voyage.

***Expert opinion on Hypothesis 2. Shipowners, shoreside managers, and seagoing officers agree that automatic navigation and positioning systems significantly reduce the likelihood of accidents on bulker and tanker voyages through the Malacca Strait.***

Mr. Anchan agreed that commercial trade route to and from Asia significantly increased and chokepoints such as Malacca Strait is congested. He added that there are a lot of activities occurring in this zone. Especially the feeder services, tugboat operations, offshore operations,



etc., are creating heavy traffic and congestion in Malacca strait. It is not just the big ships that are passing through the Malacca Strait is responsible for congestion but the small ships by creating a sort of taxi service within Asia are creating the congestion.

One should bear in mind that Malacca Strait and the surrounding area are the center point geographically for shipping activities. Singapore, and some of the Malaysian ports, are major transshipment points and, many ports in this area serve as anchoring ports. Besides, bunkering activity is immense along with lube oil and ship-to-ship transfer operations are routinely occurring in this area. Furthermore, this is a major passage for ships and cargo en-route to Australia and the Indian Ocean destinations. Thus, the Asian trade with the rest of the world with China is not fully responsible for creating congestion in the Malacca Strait but other activities contribute to this as well. He also agreed that the Strait of Malacca is vulnerable and prone to accidents due to the high volume of traffic and subsequent congestion it is creating.

He fully agreed that China's energy security is highly dependent on the safe passage of crude oil ships through the Malacca Strait. However, he stated that China's oil security is also dependent on geopolitical developments as well. For example, if India bans ships passing through the Indian Ocean, it creates a major risk to China's energy security. Also, if Iran creates a blockade at Strait of Hormuz may create havoc for the movement of crude oil to China affecting its energy security. He agreed with the respondents on the statement relating to modern navigational aide and its assistance in the safe passage of crude oil ships through the Malacca Strait.

New equipment needs more training to the user. Along with the new equipment, it is always better to train navigation officers on how to use the traditional way of navigation using charts, etc. When the technology fails in the middle of the ocean, the old methods will truly assist

the navigators to safely sail the ship forward. He believes that the old way of navigating ships is safer than using modern technology and the statistics prove it. The number of incidents is more after modern technology came into play compared to traditional navigation. It has nothing to do with the technology itself, but it always falls in the hands of an inexperienced user that eventually leads to major incidents.

***Expert opinion on Hypothesis 3. Shipowners, shoreside managers, and seagoing officers agree that a high level of training significantly reduces the risk of human error in loading and discharging ports in the Arabian Gulf and China.***

Mr. Anchan agreed that better training produces quality employees in all industries and the maritime industry is not exclusive here. Also, every layer of the shipboard crew should be trained such as the cadets, third, second, chief officers are all to be subject to intense training. Also, more and more cadets should be trained. He specifically expressed concern in modern-day ship crew size which is 12 to 13 members by which in his view, cannot achieve much. In the past, ships had more crewmembers that produced the best quality trade without many incidents along the sailing route.

Fewer the crew members, more the stress, and fatigue, which could lead to major accidents. Therefore, depending on the size of the ship, Mr. Anchan said the number of crew members should be increased to reduce incidents. Many cadets and shipboard crew are undergoing simulation training rather than on the job training. This should be controlled. Make sure the shipboard crewmembers get hands-on training on the job because the real-life experiences are much different than simulator experiences. In the past, cadets trained in this way had eventually produced excellent shipmasters. The system in the past was such that if a person is not experienced, he/she will not be given the command of the ship. Today, people who are good in simulations and navigating ships based on simulator training is getting promoted step by

step quickly and becoming ship captains within four to five years of sailing experience. That is the sole reason we are seeing more incidents than in the past years.

Mr. Anchan insists that on-the-job training is more appropriate and should be the core of all training and cadets should be coupled with good mentors on board. Also, the same process should apply with the shoreside employees as well so that we can avoid incidents such as oil spills during the load and discharge operations. He also agreed that human errors lead to accidents and would bring significant financial loss to the shipowners by indemnifying damages caused to other's properties, to the ship and crew.

Human errors are caused by lack of training statement, he agreed with respondents and added that it is by both lack of training and overconfidence of employees lead to dangerous conclusions. Thus, a high level of training, a must-have process to reduce human errors and control risks at loading and discharging ports and at sea. According to Mr. Anchan, in the maritime industry, every operation is different, and the training should reflect and suit each operation there is.

***Expert opinion on Hypothesis 4. Shipowners, shoreside managers, and seagoing officers agree that shipping companies have systems of adequate coordination among decision-makers to create efficient and safe transport of bulker and tanker cargos between the Arabian Gulf and China ports.***

Mr. Anchan agreed with the respondents that the communication between decision-makers is important as well. Shipowners, shoreside managers, and seagoing officers should be part of the decision-making process. Also, all decisions made should be mutually agreed before implementation. All decisions made should flow across the levels of employees especially people who are at the operational level. Also, adequate communication between decision-makers is in place, at a much higher level than it was before. Mr. Anchan admitted that modern communications technology (e-mails, WhatsApp, Satellite calls, etc.) is the sole reason for this

improved communication. He said that before the best way to communicate was sending telex messages which were inefficient and expensive. However, these days a shipboard crew can communicate verbally on phone or via e-mail from ships anywhere on the globe.

