Continuous Improvement: Maximization of Backhaul Utilization for Very Large Ore Carrier (VLOC)

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ABSTRACT

This study aims to explore options to develop backhauls utilization for a logistic company (pseudonym MINE CORP), which operates transporting ore from South American to Australasian Ports in Very Large Ore Carrier (VLOC) vessels, however the backhaul is currently empty. Three variables were evaluated named Backhauling of Container; Diverse Shipping Routes and Possible Products for Backhaul Logistics in VLOC, in order to identify the most significant positive impact on the maximization of its backhaul. The data for this study was gathered, and an appropriate Mean and Multilinear Regression (MLR) Analysis was conducted, along with contract, design, and legal requirement analysis. It was confirmed that all three variables have a moderate high-level relationship with the maximization of backhaul utilization, implying that all three variables have a significant positive impact on the maximization of backhaul utilization. The best products for this utilization of backhaul are steel plates and containers (20 TEU) with goods from China, options selected by MINE CORP for future investment in its backhaul strategy.

Acknowledgments

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Chapter 1

Introduction

1.1 Background of Study

The return journey of a commercial vessel carrying freight along all or part of the same route it took to get to its present location back to its roots is known as backhaul shipping logistics [1]. Backhaul logistics has long been associated with trucking, shipping, and railroad transportation, and is driven by demographics, geography, the economy, environment, and industry [2].

Specialized businesses use licensed barge lines to transport goods or individuals worldwide, and small vessels with a maximum individual capacity of 170,000 DWT to transport materials such as ore, all of which require supply chain management. This is an emerging market, so there is plenty of room for improvement in terms of economics, legal aspects, logistics and capabilities, particularly regarding sustainable cost-cutting opportunities and profits for the next five years.

VLOC, which started being manufactured in China in 2008, is the world's largest bulk carrier for shipping iron ore, it has a regular 365,000 dwt and can navigate 25,500 nautical miles at a speed of 14.5 knots [3].

Iron ore deposits account for 5% of the earth's crust. Only a small part of iron ore occurs in rich deposits. World reserves of iron ore are estimated at 170 billion tons. These reserves equate to about 81 billion tons of iron content. The Table 1.1 of Appendix I shows the global iron reserves in 2013, pointing Australia as the largest iron ore reserves with 35 billion tons, followed by Brazil with 31 billion tons.

Brazil is the largest iron ore exporter in the world, followed by China. However, China mostly exports a lower grade of iron ore. Brazil exported 13.9 million metric tons of steel in 2018, a decrease of 9% from 15.3 million metric tons in 2017. The total of steels exported by Brazil accounted for about 3% of all steels exported globally in 2017, where this country exports to more than 110 countries and territories. Brazil has recorded a growth of 62% in annual steel exports since 2009 [4]. Boosted by Brazil's exports of ore, there has been a steady increase in freight rates over the last five years. Shipping companies also expect capacity to increase as operators restore service vessels that are being retrofitted to meet new emissions restrictions.

Iron ore has a density varied between 2.65 to 3.13 ton/m3, which is greater than the density of saltwater which varies from 1.20 to 1.29 ton/m3. Therefore, the cargo hold is designed to be narrow. The journey of transporting iron ore in VLOC to its destination involves a 2-way journey on the same route. In this context, the return trip from shipping the ore is called maritime backhaul, which is a term used to define the haul of a shipment back over part of a route which it already traveled.

The backhaul of VLOC is usually empty. The expense for the empty backhauls is usually calculated into the freight rate in advance [5]. This potential in an empty VLOC, on the other hand, will provide an incentive for the shipping business to raise sales and profits.

This study aims to explore the various ways to maximize the backhaul utilization for VLOC with a case study of a chosen shipping company, MINE CORP.

1.1.1 Background of the Company

MINE CORP (the real name of the company is to be kept confidential) is an American multinational corporation operating in 25 countries. It has one of the largest logistics networks integrating mines, railroads, and shipping. [6]

In 2017, the company's gross revenue was USD28 billion, with a net income of USD4 billion. MINE CORP has shipping facilities (ports and terminals) in 12 countries, including Malaysia. Their primary operations are the extraction of metal ore from South American mines and transportation of the ore to customers in Australasia through land and sea.

China is the world's largest consumer of metals. The distance between Australian Ports/Terminals and China is 60% less than the distance between South American Ports/Terminals, as demonstrated in the Tables 1.2 & 1.3 of Appendix II.

MINE CORP has spent the last 20 years researching ways to increase its competition over its Australian rivals by implementing the following strategies:

• Investing in the creation of VLOCs in order to increase individual capacity for transporting metal ore from South American ports to Australasia ports. Prior to that, MINE CORP currently operates 75 VLOC vessels, increasing the company's capacity for growth, productivity, and long-term viability.

• Implementing a Distribution Center in Asia called Malaysia DC, where metal ore is stocked before being resold and shipped to local consumers.

1.2 Problem Statements

Usually, the cost of empty backhauls is factored into the freight rate ahead of time. The following variables will be explored in order to validate a backhaul logistics using alternative products:

- Studies for possible sea routes for backhaul.
- Verify possibility for transporting containers.
- Check out the possible products to be transported back.

1.3 Research Questions

Based on the problem statements stated in the previous section, below are the research questions for this research:

i. What are the options of products for backhaul logistics in a current VLOC carrier?

ii. What does the impact of container backhaul on maximizing the backhaul utilization for VLOC?

iii. What is the best way to maximize the backhaul utilization for VLOC?

iv. What is the impact of planning an effective and efficient shipping route on maximizing the backhaul utilization for VLOC?

v. What are the benefits of maximized backhaul utilization for VLOC on the company?

1.4 Research Objectives

The research objectives are:

- Investigating the three variables listed in the problem statement (possible sea routes, container transportation, and potential products);

- Validate the use of backhaul logistics in VLOC for alternative products, if applicable; this could be an opportunity for the shipment company to generate additional revenue and maximize profits.

1.5 Research Scope

This study focuses on the various possibilities for MINE CORP to maximize the backhaul utilization for its VLOCs. Hence, the study will be conducted to a total of 100 volunteer employees by contacting them through social media. Once they permit to join as respondents, a questionnaire will be emailed to them. A quantitative study approach is utilized to collect the data. Then, all the data will be arranged and analyzed by using the statistical tool of Statistical Package of Social Science (SPSS) using frequency, mean, and multilinear regression tests.

1.6 Research Significance

All the contents included in this study can be used as references by companies, which can then be turned into strategies to maximize backhaul utilization for VLOC. Each company may have different perspectives and develop different strategies for maximizing VLOC backhaul utilization. Nonetheless, they can all draw good comparisons from all the variables analyzed in this study to determine which variable benefits businesses the most. Profits may be increased by maximizing VLOC's backhaul use, and the benefits extend beyond arranging ship trips to finish a section on schedule. When shipments are prepared properly, fuel consumption is avoided, resulting in cost savings and less environmental impact. It also increases productivity by increasing organizational efficiency through the efficient usage of units and labor.

Chapter 2

Literature Review

This chapter highlights the literature review based on the current study. Key concepts for current research will also be explained in this chapter. Past studies related to the study are also presented in the next section, along with the research framework, as well as hypotheses to be tested for the research.

Historically, in the end of 70s the Capsize vessel (150,000 DWT) replaced the Panamax vessel (70,000 DWT) to perform long terms voyages (from Brazil to Japan, for instance). The VLOC vessel has been used as a strategy to transport significant amounts of iron per dedicated journey since 2007 [7]. MINE CORP is currently using 60 VLOC under a 25-year freight contract that began in 2020. The Figure 2.1 is showing the difference among the most common vessels from the market [8]:

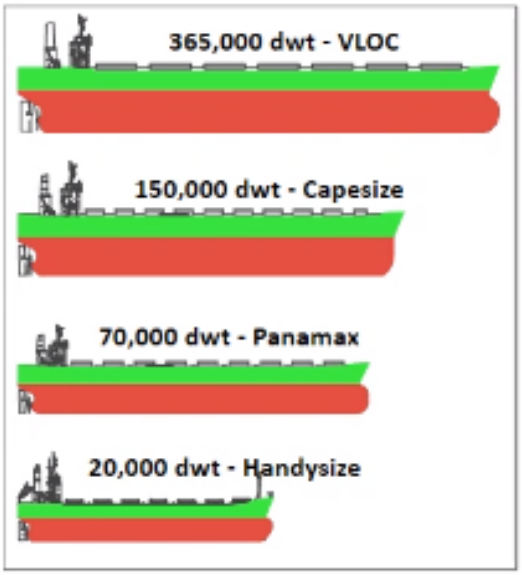


Figure 2.1: The Difference among Common Vessels in the Market.

