Factors Affecting Vessel Turnaround Time at the Port of Richards Bay Dry Bulk Terminal

By

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DECLARATION

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ACRONYMS/ABBREVIATIONS

BAP	Berth Allocation Problem
B&CAP	Berth and Quay Crane Allocation Problem
BPN	Back-Propagation Network
CA	Collaborative Approach
CART	Classification and Regression Tree
CCR	Central Control Room
DBT	Dry Bulk Terminal
DCM	Discrete Choice Model
DCT	Dual Cycling Technique
DEA	Data Envelopment Analysis
FCFC	First Come First Serve
GA	Generic Algorithm
GCA	Generalized Cost Approach
GDP	Gross Domestic Product
HHA	Hybrid Heuristic Approach
HR	Human Resource
MIP	Mixed Integer Programming
MILP	Mixed Integer Linear Programming
NLEA	Nested Loop-based Evolutionary Algorithm
OEM	Original Equipment Manufacturer
PIBS	Process Interaction Based Simulation
PBM	Parametric Bootstrapping Model
QCAP	Quay Crane Assignment Problem
QCSAP	Quay Crane Scheduling and Assignment Problem
QNW	Queuing Network Model
RBDBT	Richards Bay Dry Bulk Terminal
RBCT	Richards Bay Coal Terminal
RF	Random Forest
SAMSA	South African Maritime Safety Authority
SCP	Structure-Conduct-Performance
SLA	Service Level Agreement
SOP	Standard Operating Procedure

SPSS	Statistical Package for Social Science
TFR	Transnet Freight Rail
TOG	Terminal Operating Guide
TNPA	Transnet National Port Authority
TPT	Transnet Port Terminal
TR	Truncated Regression
UNCTAD	United Nations Conference on Trade and Development
VTAT	Vessel Turnaround Time
VTS	Vessel Traffic Service

ABSTRACT

The competitive and dynamic nature of marine industry has urged dry bulk terminal drivers to enhance their daily performance not only to entice new clients but to last long in the business. Richards Bay Dry Bulk Terminal (RBDBT) is also faced with same pressure to compete with other African ports within the continent in order to secure their position in a dynamic and competitive market. Currently, high vessel turnaround time (VTAT) at Richards Bay Dry Bulk Terminal is a major concern for both shipping lines and terminal operators. Vessel turnaround time at the terminal has increased tremendously from the previous years, and appropriate administration of it could result in major cost reductions, customers' satisfaction, and improvement in service delivery, especially in the dry bulk-shipping sector. The objective of Richards Bay Dry Bulk Terminal is to enhance its output that is, to reduce the current VTAT. VTAT relies on reliability of equipment and allocation of main resources like ship loaders, ship un-loader, conveyor belts, pay loaders, tugboats, helicopter, reclaimers, plough and people, weather, effective scheduling, and availability of cargo. Many scholars have studied and argued issues regarding vessel turnaround time since the beginning of dry bulk shipping. VTAT is a vital operational indicator that shows the terminal's capability and ability to offer exceptional service and outstanding productivity to operators. Various indicators, which increase VTAT, were identified and discussed. The research aim is to study in detail the issues affecting the VTAT at RBDBT, and give recommendations to the port to become more effective and efficient port of choice in Southern Africa.

Primary data and secondary data analysis were used to give a clear picture of the current factors affecting the vessel turnaround at Dry Bulk Terminal. The target population under study included participants from Transnet Port Terminal (TPT), shipping agents, cargo owners, stevedores, and Transnet National Port Authority coming from different background. The study used both qualitative and quantitative data to show the findings.

The study showed that factors affecting VTAT at RBDBT includes: equipment breakdowns, poor planning, unavailability of cargo, wet cargo, high wind-speed/rain, cargo spillages, too many draft surveys, route preparations, shortage of payloaders, delays in berthing and sailing of vessels, incompetent employees, and too many shift changes. The study's outcomes together with analysis and recommendations highlighted the areas which terminal management needed to focus on so that the vessel turnaround time could be reduced, and improve competitiveness of the terminal.

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CHAPTER ONE

INTRODUCTION

1.1 Preamble

This chapter provided the background of vessel turnaround time problem faced by RBDBT. It also discussed the problem statement, aim, objectives, research questions, significance of the study, delimitations, and lastly the outlines of other chapters to follow.

1.2 Background to the Problem

Richards Bay Port Terminal is one of the largest ports in Southern Africa. It is situated in the North of KwaZulu-Natal province, Republic of South Africa. The port is a gateway for import and export of raw materials for South Africa and other African countries. The port plays an essential part in facilitating trade and development of the country as well as the continent. The port is one of the best dry bulk terminals in the world and handles more than 15 million tons of cargo on an annual basis which makes up to 60% of the country's seaborne cargo (SAMSA, 2015). The port consists of two terminals namely Dry Bulk Terminal (DBT) and Multi-Purpose Terminal (MPT). The study will only focus on the dry bulk terminal as it is the heart of Richards bay port terminal. The port exports over 8 different commodities which includes magnetite, woodchips, chloride, zircon, coal, anthracite, vermiculite, fertilizer, and chrome to India, United State of America, United Kingdom, Middle East, Pacific Rim and Far East (SAMSA,2015). It also imports over 6 different commodities such as coking coal, sulphur, alumina, salt, and pet coke from Canada, Australia and various West African countries (SAMSA,2015). These commodities are handled via a centralized computer system, which controls a network of conveyor belts covering 50 kilometres to seven industrial areas around the port. The conveyor belts transport cargo from quayside to the respective manufactures and versus.

Since Globalisation, the demand of dry bulk commodities has increased tremendously, and shippers are looking for a port with high productivity and efficiency to ship their commodities on time. According to Abijath & Kokila (2017), these days' shippers are seeking for ports that can offer best services such as quicker vessel turnaround times, no cargo contamination, less equipment breakdowns, efficient customs clearance, less spillages, and direct berthing. RBDBT is still lacking in these areas and ports form an essential role in global supply chain. Consequently, this determines the large extent of the nation's global competitiveness.

Vessel Turnaround Time (VTAT) refers to the extent of vessel stay in the harbour and is considered from the moment the vessel reaches the harbour limits until it departures. According to Shah (2015), vessel turnaround time is defined as the extent of vessel stay drifting near wharf and furthermore it is seen as an operational indicator that offers outstanding performance with regards productivity, capability, and proficiency of operation process in dry bulk terminal during importing and exporting cargo. Port Regulator (2015), refers to VTAT as the period the vessel takes to come in the port and out which involves berthing, discharging/loading and sailing. SAMSA (2015), reported that Richards Bay Dry Bulk Terminal (RBDBT) has been well known for years as the cheapest port in the world to transport cargo. It has seven berths and accommodates different sizes of vessels from handy size to capsize.

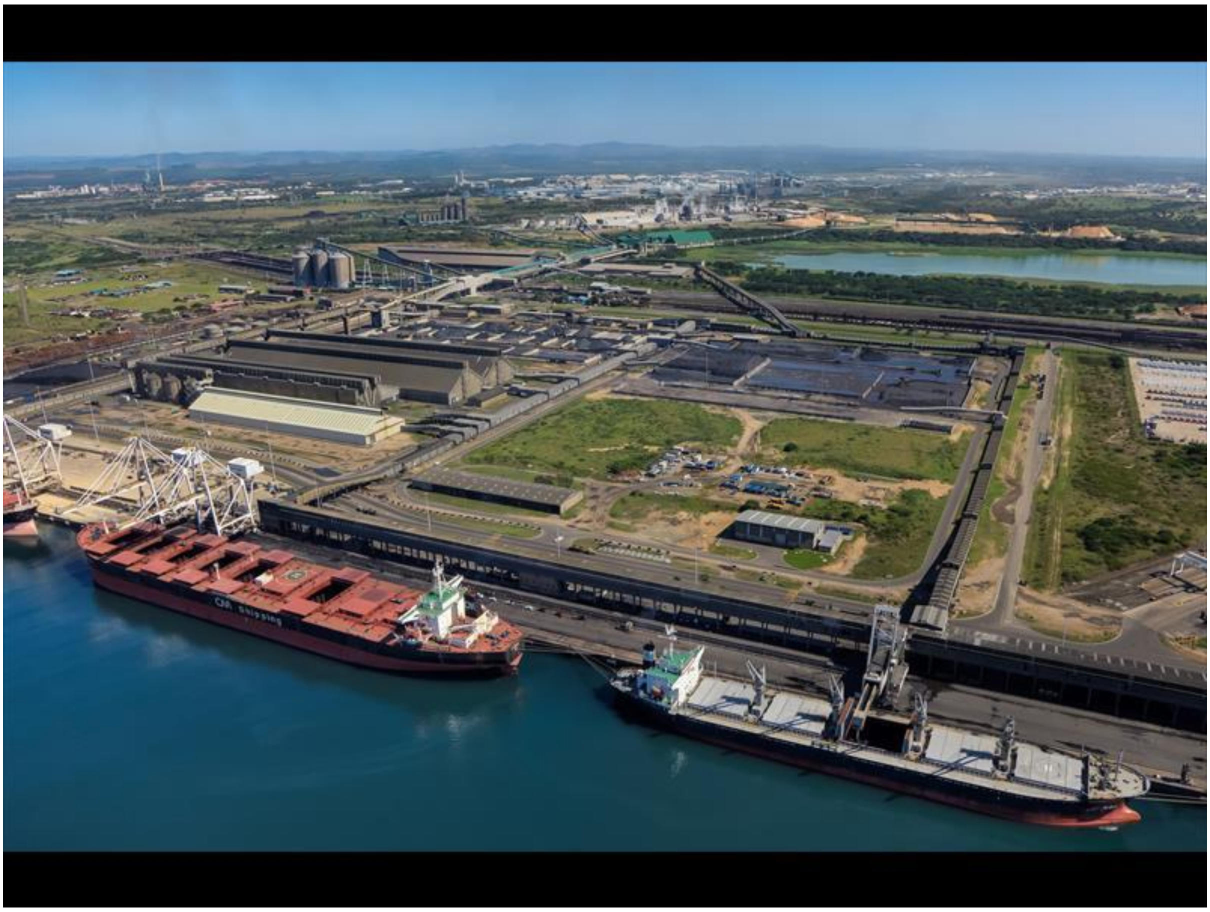

Figure 1. 1: Aerial Photo of Richards Bay Dry Bulk Terminal.
Source: (Moorcroft, 2014)

The RBDBT, see Figure 1.1 above, has the following advantages and strengths, which gives the port the competitive advantage:

- Deep-water port with a draft of 17,5 m;

- A long entrance channel with a width of 300m to allow bigger vessel to come into the port;
- Excellent rail structure with hinterland;
- Latent for greenfield developments;
- World class bulk terminal and handles large volumes of cargo such as magnetite, woodchips, chrome and coal;
- Good infrastructure and latest quality equipment; and
- Strategically located in relation to rich mineral hinterland of KwaZulu-Natal, Mpumalanga and Gauteng.

However, over the past five years the VTAT at the terminal has tremendously increased from a target of 96 hours to average of 122 hours on all the vessels (TPT Performance Report, 2018). The port management tried to come up with new ways to address this enormously poor turnaround time to enhance the port performance, however the issue still persists, and it comes up from now and again. According to Transnet Integrated Report (2017), the port of Richards Bay is challenged with poor VTAT due to an increase in number of breakdowns at the terminals. Chiganga (2015), in his study revealed that the poor vessel turnaround times in African ports is due to poor planning, poor regulatory policies, incapacitated and unreliable equipment. This increase has resulted in long waiting time at the anchorage, vessel congestion and customers being unsatisfied. Currently vessel wait to be serviced at the anchorage for an average of 5 to 9 days and pay 30 000 US dollar per day while under normal circumstances it does not wait for more than an hour to berth and be serviced if the terminal has no delays.

Nowadays, the global supply chain model is based on Just-in-Time model; the poor vessel turnaround time of Dry Bulk Terminal at Richards Bay poses stumbling blocks to exporters and importers as it results in them paying high demurrages and cargo not delivered in time. This tragedy has resulted into other customers diverting their vessels to other neighbouring countries ports like Maputo, Dar es Salaam and Malawi. The poor vessel turnaround time occurs on all berths namely 609, 701, 702, 703/4, 705, 801 and 804. The port is currently losing customers to neighbouring countries due to this poor vessel turnaround time.

1.3 Problem Statement

Globalisation has made it possible for countries to trade with one another and this has led to growth in marine transportation. This in turn led to the port of Richards bay increasing cargos handled on an annual basis hence, requiring adequate infrastructure, excellent productivity performance and sufficient capacity. The dry bulk terminal is currently operating under customer complaints due to inability of the port to meet operational performance requirement and stakeholders' expectations. In the last financial year of 2017/18, the port failed to reach the volume target of 19.1 million tons. This financial year of 2018/19, the volume target has increased to 21.1 million tons (TPT Performance Report, 2018).

The target of loading rate on woodchip, chloride, chrome, coal and magnetite are all below the targets and also the offloading rate of alumina, coking coal are below the target. This poor loading and offloading rates of different commodities has resulted in congestions at the anchorage, as well as customers paying more for demurrages thereby making the port to be more expensive to transport cargo through them. The vessel turnaround time on chloride, zircon, and woodchips, coal, sulphur, alumina, coking coal and magnetite vessels has increased from 4 days to around 6 to 10 days (TPT Performance Report, 2018).

This study aims at investigating issues influencing VTAT from the moment the vessel arrives and leaves the port. The study explores causes of high vessel turnaround time and ways in which VTAT can be decreased. This study will also come up with ways of reducing waiting time and congestion at the anchorage, assist the port to reduce the cost of transporting cargo, retain and attract more customers and give the port competitive advantage.

1.4 The Aim of the Study

The central aim of the study is to investigate the factors affecting VTAT at Richards Bay Port Terminal in a bid to proffer recommendations to reduce vessel turnaround time.

1.5 Objective of the Study

- To identify the factors which affect VTAT at Dry Bulk Terminal (DBT) and evaluate their relative significance towards VTAT.
- To identify causes for the increase in VTAT.
- To identify the impact of factors affecting VTAT at DBT.
- To identify ways in which VTAT can be decreased.

1.6 Research Questions

- What are the factors that affect VTAT at DBT and what is their relative significance towards VTAT?
- What are the causes for the increase in VTAT at DBT?
- What is the impact of factors affecting VTAT at DBT?
- What are the ways in which VTAT could be decreased?

1.7 Significance of the Study

The study will assist the port of Richards Bay to improve their vessel turnaround time. It will make the port to be more effective and efficient as well as give the port competitive advantage. It will assist the port to attract more customers and generate revenue for the country. Sintoo (2015), showed that economies and trade in general are affected by increased transport time. This has a negative impact on the whole supply chain. The reduction of the vessel turnaround time will assist the port to handle more vessels and reduce port congestion. This will ensure that cargo is delivered to clients on time and there is no delay in supply chain of raw material to other countries.

Several researches have been done in the areas of port performance, and port efficiency in container terminals. However, there are few studies focusing on vessel turnaround time at dry bulk terminal. The findings from this research will be foundation for future research on this topic and can be used in other dry bulk terminals to improve their turnaround time.

1.8 Delimitations of the Study

This study is limited to one port which is dry bulk terminal located in Richards's bay, KwaZulu-Natal province. The study does not cover other dry bulk terminals in the country. Data will only be collected and analysed for a period of six months due to time constrains. The findings of the study, while specifically relevant to the Richards Bay dry bulk terminal, can serve as a template for further studies in other ports within and outside the republic. The study can also serve as a background for a comparative studies for further research to compare different ports within the provinces in South Africa and beyond.

1.9 Chapter Outline

The research structure is outlined as follows:

Chapter 1: This section provided the summary of the study which covered a background of the elements affecting VTAT at Richards Bay Dry Bulk Terminal. It discussed background of the problem, problem statement, aim, objectives, research questions, significance of the study, delimitations and lastly the institute of the study.

Chapter 2: This chapter contained review of related literature and studies which have been completed by other scholars. It included data concerning theories, which are associated with factors affecting VTAT at Richards Bay Dry Bulk Terminal. This chapter also comprised of fundamental terms definitions and conceptual framework.

Chapter 3: This chapter presented different approaches, which were used to collect data. It described the type research design used and justification of the using that type.

Chapter 4: This chapter deliberated in more detail the study findings and presented them in form of graphs and tables.

Chapter 5: This chapter concluded the research outcomes and provided recommendations.

1.10 Conclusion

This chapter provided the summary of the study which covered the background of the factors affecting vessel turnaround time at Richards Bay Dry Bulk Terminal. It discussed the background of the problem, problem statement, aim, objectives, research questions, significance of the study, delimitations and lastly the outlines of other chapters to follow. The next chapter review the relevant literature underpinning the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section critically reviews relevant literature related to the topic of study. The aim is to build a basis upon which this study is coming from, and develop better comprehensive understanding into relevant trends and researches (Saunders, Lewis & Thornhill, 2016). The chapter discussed theoretical framework, review of relevant literature, summary of literature review and research gaps, and conceptual framework that is the conceptual theory underpinning the research.

2.2 Definitions of Key Concepts

a) **Port**: Sintoo (2015), defines port as a place where maritime terminal facilities are given. These facilities include berth where vessels can berth to load or offload cargo, sheds and storage area for storing cargo where goods can be stored for a long period.

b) **Vessel Turnaround Time**: Cahoon (2015), defines VTAT as the extent of vessel stay in the harbour from the time it comings in until departure the harbour.

c) **Terminal**: Gayathma, Sigera & Cahoon (2015), defines terminal as a place where loading and offloading of cargo or people take place.

d) **Dry Bulk**: A loose, uniform cargo such as magnetite, coal, chrome, alumina, petcoke, sulphur, chloride and rutile which are transported in a form of bulk carrier.

e) **Berth**: Stopford (2009), defines berth as designated quayside area where vessels come to load or offload cargo.

f) **Ship loader**: Equipment used to load cargo into the vessel from storage area via conveyor belt.

g) **Ship unloader**: Equipment used to offload cargo from the vessel onto conveyor belt to storage area.

h) **Vessel**: A ship used to transport cargo from one place to another.

i) **Conveyor belt**: Equipment used to transport cargo from storage area to the ship loader or equipment used to transport cargo from ship unloader to storage area.

j) **Import**: Goods brought from other countries into the country.

k) **Export**: Goods taken out of the country to other countries as their final destination.

l) **Demurrage**: A penalty paid by shippers or cargo owner for delaying the vessel beyond the allowed free time.

m) **Logistics**: Chiganga (2015), refers logistics as a portion of supply chain process which deals with planning, executing, and governs the effective, well-organized storage of goods, back and forth flow, related services and information from its origin to consumption in order to meet customer's needs.

n) **Supply Chain**: Sintoo (2015), defines supply chain management as management of all activities such as procurement and sourcing, all logistics and conversion, and planning. More essentially, it also involves collaboration and coordination through network partners.

2.3 Theoretical Framework

To this extent there is no exact theory supporting the factors affecting vessel turnaround time. However, for the purpose of this study, there are theories which, are applicable and were reviewed.