Mr. Anchan has some additional views on the decision-making process. The owner or operator will not indulge in navigational decisions that are solely left to the navigation officers. This freedom gives the ship's master to take decisions based on efficient and safe navigation of the ship. Unless there is cargo on board have restrictions put on some countries or canals and they jointly discuss and make decisions and conclude on a specific route. The best example would be military cargo passing through Suez Canal or restrictions on certain chemicals into Saudi Arabia, etc., where decisions will be made jointly with the shipowner/operator and the shipmaster. Besides, he advised that piracy-related issues such as choosing routes to avoid piracy are falling under the authority of the shipmaster, not shoreside managers or owners.

The cargo selection decision is a combined decision with the shipowner, trader, and the shipmaster. Master is responsible to certify the tank showing that the tank is ready to load, and other parties are not involved in this certification process. Also, classification society and its selection fall under the shipowner, and the shipmaster and other shoreside managers have minimal involvement in this decision-making. From the owner's side or the shoreside managers, there should not be unreasonable demands made, but all should be on the same page, and safety should be given priority. For example, if the ship's capacity is 150 thousand tons and shoreside officers, traders and shipowners can ask the master to load additional tonnage then, the master can refuse such unreasonable demands considering ship's stability and safety. Thus, in a decision-making process in the shipping organization, everyone should be on the same page and the safety of the ship must be the utmost concern. Also, the decision should be mutually agreed,

and finalization of the decisions must be based on giving equal respect to opinions of all involved in the process. All decisions should be communicated to the lowest levels since they in one or the other way, involved in the process chain while operating ships from port to port.

### **Summary of expert opinions to survey findings**

The Likert-style statements, responses received and the data analysis in chapter 3 became the primary evidence that some key operational risks exist in the carriage of crude oil from the Middle East and Africa to China using tanker ships. In Chapter 5, the discussions with the five industry experts who had extensive experience in the tanker business; having worked in various divisions of the crude oil carriage sector have in the researcher's view, confirmed the findings of Chapter 4. Thus, both chapters show that categories highlighted in the Likert-scale questionnaires do have high importance and the risks are quite serious. Captain Desa pointed out that operational versus non-operational risks awareness is vital. In his view, operational risks include accidents, collisions, maritime disasters, oil spills, etc. Non-operational risks include nonphysical such as regulations and fines levied on ship operators for non-compliance.

The key point Captain Desa made here is about the sanction by the US government and its European partners on doing business with specific countries where ship operators will end up paying heavy penalties/fines; specifically, in this case, doing business with Iran. In his view, some Chinese and other shipowners and corporations may have undergone heavy scrutiny by the US government for carrying Iranian crude oil to China. In the researcher's view, such information can be drawn only during personal interviews and thoughts and, opinions that come from an experienced professional will be invaluable.

Therefore, in this study, the Likert-style statements, and data analysis along with expert views gave substance on operational, navigational, training, and decision-making related risks

and its significances. The researcher believes that the interviews with the five experts strengthened the views obtained through the Likert-style questionnaires and gave additional knowledge on the categories of risks highlighted. It also demonstrates that it is beneficial to share the findings of data collected from the field with experts through interviews and get their opinions as well. This will add value to the overall findings of the research.

## **CHAPTER 6: SIGNIFICANCE, LIMITATIONS, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH**

There is a difference between conducting a project for business versus academia. An academic audience is interested in how theory is involved in the project and how well it is linked throughout the writing process. Whereas business-focused projects do not necessarily consider how the theory is applied. The businesses' interest is on the results of the study, its practical applicability, and its implications on the business they are in (Eriksson & Kovalainen, 2014). This study was conducted with an academic focus and the researcher applied a suitable theoretical framework using a mixed-methods approach. Various aspects discussed in the primary, intermediary, and dependent variables have been discussed in the research project, findings have been laid out and conclusions have been established on the maritime risks seen in the sea route to China from the Middle East and Africa ports.

While reviewing the scholarly literature for this study, it was evident that there was literature available on many of the intermediary and dependent variables shown in the theoretical framework of this academic study. Those literature were particularly helpful in initiating, researching, and finalizing this subject matter study. Besides, the results from the Likert-scale questionnaires, data collection, and analysis became the strongest evidence to establish key points of risks in this sea route study. The industry expert interviews further strengthened and confirmed the researcher's statement on the existence of some key risks in the crude oil carriage from the Middle East and Africa to the China sea route.

### **Significance of the Study**

In recent years, the Chinese economy is showing continuous growth and the domestic production of crude oil is not sufficient to meet the demand for energy. Thus, as indicated in the

literature review, China is already involved in importing crude oil from the oil-rich nations of the Middle East/Africa via the sea route. This phenomenon has an uptick trend, where more and more volumes of crude oil will be purchased and transported by China in the coming years. On the other hand, the tanker owners also found a niche market where they can deploy and operate their ships engaging in the carriage of crude oil to China. This is positive news for tanker owners where they can constantly find oil carriage contracts with Chinese oil importers. However, as the demand is shifting from the US route to China, the maritime industry must be aware that risks are present in the trade route and must build on ideas to avoid them.