The trade routes for iron ore export from Brazil to Asia are shown in the Figure 2.2:

Figure 2.2: Common Route for VLOC.

VLOC refers to an ore carrier that has a bigger size than the usual ore carrier. Ore carriers are typically used for specific trades such as the carriage of iron ore in bulk. It is often seen from major Brazilian or Australian ports to specific Chinese or Japanese ports. Because of the high density of ore cargoes in a seaway, it is important for ore carriers to be reinforced by class requirements. A standard VLOC has an overall length of 340m, a breadth of 60m, a draught of 21m, and a deadweight tonnage capacity of 323,000 metric tons [9].

2.1 Key Concepts of the Research

2.1.1 Backhauling of Container

Maritime shipping companies own the majority of containers, with the increasing share of container ownership attributed to them in recent years reaching 59.8% in 2008. This occurs because containers, especially for shipping lines, allow for clear brand recognition. Furthermore, containers served as an asset that enabled maritime shipping companies to better

serve their customers. Providing containers also aids in increasing containership utilization rates.

However, the container leasing business is less profitable due to the repositioning of empties and systematically low freight rates along several trade routes. Ocean carriers also have a greater ability to reposition empty containers since they control a fleet and can reposition their empty containers when capacity is available. It is also not uncommon that a whole containership will be chartered to reposition empties.

Since cargo for the return leg cannot be identified, an increasing number of containers are repositioned empty. As shippers try to control the degree of utilization of their containerized assets, the result has been an increase in repositioning costs. The location of empty containers is thus one of the most difficult issues in global freight distribution, a problem highlighted by the fact that approximately 2.5 million TEU of containers are stored empty and waiting to be used. Empty containers account for about 10% of existing container assets and 20.5% of global port handling. Trade imbalances, high repositioning costs, high manufacturing, and leasing costs, as well as user preference, are all major causes of this issue. Furthermore, it is not always an economic opportunity for shipowners, as shipping containers are only considered to increase revenue. [10].

As a result, shipping companies that want to optimize VLOC backhaul use should produce revenue by shipping containers during the backhaul.

2.1.2 Diverse Shipping Routes

Maritime transportation networks are planned to take the shortest route when serving the most important markets. As a result of this situation, different compromises have been made between the number of ports of call and the number of ships assigned to trades. Meanwhile, containerization has had a major effect on the maritime route configuration because loading and unloading a ship has become very costly and time consuming because a freight ship spends more time at port than at sea. The pattern has now shifted, with container ships spending more time at sea than in port, continuously moving between ports of call. As a result, containerships have developed into a more dynamic system capable of serving a range of markets.

Shipping companies organize the maritime route according to the commercial services they support. The services provided by maritime routes are divided into three categories: port-to-port, pendulum, and round-the-world, as demonstrated in the Figure 2.3.

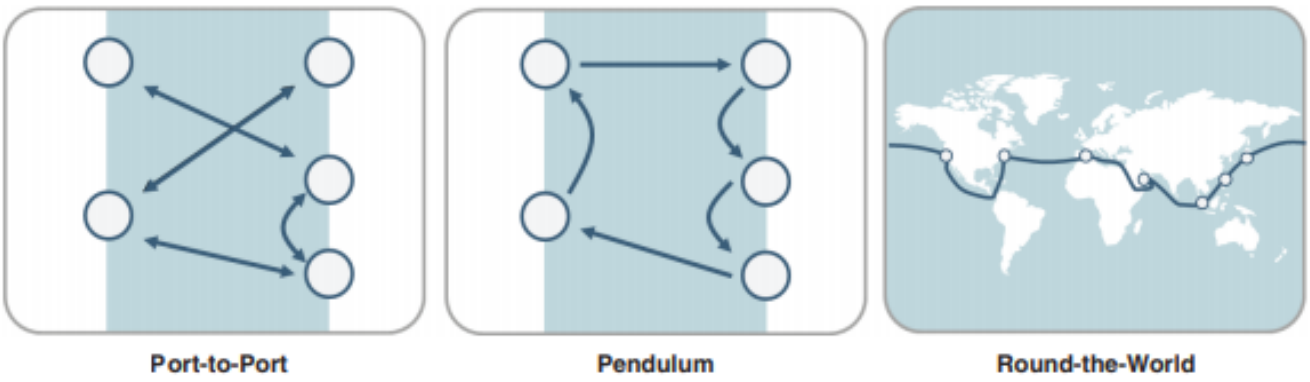


Figure 2.3: Types of Maritime Services.

i. Port-to-port services

This category reflects the traditional service structure, in which routine calls between two ports are made. Typically, ships in this group travel back and forth with a full load to their destination and an empty backhaul on their way back to their roots. When a ship transports raw material like ore, oils, and grains, this route is usually taken. Typically, chartered ships serve these markets by loading their cargo in one port near a major resource mining area and discharging it in one to three ports.

ii. Pendulum service

Pendulum routes are a form of service that involves ships that have set itineraries that cover a series of ports calls that are serviced in a specific order. The sequence of these ports is designed to optimize the load factor of the ships. The word "pendulum" describes a shipping service that alternates between two maritime ranges. Some pendulum services, on the other hand, span three maritime ranges. The three key poles of the global economy, East Asia, North America, and Western Europe have the most important pendulum paths.

iii. Round-the-world service

Round-the-world service is associated with container shipping and entails calling at a series of ports, often in both directions, in order to complete a round-the-world journey. Just a few ports are serviced per continent, but those ports are either major gateways or trans-shipment hubs. As a result, round-the-world services are an effort to link longitudinal and latitudinal exchange flows more effectively.

The project's reach is broad since it involves a complicated process that necessitates extensive and in-depth interference with the company's processes in order to arrive at solutions that can then be enforced. This is difficult to create since the organization has several divisions that need scrutiny and optimal management.

To persuade an executive board to change an internal policy within a large company, an escalation of internal levels is needed, which usually requires time and opportunities to access the right people at the appropriate times and platforms.

Another challenge is that this project has not been allocated any budget therefore all studies and execution are carried out voluntarily and not within work hours of the stakeholders.

Therefore, this document will be presented as academic results and will require vetting by the various departments for validation and implementation.

2.2 Potential Ports/Terminals

Potential Ports listed in the Table 2.1 of Appendix V are searched based on the registers in the system for any professional relationship done by MINE CORP. These ports are considered to have adequate draughts to berth VLOC vessels with an average length of 24.7 meters and the required government marine department approval for this service.

2.3 Recent Studies

According to a report by [11], the transportation industry has become extremely competitive. Fuel rates and taxes have also risen, putting pressure on many shipping firms to

lift their delivery prices. The shipping companies' productivity has been specifically harmed because of this situation. Backhauling techniques are known to minimize shipping costs while still delivering delivery services to customers. The study proposes a cooperative scenario to get the most out of backhaul strategies. Companies are rewarded for using those vehicles and routes in this cooperative situation, lowering transportation costs, and reducing the number of vehicles needed. This technique is thought to be beneficial to the atmosphere since it reduces CO2 emissions. They can also plan their routes to take advantage of backhauling strategies. [12] supports this research by suggesting that in order to optimize backhaul use, shipping companies must plan their routes effectively and diversify them so that they can access more business opportunities.

However, because of the high carbon emissions, this scenario could have an environmental impact. Furthermore, this approach necessitates the use of a particular carrier that meets specific requirements from the standpoint of a single entity. [13].

The container is in high demand on the market since it assists many companies in obtaining recognition. However, the container leasing industry has become less profitable due to increasing costs of new containers, repositioning of empties, and systematically low freight prices along many trade routes. Since they operate a fleet and can reposition their empty containers when capacity is required, ocean carriers have a greater ability to reposition empty containers. It is also not unusual to charter an entire containership to reposition empties. As a result, shipping companies profit from this situation by using the backhaul strategy for containers, while container producers save money on shipping [12].

Samsul Islam (2017) emphasizes the advantages of reducing empty backhauls, especially in terms of lowering carbon emissions [13]. Furthermore, this approach has many economic advantages, including significant cost savings for shippers. It could also mean more money for the workers, as well as more transport power for the port. In terms of environmental effects, sustainability can be practiced by drastically reducing carbon emissions. There would be less traffic and congestion as a result of carrier sharing.