2.2.1 Stakeholder Theory

According to Mwendapole (2015), stakeholders refers to anyone or group of people who impact or get impacted by achievement of the objectives of the organization. Different stakeholders have different perceptions, interests and ideas, their own interests are more valuable than others are and do not take into consideration the interests of others. The group of stakeholders constitutes various set of needs, expectation and values. This various interest cause challenges: failure to meet the interest of one stakeholder can be harmful to others due to managerial incapability and resource scarcity. Different stakeholder's interest can be aligned through the use of stakeholder theory which state that managers should take into consideration the interest of relevant stakeholders when making decision (Freeman, 1984). This theory is vital as firms need to meet the requirements of variety of stakeholders in order to survive in ever changing environment.

2.2.2 Three – Factor Theory

According to Meng & Weng (2017), customer satisfaction is described as the results of three interrelated categories, which have different impact and are known as 3-factor theory. They are categorized as follows; basic, excitement and performance factors. Basic factors are minimum requirements, which makes the consumer unhappy if not met. Excitement factors are met when the customer satisfaction is increased. Performance factors are met when there is good turnaround times of vessel and customers are satisfied. If there is poor vessel turnaround time, it produces dissatisfaction.

2.2.3 Queuing Theory on Vessel Turnaround Time

Chiganga (2015), pointed that development of many queuing models can be done and utilized to analyze the problem of vessel turnaround time. Queuing model used by the port management at RBDBT is based on booking a slot which causes congestion and too much waiting time at anchorage for the vessels that came first. The system is tailored on computerized systems and ran from Central Control Room (CCR). It is also used to assign berths, vessels, route, loaders and unloaders.

2.2.4 SCP paradigm

According to Mwendapole (2015), SCP paradigm stand for Structure Conduct Performance, and its tenet is that the structure of industry impacts the conduct of the entire industry as a whole which in turn affect the industry's fiscal performance. In the shipping industry, economic performance of the port is measured through value-added, profitability, turnaround, employment and technology development; while conduct refers to activities taking place in the port; and structure is mainly determined by market share dispersal. Bain (1956) and Scherer (1980) are the first authors to raise the structure-conduct-performance (SCP) paradigm.

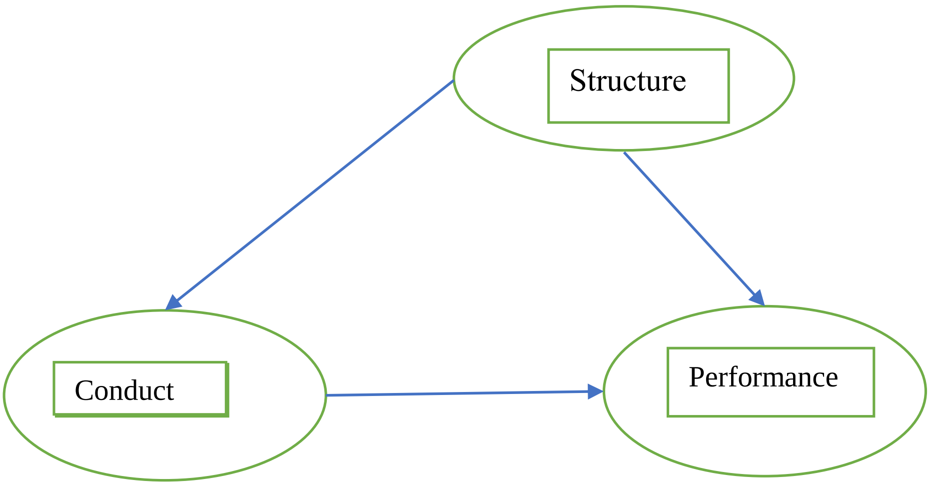

Figure 2.1: SCP.

Adapted from Mwendapole (2015).

These four theories are relevant to this study. With regards to stakeholder theory, the study encompasses of applicable stakeholders as source of practical information to show different point of opinions regarding vessel turnaround time. Concerning the three-factor theory, factors affecting vessel turnaround time were categorized to help port managers by emphasizing different implications. As for Querying theory, factors affecting VTAT and congestion were analyzed. With regards to SCP paradigm, as structure affects performance, the port structure was analyzed to see if it affects the vessel turnaround time.

2.3 Dry Bulk Terminals

According Port Regulator (2015), DBT is liable for shipment of both minor and major bulks. Main bulks generally comprise and institute the mainstream of commodities by mass such as magnetite, grains, coal, chrome and iron ore, while minor bulks mostly include mineral cargoes, steel products, forest, agricultural products, and cement. There are three main major dry bulk commodities handled by South African port system namely iron ore handled in Saldanha Bay, and both coal and magnetite handled in Richards Bay.

SAMSA (2015), reported that in order to handle different dry bulk cargoes, the port must have licences. As it stands, Transnet Port Terminal (TPT) holds about five, and South African Bulk Terminals holds two. The other operators such as Durban Coal Terminal, RBCT, FPT Port, Profert, Proterminal, and PBD Boeredienste each has one license for handling dry bulk commodities (SAMSA, 2015). RBDBT handles chloride, anthracite, zircon, vermiculite chrome, woodchips, fertiliser, magnetite, rutile, sulphate, and coal under export, and as well as the import of petcoke, sulphur, coking coal and alumina.

The role players in shipping of dry bulk cargo are dominated by the space they have since operations in DBT requires enough space, capacity and size of terminal, which provides a better picture of who is who. TPT is currently occupying a total terminal area of 642 123 square meters for dry bulk (Port Regulator, 2015). It is followed by RBCT and Durban Coal Terminal as the third place for largest terminal areas as shown in Figure 2.2 excluding TPT. The nine bulk terminal operators holding dry bulk terminal licences belong to Durban region and represents 65% of the licences, followed by Richards Bay with 2 at 14% and balanced of 21% held equally by port of Nqgura, East London, Saldanha Bay and Cape town (Port Regulator 2016).

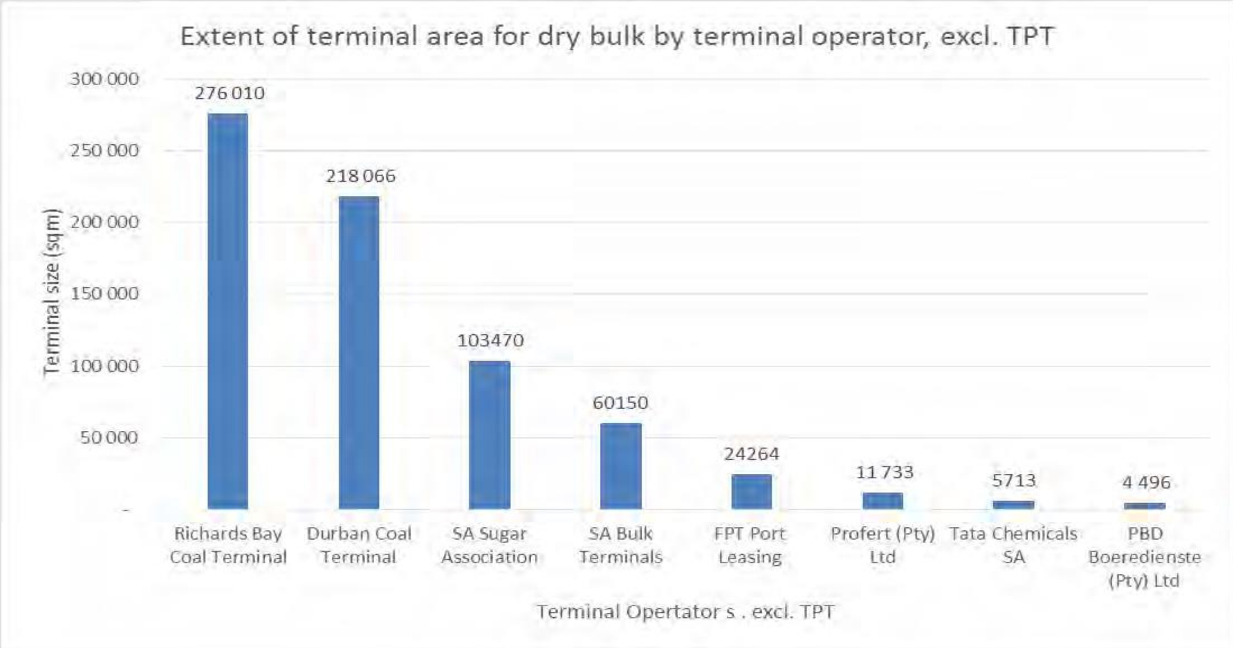

Figure 2. 2: Level of Terminal Areas excluding TPT.

Source: Port Regulator (2015)

2.4 Dry Bulk Terminal Capacity

Dry bulk carriers are categorised into four types namely: handysize, handymax, cape size, and panamax. Only three of these categories are handled in South African dry bulk terminals. Port of Saldanha Bay and Richards Bay can accommodate all types of vessels, and internationally not all the terminals can accommodate all the types of vessels due to infrastructure constrains. Table 2.1 shows summary of South African dry bulk terminal capacity. Ports of Ngqura and Durban handles panamax with deadweight between 60 000 and 100 000 tons. The most frequently used vessels in bulk sector are handymax vessels with deadweight of 60 000 tons. According to Port Regulator (2016), three types of vessels (i.e. handymax, panamax and cape size) operate on major trade routes. Table 2.1 also shows all vessel size which can be accommodated in each dry bulk port.

Table 2.1: South African Dry Bulk Terminal Capacity.

Port	Berth Length (m)	Total Berths (no)	Usable Berths (no)	Berth Draught (m)	Vessel sizes that can be accommodated (length x width x draught)	Design Capacity (tons per annum)	Terminal Installed Capacity (Tons per annum)
Richards Bay RBCT	2 060	6	6	19	Cape Size 180 000dwt (289m x 45m x 18.4m)	131 000 000	105 000 000
Richards Bay	1 863	8	6	14.5-9	Cape Size 180 000t (289mx 45m x 18.4m)	21 000 000	14 600 000
Durban	1 581	9	7	8.6	Handysize 35 000t (177m x 28m x10)	11 000 000	11 000 000
East London	388	1	1	10.7	Handysize 35 000t (177m x 28m x 10m)	984 000	470 478
Port Elizabeth	360	1	1	12.2	Handy size 35 000t (177m x 28m x 10m)	5 000 000	4 459 369
Cape Town	569	3	2	12.2 - 12.8	Handy size 35 000t (177m x 28m x 10m)	2 100 000	1 400 000
Saldanha Bay	1 260	2	2	23	Cape Size 180 000t (183m x 32m x 11m)	58 000 000	50 736 955
Total	**8 081**	**30**	**25**			**229 084 000**	**187 666 802**

Source: Port Regulator (2016)

2.5 Vessel Turnaround Time

According to Cahoon (2015), the most vital objective of seaport is to minimize vessel turnaround time (VTAT). Shipping lines consider vessel turnaround time as a significant factor when selecting a port to import and export their cargo. Jayaprakash & Gunasekaran (2012), pointed out that port's performance is widely measured using VTAT. Amongst all service performance measures, vessel turnaround time is considered to be the most vital parameter. Cahoon (2015) expressed the vitality of vessel turnaround time as to reduce the time spent on berth in his study. VTAT is directly proportional to revenue generated. The lesser the VTAT and the higher the revenue. These also saves operational and other related costs as a result the shipping lines are also improved as well.

Efficiency and productivity of port directly affect VTAT. Cahoon (2015), state that vessel turnaround time is conquered by time required to load and offload the cargo. The study further revealed that handling efficiency is the most crucial factor in identifying the port to be used in East Asian. The port management need to give priority to enhancement of port efficiency in order to improve vessel turnaround time and provide a better service. Cahoon (2015), further suggested that the port should improve their operation capabilities and planning by upgrading their equipment and have state-of-the-art technology in order to reduce VTAT. However, Gayathma et al. (2015), pointed out that it is meaningless to invest in state-of-the-art facilities without looking at world-class productivity. Rupasinghe, Sigera & Stephen (2015) and Sintoo

(2015), suggest that port management should focus on investing seriously on multi skilled manpower, equipment, infrastructure, information and communication technology in order to reach better vessel turnaround time.

Cahoon (2015), found that the most influential factors affecting VTAT are cargo transferring, berthing delays, unavailability of berths, crane speed, and operator availability. Cargo transferring delays constitutes - 57%, berthing delays – 25%, unavailability of berths delay – 8%, crane speed delay – 6% and operator availability delays – 4% at the port of Colombo. While according to Jayaprakash & Gunasekaran (2012), ports in developing counties are challenged with different unnecessary delays due to lengthy port procedure, crew working behaviour and unexpected natural disturbance. In reference to Indian ports these authors have pointed out that the highest percentage out of total turnaround time is disbursed by delays with 55%, followed by service time of 43% and pilot time of 2%. This indicate the importance of delays and non-cargo transferring time towards VTAT. Jayaprakash & Gunasekaran (2012), further state that customs clearance, health and other government procedures can also cause delays.

According to Mitrovic & Delovic (2017), there are 6 service performance measures which affect VTAT and they are based on actual time; namely arrival time, berthing time, service time, completion time, departure time and sailing time.

According to Shah (2015), operational performance as shown in Table 2.2 and port financial as shown in Table 2.3 are used globally by many ports as the port performance indicators.

Table 2.2: Operational Indicators.

Indicators	**Units**
Arrival late	Vessels/day
Waiting time	Hours/vessel
Service time	Hours/vessel
Turnaround time	Hours/vessel
Tonnage per vessel	Tons/hour
Fraction of time berthed vessels worked	-
Number of gangs employed per vessels per night	Gangs
Tons per vessel hour in port	Tons/hour
Tons per vessel hour at berth	Tons/hour
Tons per gang hour	Tons/gang-hour
Fraction of time gangs idle	-
*Calculated monthly for each berth group servicing a cargo class	

Source: Shah (2015)

Table 2.3: Financial Indicators.

Indicators	**Units**
Tonnage worked	Tons
Berth occupancy revenue per ton of cargo	Rand/ton
Cargo-handling revenue per ton of cargo	Rand/ton
Labour expenditure per ton of cargo	Rand/ton
Capital equipment expenditure per ton of cargo	Rand/ton
Contribution per ton of cargo	Rand/ton
Total contribution	Rand
*Calculated monthly for each berth group servicing a cargo class	

Source: Shah (2015)

According to Shah (2015), vessel turnaround time refers to extent of vessel stay in the harbour and is considered from the moment the vessel comes into the harbour and depart. It is normally expressed in hours and was previously expressed in days. A standard stage process for vessels called in port is shown in Figure 2.3 and Figure 2.4. The total time in the port is not meaningful if it does not include total turnaround time as a function of quantity of total cargo handled during the request.

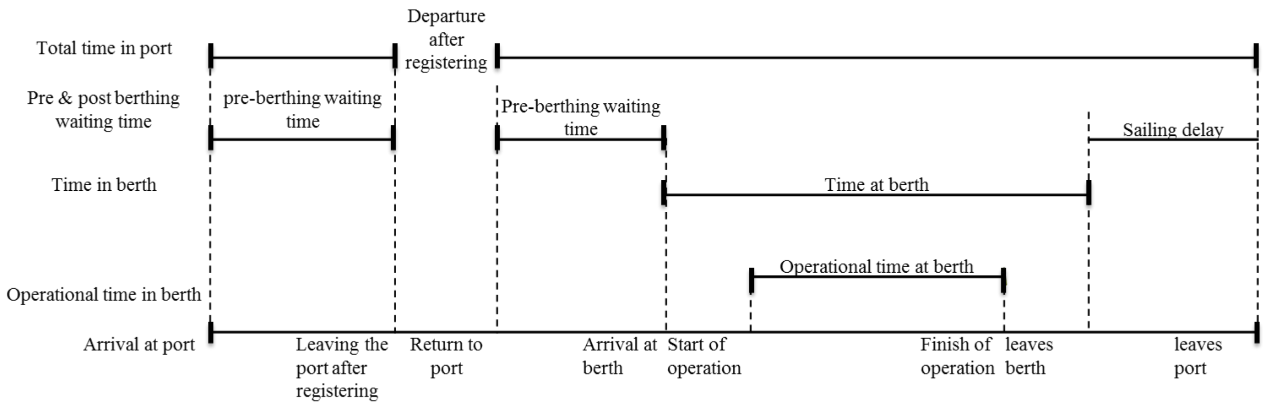

Figure 2.3: Breakdown of Vessel's time in port.

Source: (Shah, 2015)

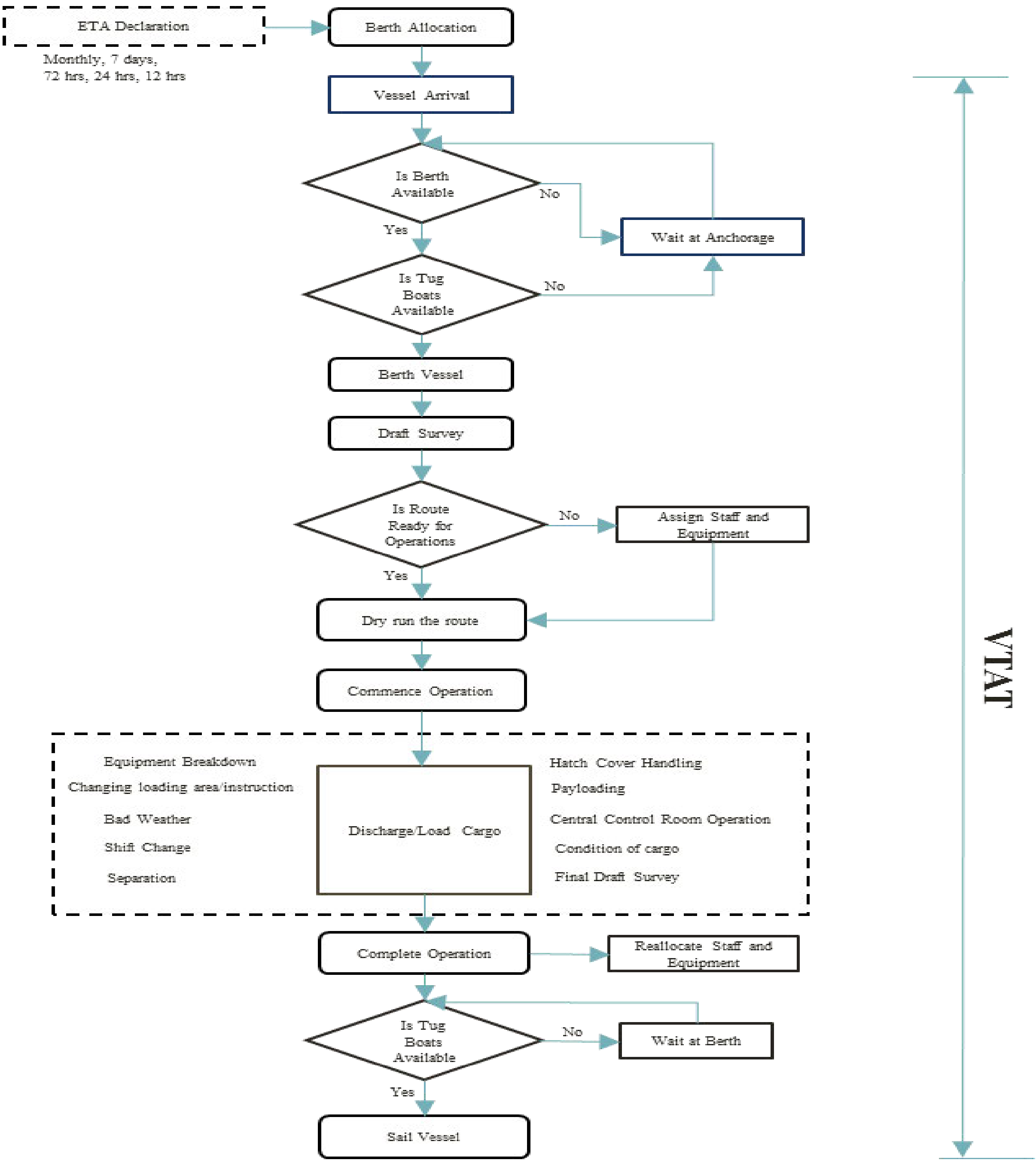

Figure 2.4: Process Flow of Dry Bulk Terminal.
Source: (Premathilaka, 2018)

Shah (2015) summaries the arrival and departure of vessel to the port and the significant interface which takes place during the period. When a vessel arrives at the port, it is clear that it does not go straight to berth. However, a number of in-between steps need to be taken into consideration before the vessel is alongside berth for cargo loading or offloading. Predominantly in a situation where shipping lines sends bigger, more proficient and expensive vessels, the superseding imperious is to shorten this whole process so that vessel's time in the port is reduced. It is therefore vital to unpack all the stages before sailing/berthing a vessel and to know how each stage functions in order to determine ways to minimize these times. However, the process is not simple as one would think. It is interconnected and complex, hence a historic view needs to be taken into consideration not to over simplify the entire process.