In this case, we can find new risks such as the hidden dangers at the Malacca Strait, geopolitical issues, piracy, and possible terroristic activities all can significantly increase risk and subsequent financial losses. Chokepoints, piracy threats, political engagements, and possible military actions are posing significant risks. Awareness of the human errors and its direct implications are going to be medium to severe and this study pointed out how significant it is to provide quality training to employees involved in the transportation of crude oil in this route. Besides, the significance of having modern navigational equipment, such as GPS and other automatic navigational aids onboard and its usefulness not only at high-seas but also for navigation through narrow passages, canals, straits, and chokepoints are been laid out in this project. The study highlighted the importance of these risk points in the oil import operations of China from the Middle East and African ports.

Therefore, high-quality training should be provided to employees to avoid impacts such as collisions and the loss of ship, cargo, and lives. Oil spills from collisions can cause marine pollution and subsequent loss of marine life. Any property damage may result in a high amount of money payouts to indemnify losses. All risks will be significant if a marine disaster does



occur and, such risks need to be identified, analyzed, and communicated to the participants in this trade.

The maritime industry involves high capital investment and decision-making in operational activities is significant. The onboard team on ships under the master and the shoreside managers including the shipowners should be part of the decision-making process to avoid risks. At the same time, ship, and her safety-related decisions in-transit; there must not be any compromise and primary decision-making in this aspect should be with the master of the ship.

Overall, in operational decision-making, there must be cooperation between the decision-makers, as all decisions made have a direct impact on safety. Also, the study has shown the significance of communicating the decisions made by decision-makers to the operational level employees to follow. This study stresses on the overall communication flow between decision-makers and then to the lowest levels in the operational divisions of a shipping organization. Every decision is significant in avoiding operational risks.

### **Limitations of the Study**

As in any other qualitative research, this case study also had its limitations. Some of the key limitations identified are mainly getting interviews with governmental agencies, such as the navy and coastguard officials of China, the Middle East, African nations, and countries through which the tanker ships pass through to complete the voyage. The real challenge here is the verification of information collected from the governmental agencies and its authenticity. Culture also plays a part in arranging interviews and openness of the participants during the interviews. Sometimes, questions asked may not seem to be secretive information from the researcher's perspective but in the participant's view, it may be considered as classified information. This

could bring some concerns when the responses to questions will be crucial for the success of the research.

The research involved some travel and could exert financial pressure on the researcher. Furthermore, translators were needed since the researcher was dealing with non-English speaking officials of other nations. These limitations forced the researcher to take the path of Likert-style survey and industry expert interviews for data collection. Finally, the maritime industry is one of the oldest industries, and materials available are older as well, especially while addressing the areas of the historical and legal environment of this research.

### **Conclusions and Recommendations for further research**

There are significant operational and navigational risks that exist for crude oil carriage to China from the Middle East and Africa. Also, the study shed light on the presence of some general maritime risks associated with crude oil carriage around the globe. Besides, some new risks are specific to this trade route. Various issues related to tanker ship operations and carriage of crude oil has become a major field of study around the globe. Risks such as navigational errors and accidents, oil spills and marine pollution, maritime piracy and taking control of ships and crewmembers for a ransom, political instabilities, possibilities of closing of canals, waterways, and straits, the threat of war and so on are becoming pressing issues for tanker owners and cargo owners alike in the international crude oil trade.

The risks are remarkable, and any unforeseen occurrences may cost tanker owners even to the verge of bankruptcy. For example, the tankers and general cargo carriers including bulk carriers pass through the Malacca Strait between Singapore and Indonesia where it is one of the most dangerous navigation channels and minor human error can cause major disasters.

Furthermore, an estimated fifty thousand ships, or 25% of the world's commerce, pass-through

the Malacca Strait each year. This would include an incredible number of oil tankers, bulk cargo, and container ships with an enormous amount of volumes by weight pass through here. Malacca Strait is geographically narrow and a piracy (terroristic) riddled area. The research is significant in pointing out the dangers present in this stretch of waterway.

The territorial claims of Iran and its hostility against American naval forces in the Middle East Gulf area can lead to the closure of the Strait of Hormuz would result in an all-out war. The recently fractured US nuclear deal with Iran and subsequently passed laws by the US Congress against Iranian oil deals has restricted a lot of oil export deals for Iran internationally. China with existing relations with Iran can further struggle with legal consequences and scrutiny if oil imports from Iran are ceased. The Iran matter has been identified as a major non-physical risk for China if not complied with the restrictions placed by the United States. Therefore, the research is timely.