2.4 Research Gap

There has been no research done to compare the best option to maximize the backhaul utilization for VLOC yet. Hence, to fill in this gap, this research, the researchers have made several literature reviews on the most possible options in maximizing the backhaul strategy for VLOC. How the research conducted will be explained in the next section.

2.5 Research Framework

The Research Framework is being presented in the Figure 2.4:

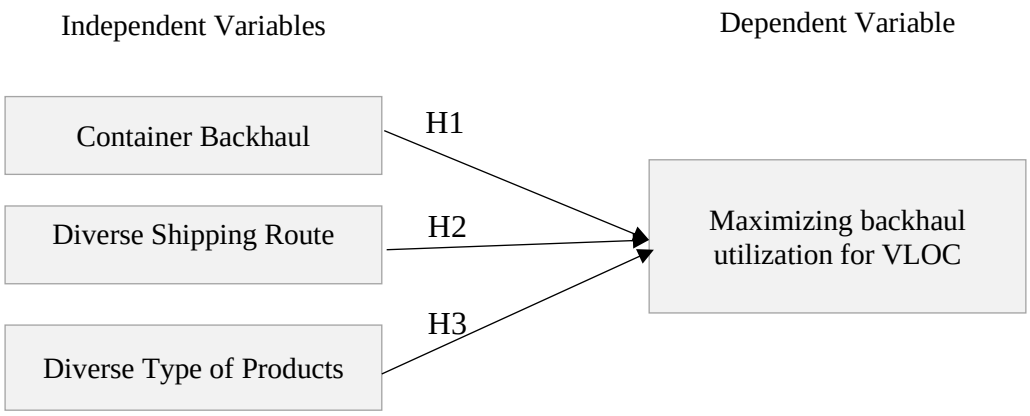


Figure 2.4: Research Framework Developed for this Research.

2.6 Research Hypotheses

For this Project development, the following hypotheses are being identified, it is necessary to verify it and proceed with proper confirmation:

- ✓ **HYPOTHESIS 1:**

  - ⇨ **H1:** The container backhauling strategy has a significant positive influence on maximizing the backhaul utilization for VLOC;

- ✓ **HYPOTHESIS 2:**

  - ⇨ **H2:** The utilization of diverse shipping route has a significant positive influence on maximizing the backhaul utilization for VLOC;

- ✓ **HYPOTHESIS 3:**

  - ⇨ **H3:** The possible products for backhaul logistics have a significant positive influence on maximizing the backhaul utilization for VLOC.

2.7 Chapter Conclusion

Thus, three factors must be checked to see whether they have a major effect on optimizing backhaul utilization for VLOC: container backhauling strategies, diverse shipping routes strategies, and a diverse type of possible products. The next chapter will describe how the study will be carried out.

Chapter 3

Research Methodology

The concept of research methodology, which is a technique for conducting research and resolving any problems that occur during the process, will be discussed in this chapter [14].

3.1 Research Paradigm

The research paradigm is characterized as the thoughts and beliefs that a researcher holds in order to investigate a specific issue [15]. The research paradigm that is selected has a huge impact on how each research process is decided.

Positivism, interpretivism, and critical theory are the three main research paradigms [16]. If researchers need to consider the research issue as well as find evidence to support the measurements used in the study, they will use the positivism model. The positivism model requires researchers to design an experiment to see how independent variables affect the dependent variable, which they discover by casual inferences. In contrast, the interpretivism paradigm is applied to conduct a research that is conducted based on the personal experiences of subjects. The researchers were able to obtain a better understanding of the subjects' experiences based on their values and beliefs, and then interpret and analyze the data [17]. Meanwhile, the critical theory paradigm is used when researchers need to investigate the research issue, as well as demonstrate and clarify what is wrong with it. Furthermore, the researchers must define several solutions or approaches to solving the problem, as well as ensure that the solution can be effectively implemented in society [18].

The aim of this study is to look at how to get the most out of a very large ore carriers backhaul (VLOC). Several variables for this study are discovered by inferences made on the fly. As a result, the researchers will use the positivism model and try to find evidence to support the study's hypothesis and discover significant data between independent and dependent variables. An experiment will be designed to understand the objectives of the research by distributing a questionnaire to the respondents.

3.2 Research Approach

Research is described as the systematic and logical pursuit for new and useful knowledge while investigating a topic [19]. The research approach, on the other hand, refers to the method used to perform the research process [20].

The qualitative research methodology is used to perform research that seeks to learn more about the participants' experiences, it's what's known as interpretive analysis and permits a wide range of data collection, with an emphasis on text data processing rather than numerical data [21]. The quantitative analysis approach, on the other hand, is solely concerned with numerical data, and the information gathered by this method must be quantified and analyzed before the results can be obtained, as a result, a specific statistical tool is needed to analyze the data to properly address the research questions. [22].

The analysis of optimizing backhaul utilization for VLOC will take a quantitative approach, in which all data obtained from the research experiment will be quantified before being analyzed to test hypotheses. The topic necessitates the collection of primary data, which

is best accomplished by the quantitative method [23]. Since quantitative analysis is more focused and the goals are compatible with the numbers and data collected, accurate and efficient variable calculation can be measured by the distribution of questionnaires to describe, explain, and predict the outcomes. The outcome would be more effective if a quantitative approach was used [24]. Furthermore, the researchers want to simplify the analysis so that they can focus on describing and comprehending the problem. Researchers may use a quantitative analysis approach to simplify and restructure a complex problem into a small number of variables.

3.3 Research Design

The conceptual blueprint for conducting research is known as research design [25]. Descriptive, explanatory, and exploratory research designs are the three styles of research designs.

The quantitative thoughts of the variables are defined using a descriptive research design. Researchers who use a descriptive analysis design have no control over the investigation and are only required to record and explain the exact data displayed, not to provide any reasons for the findings [26]. Explanatory study design, on the other hand, is used to clarify rather than describe the phenomenon under investigation [27]. It is linked to the qualitative study method because it allows the researcher to gain a better understanding of the research problem by describing the phenomenon using complex and versatile data obtained from qualitative studies. Exploratory test design, on the other hand, is used to assess the reliability of research instruments and decide if it is appropriate to continue conducting research with the instrument [28].

Due to the quantitative analysis methodology used in this study, a questionnaire will be used as the research instrument. The questionnaire will be adapted from many existing questionnaires used in previous studies; as a result, the study will employ an exploratory research design in which the questionnaire's reliability will be assessed to determine its suitability for the current study. However, later, a descriptive research design will be used to explain the research findings.

3.4 Sampling

The method of choosing a sample from a population with specific characteristics is referred to as sampling [29]. Sampling may be used to generalize the relationships found in a current theory of a specific problem and draw conclusions about a specific population.

3.4.1 Sampling Design

The method for choosing a sample for a survey is referred to as sampling design, and it has a profound impact on the important aspects of that survey. A proper sampling design has the benefit of estimating both the sample and the underlying population. [30].

Probability sampling and non-probability sampling are the two kinds of sampling techniques. Probability sampling, also known as random sampling, aims to give the population the same probability of being selected as a sample and is often correlated with a quantitative survey. Non-probability sampling, on the other hand, is used to allow researchers to rely on a particular sample size and is often correlated with qualitative study.

A convenient sampling of the probability is chosen as the sampling technique for this research. This decision was made because it allows researchers to reach out to those targeted audiences that are easily available. Furthermore, this method is the least expensive and time-consuming. As a result, study costs will be lower, and researchers will have more time to focus on data collection rather than having to spend extra time gathering data from the target population.

3.4.2 Population

A population is characterized as a group of individuals in a given area who share similar characteristics [31]. Setting a target population for study is critical because it is difficult for researchers to interview and survey each person without a focus group. The target population must be homogeneous and accurate for research purposes.

The employees of MINE CORP were selected as the study's target population. They were chosen because they have a close relationship and are the most qualified to address the issue of optimizing backhaul utilization for a very large ore carrier (VLOC). The best details could be obtained by focusing on MINE CORP employees. The researchers will communicate with them through social media.

3.4.3 Sample Size

Sample size is referred to as the number of units chosen to gather a specific collection of data [32]. It is important to choose an adequate sample size so that any error or sampling biases can be avoided [33].

A total of 100 of MINE CORP employees have been chosen as the sample size for this study. Choosing this number of respondents will help researchers to collect an ideal amount of data that could be efficiently studied and analyzed.