The port and terminal receive a notification of the arrival/departure of the vessel. The vessel would normally wait at anchor after the arrival at the port and will be issued with orders to come in after the marine services and pilot have been notified to assist it to berth. Once it is alongside the quay, the terminal will start with loading or offloading of the cargo provided all requirements and documentation are finalized. Then, the total vessel turnaround time would be measured which in turn shows the efficiency of the port.

With the introduction of globalisation, the demand of efficiency in maritime transportation is needed in order for countries to grow their economy and have sustainability. According to Rupasinghe *et al.* (2015), it is vital to improve efficiency of dry bulk shipping process because maritime transportation forms the key link in global supply chain to attain customer satisfaction and just in time operation.

Vessel's total voyage time can be calculated by adding time at the ports and sea. Further, Rupasinghe *et al.* (2015) mentioned that, cost of total voyage can be calculated as the summation of the cost incurred at both sea and ports. An advanced methodological framework proposed by Moon & Woo (2014), take in accord time in port, complete voyage time, vessel speed and time at sea. In conjunction with that, Alvarez (2014), has developed a mathematical model of goods transit in a liner shipping network using time factor. The model takes into consideration time spent during port calls, time spent idling in the terminal and time spent in open waters.

According to Mitrovic & Delovic (2017), the most influential factors affecting berth productivity involves vessel size, vessel stowage, skills of crane operators and dockworkers, contractual price paid by carriers to terminal operators, volume unloaded and loaded, and inefficiency yard and gate operations. Abijath & Kokila (2017), in their study to reduce VTAT at Cochin Port pointed out that equipment breakdowns were the major factor affecting the vessel turnaround time, followed by power failure, weather constraints, frequent labour strikes, shifts in gang and season contract workers who do not have experience in handling cargo.

Today vessel operators are heading towards Triple E ships which are energy efficient, economically and environmentally friendly in order to minimize the cost and time spent at sea. Therefore, to improve time spent at the port by vessels, operators tend to choose ports which offer efficient services where vessels are turned around quicker as customers are mostly concerned about ship transit time when choosing a carrier.

Currently, Richards Bay Dry Bulk Terminal is trying to provide world class services to the clients and customers by minimising VTAT as they are constantly monitoring vessel performances. According to Rupasinghe *et al.* (2015), port performance demand to be given maximum attentation by port operators as it is the lifeblood of ports. Ports like Shanghai and Durban collect their vessel turnaround times systematically in their own permisses according to Hong, Merk, Xufeng & Jinggai (2013). Futher, Rupasinghe *et al.* (2015), stated that ports ought be effective enough to reach their optimum results as they are the countries' backbone. Citing Nyema (2014) and UNCTAD (2013), they also argued that when it comes to port performance in dry bulk terminal, the vessel turnaround time is extremely vital. Shah (2015), argued that for any competitive port terminal, high productivity is a must and it is the one which attracts shipping lines to bring vessels to berth.

2.6 Maritime Services

Marine services such as mooring, pilotage, anchoring, Vessel Traffic Service (VTS) services, tug and towing assistance, berthing and sailing services, watering and fuelling, ballast waste disposal and garbage collection, port captain's services, navigational and lights aids form an integral part of the activities of a ports system. According SAMSA (2015/16), Transnet National Port Authority (TNPA) controls and manages marine services in all eight major ports in the country. TNPA is a solo provider and their services are characterised by monopolistic practices with inefficiencies and high transaction costs. RBDBT provides the value-producing activities which ranges from basic storage activities and cargo-handling to cargo attestations and tracking of cargo. Figure 2.5 shows a comprehensive analysis of the value chain provided by the port. SAMSA (2015/16), indicated that the value given to shippers is taken from moving of cargo through different modes at a specified condition and specific time. This means that the port may maximise this value by minimizing time needed to ship cargo through the terminal without damage or loss. According to UNCTAD (2015), transport and ship operators' value is derived from prompt and vigilant handling of cargo to and from trucks and vessels at a specific given time. UNCTAD (2015), indicated that the port may raise the value by minimising the trucks and vessel turnaround time, and also by maximising their security around the port and even around stockpiles.

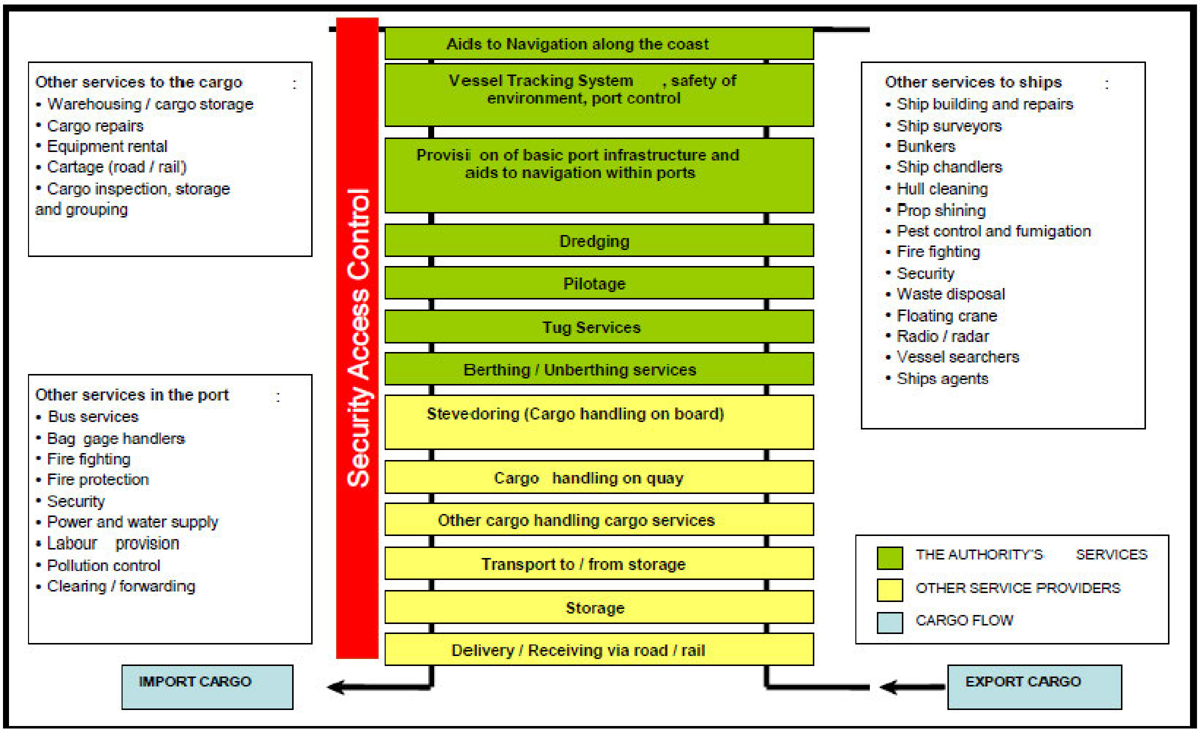

Figure 2.5: Port Services Value Chain.

Source: SAMSA (2015/16)

As competition increases among different ports, the port of Richards bay needs to put more effort to have a competitive advantage that makes them to stay in business. According to Vianen, Ottjes & Lodewijks (2014), in the past, competitive edge was provided by the depth of the port's navigational channel, geographical location, and the security provided by the terminal. However, these days it is derived from providing better services to cargo and vessels inside the port. Vianen *et al*. (2014), indicated that competitive advantage of port can be accomplished through service differentiation or cost leadership. This means that previously, ports attempted to become lower-cost provider for facilities or services instead of seeking to offer superior quality of facilities and services.

2.7 Review of Relevant Literature

Vessels earns more money when they sail a lot. Sailing is directly proportional to earnings. As a result, shipping liners and ship owners requires quicker operations at the ports to reach shorter VTAT which in turn causes an increase in number of trips taken by their vessels per year. According to Premathilaka (2018), in the year 2000, a handy size dry bulk vessel consumed nearly 60% of its duration on berths and charged about $65000 per day. Similarly, the outcome of scale of economies that is the bigger the vessel reduces the cost per unit. Hence, shipping lines chooses to disseminate both panamax and capsize vessels into operations as compared to handy size vessels (Premathilaka, 2018). Nevertheless, this generates continuous pressure on dry bulk terminals as its superstructure and infrastructure facilities were not designed for the bigger size vessels and cannot be developed at the same pace. As conversed by Meng & Weng (2017), current day facilities of the port may not be adequate enough to cater mega vessels in the upcoming future. The researchers in their study used the Queuing Network Model (QNW) together with couple of simulation models where ARENA software was considered to disperse the complexity of computation. In addition, longer waiting times, port stay times and high utilization rates were also indicated as key worries for shipping lines together with port's physical restrictions.

Premathilaka (2018), in his study also mentioned that the vital roles of seaport are to handle passengers and cargo, provide services and shelter for vessels, and provide backup for industrial growth by being part of greater transport systems. Moon (2018), later highlighted that terminals are chosen operational areas which are dedicated for storing and handling cargo. This cargo is discharged, offloaded, loaded, stockpiled, transported and facilitated from different types of mode of transport. Thinking of port operations, many studies have been conducted to cognizance what are issues affecting terminal performance and how port operator can improve their efficiency in dry bulk operations. Further, Lee & Kim (2015), made terminal operation to be easy by separating it into two types namely receiving and delivery operations, and vessel operations. In another study the terminal operations was categorised into three planning phases which are equipment scheduling and yard planning, vessel planning and berth planning (Cao, Lee & Shi, 2010).

According to Niavis & Tsekeris (2012), ports performs much better if they are bigger in size compared with smaller once. The researchers above used outcomes from both truncated and tobit regression along with parametric bootstrapping models to arrive at that conclusion in their study to identify main causes of technical efficiency in the ports. Furthermore, Cariou & Oliveira (2015), mentioned that efficiency of a port is directly proportional to the size and also indicated in support of the claim that changes in ownership to private sector from public advances fiscal productivity of the ports. Heng & Tongzon (2016), further said that when a port is privatized the levels of efficiency improves as well. Mitrovic & Delovic (2017), furthermore said that Gross Domestic Product (GDP) of the country, population, country's per capita and main shipping route which need to be travelled were also acknowledged as influencing components to advances efficiency. Alemán, Morales, Serebrisky & Lourdes (2016), in their study of efficiency analysis posit an incline trend in the harbour efficiency in emerging counties where their duration sequences demonstrated an upsurge outcome between 2000 to 2010 from of 51% to 61% respectively. The study also deliberates enhancements due to involvement of private sector, expansions of multi interlinked system and a fight against corruptions in the government sector has prejudiced a rise in efficiency stages at the ports in developing countries.

In a study by Cariou & Oliveira (2015), the researchers used Parametric Bootstrapping Model (PBM) and Truncated Regression (TR) to investigate how port efficiency is affected by the level of competition measured at diverse impact stages. According to their study, competitiveness between ports can produce negative and positive impacts when changing the levels of performance in individual ports. In other words, competition between the ports could lead to advanced port efficiency due to amount of pressure arriving as a result of competitive environment. They have also mentioned that it may also affect the port negatively, if the port under pressure succumb to the pressure and invest too much on superstructure and infrastructure without paying attention to long term outcomes, consequently dropping levels of efficiency.

Kavirathna, Kawasaki & Hanaoka (2018), used Discrete Choice Model (DCM) and Generalized Cost Approach (GCA) to examine the competitiveness of Colombo port as a transit hub. Their outcomes emphasized that, nonexistence of competitiveness of Colombo Port in conveying networks together with other feeder ports have largely caused low performance in the port due to high deviations in not following the main sea routes as they supposed to. Wilmsmeier, Tovar & Sanchez (2013), used Data Envelopment Analysis (DEA) in their study to find the consequences of dynamic fiscal environments on productivity and efficiency of ports. They took into consideration 20 ports from 10 different nations in Latin America. Also Ding, Jo, Wang & Yeo (2015), carried out a study using Malmquist Productivity Index (MPI) and Data Envelopment Analysis (DEA) to assess productivity and operational efficiency of port terminals in China. In addition, the researchers have estimated the factors influencing change in throughput efficiency using at Tobit Regression.

Ports have inadequate stockpiles spaces in the yard, therefore cargo with same properties are stacked next to each other while following Terminal Operating Guideline (TOG) to maximise the availability of stockpile spaces. According to Carlo, Vis & Roodbergen (2014), in their study to investigate the effects of diverse yard distribution approaches on the vessel throughput that is in operations anticipated a structure for distributing stacking area based on the tonnage of cargo to be stored in the yard.

According to Budipriyanto, Wirjodirdjo, Pujawan & Gurning (2017), the terminals' performance is mainly based on total vessel turnaround time, cargo handling time and waiting time. These performance measures can be significantly influenced by arriving vessel at the port, which has available and allocated berth. The researchers carried out a replication study amongst terminals using Collaborative Approach (CA) to obtain best resolutions for Berth Allocation Problem (BAP) beneath different situations. In their outcomes, the researchers emphasised that collaborative strategy aids to minimize total cargo-handling time, vessel turnaround time and waiting time offering rewards to both the terminals and shipping lines. Budiprivanto *et al.* (2015), used Mixed Integer Programming (MIP) model in another study for both Quay Crane Assignment Problem (QCAP) and Berth Allocation Problem (BAP) to deliver best solutions for saving overall berthing costs through saving of energy and time.

According to Li, Hong, Geng & Wang (2017), the researchers have attempted to come up with a productive method used by many terminal users to address QCAP and BAP. Their study contemplated both QCAP and BAP as one sole problem, and it was now called Berth and Quay Crane Allocation Problem (B&CAP), where an amalgamated technique has been taken into account. Researchers suggested a Nested Loop-based Evolutionary Algorithm (NLEA) technique after conducting several computational experiments, and proposed a new technique to be able to reach small enhancement in performances.

Likewise, BAP has been studied for some time now due to its intricacy and has capacity in creating substantial effect on VTAT. In addition, it is vital to comprehend that VTAT is not merely limited to allocation of berth, but there are other elements such as amount of payloaders used, the speed of route, equipment breakdowns and many more (Hendriks, Lefeber & Udding, 2013). Hence, according to Cullinane & Wang (2015), the efficiency of the terminal rest on effective use of mainly labour, machinery, and land. Therefore, the impact of human factor on productivity of dry bulk terminal should not be ignored even though it is relatively hard to compute, gather data and scrutinize.

Taking into account the impact of berth tenancy on VTAT, Guo, Tang, Wang & Qiao (2016), carried out a study to analysis the impact of dimensions of channel entrance into the terminal to eradicate possible holdups in the performance of the terminal through the use berth occupancy. The authors used Process Interaction Based Simulation (PIBS) pattern and simulation tests to activate operation of the terminal at channel entrance. Their outcomes demonstrated that the occupancy of berth relies on the sizes of channel entrance. Berth occupancy is directly proportional to number of berths, reduced travel time in channel and freeway traffic channel. Dinu, Rosca, Dragu & Ilie (2018), indicated that the total wharf operations efficiency is affected by many components; such as the existing quayside capacity and the terminal productivity of the bulk handling equipment can be recognized as dominant. ARENA software and other analytical models were used by researchers to find methods to improve transmission function by changing the throughput. Diabat, Fu & Tsai (2014), used Mixed-Integer Programming (MIP) to study Quay Crane Scheduling and Assignment Problem (QCSAP). The authors emphasised that it is almost hard to get the best resolutions for complex challenges using old tactics; therefore, they proposed a GA technique to solve existent practical problems of QCSAP.

According to Zeng, Diabat & Zhang (2015), reduction of vessel turnaround time is recognized as one of the main objectives in the terminal scheduling. The quay cranes performance plays a vital role in operations of dry bulk terminal, and they can make a substantial effect on vessel turnaround times. In order to solve Hybrid Heuristic Approach (HHA), and QCSAP, the researchers suggested and used a Mixed Integer Linear Programming (MILP) technique. Their research of Dual Cycling Technique (DCT) demonstrated that appropriate application can assist in reduction of the number of running empty of quay cranes, consequently enhancing the dual cycle schedules head to minimized VTAT. Li et al. (2017), proposed that the terminal performance can be enhanced by accurate forecast of arrivals vessels by knowing its where-about. They used Random Forest (RF), Classification and Regression Tree (CART) and Back-Propagation network (BP) together with other series of simulation tests to carry out their study.

2.8 Summary of Literature Review and Research Gaps

Most research done covers vessel turnaround time (VTAT) of container and bulk terminals, there is no research done which focuses on the VTAT of dry bulk terminal. The impact of breakdowns of key equipment, cargo condition, cargo spillage, route readiness, cargo availability, poor planning, shift changes, poor cargo flow rate, skills of both operation and technical employees which affect vessel turnaround time in dry bulk terminal have not been studied. This research looks to fill that gap as not all commodities require to be shipped via containers.

2.9 Conceptual Framework

Different input and outputs of vessel turnaround time at Richards Bay Dry Terminal (RBDBT) were taken into consideration. The input variables ranges from the availability of tugs and pilot, custom clearance, vessel breakdown, availability of ship-loaders and unloaders among other variables. These also includes cargo availability, berth availability, equipment breakdowns, speed of the conveyor belts, poor planning, cargo separation, cargo condition, weather condition, workmanship of both technical and operation employees, cargo spillages on transfer points, route readiness, shift change, cargo separation, availability of front end loaders, and cross contamination. While the output variable is vessel turnaround time, Figure 2.6 below shows the independent variables, which affect the dependent variable.