The researcher would recommend studies on the below two areas

1. If a maritime collision/major oil spill occurs along this route, who would be responsible for the clean-up process? The study should answer the below questions:
  - What would be China's role as a buyer of crude oil if a disaster happens in the coastal waters of another country such as Sri Lanka or Indonesia?
  - Who would be paying for the clean-up process?
  - What additional regulations China will bring if this occurs in their coastal waters?
2. The Middle East to the US oil trade, the United States, and the European partnered navies are actively involved in protecting the oil tankers from piracy. How involved China is in protecting oil tankers in this route? How well can China initiate and

execute well-established cooperation with other countries along the route to ensure China's energy security?

## APPENDIX-1

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## APPENDIX-2

### Survey and Results

#### *Topic # 1 questionnaire and responses*

##### **Category of Risk:**

**Key operational risks affecting tanker ships from Middle East to China voyages.**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither Agree nor Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
There are many new and existing operational risk factors present in the Middle East to China voyages affecting tanker ships	1	2	3	4	5
Operational risks are equally distributed among the origin, destination ports and during the voyage at sea.	1	2	3	4	5
Mistakes in operational activities is a high-risk area in international crude oil transportation by sea between Middle East and China	1	2	3	4	5
It is important to identify and analyze key operational risk factors by the crude oil tanker operators in order to avoid maritime disasters while engaging in crude oil transportation between Middle East and China	1	2	3	4	5
Failure to identify and eliminate operational risk factors has potential impact on profit maximization of tanker shipping companies operating between Middle East and China route	1	2	3	4	5



**Survey Responses for Topic 1**

Respondent	Question 1	Question 2	Question 3	Question 4	Question 5
1	Disagree	Agree	Agree	Agree	Neither Agree nor
2	Agree	Agree	Agree	Agree	Agree
3	Agree	Disagree	Agree	Strongly Agree	Strongly Agree
4	Strongly Agree	Strongly Agree	Agree	Strongly Agree	Strongly Agree
5	Neither Agree nor Disagree	Disagree	Neither Agree nor Disagree	Strongly Agree	Strongly Agree
6	Neither Agree nor Disagree	Strongly disagree	Agree	Agree	Strongly Agree
7	Agree	Agree	Strongly Agree	Strongly Agree	Agree
8	Neither Agree nor Disagree	Agree	Agree	Strongly Agree	Strongly Agree
9	Neither Agree nor Disagree	Disagree	Strongly Agree	Strongly Agree	Strongly Agree
10	Agree	Neither Agree nor Disagree	Agree	Strongly Agree	Strongly Agree
11	Neither Agree nor Disagree	Disagree	Neither Agree nor Disagree	Strongly Agree	Strongly Agree
12	Neither Agree nor Disagree	Strongly disagree	Agree	Strongly Agree	Strongly Agree
13	Agree	Neither Agree nor Disagree	Agree	Agree	Agree
14	Agree	Agree	Agree	Strongly Agree	Strongly Agree
15	Neither Agree nor Disagree	Strongly Agree	Agree	Strongly Agree	Strongly Agree
16	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Neither Agree nor	Neither Agree nor
17	Agree	Disagree	Agree	Strongly Agree	Strongly Agree
18		Agree	Strongly Agree	Neither Agree nor	Neither Agree nor
19	Agree	Neither Agree nor Disagree	Agree	Neither Agree nor	Agree
20	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor	Neither Agree nor
21	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Strongly Agree
22	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Agree
23	Agree	Disagree	Neither Agree nor Disagree	Strongly disagree	Strongly disagree
24	Strongly disagree	Disagree	Agree	Agree	Strongly Agree
25	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Agree
26	Neither Agree nor Disagree	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
27	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Strongly Agree
28	Neither Agree nor Disagree	Agree	Agree	Strongly Agree	Agree
29	Agree	Neither Agree nor Disagree	Agree	Agree	Strongly Agree
30	Agree	Neither Agree nor Disagree	Agree	Strongly Agree	Agree

**Total response count by the question -topic 1**

	Question 1	Question 2	Question 3	Question 4	Question 5
Count (N)	29	30	30	30	30
Not Answered	1	0	0	0	0
Total	30	30	30	30	30

**Total count by the scale and question-topic 1**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree	1	2	0	1	1
Disagree	1	7	0	0	0
Neither Agree nor Disagree	14	9	5	4	4
Agree	11	9	20	6	8
Strongly Agree	2	3	5	19	17
Total	29	30	30	30	30

**Percentage by question by scale -topic 1**

Questions	Total	Strongly disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	Total
Question 1	29	3%	3%	48%	38%	7%	100%
Question 2	30	7%	23%	30%	30%	10%	100%
Question 3	30	0%	0%	17%	67%	17%	100%
Question 4	30	3%	0%	13%	20%	63%	100%
Question 5	30	3%	0%	13%	27%	57%	100%

**Overall percentage by Scale and total response -topic 1**

Scales	Question 1	Question 2	Question 3	Question 4	Question 5	Total Responses by Scale	Total Responses to all Questions	Scale Percentage all Questions
Strongly disagree (%)	1	2	0	1	1	5	149	3%
Disagree (%)	1	7	0	0	0	8	149	5%
Neither Agree nor Disagree (%)	14	9	5	4	4	36	149	24%
Agree (%)	11	9	20	6	8	54	149	36%
Strongly Agree (%)	2	3	5	19	17	46	149	31%
<b>Total Responses by Question</b>	<b>29</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>149</b>	<b>149</b>	<b>100%</b>