3.5 Data Collection Method

Data collection is referred to the collection of facts through various ways such as descriptions, observations, values, or measurements [34]. There are 2 types of data collection methods named primary and secondary data collections.

Primary evidence is information gathered by researchers on their own when doing studies. It can be gathered using a variety of research methods, including experiments, questionnaires, polls, interviews, and field observations. Secondary data, on the other hand, refers to information gathered by researchers from known databases that is important to the present study. It can be gathered from current books, magazines, documents, governmental sources, and existing databases [35].

The researchers will utilize primary data collection for this research since the topic being studied needs a statistical survey to be carried out where primary data collection is required to collect, study, and analyze the data.

3.5.1 Research Instrument

The research instrument of this study is a survey questionnaire. It was chosen over an interview questionnaire because this analysis employs a quantitative approach of primary

data collection, which can only be accomplished with a survey questionnaire. An interview questionnaire is not suitable, and it can only be used in qualitative research studies.

Respondents will receive the survey questionnaire from online sites in the form of a Google Form. Since an online survey is not restricted to being distributed in a specific region, this allows the researcher to reach the intended population more easily. Furthermore, since the employees are occupied, it is easier for them to simply fill out a questionnaire and return it to the researcher via mail.

The questionnaire is designed using a closed-ended questionnaire with a Likert Scale style and a 5-Point Likert Scale rather than a 7-Point Likert Scale. The 5-Point Likert Scale was chosen to prevent any confusion for respondents when answering any statements in the questionnaire where available points are not so identical to each other. The scale runs from 1 to 5, with 1 being “disagree very much” to 5 being “agree very much”, and 3 being “neutral”.

3.6 Data Analysis and Interpretation

Data analysis is defined as the process of working with the information to support the goals, plans, and work of research. It has the purpose to find a significant relationship between the variables [36].

All the data collected from the survey questionnaire will be arranged and analyzed through the Statistical Package for Social Sciences (SPSS). SPSS is a software for data management and statistical analysis which can conduct complex statistical analyses on its own

[37]. Percentage, mean, and Multilinear Regression (MLR) tests will be used as the statistical method to analyze the data. The data then will be tabulated and presented in the form of a graphical method. The relationship between the variables will be explained by using a descriptive method, as shown in the Table 3.1:

Table 3.1**:** Interpretation of Mean Value

Mean Value	**Level**
4.01 – 5.00	High
3.01 – 4.00	Moderate High
2.01 – 3.00	Moderate Low
1.01 – 2.00	Low

Source: Khodijah Abdul Rahman *et al.* (2018)

3.7 Ethical Consideration

When conducting experiments with human subjects, there are certain things to keep in mind [38]. If a researcher wants to gather data from human subjects, ethical behavior during the study activity is critical [39]. Via relevant ethical standards, this concern aims to protect human subjects in a specific research study [40].

Informed analysis and informed consent were used to make ethical decisions in this study. The paper is written in English by the researchers. The researchers will first contact the employees through LinkedIn to clarify the study's intent. When participants enter the study as respondents, they will be briefed about the study and their rights. They may withdraw from the

research at any time. Then, the researcher will make sure the respondents know the investigator's rights to acquire information from respondents. Only after making sure the respondents understood both informed study and informed consent, they are asked to sign an informed consent before answering the questionnaire. Data has been collected only after the respondents were ready to participate in the survey. No respondent has been forced to participate. To reach out to the generally busy respondents, an online survey questionnaire has been mailed to them. This has allowed them to send back completed questionnaire according to their free time. Analysis of data has been done using a 5-Point Likert Scale and no data misinterpretation has been made.

3.8 Summary of Research Methodology

In summary, this research utilizes a quantitative study approach with the primary data collection method. A survey questionnaire is used as the research instrument to collect data from 10 employees of MINE CORP, and it is distributed online in the mean of Google Form. The data collected is then arranged in the SPSS and analyzed by using percentage, mean, and Multilinear Regression (MLR) tests. All the findings will be tabulated and presented in the form of a graphical method. Furthermore, the descriptive method will be used to describe all the findings and the relationship between the variables. The next chapter will present all the findings for this research.

Chapter 4

Result and Discussion

This chapter will discuss all the conclusions from this particular study. The findings are shown as graphs and charts, and then explained using the descriptive approach. The relationship between each independent variable and dependent variables is determined using the Multilinear Regression (MLR) approach at the end of the chapter to decide the best choice for optimizing the backhaul utilization for a very large ore carrier (VLOC).

4.1 Demographic Profile

A total of 100 employees from MINE CORP were approached through the social media platform to ask for their permission to join the research. From a total of 100 employees, 80 respondents, or 80% of them participated in this research by answering the Forms in Appendices 3 & 4.

4.2 Mean and Multilinear Regression (MLR) Analysis

4.2.1 Container Backhauling Strategy

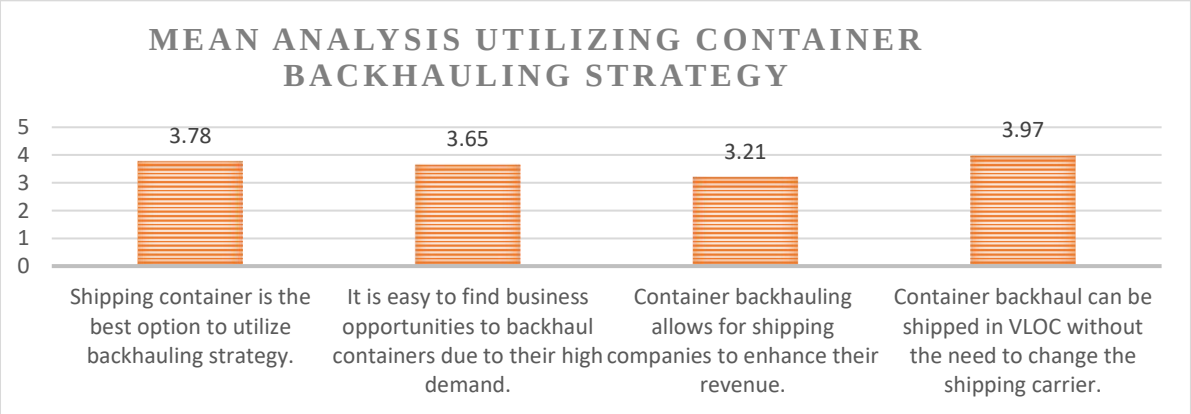
I. Impact of Container Backhauling Strategy on Maximization of Backhaul Utilization for VLOC

Table 4.1 and Graph 4.1 show the mean analysis for container backhauling strategy. Shipping container is the best option to utilize backhauling strategy, It is easy to find business opportunities for backhaul containers due to their high demand, Container backhauling allows

for shipping companies to enhance their revenue, and Container backhaul can be shipped in VLOC without the need to change the shipping carrier.

Table 4.1: Mean Analysis for Container Backhauling Strategy.

No.	Statement	Mean	Description
1	Shipping container is the best option to utilize backhauling strategy.	3.78	Moderate High
2	It is easy to find business opportunities for backhaul containers due to their high demand.	3.65	Moderate High
3	Container backhauling allows for shipping companies to enhance their revenue.	3.21	Moderate High
4	Container backhaul can be shipped in VLOC without the need to change the shipping carrier.	3.97	Moderate High
	Average Mean	3.65	Moderate High



Graph 4.1: Mean Analysis for Container Backhauling Strategy.

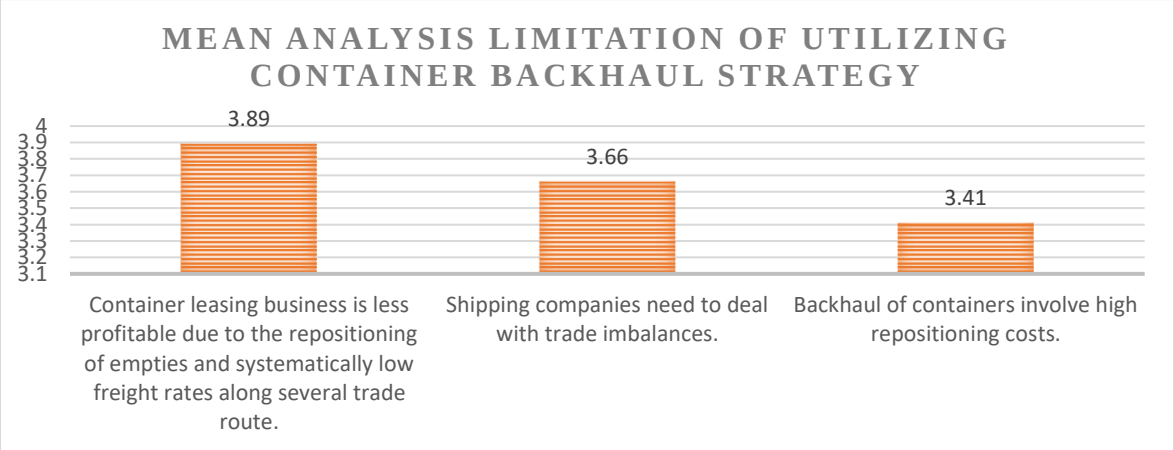
These are the constructs being researched. All four construct have moderate high interpretation with mean value 3.78, 3.65, 3.21, and 3.97, respectively. Meanwhile the average mean of all four construct is 3.65, also interpreted as moderate high level.