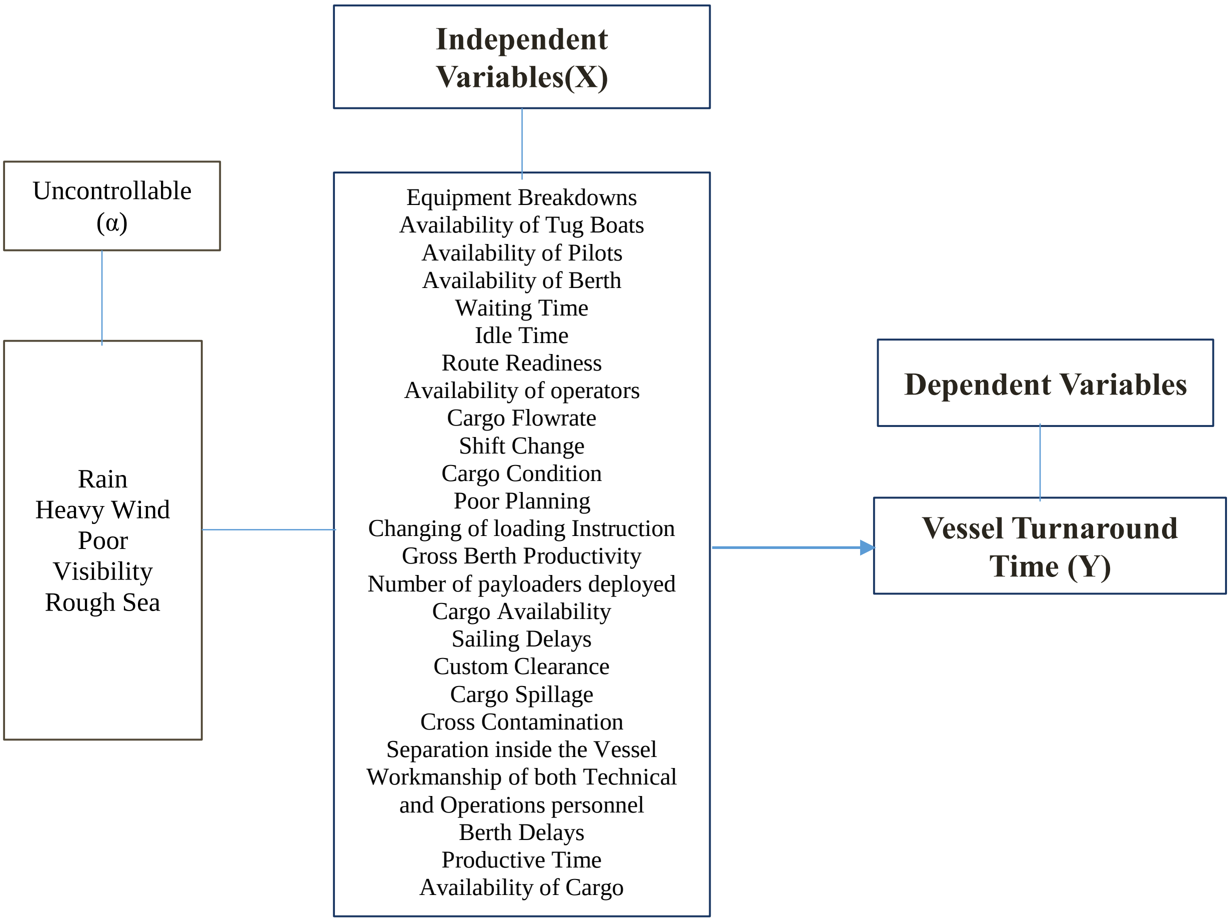

Figure 2.6: Conceptual Framework drawn by Researcher

The dry bulk terminal operation is a highly competitive and complex operation; thus, the terminal continuously implements a number of performances methods in order to improve their productivity. As discussed in the literature, Vessel Turnaround Time (VTAT) is recognized as a generally used parameter when it comes to dry bulk vessel operations in the world. VTAT is affected by many factors, hence can be demonstrated as a function of independent variables (X_i) and a constant (α) which is uncontainable factors. The equation is represented as follows:

$$VTAT(Y) = f\big(Independent\ variables\ (X_i)\big) + \alpha \qquad (1)$$

Moon (2018), defines VTAT as a sole time element that is a result of summation of numerous activities like idles times, berthing time, discharge/loading time, maneuvering time, waiting time for berth, and other time constituents between vessel arrival and departure.

2.10 Conclusion

This chapter discussed four theories namely: stakeholder, three-factor, queuing, structure-conduct-performance paradigm relevant to the study. Under these theories, it was noted that it is vital to meet the demand of stakeholder and satisfy customer’s requirements failing which will result in customers moving their cargo to other ports due to the vessels not turned around quicker as planned. This also lead to congestion in the port as other vessel wait longer at the port entrance waiting to be serviced. The relevant literature underpinning the study was reviewed. The research gaps were identified and discussed. Lastly, the conceptual framework underpinning the study was also discussed in details.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research design, research paradigm and approach, study site, target population, sampling strategy, and sampling size used for the study. The chapter further described how data were gathered, examined, expected outcomes, as well as provide a short description of the study undertakings or program, and the work plan along with references. The data collected by the researcher was analysed using STATA and Statistical Package for Social Science (SPSS).

3.2 Research Design

Research strategies comprise of case study, grounded theory, ethnography, survey, action research, archival research and experiment (Saunders, Lewis & Thornhill, 2016). The selection of the current research strategy was led by the objectives of the study. This study excluded action research. The rationale behind excluding action research was due to a lot of money required, time and accessibility constraints. Ethnography and ground theory are purely qualitative and as results, they were excluded since they cannot accomplish the study's objectives by producing necessary quantitative data. For the purpose of this study, a case study was thought-out to be a suitable method. Hence, it was adopted for the study.

The case research was narrowed to certain context as this study aimed at investigating some factors affecting vessel turnaround time at RBDBT. According to Yin (2017), a case study is a comprehensive investigation into a theme inside its real-life setting. Also Creswell & Creswell (2017), indicated that a key factor in outlining a case study is to select the case to be studied and determine the boundaries of the study. According to Mwedapole (2015), case study strategy is used for conducting research which includes an empirical analysis of coexistent phenomenon within a context, or existent life setting using various bases of evidence. According to Ridder, Hoon & McCandless (2014) and Yin (2017), case study has the capacity to generate comprehensions from in depth and intensive research. Bell, Bryman & Harley (2018), pointed out that interaction between the subject of the case and its context are best understood through comprehensive case studies.

A case study was thought-out to be a suitable method to examine the factors affecting vessel turnaround time at RBDBT as it offers a chance to study into details and offers a well-ordered information with regards to the area of focus. Furthermore, case study strategy was thought-out to be suitable as it permits direct observations of the proceedings happening at the terminal being studied as well as the interviews of people involved in its operations. Facilities, and physical working environment and through interviewing terminal operators, management, cargo owners, landlord, users and shippers gave a clear picture of vessel turnaround time efficiencies. A case study strategy has the ability to enable the researcher to use several methods during collection of data. According to Yin (2017), the case study research approach is not confined to one evidence source since it depends on multiple sources of evidence. Thus, in this study, interviews, survey, direct observations and documentary evidence, were used as procedures for data collection.

The motive behind using a case study is due to its fairly comprehensive technique which allows the researcher to study thoroughly and deeply on various form of the sensation, saves both cost and time, and malleable with regards to data collection methods according to Creswell (2014). It is well-liked because it accommodates both quantitative and qualitative research. RBDBT was selected to be a case since it is the only dry bulk terminal in South Africa facing poor VTAT. The researcher applied and followed descriptive research approach. The approach was used due to its resilience and capability of handling data collection on time without financial requirements.

3.3 Research Paradigm

According to Saunders *et al.* (2016), research paradigm is defined as board framework which involves beliefs, perception and understanding of some practices and theories which are used to carry out research. It can also be classified as a process which contains several steps where by the researcher builds a relationship amongst the research questions and objectives.

Research paradigm are categorized into three components namely Ontology, Epistemology and Axiology. Ontology implies to the mutual assumptions which are made to understand the nature of reality in the society (Burrell & Morgan, 2017). Epistemology connotes the common assumptions and parameters which are associated with knowledge and are regarded as legitimate, acceptable and valid knowledge. It also encompasses of how such knowledge can be shared amongst one another (Burrell & Morgan, 2017). Axiology on the other hand connotes the parameters in research process associated with role of ethics and value (Burrell & Morgan, 2017). Bryman & Bell (2015), also pointed out that researches are categorized into paradigms such as phenomenology and positivism. This study adopted principles of phenomenology of which the results emanated from natural facts during the course of the study. The rationale behind using one paradigm was due to the type of study under investigation. This needed the researcher to look at the operation as a whole in the port to find out the causes of poor vessel turnaround time at Dry Bulk Terminal and to come with a detailed examination displaying the real situation which took place at the terminal.

3.4 Study Site

The site of study was conducted at the Dry Bulk Terminal Port of Richards Bay due to the fact that DBT plays an important role in international trade and generates revenue for the South African government. The key players involved in the port business involved Transnet Port Terminal (TPT), Transnet National Port Authority (TNPA), stevedoring, cargo owners and shipping agents.

3.5 Study Population

Mwendapole (2015), defined population as a group of people, items or objects which conform to specific criteria and where samples are drawn from for the purpose of measurement. These refers to the group of people or elements that have something in common. These may include overall demographics such as class, education, gender and age. The population under study consisted of Terminal operators (TPT and TNPA staffs), cargo owners, shipping agent, and stevedoring personnel. The total population which the sample size was taken from is 150 people.

3.6 Data Analysis Units

Through the use of questionnaire and interviews, data was collected, scrutinized, organized, classified and tabulated. SPSS was used to analyse the data collected. Using this method, the researcher was able to examine the current state in details, conclude and give recommendations to improve the VTAT at RBDBT.

3.7 Variables and Measurements

Statistical tools like means and relative frequencies were used to measure the variables of the sample taken. The data under these measurements are ordinal to allow the mathematical and statistical operations requisite to the study. Mwendapole (2015), pointed out that ordinal data analysis are vital in a research as they judge the quality measures associated in collection of research data and determine the level of reliability and ralidity.

3.8 Sampling Size and Techniques

3.8.1 Sampling Size

A sample size is derived from taking into account the relationship between the confidence level of target population and margin of error according to Saunders *et al*. (2016). Creswell & Creswell (2017), pointed out that the selection of a sample size in a research needs to exemplify a set which will fit in all cases that is significant and justifiable.

The researcher used sample size table from The Research Advisors (2006) shown in appendix F to determine a sample size of 108 participants from a sampling frame of 150 key business players of RBDBT. The sample size was at a 95% confidence level with a 5% margin of error. The researcher selected these participants from a population consisting of diverse institutions, sections and departments operating in within the terminal. These participants are classified as 25 from TPT technical, 25 from TPT operations, 10 from shipping agents, 10 from cargo owners, 10 from stevedores, 5 from TPT commercial, 5 from TPT planning, 5 from TPT finance, 5 from TPT security, and 4 from TNPA port control.

3.8.2 Sampling Techniques

Jongile (2015), argued that sample procedure is the process of choosing a part of the population to represents the total population whereby judgment can be made. It is a process of choosing a set of people, events or other components with which to carry out a study. Again it also involves choosing of technique to be used during assortment process. A vital problem affecting the selection of a sampling method to be used in a study is the availability of a sampling frame. Researchers are advised to use probability sampling techniques such as systematic, cluster, stratified, simple and multi-stage random sampling if a sample frame is available (Saunders *et al*., 2016). On the other hand, if sample size is not present, the researcher has to utilize non-probability sampling methods like quota, purposive, hard convenience and volunteer sampling techniques (Saunders *et al*., 2016).

For the purpose of this study, a convenience sampling technique was adopted to choose respondents for the study. The rationale behind using this technique is due to unavailability of sample frame and random selection of sample. Considering that this is an academic study and as a result of time constrains, there was relatively no adequate time to conduct pilot study where determination of sample frame could be carried out. According to Jongile (2015), convenience sampling is one type of non-probability sampling where by sample cases selected are easily available; therefore, the research involved respondents who were prepared to participate.

Table 3.1: Sample Size.

S/No	Institution	NO.
i.	TPT Technical Staff	25
ii.	TPT Operations Staff	25
iii.	Cargo Owners	10
iv.	Shipping Agents	10
v.	Stevedores Staff	10
vi.	TPT Planning Staff	5
vii.	TPT Finance Staff	5
viii.	TPT Commercial Staff	5
ix.	TPT Security Staff	5
x.	TPT Human Resource Staff	4
xi.	TNPA Port Control Staff	4
xii.	TOTAL	108

3.9 Methods & Instrumentation for Data Collection

Documentary review was applied and used as a method of collecting research data for the study. For the study, the researcher went through DBT performance reports and some other essential organisational documents to collect data and information available which was crucial to be used in evaluating factors affecting VTAT at RBDBT. Also the researcher carried out observations at operational areas (export and import sections) and interviews. The researcher observed port operations from planning of vessels, stockpiles where cargo is loaded with payloaders till quayside where cargo is loaded to vessels by ship-loaders, and from quayside to storage area during offloading of cargo. The researcher had one on one with participants during interview sessions so that participants can feel free to talk and also not being influenced by the answers given by others if they are in a group. In this research, secondary data was used due to constraints in resources. Questionnaires, observation and interview were also used to corroborate documentary data [see Appendix B - Questionnaire, C – Interview Questions and

D - Observations Checklist]. Chingaga (2015), argued that a careful oberavation is vital and must be highly used when conducting a study in the port which involves studying a lot of activicities which cause high vessel turnaround time. Observations assisted the researcher to observe each and every activity in the port in order to establish the causes of poor vessel turnaround times.

3.10 Data Analysis

According to Mwendapole (2015), data analysis is defined as the process of computation of certain indices or measures along with searching for patterns of relationship that exist among the data groups.

Descriptive statistics of frequency tables were used to analyse and present the data from questionnaires. The researcher used both SPSS and STATA software package to generate frequency tables and graphs as means of presenting data. The data was summarized, analysed and interpreted as on each research objective. In contrast, qualitative data from interview scripts, notes and statements was systematically coded and classified into broad descriptive categories while exploring themes, meanings and/or issues that emerged from the information gained from the interview. These data were further linked to the research objectives/questions to generate meaning and explanation on the study topic.

3.11 Validity & Reliability

3.11.1 Validity

Jongile (2015), defines validity as the degree to which research methods and data used attain accurate, precise, and correct findings. The explanation furthermore imitates on inquiries of how best the outcomes replicate the authenticity, and certainty of the key inquiries. Validity can be categorized into three classes which researchers accept, namely internal, external and construct validity (Lillis, 2006). Construct validity is concerned with forming the procedures of the right functional measures for the models under study. The researcher used analytical software (SPSS) to re-exam the data before performing the analysis and ensured repetition of the procedure was done in order to ensure that the results are spot-on.

External validity is designed to check if the research's outcomes are potential to simplify outside the instant case study. Since the research was carried out at RBDBT, which is the premier port of South Africa, consequently, the information attained at the port represent the other dry bulk terminals in the country.

3.11.2 Reliability

Jongile (2015), defines reliability as the degree in which outcomes are consistent over a period of time. Chingaga (2015), indicated that consistency of a measuring instrument was instituted by defining the relationship amongst the scores attained from various officers/staff. An instrument is measured to be consistent if the association degree is high. Commonly used techniques to check reliability are split-half, test-retest, the Cronbach alpha and equivalent-form (Lillis, 2006). Cronbach alpha coefficient was used to calculate the internal uniformity of the assessing scales in this study. It shows the degree to which a set of test objects can be handled as one quantifying latent variable and is extra precise and vigilant technique of instituting the consistency of quantifying instrument (Chingaga, 2015). Wadkar, Singh, Chakravarty & Argade (2016), opined that the Cronbach alpha reliability constant spread between 0 and 1. The more it is nearer to alpha coefficient of 1.0, the higher the internal reliability of the items in the scale. Bonett & Wright (2015), posit that 0,70 or above of Cronbach alpha coefficient is taken as ideal. Other studies consider a 0,50 of Cronbach alpha coefficient as satisfactory for a simple research (Peters, 2014). 0,70 of Cronbach alpha implies that 70% of discrepancy of practical scores are due to the discrepancy of true scores. This basically means that the scores attained from measuring instrucment shows a true reflection of about 70% undelying features measured. Thus, the measures of variables were done as follows:

Equipment used; the variables used were the use and efficiency of shiploader/loaders, conveyor belts, ploughs, reclaimers, number of payloaders, scada, tug boats, and helicoptor. The reply mode of this variables had 0,760 of Cronbach alpha and a Likert-scale of 4 points was releaved when reliability check was carried out, which demonstrates that the measure was trustworthy. Other factors afecting vessel turnaround time; the variables used were cargo condition, size of vessels, lack of skilled staff, lack of maintenance (breakdowns), poor vessel planning and scheduling, poor management, and old infrastructure. The variables had 0,708 of Cronbach alpha and a Likert-scale of 5 point was releaved when reliability check was carried out, which demonstrates that the measure was trustworthy. Strategies for improving vessel turnaround times; the variables used were implement shutdowns to do proper maintenance, equipment refurbishment, insource payloading, plant upgrade and standarisation, purchasing of new machines. Service Level Agreement (SLA) with Original Equipment Manafauctors (OEM) and customers, penalty system for poor performance, expand size of the port, upskilling staff, use and adhere to Terminal Operating Guideline (TOG), install new conveyor belts going straight to the quaysite from the stockpiles, increase railway shipping system efficiency, reduce road transport traffic inside the port and widden the roads. The variables had 0,806 of Cronbach alpha and a Likert-scale of 5 point was releaved when reliability check was carried out, which demonstrates that the measure was trustworthy.

Table 3.2: Cronbach Alpha

Inputs	Objects	Cronbach Alpha
Equipment and Methods utilized	7	0.760
Other issues affecting VTAT	5	0.708
Strategies for improving vessel turnaround time	14	0.806
Trustworthiness of questionnaire	25	0.789

3.12 Ethical Consideration

According to Alshenqeeti (2014), research is anticipated to follow ethical consideration in all the phases when it comes to people and organisation since its goes into participants' sensitive information and private lives or organisation's information. Participants should start by agreeing to participate through completion of a consent form before filling questionnaire and participating in an interview. In view of this, the researcher requested permission from RBDBT senior management to use the port as the case study for the research. Saunders *et al*. (2016), indicated that there are two types of access namely internet-mediated and traditional access. Traditional access refers having face to face communications through conducting interviews, observations, experiments, questionnaires, focus groups, data archives reviews and telephonically. The technique used during data collection ramified having face-to-face interactions with participants who were TPT staff, TNPA staff, stevedoring staff, shipping agents and cargo owners. Ethical issues were well thought off and could not be ignored. Hence, the researcher was obligated to be honest as well as respect the participants. Walliman (2017) posit that people should be treated with dignity, and respect as any bad treatment can result in many implications during the research. Creswell (2014), pointed out that in order for a researcher to gain access to study area and participants, he/she need to apply for approval from the management (gatekeepers). The method entails writing a letter that shows potential impact, extent of time, benefits and results of the research. The researcher followed the same process and obtained permission from Terminal Manager of port of Richards Bay to access vessels database for sampling and data collection within the dry bulk terminal. The RBDBT permission was supported by application and approval of ethical clearance, which the researcher did, and was granted by the ethical committee from the University of KwaZulu-Natal.