***Topic #2 questionnaire and responses*****Category of Risk:**

**Automatic Navigation and Global Positioning Systems significantly reduces the likelihood of accidents of tanker ship voyages through the Malacca Strait.**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither Agree nor Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
Commercial trade route to and from Asia has significantly increased and chokepoints such as straits and canals in the sea-route is getting more and more congested.	1	2	3	4	5
Strait of Malacca in particular, is becoming highly vulnerable to congestion and prone to accidents due to high-volume of sea traffic.	1	2	3	4	5
China's oil security is highly dependent on crude oil ships and their safe passage through Malacca Strait.	1	2	3	4	5
Modern navigational aids are crucial for the safety of ships, its cargo and crewmembers while passing through the Strait of Malacca.	1	2	3	4	5
Implementation of modern navigational aids such as automatic navigation and positioning systems significantly reduce the likelihood of accidents on tanker voyages through Malacca Strait.	1	2	3	4	5

**Survey Responses for Topic 2**

Respondent	Question 1	Question 2	Question 3	Question 4	Question 5
1	Agree	Agree	Agree	Neither Agree nor disagree	Neither Agree nor disagree
2	Agree	Agree	Agree	Agree	agree
3	Neither Agree nor disagree	Neither Agree nor disagree	Neither Agree nor disagree	Strongly Agree	Agree
4	Agree	Agree	Agree	Strongly Agree	Agree
5	Agree	Agree	Agree	Strongly Agree	Strongly Agree
6	Agree	Neither Agree nor disagree	Neither Agree nor disagree	Agree	Agree
7	Strongly Agree	Agree	Strongly Agree	Agree	agree
8	Agree	Agree	Agree	Agree	Strongly Agree
9	Agree	Neither Agree nor disagree	Neither Agree nor disagree	Strongly Agree	agree
10	Agree	Neither Agree nor disagree	Neither Agree nor disagree	Agree	Strongly Agree
11	Neither Agree nor disagree	Neither Agree nor disagree	Agree	Agree	Agree
12	Agree	Neither Agree nor disagree	Strongly Agree	Agree	Neither Agree nor disagree
13	Agree	Agree	Neither Agree nor disagree	Agree	agree
14	Strongly Agree	Neither Agree nor disagree	Strongly Agree	Strongly Agree	Strongly Agree
15	Agree	Neither Agree nor disagree	Agree	Agree	Agree
16	Agree	Agree	Agree	Disagree	Neither Agree nor disagree
17	Agree	Agree	Agree	Strongly Agree	agree
18	Neither Agree nor disagree	Agree	Agree	Agree	agree
19	Neither Agree nor disagree	Agree	Strongly Agree	Agree	Strongly Agree
20	Neither Agree nor disagree	Neither Agree nor disagree	Neither Agree nor disagree	Agree	agree
21	Agree	Agree	Neither Agree nor disagree	Agree	agree
22	Neither Agree nor disagree	Neither Agree nor disagree	Neither Agree nor disagree	Agree	Strongly Agree
23	Agree	Agree	Neither Agree nor disagree	Agree	agree
24	Neither Agree nor disagree	Neither Agree nor disagree	Disagree	Agree	Neither Agree nor disagree
25	Neither Agree nor disagree	Neither Agree nor disagree	Disagree	Agree	Neither Agree nor disagree
26	Neither Agree nor disagree	Agree	Agree	Strongly Agree	Strongly Agree
27	Agree	Agree	Strongly Agree	Strongly Agree	agree
28	Neither Agree nor disagree	Agree	Agree	Strongly Agree	Strongly Agree
29	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Agree
30	Neither Agree nor disagree	Agree	Agree	Strongly Agree	Strongly Agree

**Total response count by the question -topic 2**

	Question 1	Question 2	Question 3	Question 4	Question 5
Count (N)	30	30	30	30	30
Not Answered	0	0	0	0	0
Total	30	30	30	30	30

**Total count by the scale and question-topic 2**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree	0	0	0	0	0
Disagree	0	0	2	1	0
Niether Agree nor Disagree	12	13	9	1	5
Agree	16	16	12	17	16
Strongly Agree	2	1	7	11	9
Total	30	30	30	30	30

**Percentage by question by scale**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree (%)	0%	0%	0%	0%	0%
Disagree (%)	0%	0%	7%	3%	0%
Niether Agree nor Disagree (%)	37%	40%	30%	3%	17%
Agree (%)	57%	57%	43%	57%	53%
Strongly Agree (%)	7%	3%	20%	37%	30%
Total	100%	100%	100%	100%	100%

**Overall percentage by the scale and total response -topic 2**

Questions	Strongly disagree (%)	Disagree (%)	Neither Agree nor Disagree (%)	Agree (%)	Strongly Agree (%)	Total Responses by Question	Total Response	Percentage by Question
Question 1	0	0	0	0	0	0	150	0%
Question 2	0	0	2	1	0	3	150	2%
Question 3	11	12	9	1	5	38	150	25%
Question 4	17	17	13	17	16	80	150	53%
Question 5	2	1	6	11	9	29	150	19%
Total responses by Scale	30	30	30	30	30	150	150	100%