II. Limitation of Container Backhauling Strategy

Table 4.2 and Graph 4.2 show the mean analysis for limitation in container backhauling strategy. Three constructs were being studied, they were named container leasing business is less profitable due to the repositioning of empties and systematically low freight rates along several routes, shipping companies need to deal with trade imbalances, and backhaul of containers involve high repositioning costs.

Table 4.2: Mean Analysis for Limitation in Container Backhauling Strategy.

No.	Statement	Mean	Description
1	Container leasing business is less profitable due to the repositioning of empties and systematically low freight rates along several trade route.	3.89	Moderate High
2	Shipping companies need to deal with trade imbalances.	3.66	Moderate High
3	Backhaul of containers involve high repositioning costs.	3.41	Moderate High
	Average Mean	3.65	Moderate High



Graph 4.2: Mean Analysis for Limitation in Container Backhauling Strategy.

All three constructs have moderate high coefficient value with mean 3.89, 3.66, and 3.41, respectively. Meanwhile the average mean is 3.65 with moderate high level.

Related to Multilinear Regression (MLR) Analysis for relationship between utilization container backhauling strategy and the maximization of backhaul for VLOC, results are being presented in the Table 4.3:

Table 4.3: Relationship between utilization container backhauling strategy and the maximization of backhaul for VLOC.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.867[a]	.751	.742	.714

a. Predictors: (Constant), CONT4, CONT3, CONT2

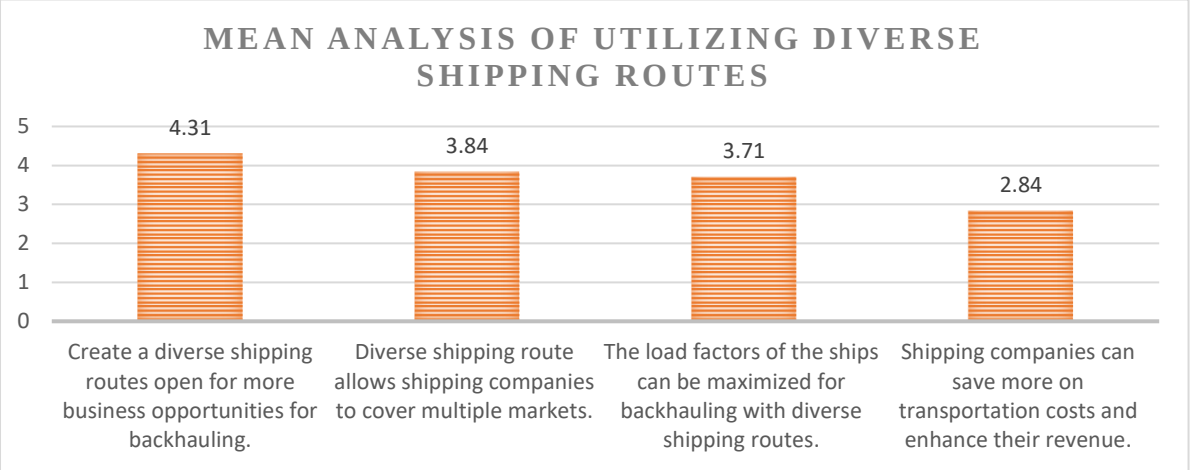
4.2.2 Diverse Shipping Routes

I. Impact of Utilization of Diverse Shipping Routes on Maximization of Backhaul Utilization for VLOC

Table 4.4 and Graph 4.3 show the mean analysis for diverse shipping routes. The first construct studied has a mean of 4.31 with high level interpretation. The second construct studied has a mean of 3.84 with moderate high interpretation.

Table 4.4: Mean Analysis for Diverse Shipping Routes.

No.	Statement	Mean	Description
1	Create a diverse shipping routes open for more business opportunities for backhauling.	4.31	High
2	Diverse shipping route allows shipping companies to cover multiple markets.	3.84	Moderate High
3	The load factors of the ships can be maximized for backhauling with diverse shipping routes.	3.71	Moderate High
4	Shipping companies can save more on transportation costs and enhance their revenue.	2.84	Moderate Low
	Average mean	3.68	Moderate High



Graph 4.3: Mean Analysis for Diverse Shipping Routes.

The third has a mean of 3.71 with moderate high interpretation. the last construct has a mean of 2.84 with a moderately low interpretation.

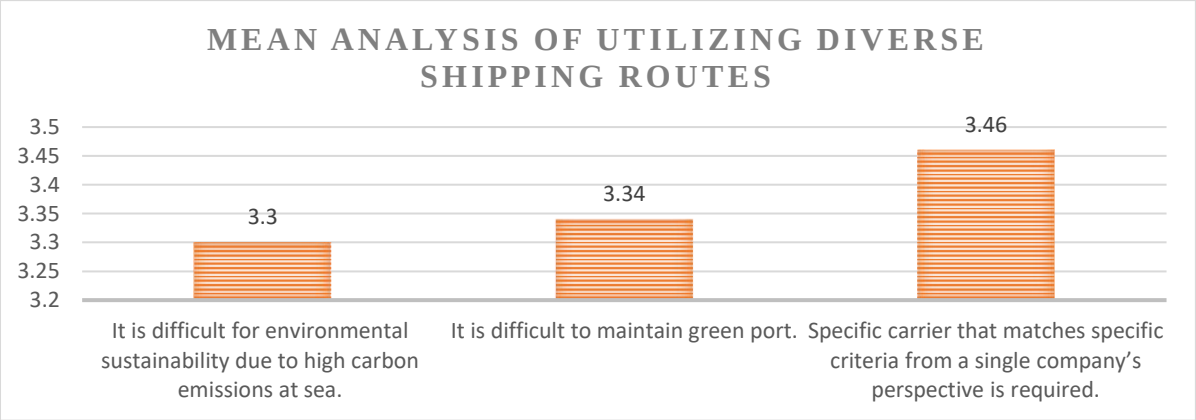
II. Limitation of Diverse Shipping Routes

Table 4.5 and Graph 4.4 show the mean analysis for limitation of diverse shipping routes. There are three constructs being research, they are, “It is difficult for environmental sustainability

due to high carbon emissions at sea", "It is difficult to maintain green port", and "Specific carrier that matches specific criteria from a single company's perspective is required".

Table 4.5: Mean Analysis for Limitation of Diverse Shipping Routes.

No.	Statement	Mean	Description
1	It is difficult for environmental sustainability due to high carbon emissions at sea.	3.30	Moderate High
2	It is difficult to maintain green port.	3.34	Moderate High
3	Specific carrier that matches specific criteria from a single company's perspective is required.	3.46	Moderate High
	Average Mean	3.37	Moderate High



Graph 4.4: Mean Analysis for Limitation of Diverse Shipping Routes.

All the constructs recorded mean value of 3.30, 3.34, and 3.46 with moderate high-level interpretation, respectively. Meanwhile, the average mean for all the constructs is 3.37.

Related to Multilinear Regression (MLR) Analysis for relationship between diverse shipping routes and the maximization of backhaul for VLOC, results are being presented in the Table 4.6:

Table 4.6: Relationship between diverse shipping routes and the maximization of backhaul for VLOC**.**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.663[a]	.440	.418	.614

a. Predictors: (Constant), ROUTE4, ROUTE2, ROUTE3

4.2.3 Possible Products for Backhaul Logistics in VLOC

Apart from maximizing routes, it is necessary to analyze that in order to successfully proceed with this logistics, it is necessary to establish clear procedures among customers and suppliers, establish picking responsibilities, set timelines to obtain the product, share cost savings among peers, and implement proper KPIs – Key Performance Indicators to control product delivery.