The data collected and details concerning participants were treated as confidential. The data were classified and also kept safely. The participants were issued with consent forms and were asked to sign that they are participating willing before conducting interviews and filling a questionnaire. All essential clarity was given to participants and all questions asked by participants were answered in order to make participants comfortable in taking part in the study. The study was for academic purpose and also intended to benefit the port in improving their vessel turnaround time as the study intend to uncover the causes affecting VTAT and come up with strategies to overcome those factors.

3.13 Conclusion

The chapter explained and justified the research methodology used during the data collection and data analysis in this study. The chapter also described how data analysis was conducted as well as how the requirements for reliability and validity of the research design were met. The chapter also looked at ethical issues which needed to be taken into consideration during the study. The next chapter deals with analysis and discussion of research results.

CHAPTER FOUR:

FINDINGS ANALYSIS AND DISCUSSION

4.1 Introduction

The previous chapter discussed in details the designed methodology of this study. It also detailed the key components in the collection of data and analysis, as well as the validity and reliability of the study. This chapter shows the outcomes of the study, which were established through, interviews and completed questionnaires with workforces of Transnet Port Terminals (TPT), Transnet National Port Authority (TNPA), Cargo Owners, Shipping Agents, and Stevedoring. The chapter is divided into two parts. Part one showed demographic traits of the participants and part two showed outcomes to the objectives of the research.

4.2 Demographic Traits of the Participants

The outcomes which follows illustrate the participants' background. Background of participants was presented through the use of cross tabulations. The participants' characteristics comprise of age, gender, working experience and level of education. The outcomes are shown as follows: -

4.2.1 Participants' Gender

Cross tabulation was used to analyze and examine the spread of participants 'gender. The outcomes are presented in Table 4.1. The participants 'gender was documented because the researcher wanted to illustration the diversity of gender represented by the study's participants.

Table 4.1: Participants' Gender

			Categories of Participants											Aggregate
			TPT Technical Staff	TPT Operations Staff	TPT HR Staff	TPT Commercial Staff	TPT Security Staff	TPT Planning Staff	TPT Finance Staff	TNPA Port Control Staff	Cargo owners	Stevedores Staff	Shipping Agents	
Participants' Gender	Male	Tally	22	15	0	1	2	4	3	1	8	10	8	74
		% within Groups of participants	88%	60%	0%	20%	40%	80%	60%	25%	80%	100%	80%	69%
		% of Aggregate	20.37%	13.89 %	0.00%	0.93%	1.85%	3.70%	2.78%	0.93%	7.41%	9.26%	7.41%	69%
	Female	Tally	3	10	4	4	3	1	2	3	2	0	2	34
		% within Groups of participants	12%	40%	100%	80%	60%	20%	40%	75%	20%	0%	20%	31%
		% of Total	2.78%	9.26%	3.70%	5.50%	2.78%	0.93%	1.85%	2.78%	1.85%	0.00%	1.85%	31%
Aggregate		Tally	**25**	**25**	**4**	**5**	**5**	**5**	**5**	**4**	**10**	**10**	**10**	**108**
		% within Groups of participants	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
		% of Aggregate	**23.15%**	**23.15 %**	**3.70%**	**4.63%**	**4.63%**	**4.63%**	**4.63%**	**3.70%**	**9.26%**	**9 26%**	**9.26%**	**100%**

In all the institutions visited, the outcomes shown in Table 4.1 demonstrates that the majority of participants were male except for TPT HR, TPT commercial, TPT security, and TNPA port control. In general, male participants accounted for 69% while female accounted for 31% of the participants. This result clearly indicate that activities related to operations and port management are dominated by males. On other hand, this study can be considered not bias in term of participants' gender as it involves the opinions of both genders.

4.2.2 Participants' Age

Table 4.2 below shows the outcomes produced by means of cross tabulation to illustrate the spread of the participants' age groups. Participants' age group were documented because in state own companies/institution when they do monitoring, the age of employees is vital and it matters alot.

Table 4.2: Participants' Age

			Categories of Participants											Aggregate
			TPT Technical Staff	TPT Operations Staff	TPT HR Staff	TPT Commercial Staff	TPT Security Staff	TPT Planning Staff	TPT Finance Staff	TNPA Port Control Staff	Cargo owners	Stevedores Staff	Shipping Agents	
Participants' Age	18-28 years	Tally	1	1	0	1	0	0	0	0	2	1	1	7
		% within Groups of participants	4%	4%	0%	20%	0%	0%	0%	0%	20%	10%	10%	6%
		% of Aggregate	0.93%	0.93%	0.00 %	0 93%	0.00%	0.00%	0.00%	0.00%	1.85%	0.93%	0.93%	6%
	29-39 years	Tally	12	3	3	2	0	2	0	1	1	2	5	31
		% within Groups of participants	48%	12%	75%	40%	0%	40%	0%	25%	10%	20%	50%	29%
		% of Aggregate	11.11%	2.78%	2.78 %	1.85%	0.00%	1.85%	0.00%	0.93%	0.93%	1.85%	4.63%	29%
	40-50 years	Tally	7	14	1	1	4	2	3	2	5	5	2	46
		% within Groups of participants	28%	56%	25%	20%	80%	40%	60%	50%	50%	50%	20%	43%
		% of Aggregate	6.48%	12.96%	0.93 %	0 93%	3.70%	1.85%	2.78%	1.85%	4.63%	4.63%	1.85%	43%
	51-61 years	Tally	5	7	0	1	1	1	2	1	2	2	2	24
		% within Groups of participants	20%	28%	0%	20%	20%	20%	40%	25%	20%	20%	20%	22%
		% of Aggregate	4.63%	6.48%	0.00 %	0 93%	0.93%	0.93%	1.85%	0.93%	1.85%	1.85%	1.85%	22%
Aggregate		Count	25	25	4	5	5	5	5	4	10	10	10	108
		% within Groups of participants	100%	100%	100 %	100%	100%	100%	100%	100%	100%	100%	100%	100 %
		% of Aggregate	23.15%	23.15%	3.70 %	4.63%	4.63%	4.63%	4.63%	3.70%	9.26%	9.26%	9.26%	100 %

Table 4.2 above illustrates the outcomes of the study from the different age group participants. The age group of 40-50 years old had 43% of the participants, the age of group of 29- 39 years old had 29% of the participants, while the age group of 51-61 years old has 22% of the participants and the age group of 18 – 28 years old had 6% of the participants. It is therefore assumed that with these findings most of the participants were matured individuals aged between 29 to 60 years old. These are the enterprising and energetic people who are well familiarity with the port operations.

4.2.3 Level of Education of Participants

Cross Tabulation was used to generate the outcomes in Table 4.3 in order to see the spread of the participants' level of education. A majority of participants in all the institutions visited had a bachelor degree qualification except in TPT operations where most participants had diploma. The results are as follows 45% participants had degree qualifications, 30% had diploma, 11% had master's degree, 10% had certificates and 4% had postgraduate diploma. Since most of participants where educated, it can be said that the research collected data from individuals who are able to give a flawless, objective response as well as think logically. Hence, the outcomes are considered reliable since they arose from knowledgeable individuals.

Table 4. 3: Education Level of the Participants

			Categories of Participants											
			TPT Technical Staff	TPT Operations Staff	TPT HR Staff	TPT Commercial Staff	TPT Security Staff	TPT Planning Staff	TPT Finance Staff	TNPA Port Control Staff	Cargo owners	Stevedores Staff	Shipping Agents	Aggregate
Education level of participants	Certificate	Tally	6	4	0	0	0	0	0	0	0	0	1	11
		% within Groups of participants	24%	16%	0%	0%	0%	0%	0%	0%	0%	0%	10%	10%
		% of Aggregate	5.56%	3.70%	0.00 %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00 %	0.00%	0.93%	10%
	Diploma	Tally	6	11	0	3	1	2	0	0	1	5	3	32
		% within Groups of participants	24%	44%	0%	60%	20%	40%	0%	0%	10%	50%	30%	30%
		% of Aggregate	5.56%	10.19%	0.00 %	2.78%	0.93%	1.85%	0.00%	0.00%	0.93 %	4.63%	2.78%	30%
	Degree	Tally	10	6	4	2	3	1	3	2	8	4	6	49
		% within Groups of participants	40%	24%	100 %	40%	60%	20%	60%	50%	80%	40%	60%	45%
		% of Aggregate	9.26%	5.56%	3.70 %	1.85%	2.78%	0.93%	2.78%	1.85%	7.41 %	3.70%	5.56%	45%
	Postgraduate diploma	Tally	1	2	0	0	0	0	0	0	0	1	0	4
		% within Groups of participants	4%	8%	0%	0%	0%	0%	0%	0%	0%	10%	0%	4%
		% of Aggregate	0.93%	1.85%	0.00 %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00 %	0.93%	0.00%	4%
	Master's Degree	Tally	2	2	0	0	1	2	2	2	1	0	0	12
		% within Groups of participants	8%	8%	0%	0%	20%	40%	40%	50%	10%	0%	0%	11%
		% of Aggregate	1.85%	1.85%	0.00 %	0.00%	0.93%	1.85%	1.85%	1.85%	0.93 %	0.00%	0.00%	11%
Aggregate		Tally	25	25	4	5	5	5	5	4	10	10	10	108
		% within Groups of participants	100%	100%	100 %	100%	100%	100%	100%	100%	100%	100%	100%	100%
		% of Aggregate	23.15%	23.15%	3.70 %	4.63%	4.63%	4.63%	4.63%	3.70%	9.26 %	9.26%	9.26%	100%

4.2.4 Participants' Work Experience

The study lastly analyzed the working experience of participants in their respective organizations. Cross tabulation was used again to explore the data collected and the outcomes are as presented in Table 4.4 as thus;

Table 4.4:Participants' Work Experience

			Categories of Participants											Aggregate
			TPT Technical Staff	TPT Operations Staff	TPT HR Staff	TPT Commercial Staff	TPT Security Staff	TPT Planning Staff	TPT Finance Staff	TNPA Port Control Staff	Cargo owners	Stevedores Staff	Shipping Agents	
Participants' work experience	1-5 years	Tally	5	0	1	1	1	0	1	0	4	1	1	15
		% within Groups of participants	20%	0%	25%	20%	20%	0%	20%	0%	40%	10%	10%	14%
		% of Aggregate	4.63%	0.00%	0.93%	0.93%	0.93%	0.00%	0.93%	0.00%	3.70%	0.93%	0.93%	14%
	6-10 years	Tally	12	4	3	1	0	2	0	1	0	3	4	30
		% within Groups of participants	48%	16%	75%	20%	0%	40%	0%	25%	0%	30%	40%	28%
		% of Aggregate	11.11%	3.70%	2.78%	0.93%	0.00%	1.85%	0.00%	0.93%	0.00%	2.78%	3.70%	28%
	11-15 years	Tally	3	5	0	1	3	2	2	2	2	1	1	22
		% within Groups of participants	12%	20%	0%	20%	60%	40%	40%	50%	20%	10%	10%	20%
		% of Aggregate	2.78%	4.63%	0.00%	0.93%	2.78%	1.85%	1.85%	1.85%	1.85%	0.93%	0.93%	20%
	16-20 years	Tally	1	8	0	1	0	0	0	0	2	3	2	17
		% within Groups of participants	4%	32%	0%	20%	0%	0%	0%	0%	20%	30%	20%	16%
		% of Aggregate	0.93%	7.41%	0.00%	0.93%	0.00%	0.00%	0.00%	0.00%	1.85%	2.78%	1.85%	16%
	21 years and above	Tally	4	8	0	1	1	1	2	1	2	2	2	24
		% within Groups of participants	16%	32%	0%	20%	20%	20%	40%	25%	20%	20%	20%	22%
		% of Aggregate	3.70%	7.41%	0.00%	0.93%	0.93%	0.93%	1.85%	0.93%	1.85%	1.85%	1.85%	22%
Aggregate		Tally	25	25	4	5	5	5	5	4	10	10	10	108
		% within Groups of participants	100%	100%	100%	100%	100%	100%	100%	100%	100.00%	100%	100%	100%
		% of Aggregate	23.15%	23.15%	3.70%	4.63%	4.63%	4.63%	4.63%	3.70%	9.26%	9.26%	9.26%	100%

The results in Table 4.4 shows that 28% of participants have worked in their companies for 6 to 10 years. This was followed by 20% of those who worked in their companies for 11 – 15 years. An estimated 20% of participant worked in their companies for 11 – 15 years, while those who worked in their companies for a period of 16 – 20 years and 1 – 5 years are 16% and

14% respectively. This shows that participants in this study are well experienced and have worked in their companies for a number of years. This implies that they understood their company's culture in the sense of how things work around the port from planning vessels, berthing them, working them until sailing them out of the port.

4.3 Outcomes of Research Objectives

4.3.1 Findings and discussion from questionnaire

The findings and discussion from questionnaire were presented as follows:

4.3.1.1 How do you assess VTAT at RBDBT?

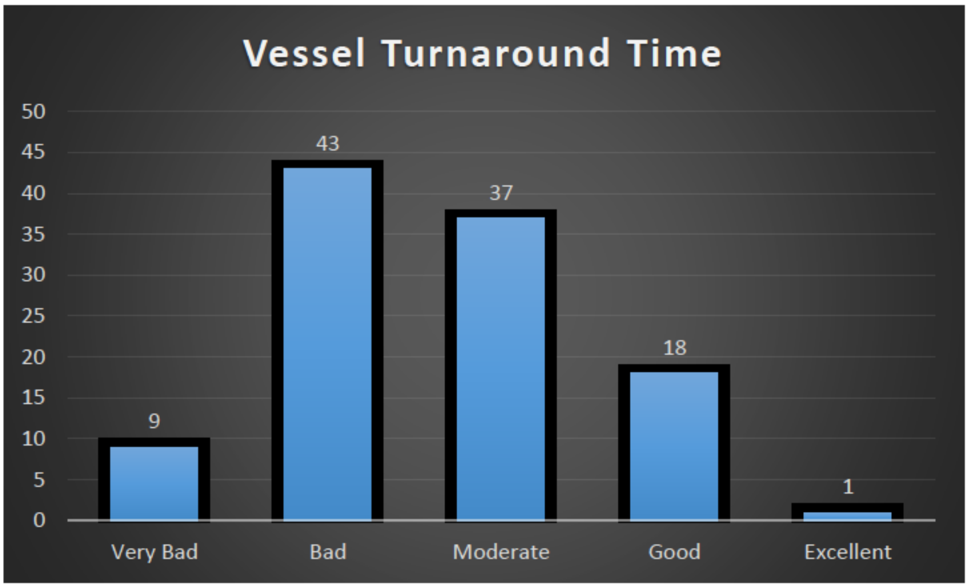

Figure 4.1:Vessel Turnaround Time

The study desired to assess VTAT at RBDBT (Figure 4.1). The results reveal that 39.8% of participants assess VTAT to be bad. Another 34.3% assess it to be moderate, 16,7% of participants assess it to be good, 8,3% assess it to be very bad, while 0,9% participants assess it to be excellent. This indicates that the VTAT at RBDBT is bad.

4.3.1.2 How reliable are the equipment used to load/offload cargo at RBDBT?

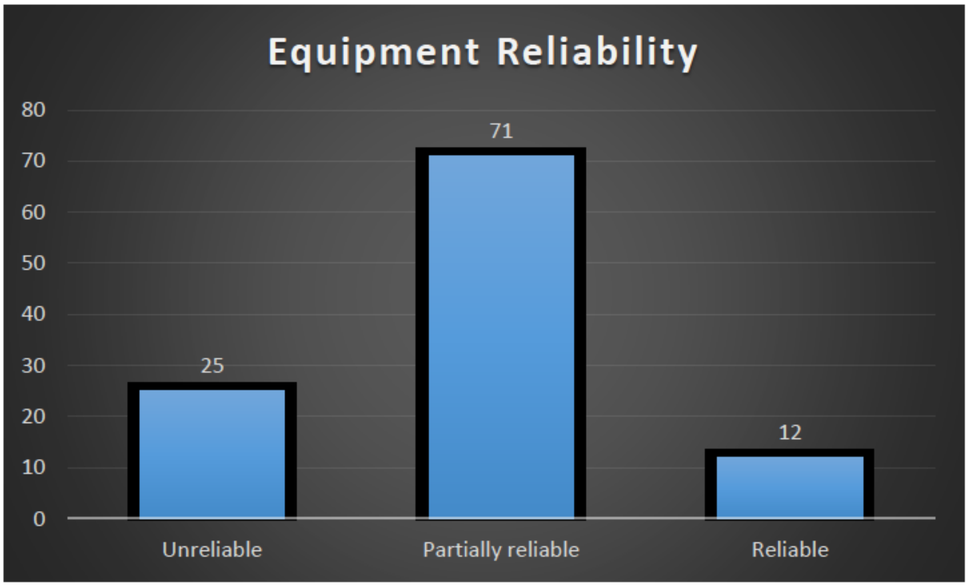

Figure 4.2: Equipment Reliability

The study desired to assess the reliability of equipment used to load/offload cargo at RBDBT (Figure 4.2). The results reveal that 65.7% of participants assess the equipment as partially reliable, 23.1% assess the equipment as unreliable, while 11.1% assess them as reliable. This implies that the equipment used to load/offload are partially reliable. This indicates that from time to time equipment used breaks down during loading/offloading. In support of the finding, Abijath & Kokila (2017), also discovered that eqiupment breakdowns at Cochin Port is a major factor affecting VTAT.

4.3.1.3 How do you assess the competency of technical employees at RBDBT?

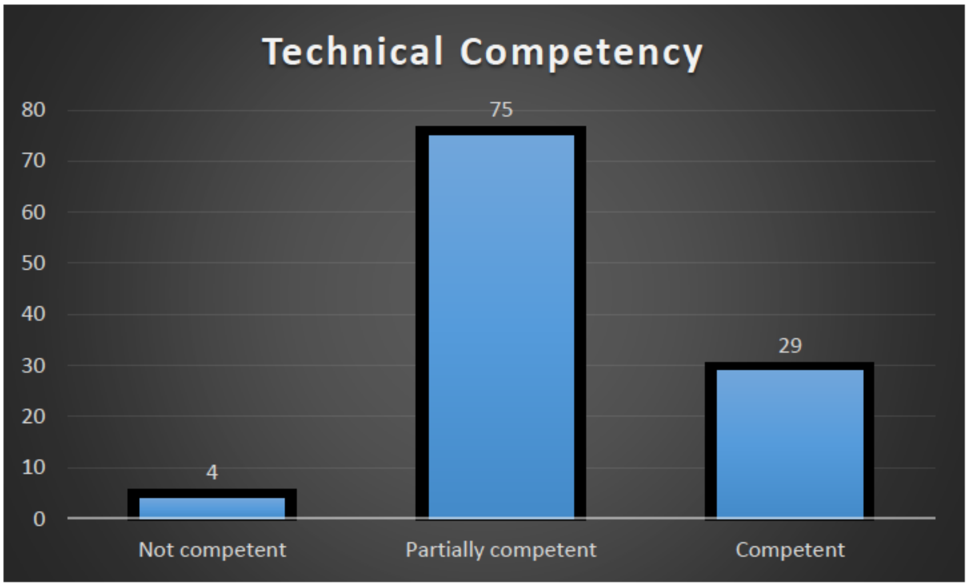

Figure 4.3: Technical Competency

The study sought to assess the competency of technical personnel doing maintenance of equipment used to load/offload cargo at RBDBT (Figure 4.3). The results reveal that 69.4% of participants assessed the competency of technical personnel as partially competent, while 26.9% of participants were competent. An estimated 3.7% of the participant consider technical staff as not competent. This indicate that some of the technical staff know what they are doing while others do not know what they are doing. This is supported by the response of vessel turnaround time and equipment reliability. They are not well trained and partially competent. Cullinane & Wang (2015), pointed out that the effeciency of the terminal rest on effective use of labour, machinery and land. Pairing unexperienced and experienced exployees with assisst the port to before better.