***Topic #3 questionnaire and responses*****Category of Risk:**

**A high level of training significantly reduces risk of human errors at loading and discharging ports in the Middle East and China.**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither Agree nor Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
The Maritime oil pollution from crude oil trade is both universal and regional. Regionally, in Middle East or in China, errors during load and discharge operations could result in significant marine pollution.	1	2	3	4	5
Oil spills during load / discharge operations are caused by human errors in the Middle East to China crude oil trade.	1	2	3	4	5
Human errors during port operations and subsequent oil spills, damage to personnel and property could result in significant financial loss to shipowners.	1	2	3	4	5
Human errors at the load and discharge port in Middle East and China is directly related to lack of employee training.	1	2	3	4	5
High level of training significantly reduces risk of human errors at loading and discharging ports in the Middle East and China.	1	2	3	4	5

**Survey Responses for Topic 3**

Respondent	Question 1	Question 2	Question 3	Question 4	Question 5
1	Neither Agree nor Disagree	Agree	Agree	Agree	Neither Agree nor Disagree
2	Agree	Agree	Agree	Agree	Agree
3	Agree	Agree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree
4	Agree	Agree	Agree	Agree	Strongly Agree
5	Agree	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree
6	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Neither Agree nor Disagree	Strongly Agree
7	Agree	Neither Agree nor Disagree	Agree	Strongly Agree	Strongly Agree
8	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Agree	Strongly Agree
9	Strongly Agree	Neither Agree nor Disagree	Strongly Agree	DisAgree	Agree
10	Strongly Agree	Agree	Agree	Neither Agree nor Disagree	Agree
11	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree
12	Strongly Agree	Neither Agree nor Disagree	Strongly Agree	Neither Agree nor Disagree	Strongly Agree
13	Agree	DisAgree	Agree	DisAgree	Agree
14	Strongly Agree	Strongly Agree	Agree	Neither Agree nor Disagree	Agree
15	Neither Agree nor Disagree	Agree	Agree	Agree	Agree
16	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree
17	Strongly Agree	Strongly Agree	Strongly Agree	Agree	Strongly Agree
18	Agree	Agree	Agree	Agree	Agree
19	Neither Agree nor Disagree	Agree	Strongly Agree	Agree	Agree
20	Agree	Agree	Agree	Agree	Agree
21	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Strongly Agree
22	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Neither Agree nor Disagree
23	Strongly Agree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
24	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Agree
25	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Strongly Agree
26	Agree	Agree	Strongly Agree	strongly Agree	Agree
27	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Agree	Agree
28	Agree	Agree	Strongly Agree	Strongly Agree	Agree
29	Disagree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
30	Strongly Agree	Agree	Neither Agree nor Disagree	DisAgree	Agree

**Total response count by the question -topic 3**

	Question 1	Question 2	Question 3	Question 4	Question 5
Count (N)	30	30	30	30	30
Not Answered	0	0	0	0	0
Total	30	30	30	30	30

**Total count by the scale and question-topic 3**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree	0	0	0	0	0
Disagree	1	1	0	3	0
Niether Agree nor Disagree	11	13	8	11	3
Agree	10	14	15	12	17
Strongly Agree	8	2	7	4	10
Total	30	30	30	30	30

**Percentage by question by scale**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree (%)	0%	0%	0%	0%	0%
Disagree (%)	3%	3%	0%	10%	0%
Niether Agree nor Disagree (%)	37%	43%	27%	37%	10%
Agree (%)	33%	47%	50%	40%	57%
Strongly Agree (%)	27%	7%	23%	13%	33%
Total	100%	100%	100%	100%	100%

**Overall percentage by the scale and total response -topic 3**

Scales	Question 1	Question 2	Question 3	Question 4	Question 5	Total Response	Total Response	Scale Percentage - all Questions
Strongly disagree (%)	0	0	0	0	0	0	150	0%
Disagree (%)	1	1	0	3	0	5	150	3%
her Agree nor Disagree	11	13	8	11	3	46	150	31%
Agree (%)	10	14	15	12	17	68	150	45%
Strongly Agree (%)	8	2	7	4	10	31	150	21%
<b>Total Responses by Question</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>150</b>	<b>150</b>	<b>100%</b>



***Topic #4 questionnaire and responses*****Category of Risk:**

**Importance of coordination among decision makers at shipping enterprises to create efficient and safe transport of crude oil between Middle East and China.**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither Agree nor Disagree</b>	<b>Agree</b>	<b>Strongly Agree</b>
Communication among decision makers at shipping enterprises plays a crucial role in efficient and safe transport of crude oil between Middle East and China.	1	2	3	4	5
Ship owners, shoreside managers and seagoing officers are part of the decision-making process at the shipping companies engaged in the sea-transport of crude oil from Middle East to China.	1	2	3	4	5
To ensure efficiency and safety of crude oil transportation between Middle East to China, decision makers should mutually agree upon adequate steps.	1	2	3	4	5
It is critical that decisions related to efficiency and safety to be communicated to the employees in the operational level for adequate implementation.	1	2	3	4	5
Currently, shipping companies have systems of adequate coordination among decision makers to create efficient and safe transport of crude oil between Middle East and China ports.	1	2	3	4	5