For this Project development, a market analysis in South America was developed for verifying the most common products being imported over there, using this information as fundamental for analysis on VLOC backhaul logistics.

The products are mentioned in Table 4.7 along with their probable source of origin and a brief industry history:

Table 4.7: Probable Products to be studied for Backhaul Logistics.

ITEM	PRODUCT	PROBABLE SOURCE OF ORIGIN
1	Mineral Coal	Australia
2	Steel Plates	China
3	Fertilizer	China
4	Container with Goods	China or Malaysia
5	Oil Palm Gallons	Malaysia
6	Sugar	Australasia (General)
7	Soybean	Australasia (General)

4.2.3.1 Overview of a Market History of the Products of Table 4.7

Mineral coal is a form of fossil fuel extracted through mining. This form of product is in high demand in Brazil due to its importance as a raw material for steel production. “Due to the low quality of domestic coal, Brazil needs to import around 50% of the country's coal and coke needs” [41].

Steel plates are in high demand in Brazil, which is home to one of the world's largest steel producers. High taxes on steel plates imported in the internal market, on the other hand, influence the internal industry. As a result, several producers have purchased steel plates from

China to lower the final cost of their goods. This is often used in situations where basic steel plates are technically required (but not special steel plates), and it provides an interesting alternative.

Currently, the company offers a variety of logistical services to fertilizer manufacturers. The chemical characteristics of this substance, as well as its potentially corrosive capability, are critical factors in determining its acceptability or viability as a potential product for fertilizer transport using the VLOC.

Goods such as electronics are frequently purchased from China as these products are readily acceptable in Brazil given their cheaper price to transport and is listed as containers with goods in Table 4.8.

Table 4.8: Most Accepted Imported Goods in the South American Market

PRODUCT	RECCOMMENDED BRAND	PRICE MALAYSIA (USD)	PRICE IN CHINA (USD)	AFTER IMPORT
Television 55 inch	Sharp	574,00	498,00	+50% to 65%
Laptop	Acer Swift 3/14”/15	618,00	510,00	
Sunglass	Ray-ban RB3016	288,00	191,00	
Mobile phone	I phone XS	1187,00	550,00	
	Samsung S10	816,00	435,00	

As per market evaluation, goods from China area on an average are lower than goods from Malaysia. Although the goods are transported in containers of a different nature, it is possible to investigate whether the VLOC vessel, due to its large internal dimensions, can be internally modified to satisfy the specifications and thereby become a viable choice for transport. To promote this plan, a related report on maritime rules and vessel engineering will be conducted.

"For palm oil gallons**,** not only does the global demand for palm oil as an edible oil continue to grow, but it was also recently considered ideal for biofuels." Roughly 80% of palm oil is used in food for human consumption. The remainder is used in personal care products, animal feed and biofuel. According to Adapa Srinivasa Rao, 2015, the worldwide production of palm oil in 2011 was expected to reach 48.98 million tons (Mt) in 2011 covering an area of 13.41 million hectares.

From several million tons in the 1960s, palm oil production had grown exponentially, doubling every 10 years." [42]

In this regard, it is worth noting that, even though agricultural commodity markets, including sugar, have significantly opened up in recent years, the trade in agricultural produce in general, and sugar in particular, remains one of the world's most skewed markets. Furthermore, the sugar market is currently undergoing very significant changes that very dramatically modify its character. This is due mainly to the protectionist policies of many

governments. Production and trade in sugar are also very closely linked with the policies of sustainable development.

"The process of liberalization and globalization of the world market for agricultural and food products, which began in the 1990s through the Uruguay Round of the GATT, weakened the position of some major players on the global sugar market (notably the European Union and the United States) while strengthening the production and trading positions of Latin American countries. The global demand has been very dynamic in recent years, both in terms of sugar production and in terms of sugar crop cultivation (primarily sugar cane), which, as previously stated, is increasingly being used for biofuel conversion." [43]

With respect to soybeans "shifting trade flows are redefining the Brazilian landscape and spurring more farmers to align their crops with Chinese appetites," according to the study. According to government statistics, soy plantings in the United States have grown by 2 million hectares in two years, covering a region the size of New Jersey, while cane plantings have shrunk by approximately 400,000 hectares.

China's growing demand for meat has supercharged soy imports for animal feed. The Asian nation paid $20.3 billion last year for 53.8 million tons of soybeans from Brazil, nearly half its output — and up from 22.8 million tons in 2012.

Brazilian soybean exports to China rose to nearly 36 million tons in the first half of 2018, up 6% from a year ago. In July, it surged 46% from the same month a year earlier to 10.2 million tons.

Brazil's grains boom has it rivaling United States as the world's top soy producer this year, after outpacing U.S. exports over the past five years." [44] The maximum capacity of the VLOC vessel is 400 kilotons (for Metal Ore type 1: Density 2.65 ton/m3 and Metal Ore type 2: Density of 3.13 ton/m3). In this case, as observed in the Table 4.9, the capacity to transport each suggested product is estimated based on their densities:

Table 4.9: Analysis of Densities (Capacities) of Possible Products for Backhaul Logistics

ITEM	PRODUCT	DENSITY (Kg/m3)	MAXIMUM VOLUME IN VLOC	ORIGIN PORT LOCATION
1	Mineral Coal	833	480,192 Kg	Australia
2	Steel Plates	8,050	49,689 Kg	China
3	Fertilizer	961 to 1,770	416,233 to 225,989 Kg	China
4	Container with Goods	To consider maximum loading capacity per container 20 TEU (Foot Equivalent Unit), 28 tons	14,285 Containers of 20 TEU	China or Malaysia
5	Oil Palm Gallons	890.1	449,388 Kg	Malaysia
6	Sugar	700 to 1507.7	571,429 to 265,305 Kg	Asia (General)
7	Soybean	753	531,208 Kg	Asia (General)

Thus, the deviations of each suggested product should be considered. The constraints are determined and listed in the Table 4.10:

Table 4.10: Analysis of Constraints of Possible Products for Backhaul Logistics

ITEM	PRODUCT	CONSTRAINTS	
1	Mineral coal from Australia	Distance from Asian to Australasian Ports	Necessity to check demand of mineral coal in South America
2	Steel plates from China	Quality of the fabricated plates	Necessity to check demand of steel plates in South America
3	Fertilizer from China	China is not a traditional supplier of fertilizer	Necessity to check demand of fertilizer in South America
4	Container with goods from China or Malaysia	Necessity to define types of needed goods in South America	Necessity to check demand of goods in South America
5	Oil palm gallons from Malaysia	Checking dimensions of ports in Malaysia where can berth VLOC vessels	Necessity to check demand of palm oil in South America
6	Sugar from Australasia (General Locations)	Australasia is not a traditional supplier of sugar	Necessity to check demand of sugar in South America
7	Soy from Australasia (General Locations)	Australasia is not a traditional supplier of soybean	Necessity to check demand of soy in South America

4.3 Summary of Result and Discussion

In conclusion, by verifying and testing the three variables: container backhauling strategies, diverse shipping routes strategies, and a diverse type of possible products, by using mean analysis for container backhauling strategies, diverse shipping routes strategies, it is found that all 3 variables have moderate high-level relationship with the maximization of backhaul utilization for VLOC. It means that all the variables have significant positive impact on the maximization of backhaul utilization for VLOC. Average mean for utilization of container backhaul strategy is 3.65, and diverse shipping routes is 3.68. However, according to the result from the Multilinear Regression analysis, it is found that container backhauling strategy has the most significant positive impact on maximization of backhaul utilization for VLOC with R square 0.751, followed by diverse shipping routes with R square 0.440. As for the limitation for each variable, it is found that diverse shipping route has the least limitation to utilize with average mean of 3.37, followed by container backhauling strategy with average mean of 3.65.

For diverse type of possible products and market study was performed together with current shipping contract from MINE CORP, thus some products area being presented technical and commercial viability (best options for products in backhauling), being its conclusion well presented in summary the Chapter 5.

Chapter 5

Conclusion and Recommendation

This is the final chapter of the report, and it contains the researcher's conclusion on all of the conclusions. The following session will have a summary of the study's implications. This portion will primarily present the importance of the discovery for either scholarly or commercial purposes. Finally, in the final segment, certain suggestions for future studies will be addressed.