4.3.1.4 Does the unavailability of spares during breakdowns causes poor VTAT?

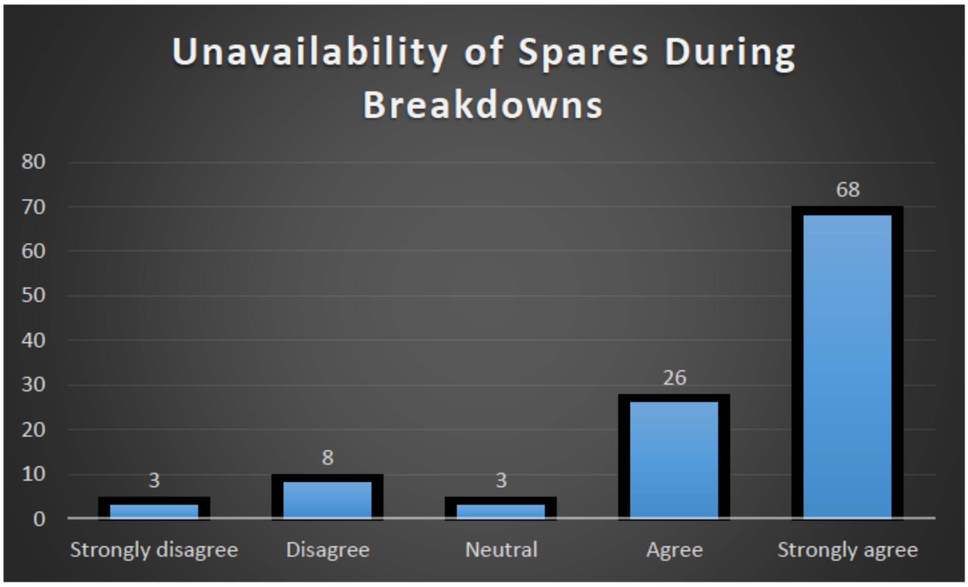

Figure 4.4: Unavailability of Spares during Breakdowns

The study sought to assess if the unavailability of spares during breakdowns causes poor vessel turnaround time (Figure 4.4). The results reveal that 63% participants strongly agree that the unavailability of spares during breakdowns causes poor VTAT. An estimated 24.1% participants agree, while 7.4% participants disagree, and 2.8% participants strongly disagree. About 2.7% participants were neutral in their position on the subject matter. From the data, this implies that a significant majority adjudged the unavailability of spares during breakdowns as a cause for poor VTAT. This implies longer periods for repairs in the event of breakdowns.

4.3.1.5 How do you assess the competency of operators at RBDBT?

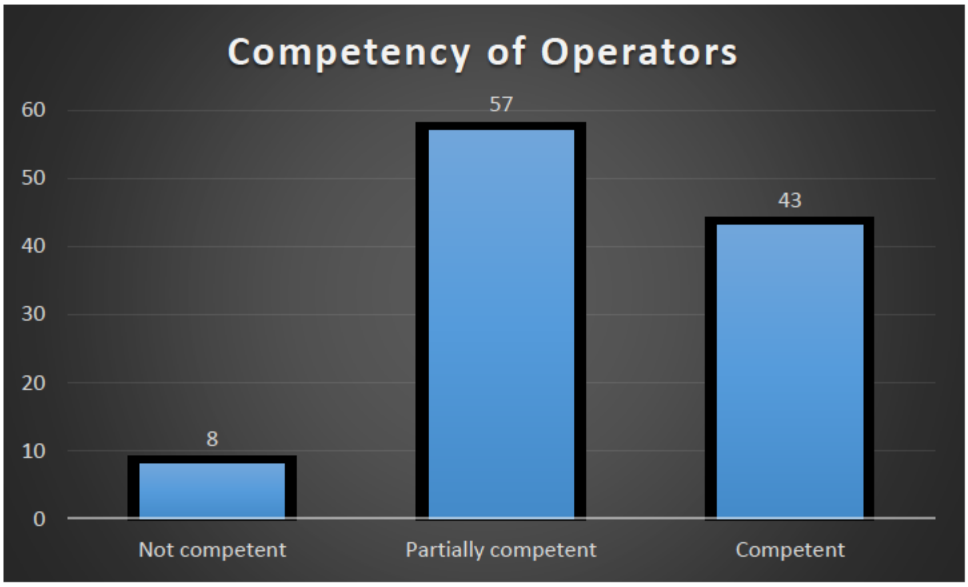

Figure 4.5: Competency of Operators

The study sought to assess if the operators are competent enough to operate the equipment to load/offload cargo at RBDBT (Figure 4.5). The findings reveal that 52.8% of participants assessed the competency of operators as partially competent, 39.8% of participants assessed them to be competent, while 7.4% of the participants assessed them to be incompetent. This implies that the competency of operators at RBDBT is partially competent. Mitrovic & Delovic (2017), also mentioned that skill of operators is one of the most influential factors affecting berth productivity. This means that the more operators are competent the more cargo is loaded/offloaded from the vessel and less equipment damages.

4.3.1.6 Route preparation affect VTAT

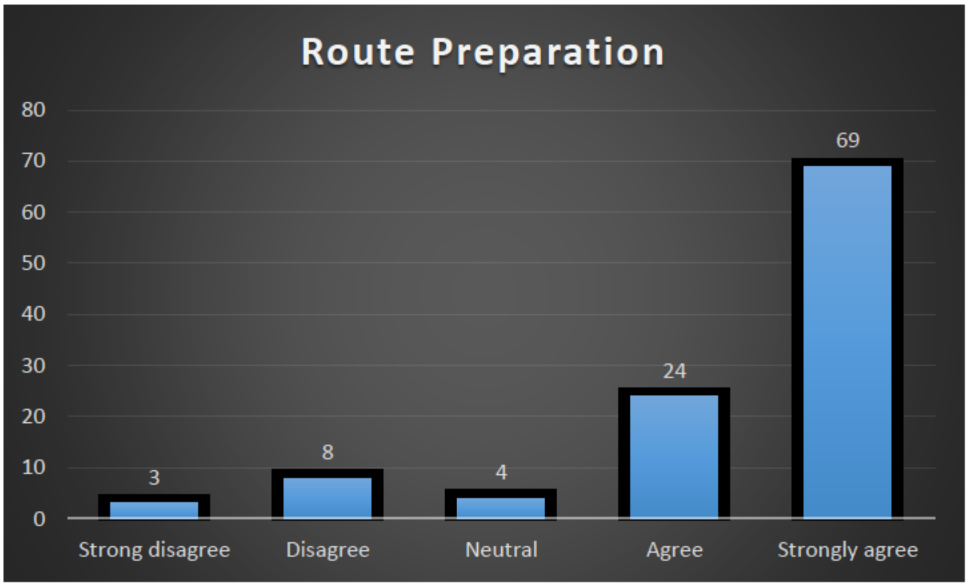

Figure 4.6: Route Preparation

The study sought to find out if route preparation affects VTAT (Figure 4.6). The findings reveal that 63.9% participants strongly agree, while 22.2% participants agree that route preparations affect VTAT. An estimated of 7.4% participants disagree, while 2.8% participants strongly disagree with this assertion. About 3.7% participants were neutral. This implies that route preparation does affect VTAT however, it must be done as the port load/offload different commodities using the same equipment as they do not want to contaminate these commodities. The longer time operations take to clean the route in preparing for the next vessels the more the vessels wait longer to be serviced.

4.3.1.7 Unavailability of cargo causes poor VTAT

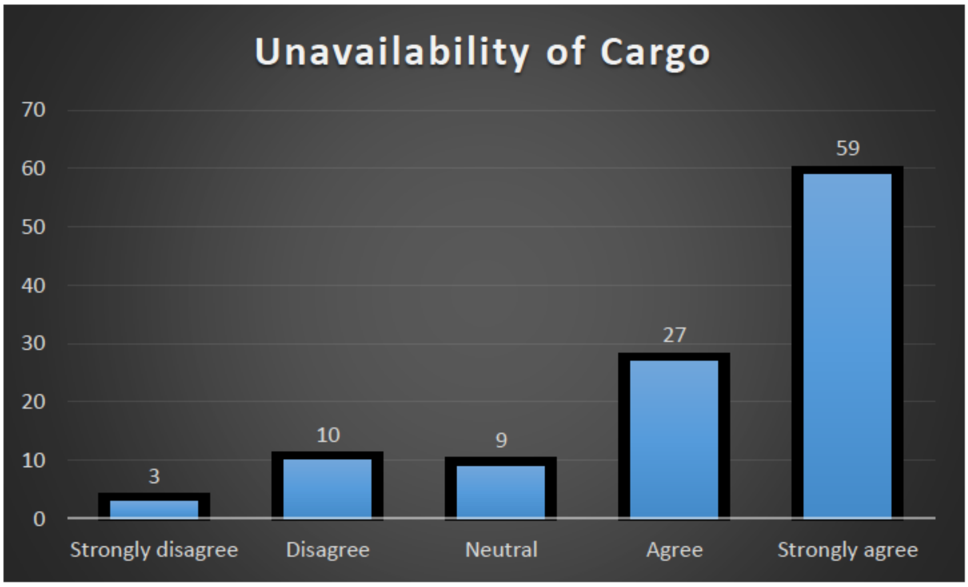

Figure 4.7: Unavailability of Cargo

The study sought to find out if unavailability of cargo during loading affects vessel turnaround time at RBDBT (Figure 4.7). The findings reveal that 54.6% participants strongly agree that unavailability of cargo during loading affects VTAT. About 25% participants agree with this assertion, while 9.3% and 2.8% participants disagree and strongly disagree respectively. Again, 8.3% participants opted to be neutral on the subject matter. This indicates that a shortage of cargo in the port affect VTAT, and vessels stays longer than planned service time on berth. In support, Gayathma et al. (2015), also found that unavailbility of cargo in port affect VTAT in their study.

4.3.1.8 Delays in stopping vessels from loading/unloading due dust causes poor VTAT

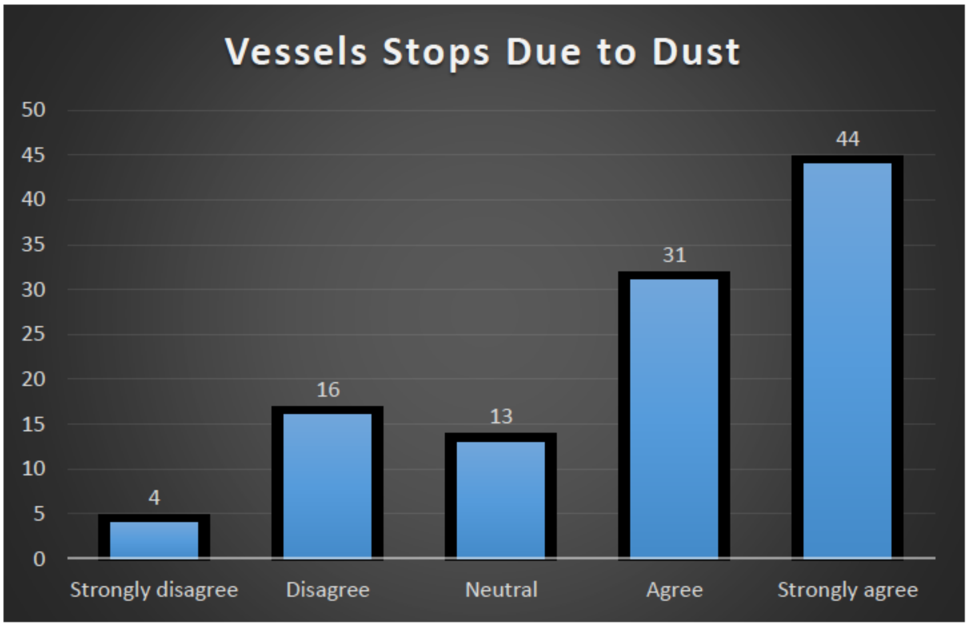

Figure 4.8: Vessels Stoppages due to Dust

The study sought to find out if delays in stopping vessels due to dust causes poor VTAT at RBDBT (Figure 4.8). The study reveal that 40.7% participants strongly agree, and 28.7% participants agree that delays in stopping vessels from loading/unloading due dust causes poor VTAT. An estimated 14.8% participants disagree, 12% participants were neutral, while 3.7% participants strongly disagree. This concludes that the delays in stopping vessels due to dust does causes poor vessel turnaround time at RBDBT. In support of the finding, Gayathma et al. (2015), also pointed out that weather condition affects VTAT. If dust blows to the residential area, it causes environment issues and health hazard to the lives of the people living around. Hence, vessels have to stop for the wind direction to blow away from the residential area.

4.3.1.9 Delays in loading/offloading wet cargo causes poor VTAT

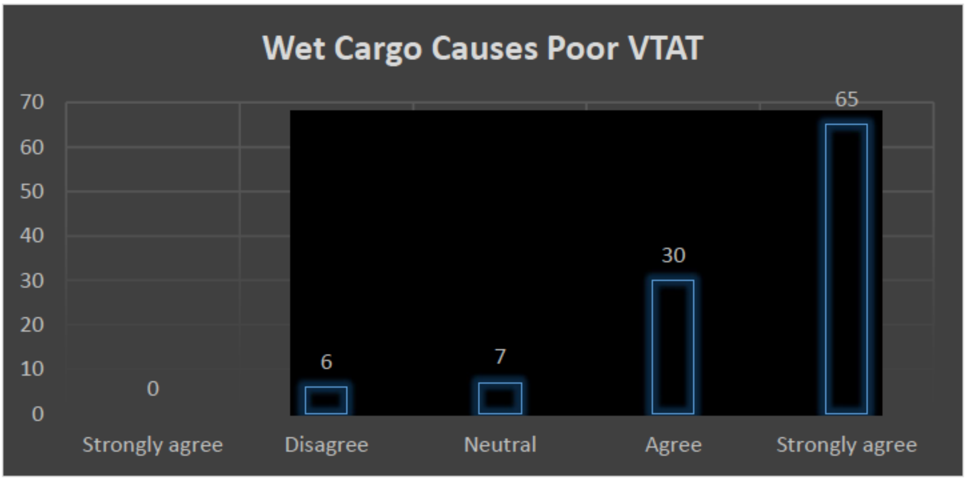

Figure 4.9: Wet Cargo Causes Poor VTAT

The study sought to find out weather delays due to wet cargo during loading/offloading causes poor VTAT at RBDBT (Figure 4.9). The results reveal that 60.2% participants strongly agree that wet cargo causes poor VTAT. About 27.8% participants agree and 6.5% participants were neutral in this assertion. An estimated 5.6% participants disagree with the assertion. This conclude that delays caused by wet cargo during loading/offloading which blocks hoppers and transfer chutes causes poor VTAT. These blockages require vessels to stand while operations staff clear them up. In support, Cahoon (2015), discovered that transfer point is one of the major concern that causes poor VTAT. That is cargo at transfer point spills and blocks which requires operations to stop loading in order for it to be cleared.

4.3.1.10 Delays in stopping the vessels due to high wind speed/rain causes poor VTAT

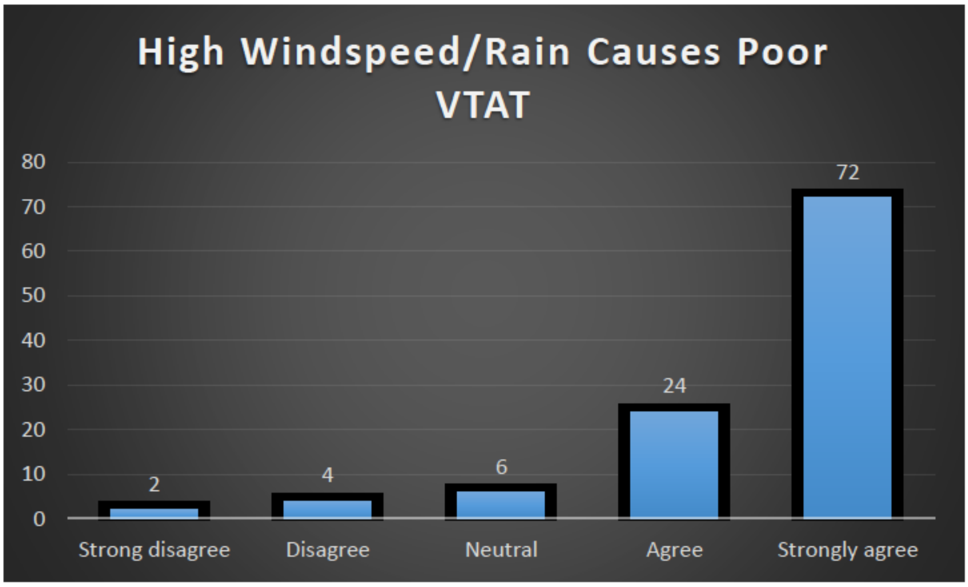

Figure 4.10: High Windspeed/Rain Causes Poor VTAT

The study sought to find out whether delays due to high wind speed or rain during loading/offloading causes poor VTAT (Figure 4.10). The findings reveal that 66.7% and 22.2% participants strongly agree and agree respectively that delay due to high wind speed or rain during loading/offloading caused poor VTAT. While 5.6% participants opted to be neutral, 3.7% and 1.9% participants disagree and strongly disagree respectively to this claim. This implies that delays due to high wind speed or rain causes poor VTAT. Some of the other commodities are weather sensitive and also equipment is designed to operate below certain high wind speed limits over and above that the equipment trips. In support, Gayathma et al. (2015), discovered that weather condition also affects VTAT.