**Survey Responses for Topic 4**

Respondent	Question 1	Question 2	Question 3	Question 4	Question 5
1	Agree	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Agree
2	Agree	Agree	Agree	Agree	Agree
3	Agree	Agree	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree
4	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree	Agree
5	Agree	Strongly Agree	Agree	Strongly Agree	Neither Agree nor Disagree
6	Agree	Neither Agree nor Disagree	Strongly Agree	Strongly Agree	Neither Agree nor Disagree
7	Strongly Agree	Agree	Strongly Agree	Agree	Strongly Agree
8	Strongly Agree	Strongly Agree	Agree	Agree	agree
9	Strongly Agree	Neither Agree nor Disagree	Agree	Strongly Agree	Neither Agree nor Disagree
10	Agree	Agree	Agree	Agree	Strongly Agree
11	Neither Agree nor Disagree	Neither Agree nor Disagree	Strongly Agree	Strongly Agree	Neither Agree nor Disagree
12	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neither Agree nor Disagree
13	Agree	Neither Agree nor Disagree	Agree	Agree	Neither Agree nor Disagree
14	Agree	Strongly Agree	Strongly Agree	Strongly Agree	Neither Agree nor Disagree
15	Agree	Agree	Agree	Agree	Agree
16	Agree	Strongly Agree	Strongly Agree	Agree	Strongly Agree
17	Neither Agree nor Disagree	Agree	Neither Agree nor Disagree	Strongly Agree	Neither Agree nor Disagree
18	Agree	Agree	Strongly Agree	Strongly Agree	Agree
19	Neither Agree nor Disagree	Neither Agree nor Disagree	Agree	Agree	Strongly Agree
20	Strongly Agree	Agree	Agree	Strongly Agree	Agree
21	Neither Agree nor Disagree	Agree	Agree	agree	Agree
22	Neither Agree nor Disagree	Agree	Agree	Agree	Agree
23	Agree	Neither Agree nor Disagree	Strongly Agree	Neither Agree nor Disagree	Disagree
24	Agree	Neither Agree nor Disagree	Agree	Agree	Strongly Agree
25	Neither Agree nor Disagree	Disagree	Agree	Agree	Disagree
26	Disagree	Agree	Agree	Agree	Strongly Agree
27	Neither Agree nor Disagree	Agree	Disagree	Agree	Agree
28	Agree	Strongly Agree	Agree	Strongly Agree	Neither Agree nor Disagree
29	Agree	Agree	Strongly Agree	Neither Agree nor Disagree	Neither Agree nor Disagree
30	Agree	Disagree	Agree	Neither Agree nor Disagree	Agree

**Total response count by the question -topic 4**

	Question 1	Question 2	Question 3	Question 4	Question 5
Count (N)	30	30	30	30	30
Not Answered	0	0	0	0	0
<b>Total</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>

**Total count by the scale and question-topic 4**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree	0	0	0	0	0
Disagree	1	2	1	0	2
Niether Agree nor Disagree	7	8	2	5	10
Agree	17	13	17	14	12
Strongly Agree	5	7	10	11	6
<b>Total</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>

**Percentage by question by scale**

	Question 1	Question 2	Question 3	Question 4	Question 5
Strongly disagree (%)	0%	0%	0%	0%	0%
Disagree (%)	3%	7%	3%	0%	7%
Niether Agree nor Disagree (%)	23%	27%	7%	17%	33%
Agree (%)	57%	43%	57%	47%	40%
Strongly Agree (%)	17%	23%	33%	37%	20%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Overall percentage by the scale and total response -topic 4**

Scales	Question 1	Question 2	Question 3	Question 4	Question 5	Total Response	Total Response	Scale Percentage -all Questions
Strongly disagree (%)	0	0	0	0	0	0	150	0%
Disagree (%)	1	2	1	0	2	6	150	4%
Neither Agree nor Disagree (%)	7	8	2	5	10	32	150	21%
Agree (%)	17	13	17	14	12	73	150	49%
Strongly Agree (%)	5	7	10	11	6	39	150	26%
<b>Total Responses by Question</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>150</b>	<b>150</b>	<b>100%</b>

## Demography analysis

### *Demography questions to respondents*

#### **Operational Risk in Tanker Voyages**

This survey seeks to understand the factors in tankship movements between the Middle East and China.

#### **Demographic Information**

1. Which of the following describes the bulk of your maritime experience?  
 Operations  Finance  Cargo  Shoreside  None of these.
2. Which describes your years of maritime work experience?  
 0 to 2  3 to 10  More than 10
3. Which describes your years of work experience in the Middle East or China?  
 0 to 2  3 to 10  More than 10
4. Which describes your years of work experience dealing with the Middle East?  
 0 to 2  3 to 10  More than 10
5. Which describes your years of work experience dealing with China?  
 0 to 2  3 to 10  More than 10

For each of the questions below, circle the response that best explains your belief.