5.1 Conclusion of the Study

With a case study of a chosen shipping company, MINE CORP, this study aims to investigate the different ways to optimize the backhaul usage for VLOC. In this analysis, three independent variables are being investigated: container backhauling strategies, diverse shipping routes strategies, and a diverse type of possible products. All three independent variables are expected to have a substantial positive effect on VLOC backhaul utilization maximization. The data for this study is collected through the distribution of a questionnaire to the MINE CORP employees, who were being approached through the LinkedIn platform at first. Then, the data collected is analyzed in SPSS statistical tool. The result shows that all three independent variables have a positive significant impact on the maximization of backhaul utilization for VLOC. According to the mean analysis, it is found that all 3 variables have moderate high-level relationship with the maximization of backhaul utilization for VLOC. It means that all the variables have a significant positive impact on the maximization of backhaul utilization for VLOC. Thus, all the hypotheses set up to conduct this research are approved.

However, according to the result from the Multilinear Regression analysis, it is found that container backhauling strategy has the most significant positive impact on the maximization of backhaul utilization for VLOC with R square 0.751, followed by diverse shipping routes with R square 0.440.

In terms of limitations for each element, it is discovered that a diverse shipping path has the fewest limitations to use, with an average mean of 3.37, followed by a container backhauling approach, with an average mean of 3.65. Concerning the container backhauling policy, the most significant issue is that the container leasing industry is less lucrative as a result of repositioning of empties and systematically poor freight prices in many trading routes with a mean 3.89. Shipping firms must contend with trade imbalances, with mean 3.66 being the second most significant problem associated with container backhauling policy, followed by high repositioning prices, with mean 3.41. Meanwhile, diverse shipping routes concern the most due to shipping companies need specific carrier that matches specific criteria from a single company's perspective is required with mean 3.46, followed by this strategy make it difficult to maintain green port and practicing environmental sustainability with mean 3.34 and 3.30, respectively.

5.2 Recommendation for Potential Backhaul Products

5.2.1 Potential Ports to be Considered

Table 5.1 below shows the potential ports as new journey routes to maximize the utilization of backhaul for VLOC:

Table 5.1: Potential ports as new journey for utilizing backhaul.

No.	Potential Port	Technical Proposal	Estimated Budget (USD)
1	TUBARAO Brazil	Install a single line of belt conveyors with two machines for discharging products	80,000,000.00
2	PONTA DA MADEIRA Brazil		
3	TELUK RUBIAH Malaysia	Install a single line of belt conveyors with one machine for charging the approved products	50,000,000.00
4	GWANGYANG South Korea		
5	DANGJIN South Korea		
6	VILLANUEVA Filipinas		
7	SUBIC BAY Filipinas		
8	OITA Japan		
9	KIMITSU Japan		
10	QINGDAO China	Not Applicable for Technical Proposal	Not Applicable for Budget
11	DALIAN China		
12	TANGSHAN CAOFEIDIAN China		
13	NINGBO-ZOUSHAN China		
14	LIANYUNGANG China		
15	KASHIMA China		

The estimated budget is completed after further discussion with the MINE CORP project team as a plan for backhauling strategy. This is a basic budgeting guide based on information obtained from MINE CORP's project team and registered in an internal document without a number.

As a result of this comparative review for new potential ports, the following may be confirmed:

- Brazil is a unique South American country suitable for VLOC operations;
- It is possible to operate VLOC vessels in five countries within Asia, namely Malaysia, South Korea, Filipinas, Japan, and China;
- Only in China there are ports suitable to operate VLOC vessels for both the charging and discharging process. In all other Ports some adaptation is necessary;
- No ports in Australia are suitable for VLOC operation.

Based on this Ports design analysis it is possible to confirm in Table 5.2 the better Ports for operating VLOC:

Table 5.2: Better Ports to Operate VLOC.

Port	Country
Qingdao	CHINA (Asia) **(Ports suitable for operating VLOC for charging and discharging process)**
Dalian	
Tangshan Caofeidian	
Ningbo-Zoushan	
Lianyungang	
Qingdao	
Tubarao	BRAZIL (South America) **(Ports suitable for operating VLOC only for charging process, so its necessary Ports adaptation for discharging process)**
Ponta Da Madeira	

Potential ports analysis conclusion:

- ✓ Ports in China within Asia is more suitable than South American ports given that there is no requirement for ports adaptation (basically zero cost for adaptation);

- ✓ Without proposing the construction of new ports for South America, specifically Brazil, it is then necessary to check in the internal market for the best product that has sufficient commercial demand for justifying this investment for port adaptation (estimated of 80,000,000USD for each port).

5.2.2 Potential Products for Backhaul to be Considered

I - Steel Plates from China

- Brazil has the of top steel manufacturing plants in the world and its internal demand in the country for steel plates is vast, it is usually supplied from an internal market;
- Steel plates from China are of lower quality (average 60% less), they are therefore cheaper (average 50% less) compared to steel plates from Brazil;
- From the Brazilian government's perspective there are no restrictions to proceed with the import process of steel plates in Brazil.

Thus, this option can be recommended to fulfill market C in Brazil and should be considered for sales for companies that use steel plates with lower quality and cheaper prices as raw material for fabricating small devices and tools, as per content in the Table 5.3:

Table 5.3: Constraints to Ship Steel Plates from China

Product	Constraints / Attention Point
Steel plates from China	1. Quality of the Steel Plates fabricated in China. 2. Ports suitable for operating VLOC in Brazil only for charging process, so it is necessary for ports adaptation for discharging process.
	Necessity to check demand of Steel Plates in South America

II - Containers with Goods from China

- ✓ Commodities are in high demand in Brazil, and once received, containers can be shipped by truck (roads) to other countries in South America using Mercosur laws (Southern Common Market, likelihood of lower taxes for export);

- ✓ Goods from China present average prices which are less than Malaysia. Based on the Better Potential Ports results, only ports from China have been included;

- ✓ List of average prices of main goods used in South America;

- ✓ Transporting containers with goods through **VLOC** will require a special loading plan to be followed and minor adaptations (estimated budget 2,000.00 USD/vessel) for a tight fit.

Thus, this option is recommended, as per content in the Table 5.4:

Table 5.4: Constraints to Ship Container with Goods from China

Product	Constraints/ Attention Points
Container with Goods from China or Malaysia (China being best option)	Necessity to check demand of goods in South America.
	Necessity to define type of goods which area demanded by South America.
	Necessity of adaptation in the VLOC vessels for operating Container with goods.
	Necessity to install a container unloading machine at ports for container terminals to be able to load and unload containers from a VLOC. This action requires an estimated of 25 Million USD for each machine.

Due to several constrains for reusing VLOCS, markets or contracts, it was not recommended to Mine Corp board to invest in research development for backhauling of Mineral Coal, Fertilizer, Oil palm gallons, Sugar or Soybean. **In summary, the best options to be considered for backhauling strategy using VLOC is transporting Steel Plates and Container with Goods from China.**

5.2.3 Potential Customers from Internal Markets (C Market)

The potential customers for this market are placed in Brazil basically in three regions in the Figure 5.1:

- ✓ Southeast: 160 potential customers;
- ✓ Northeast: 50 potential customers;
- ✓ South: 70 potential customers.

Figure 5.1: Brazil Regions Map

The Port of Tubarao, Brazil, in the Southeast, has the capability of operating VLOC vessels, but would need adaptation for discharging material, as it is currently only used for filling the vessel (as per content of Table 5.5). Ponta Da Madeira in northeastern Brazil is another port with the capacity of operating VLOC vessels.

Table 5.5: Estimated Price for Adaptation

Adaptation Description	Estimated Price for Adaptation
Install two machines and a single line to discharge the products approved.	USD80,000,000.00

The prices of establishing China as the port of origin is cheaper than Malaysia being the port of origin as this would avoid Malaysia's extra charges of USD38.50 for docking of more than 20 days of the unused VLOC and its impact on internal logistics. In all of the alternatives we considered three more days for charging the VLOC, then based on the total travel time, the approved alternatives are stated in the Table 5.6:

Table 5.6: Approved Alternatives for Backhauling Products.

APPROVED OPTIONS		TRAVEL TIME FOR ORIGIN	TRAVEL TIME FROM MALAYSIA TO AUSTRALIA	CHARGE TIME	TRAVEL TIME FROM AUSTRALIA	IMPACT TIME BY EXTENDING THE NORMAL BACKHAUL JOURNEY TO BRAZIL
ITEM	DESCRIPTION					
1	Steel Plates	China	10	3	10	23
2	Containers of Goods	China	10	3	10	23

5.3 Recommendation for Future Research

This research employs a quantitative method of investigation by administering questionnaires to respondents. Researchers can perform the next analysis using a combination of qualitative and quantitative research methods. Qualitative analysis approaches, such as in-depth interviews and focus group conversations, will assist the researcher in gaining a clearer

and deeper understanding of the current problem. When doing a qualitative survey, the researcher will collect an unlimited amount of data in the form of opinions. As a result, the researcher could make a new discovery important to the topic. Aside from that, other statistical analyses may be used to interpret the collected data. It can be t-test, Pearson correlation analysis and many more.