4.3.1.11 Delays due to incidents during loading/unloading causes poor VTAT

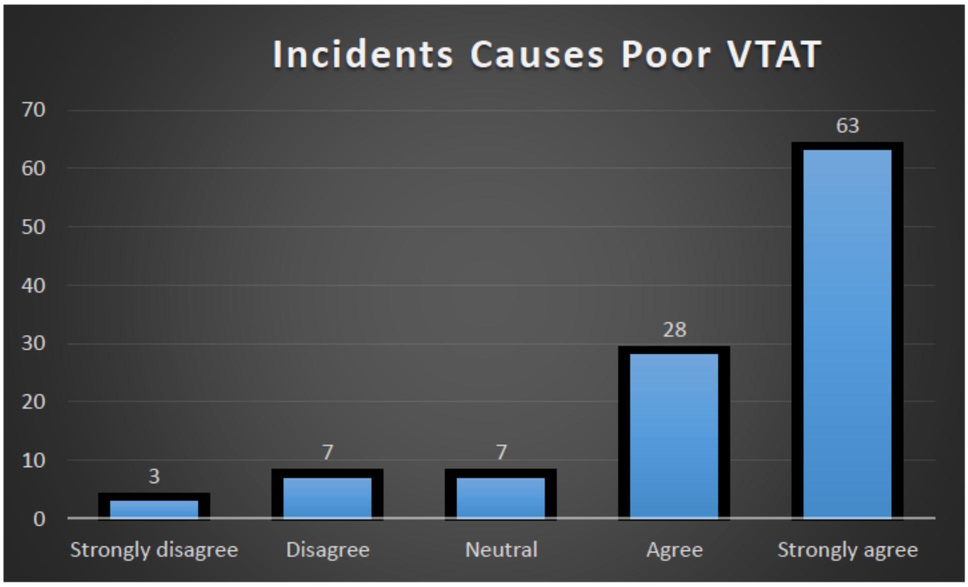

Figure 4.11: Incidents Causes Poor VTAT

The study sought to find out weather delays due to incident during loading/offloading causes poor VTAT (Figure 4.11). The findings reveal that 58.3% participants strongly agree, while 25.9% participants agree that having incidents does causes poor VTAT. An estimated 6.5% participants were neutral. Another 6.5% and 2.8% participant disagree and strongly disagree respectively. This concludes that any incident encountered during loading/offloading causes poor VTAT.

4.3.1.12 Delays due to cargo spillage during loading/offloading causes poor VTAT

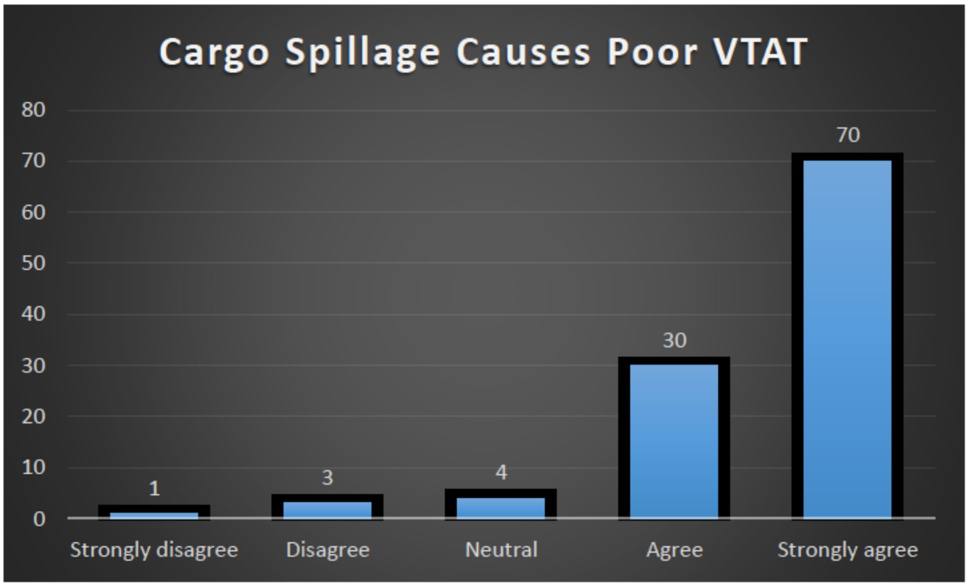

Figure 4.12: Cargo Spillages Causes Poor VTAT

The study sought to find out whether delays caused by cargo spillage during loading/offloading causes poor VTAT (Figure 4.12). The results reveal that 0.9% participants strongly disagree, 2.8% participants disagree, 3.7% participants were neutral, 27.8% participants agree and 64.8% participants strongly agree. This implies that cargo spillage does affect VTAT and when cargo spills, the vessel has to stop for operations to clear the spilled cargo from the route. However, Cahoon (2015) argues that cargo spillages causes poor VTAT. The spilled cargo needs to be cleaned and during that period vessel will not be working as result it affect the VTAT.

4.3.1.13 Delays due to cross contamination of cargo during loading/offloading causes poor VTAT

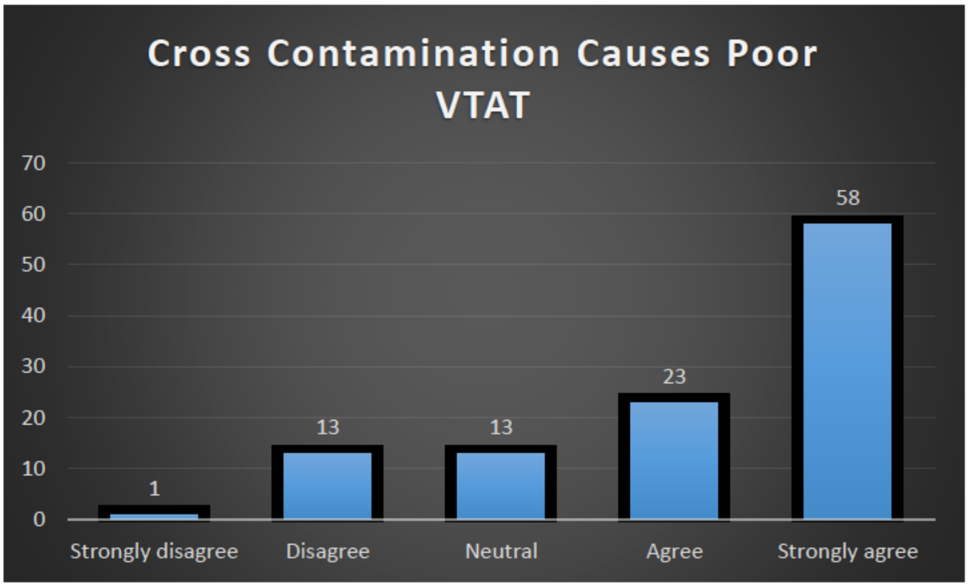

Figure 4.13: Cross Contamination Causes Poor VTAT

The study sought to find out whether delays due to cross contamination during loading/offloading cargo from vessels causes poor VTAT (Figure 4.13). The findings reveal that 0.9% participants strongly agree, while 12% participants disagree. Another 12% were neutral, while 21.3% and 53.7% participants agree and strongly agree respectively. This conclude that cross contamination causes long-standing time as cargo needs to be offloaded from the vessel. This in turn led to poor VTAT at RBDBT.

4.3.1.14 Delays due to not following Safe Operating Procedures (SOP) causes poor VTAT

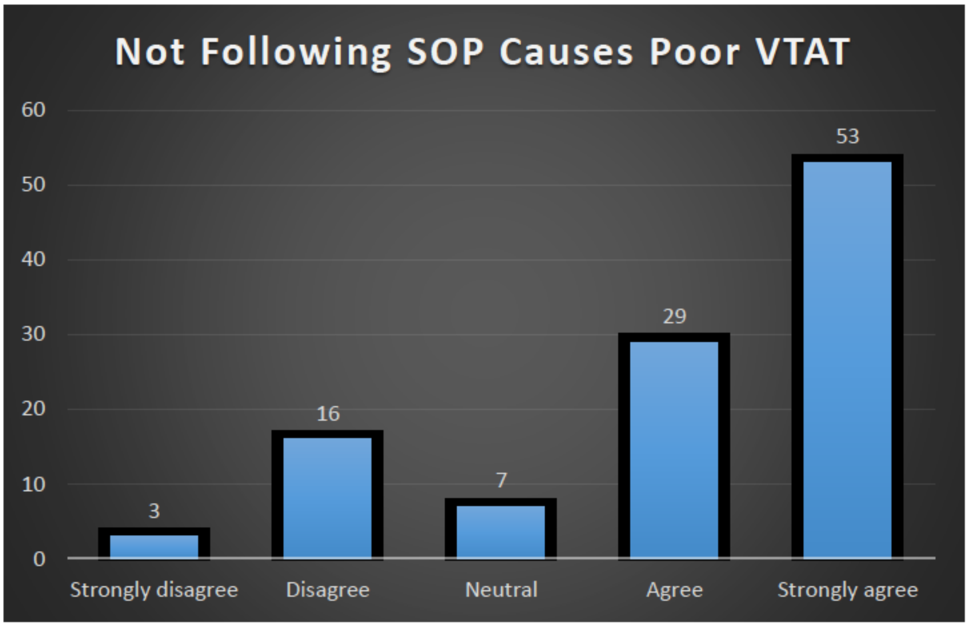

Figure 4.14: Not Following SOP Causes Poor VTAT

The study sought to find out whether delays due to staff not following standard operating procedures loading/offloading causes poor vessel turnaround time (Figure 4.14). The findings reveal that 2.8% participants strongly disagree, 14.8% participants disagree, 6.5% participants opted to be neutral, 26.9% participants agree, while 49.1% participants strongly agree. This concludes that not following standard operating procedure causes poor VTAT.

4.3.1.15 Poor scheduling of vessel causes poor VTAT

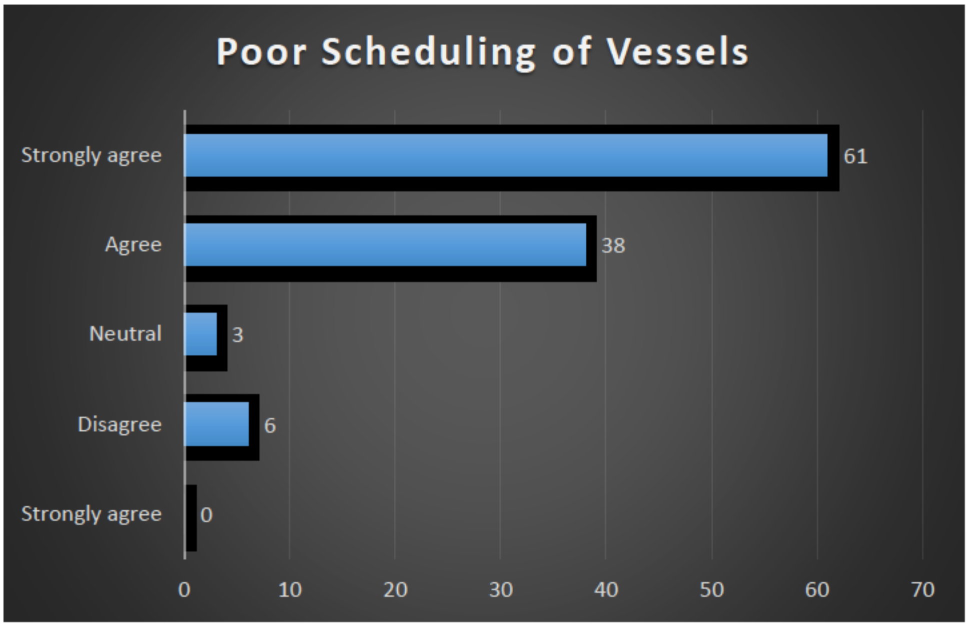

Figure 4.15: Poor Scheduling of Vessels

The study sought to find out whether poor scheduling of vessels causes poor VTAT (Figure 4.15). The findings reveal that 5.6% participants disagree, 2.8% participants opted to be neutral, 35.2% participants agree, while 56.5% participants strongly agree. This implies that poor scheduling of vessels causes poor VTAT at RBDBT. In support, Cao et al. (2010), pointed out that poor scheduling and yard planning, vessel and berth planning causes incidents and also longer VTAT.

4.3.1.16 The size of vessel affects the VTAT

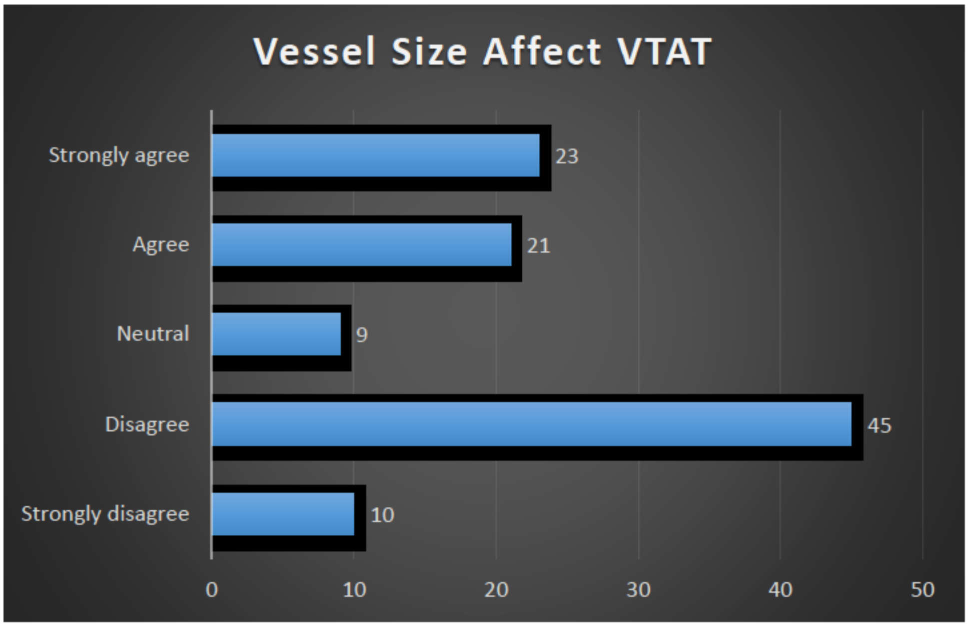

Figure 4.16: Vessel Size Affects VTAT

The study sought to find out whether the size of vessel affects VTAT at RBDBT (Figure 4.16). The outcomes reveal that 9.3% participants strongly disagree, 41.3% participants disagree, 8.3% participants opted to be neutral, while 19.4% participants agree, and 21.3% participants strongly agree. This concludes that the size of vessel does not affect VTAT. However, Niavis & Tsekeris (2012), found out that port perform much better if they load/offload bigger vessels compared to small vessels.

4.3.1.17 Too many draft survey during loading/offloading causes poor VTAT

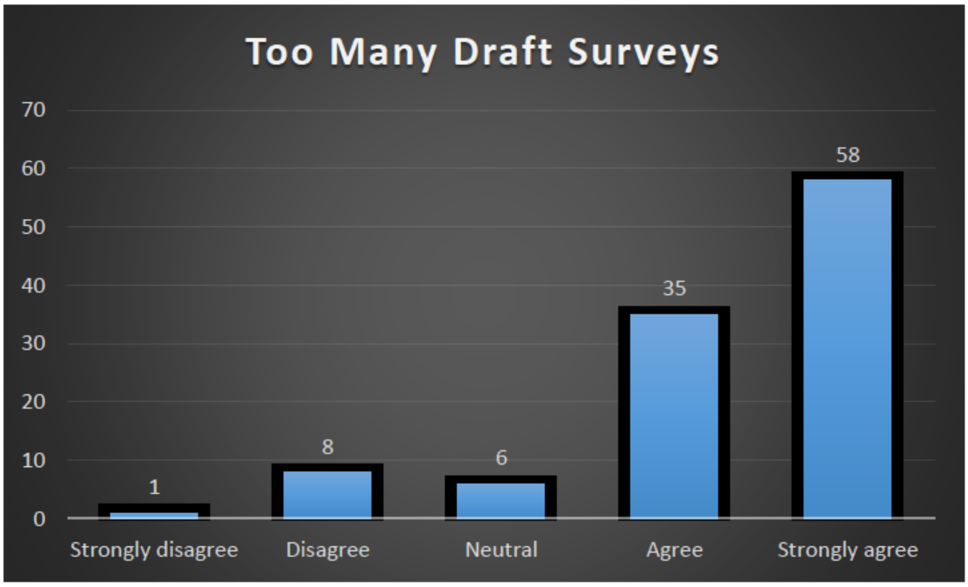

Figure 4.17: Too Many Draft Surveys

The study sought to find out whether too many draft surveys during loading/offloading cargo from vessels causes poor VTAT at RBDBT (Figure 4.17). The outcomes reveal that 0.9% participants strongly disagree, 7.4% participants disagree, and 5.6% participants opted to be neutral, 32.4% participants agree, while 53.7% participants strongly agree. This concludes that having too many draft surveys more than planned ones causes poor VTAT at RBDBT.

4.3.1.18 Delays in vessel failing hatches affect VTAT

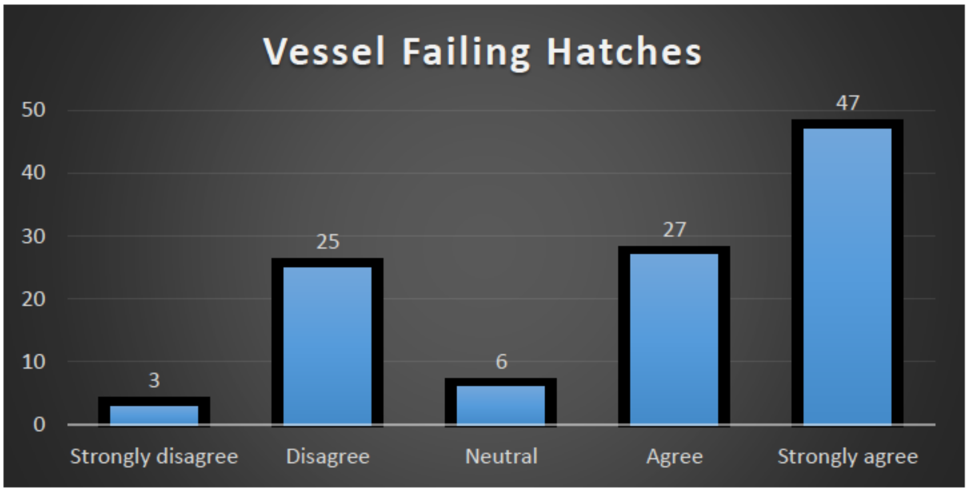

Figure 4.18: Vessel Failing Hatches Affects VTAT

The study sought to find out whether delays caused by vessels failing hatches affects VTAT at RBDBT (Figure 4.18). The findings reveal that 2.8% participants strongly disagree, 23.1% participants disagree, 5.6% participants opted to be neutral, while 25% participants agree and 43.5% participants strongly agree. This concludes that delays caused by vessel failing hatches affects VTAT at RBDBT.