### **Data Analysis Results**

#### **Respondents' Bulk of Experience in the Maritime Industry**

Area of experience	Number of participants	Percentage
<b>Cargo</b>	3	10%
<b>Finance</b>	1	3%
<b>Operations</b>	10	33%
<b>Shoreside</b>	11	37%
<b>None of these</b>	5	17%
<b>Total</b>	<b>30</b>	<b>100%</b>

**Analysis – Respondents from Cargo section**

	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
	Cargo	3 to 10	0 to 2	0 to 2	3 to 10
	Cargo	3 to 10	0 to 2	0 to 2	0 to 2
	Cargo	3 to 10	3 to 10	0 to 2	0 to 2
<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
Years of Experience	0 to 2 yrs.	0	2	3	2
Years of Experience	3 to 10 yrs.	3	1	0	1
Years of Experience	more than 10 yrs.	0	0	0	0
Years of Experience -%	0 to 2 yrs.	0%	67%	100%	67%
Years of Experience -%	3 to 10 yrs.	100%	33%	0%	33%
Years of Experience -%	more than 10 yrs.	0%	0%	0%	0%

**Analysis – Respondents from the Finance section**

	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
	Finance	0 to 2	more than 10	more than 10	0 to 2
<b>Total</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>
Years of Experience	0 to 2 yrs.	1	0	0	1
Years of Experience	3 to 10 yrs.	0	0	0	0
Years of Experience	more than 10 yrs.	0	1	1	0
Years of Experience -%	0 to 2 yrs.	100%	0%	0%	100%
Years of Experience -%	3 to 10 yrs.	0%	0%	0%	0%
Years of Experience -%	more than 10 yrs.	0%	100%	100%	0%

**Analysis – Respondents from the Operations section**

	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
	Operations	3 to 10	0 to 2	0 to 2	0 to 2
	Operations	more than 10	0 to 2	0 to 2	0 to 2
	Operations	more than 10	0 to 2	0 to 2	0 to 2
	Operations	0 to 2	0 to 2	0 to 2	0 to 2
	Operations	3 to 10	0 to 2	0 to 2	0 to 2
	Operations	more than 10	0 to 2	0 to 2	0 to 2
	Operations	more than 10	0 to 2	0 to 2	0 to 2
	Operations	3 to 10	3 to 10	3 to 10	3 to 10
	Operations	more than 10	3 to 10	3 to 10	3 to 10
	Operations	3 to 10	0 to 2	0 to 2	0 to 2
<b>Total</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>
Years of Experience	0 to 2 yrs.	1	8	8	8
Years of Experience	3 to 10 yrs.	4	2	2	2
Years of Experience	more than 10 yrs.	5	0	0	0
Years of Experience -%	0 to 2 yrs.	10%	80%	80%	80%
Years of Experience -%	3 to 10 yrs.	40%	20%	20%	20%
Years of Experience -%	more than 10 yrs.	50%	0%	0%	0%

**Analysis – Respondents from the Shoreside section**

	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	more than 10	more than 10	more than 10
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	0 to 2	0 to 2	0 to 2
	Shoreside	0 to 2	3 to 10	3 to 10	3 to 10
	Shoreside	3 to 10	3 to 10	0 to 2	3 to 10
	Shoreside	more than 10	0 to 2	3 to 10	0 to 2
<b>Total</b>	<b>11</b>	<b>11</b>	<b>11</b>	<b>11</b>	<b>11</b>
<b>Years of Experience</b>	0 to 2 yrs.	9	8	8	8
<b>Years of Experience</b>	3 to 10 yrs.	1	2	2	2
<b>Years of Experience</b>	more than 10 yrs.	1	1	1	1
<b>Years of Experience -%</b>	0 to 2 yrs.	82%	73%	73%	73%
<b>Years of Experience -%</b>	3 to 10 yrs.	9%	18%	18%	18%
<b>Years of Experience -%</b>	more than 10 yrs.	9%	9%	9%	9%

**Analysis – Respondents from the “none of these” category**

	Area of Experience	Maritime Experience	Middle East/Africa to China Experience	Dealing with Middle East	Dealing with China
	None of these	0 to 2	0 to 2	0 to 2	0 to 2
	None of these	3 to 10	0 to 2	0 to 2	0 to 2
	None of these	0 to 2	3 to 10	3 to 10	0 to 2
	None of these	0 to 2	0 to 2	0 to 2	0 to 2
	None of these	0 to 2	3 to 10	3 to 10	0 to 2
<b>Total</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Years of Experience</b>	0 to 2 yrs.	4	3	3	5
<b>Years of Experience</b>	3 to 10 yrs.	1	2	2	0
<b>Years of Experience</b>	more than 10 yrs.	0	0	0	0
<b>Years of Experience -%</b>	0 to 2 yrs.	80%	60%	60%	100%
<b>Years of Experience -%</b>	3 to 10 yrs.	20%	40%	40%	0%
<b>Years of Experience -%</b>	more than 10 yrs.	0%	0%	0%	0%