5.4 Chapter Conclusion

It is discovered that the container backhauling technique has the greatest beneficial effect on maximizing VLOC backhaul use. In conclusion, the best backhauls items for Mine Corp to consider when implementing a VLOC backhauling plan is transporting steel plates and containers filled with goods from China.

The variables investigated in this study can be used to develop a successful plan for shipping companies to increase the use of backhaul for VLOC, thus increasing their company revenue. However, there are many implications for this report, as many shipping firms may profit from it considering their varying market goals and interests, and they may respond to this analysis from their own viewpoint.

As a result, academic organizations such as writers, scholars, observers, and others may refer to this study to further their research on a relevant subject, recommend improvements to this study, and use it as additional information.

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APPENDICES

I. Global Iron Reserve 2013

Table 1.1: Global Iron Reserve 2013.

Country	Crude Ore (Mt)	Iron Content (Mt)
Australia	35 000	17 000
Brazil	31 000	16 000
Russia	25 000	14 000
China	23 000	7 200
India	8 100	5 200
United States	6 900	2 100
Ukraine	6 500	2 300
Canada	6 300	2 300
Venezuela	4 000	2 400
Sweden	3 500	2 200
Iran	2 500	1 400
Kazakhstan	2 500	900
South Africa	1 000	650
Other countries	14 000	7 100
World total	**170 000**	**81 000**

II. Distance from South American to Australasia Ports/Terminals

Table 1.2 indicates the average distance (in days/nautical miles) from South American Ports/Terminals to Australasia and sets out the distance in terms of days and nautical miles from Australian Ports/Terminals, the company's competitors, to attend to customers in the Asian Ports/Terminal which are on an average of 8 to 12 days/4500 to 500 nautical miles.

Table 1.2: Distance from South American to Australasia Ports/Terminals.

ID	Origin	Destiny	Travelling Distance (Nautical Miles)	Travelling Distance (Days)
1	South America	Asia - Malaysia	9,000 to 10,000	35 to 45
2		Asia – China	8,900 to 9,900	35 to 45
3		Asia – Japan	9,300 to 10,300	37 to 47
4		Asia – South Korea	9,500 to 10,500	39 to 49
5		Australia	8,400 to 9,400	33 to 43

The implementation of Malaysia DC places MINE CORP on the same footing as its Australian competitors. The company recorded an increased competitiveness of 75% as it reduced travel by 30 days from the product area to the end-customer with the metal ore stocked in Asian ports. This is observed in Table 1.3:

Table 1.3: Distance from Asian (Malaysia) Distribution Center to Australasia Ports/Terminals

ID	Origin	Destiny	Travelling Distance (Nautical Miles)	Travelling Distance (Days)	Reduction Compared with Table 1 (%)
1	Asian (Malaysia) Distribution Center	Asia – Malaysia	0	0	100
2		Asia – China	1,900 to 2,300	7 to 10	60
3		Asia – Japan	2,700 to 3,200	9 to 13	65
4		Asia – South Korea	2,300 to 2,800	8 to 10	63
5		Australia	2,500 to 3,000	9 to 15	55

The Company handles three types of metal ore with the following technical specifications:

- Metal Ore Type 1: This is metal ore from South American mines (South-East regions), with high concentration of silica and lower concentration of base metal. The higher concentration of the silica stabilizes the melting of the inputs to make liquid metal;
- Metal Ore Type 2: This is metal ore from South American mines (North regions) and has the largest concentration of base metal in the world - approximately 64% - and a low concentration of silica. The higher concentration of base metal is important to promote the final quality of the metal industry product;

• Metal Ore Type 3: This is also referred to as Mixed Metal Ore, a combination of Types 1 and 2 produced in the Australasian Ports/Terminals, and presents a medium concentration of silica as well as a medium concentration of base metal which presents an excellent final quality and performance during the melting process. For producing Metal Ore Type 3, the Australasian Ports/Terminals manage three operational processes:

- Discharging Process – The metal ores from the VLOC vessels are discharged using equipment called ship-unloaders and are moved through discharging belt conveyors lines right up to stacking by yard machines in stockyards;

- Mixing Process – Once in the stockyards yard machines are used to combine Metal Ores Types 1 and 2 to obtain the specified Mixed Metal Ore (Metal Ore Type 3) according to the customer's technical specification and subsequently validated by Internal Quality Control Department;

- Charge Process – Where the specified Mixed Metal Ore is removed from stockyards and transferred to charging belt conveyors lines to ship loaders, which are equipment used to carry small vessels or loads weighing from 90 to 170 tons per load, it is then shipped to other Australasian ports/terminals.

III. Questionnaire Form

RESEARCH QUESTIONNAIRE

MAXIMIZING BACKHAUL UTILIZATION FOR VERY LARGE ORE CARRIER (VLOC)

Strongly Agree (SA)	Agree (A)	Neutral (N)	Disagree (D)	Strongly Disagree (SD)
5	4	3	2	1

INSTRUCTION: Please tick (/) your answer in the right box.

SECTION B: MAXIMIZING BACKHAUL UTILIZATION FOR VLOC

INSTRUCTION: Please read each statement carefully, determine the extent to which you agree to each statement by selecting the appropriate number to the right according to the following options and tick (/) your opinion in the space provided.

A. CONTAINER BACKHAULING STRATEGY

No.	Statement	Score				
		1	2	3	4	5
1	Shipping container is the best option to utilize backhauling strategy.					
2	It is easy to find business opportunities to backhaul containers due to their high demand.					
3	Container backhauling allows for shipping companies to enhance their revenue.					
4	Container backhaul can be shipped in VLOC without the need to change the shipping carrier.					
Limitation of Container Backhauling Strategy						
1	Container leasing business is less profitable due to the repositioning of empties and systematically low freight rates along several trade route.					
2	Shipping companies need to deal with trade imbalances.					
3	Backhaul of containers involve high repositioning costs.					

B. DIVERSE SHIPPING ROUTES

No.	Statement	Score				
		1	2	3	4	5
1	Create a diverse shipping routes open for more business opportunities for backhauling.					
2	Diverse shipping route allows shipping companies to cover multiple markets.					
3	The load factors of the ships can be maximized for backhauling with diverse shipping routes.					
4	Shipping companies can save more on transportation costs and enhance their revenue.					
Limitation of Diverse Shipping Routes						
1	It is difficult for environmental sustainability due to high carbon emissions at sea.					
2	It is difficult to maintain green port.					
3	Specific carrier that matches specific criteria from a single company's perspective is required.					

IV. Ethical Consideration Form

ID:

My name is …… I/C number …….

I have agreed to join this survey titled **MAXIMIZATION OF BACKHAUL UTILIZATION FOR VERY LARGE ORE CARRIER (VLOC).**

I agree that my personal information and all statements made are used specifically for the purpose of this research. Other than that, I do not allow any information obtained from this questionnaire to be used for purposes other than this study.

Sincerely,

……

Name:

V. Table 2.1: Analysis of Potential Ports which can Operates VLOC Vessels

ITEM	POTENTIAL PORT	COUNTRY	VLOC OPERATION SUITABLE FOR OPERATION		
			CHARGING	DISCHARGING	BOTH
1	TUBARAO	Brazil (South America)	X		
2	PONTA DA MADEIRA	Brazil (South America)	X		
3	TELUK RUBIAH	Malaysia (Asia)		X	
4	GWANGYANG	South Korea (Asia)		X	
5	DANGJIN	South Korea (Asia)		X	
6	VILLANUEVA	Filipinas (Asia)		X	
7	SUBIC BAY	Filipinas (Asia)		X	
8	OITA	Japan (Asia)		X	
9	KIMITSU	Japan (Asia)		X	
10	QINGDAO	China (Asia)			X
11	DALIAN	China (Asia)			X
12	TANGSHAN CAOFEIDIAN	China (Asia)			X
13	NINGBO-ZOUSHAN	China (Asia)			X
14	LIANYUNGANG	China (Asia)			X
15	KASHIMA	China (Asia)			X