4.3.1.19 Delays in berthing/sailing the vessel causes poor VTAT

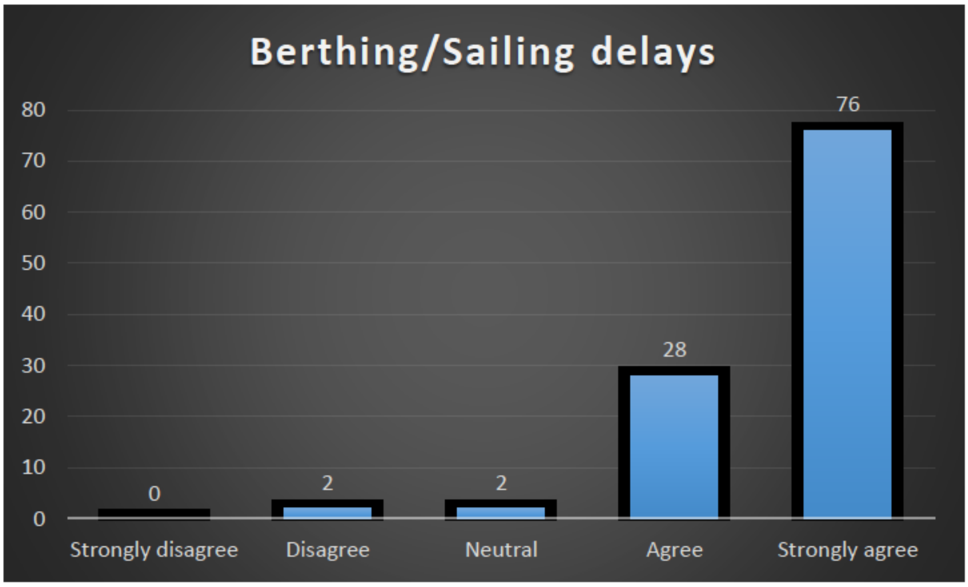

Figure 4.19: Berthing/Sailing of Vessels

The study sought to find out whether delays caused by long or late berthing/sailing of vessels causes poor VTAT at RBDBT (Figure 4.19). The findings reveal that 0% participants strongly disagree, 1.9% participants disagree. Another 1.9% participants opted to be neutral while 25.9% participants agree, and 70.4% participants strongly agree. This concludes that delays caused by long or late berthing/sailing of vessels causes poor VTAT at RBDBT. In support, Premathilaka (2018), in his study discovered that any delays in berthing/sailing a vessel cause poor VTAT. The more time taken by port authority to berth/sail the more the vessel stays in the port ot outside the port.

4.3.1.20 Unavailability of pilot causes poor VTAT

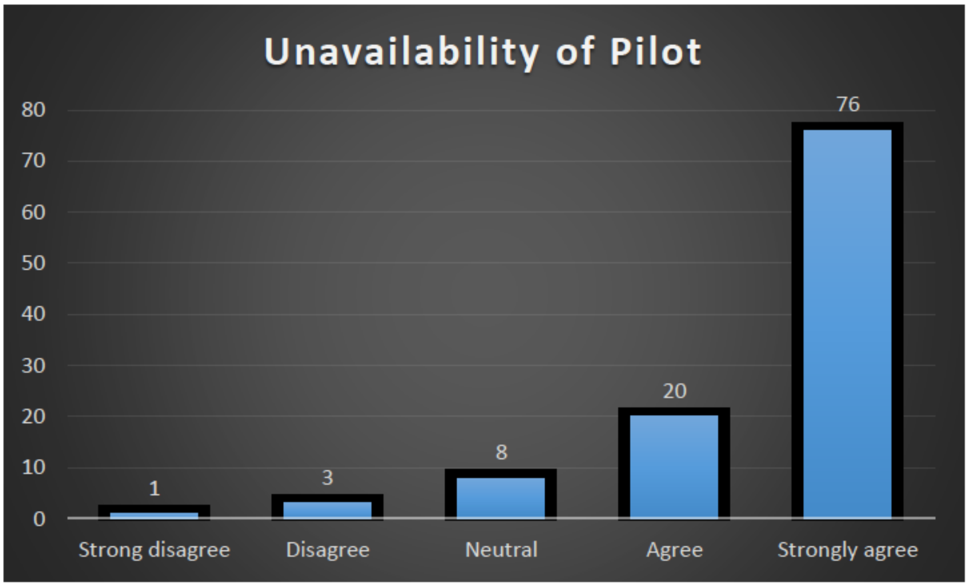

Figure 4.20: Unavailability of Pilot

The study sought to find out whether delays caused by the unavailability of pilot to fly a helicopter in order to pick up and drop off vessel captain after vessel berthed and after the completion of vessel from loading/offloading to sail out causes poor VTAT at RBDBT (Figure 4.20). The findings reveal that 0.9% participants strongly disagree, 2.8% participants disagree, 7.4% participants opted to be neutral, while 18.5% participants agree and significant 70.4% of participants strongly agree. This concludes that the unavailability of pilot causes poor VTAT at RBDBT. Cahoon (2015), pointed out that unavailability of pilot during berthing/sailing of vessels causes longer VTAT.

4.3.1.21 Tug breakdowns causes poor VTAT

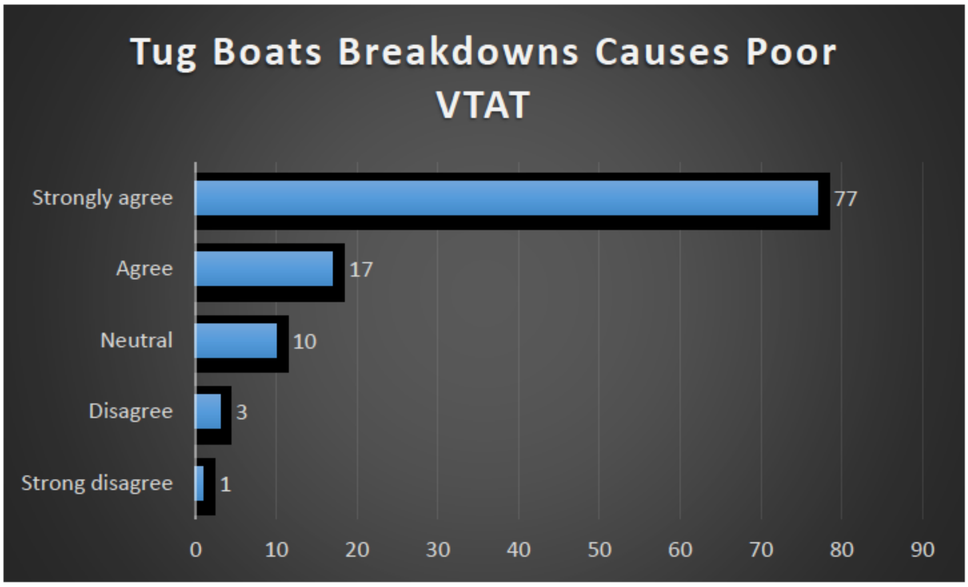

Figure 4.21: Tug Boats Breakdowns Causes Poor VTAT

The study sought to find out whether tugboats breakdowns causes poor VTAT at RBDBT (Figure 4.21). The findings reveal that 0.9% participants strongly disagree, 2.8% participants disagree, 9.3% participants opted to be neutral, while 15.7% participants agree and 71.3% participants strongly agree. This concludes that tugboats breakdown causes poor VTAT at RBDBT, as during the breakdown, vessels cannot be assisted to berth or sail out of the port. In cases like this, vessels need to wait until tugboats are repaired before berthing or sailing, as they cannot manoeuvre on their own inside the port limits due to the confined space.

4.3.1.22 Delays in route inspection prior to loading/offloading causes poor VTAT

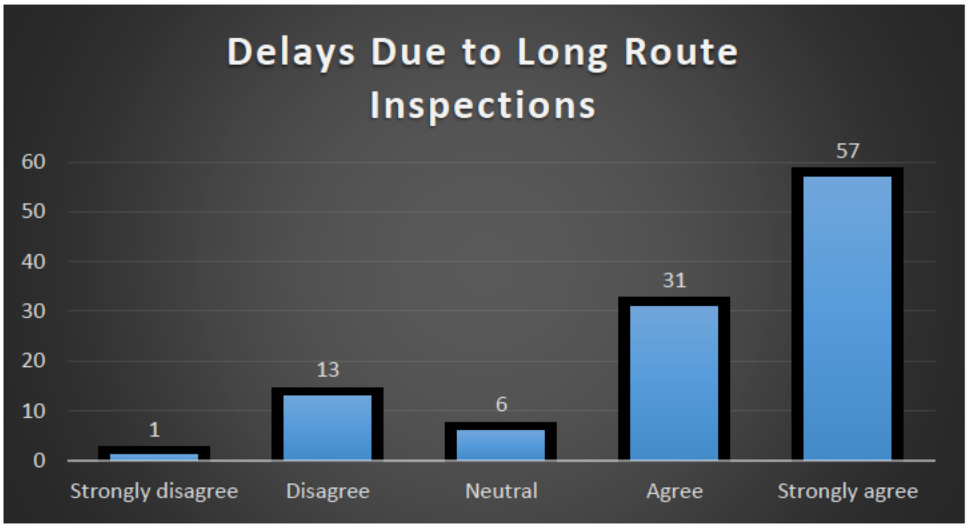

Figure 4.22: Delays Due to Long Route Inspection

The study sought to find out whether delays caused by inspectors taking long to inspect the route prior to loading/offloading causes poor VTAT at RBDBT (Figure 4.22). In order to eliminate contamination, it is standard requirement that prior to loading/offloading any vessel; inspectors inspect the route and pass it as clean to load/offload cargo. The findings show that 0.9% participants strongly disagree, 12% participants disagree, 5.6% participants opted to be neutral, while 28.7% participants agree, and 52.8% participants strongly agree. This concludes that delays in the event of failed inspection requires more time to clean, and therefore causes poor VTAT at RBDBT. In support, Jayaprakash & Gunasekaran (2012), found out that the lengthy port procedures causes delays.

4.3.1.23 Changing of loading/offloading instruction causes poor VTAT

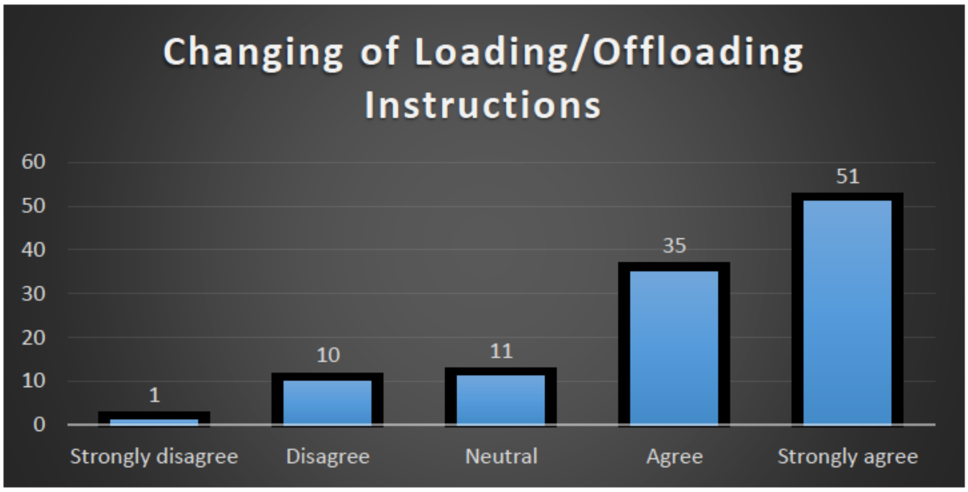

Figure 4.23: Changing of Loading/Offloading Instructions

The study sought to find out whether changing of loading/offloading instructions causes poor VTAT at RBDBT (Figure 4.23). The findings reveal that 0.9% participants strongly disagree, 9.3% participants disagree, 10.2% participants opted to be neutral, 32.4% participants agree, while 47.2% participants strongly agree. This concludes that changing of loading/offloading instruction causes poor VTAT at RBDBT. All vessels come with a pre-plan. Hence, any changes to it affect the vessel, as it has to wait for all stakeholders to approve. Jayaprakash & Gunasekaran (2012), found out that the lengthy port procedures of changing loading/offloading instructions causes delays.

4.3.1.24 Long custom clearance causes poor VTAT

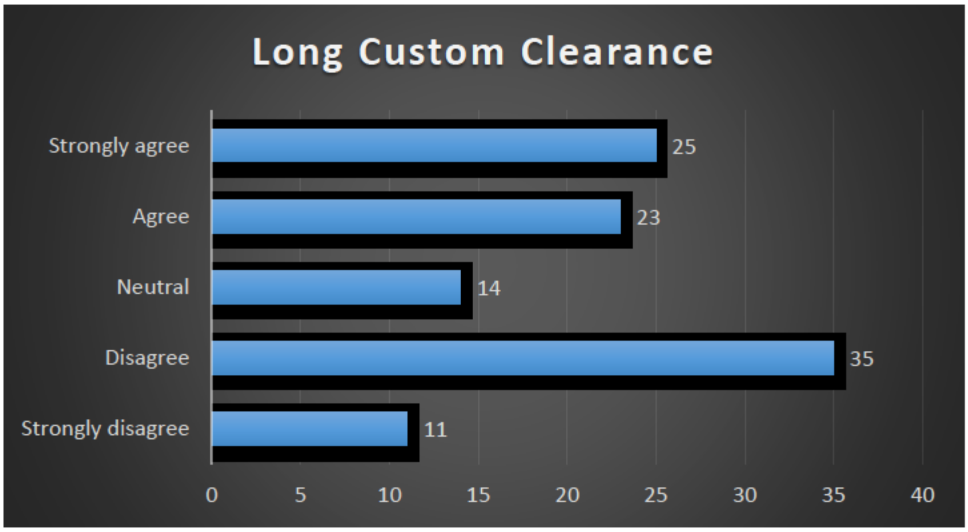

Figure 4.24: Long Custom Clearance

The study sought to find out whether long custom clearance causes poor VTAT at RBDBT (Figure 4.24). The findings reveal that 10.2% participants strongly disagree, 32.4% participants disagree, 13% participants opted to be neutral, 21.3% participants agree, while 23.1% participants strongly agree. This concludes that long custom clearance causes poor VTAT at RBDBT. In support, Gayathma et al. (2015), pointed out that government authotities such as customs and health, and their procedures also causes delays.

4.3.2 Discussion of Interview Questions

4.3.2.1 What are the factors affecting VTAT at RBDBT?

The participants responded that a recurring factor which affect VTAT is equipment breakdowns now and again due to lack of proper maintenance and aged equipment. Hendriks et al. (2013), also in their study found that equipment breakdowns are a major factor affecting efficiency of the terminal. TPT planned maintenance program, runs maintenance on SAP for 28 days' cycle where each equipment is planned to be taken out of service to be maintained. These are scheduled on a monthly basis, but because of the port is volume based, the maintenance is skip and only minor critical maintenance activities are done to get the vessels operational that is loading/discharging until the next available gap comes. However, this does not happen as vessels wait for a long time as results of breakdowns which could have been prevented if maintenance was done. Some of the participants feel that incompetent people conduct maintenance as results when maintenance gaps are given to technical workforce the equipment have more breakdowns than it had previously. Cullinane & Wang (2015), also discovered that the impact of human factor on productivity of dry bulk terminal should not be ignored even though it is relatively hard to compute, gather data and scrutinize.

Some of the participants believe that vessel turnaround time at the port of Richards Bay is affected by lack of communication between planning, operations and technical departments. They assert that while technical team plans to do maintenance on a certain equipment, planning department may be planning to bring in a vessel, which was not on the bar chart, and the operations department might be busy cleaning somewhere else. In view of this, there is no alignment between the three departments and all are working in silos. Some thinks that the system used by TPT planning of having slot vessels causes poor VTAT as senior vessels to slot vessels cannot be service during that slot time. The port will wait for those slot vessels to come in and be loaded while other vessels have been outside the port for a long time. In support, Cao et al. (2010), pointed out that poor scheduling and yard planning, vessel and berth planning causes incidents and also longer VTAT.

Some participants think that shift changes causes poor VTAT as TPT workforce work for a 8-hour shifts during the week and 12 hours shift during the weekend. The tonnages worked in 12 hours vs 8 hours shifts are very different. In a 12-hour shift, there is only one shift change, while in a 8-hour shift, there are three shift changes. These shift changes result in time lost. Premathilaka (2018), in support also found that there are delays during shift changes in the morning and evening *(around 06:00hrs/14:00hrs/22:00hrs)*, during meal times *(around 12:00 hrs/18:00 hrs/21:00 hrs*) and during tea breaks *(around 10:00 hrs/16:00 hrs/00:00hrs).* Some believes that poor quality of training i.e. PLC was not offered to them at training centre as result this lead them into taking longer to resolve breakdowns, as their fault-finding skills are not good. Some of the participants opined that unskilled riggers take time to do simple jobs of 2 hours and take them about 4-6 hours. Some participants think that bad weather (when its windy or raining) lead to vessels closing hatches, and operations coming to stand still which in turn affect VTAT. In support, Mitrovic & Delovic (2017), found that the most influential factors affecting berth productivity are vessel size, vessel stowage, skills of operators, weather, and shortage of equipment and staff. Some participants think that wet cargo blocks transfer points and hoppers as result the also affect VTAT. While others strongly believe that unavailability of helicopter, pilot and tug affect the VTAT.

Most of the participants think that having too much draft surveys due to unreliable TPT scales, which are always out by 20%, affect the vessel turnaround time. Some believe that the service provided by service providers is of the poor quality as a result after equipment has being repaired it breaks down within week while, it supposed to last for more than a period of six months without breaking. Some believe that shortage of both technical and operations staff affect VTAT as not all the work is done and cover in day. Some believe that shortage of spares during breakdowns affects VTAT. Some opined that the shortage of cargo during loading of vessels due to sister company TFR for not supplying trains to client to bring the cargo to the port is also a factor affecting VTAT. Some thinks that shortage of payloader is also a factor affecting VTAT as payloaders continue to breakdown now and again. Gayathma et al (2015), in support pointed out that factors affecting VTAT include berthing delays, cargo transfering delays, unavailability of berths, weather conditions, documentations delays, pilotage delays, equipment breakdowns, quay crane operating speed, unavialabity of equipment operators and cargo clearance. Sometimes payloader drivers take long shift changes and also go on strike from time to time. Some thinks that the berth restrictions and configuration of vessels are also some of the factors affecting VTAT. Abijath & Kokila, (2017), in their study to reduce VTAT at Cochin Port also found that equipment breakdowns were major factor, followed by power failure, weather constratints, labour strikes, and shortage of skills on operators. Some believes that route inspections, route preparations and cargo spillage are the aspects affecting VTAT.

4.3.2.2 To what extent does each factor affect VTAT?

Some participants think that all of the factors have the same effect, as four hourly set norms are not reached, vessels stay longer in the port. Some factors require vessels to shift or turnaround in order to load or offload. Some participants indicated that faultfinding take longer than anticipated during breakdowns due to poor quality of training. Some participants observed that repairs of splices for example takes longer times to repair, as requisitions need to be created and three quotation system needs to be followed in order to get splicers and riggers out to site. It’s a long process of getting external service providers, which further delays the vessels from finishing on time.

Some of the participants mentioned that wet cargo blocks the hoppers and transfer chutes blocks, which results in no cargo going to the vessels or coming from the vessels. Vessels wait for more than one hour waiting for cargo to be unblocked. Some participants believe that changing of weather affect berthing and sailing of vessels and also affect operations which has to stop for the weather to clear as it is unsafe to operate any equipment when it windy or raining. Vessels end up staying longer in the port than planned days. Some participants indicate that spilled cargo takes too much time to recover and delays the next vessels from starting on time. Some think that shortage of payloaders lead to vessels finishing to load in 6 days more than normal planned days of 4. Some participants mentioned that too many draft surveys result in a vessels completing after one day of planned time. If vessels were planned to complete loading/offloading in 4 days, they end up completing in 5 days.

All the factors mentioned above has a ripple effect on the clients and customers, and some are even taking their cargo elsewhere. When vessels are waiting without loading/offloading, the whole industry's supply chain comes to complete stand still. The impact of poor vessel turnaround time at DBT are loss of revenue/profit, loss of customer trust and business, less confidence in customers to ships their cargo through the port and less competitive edge.

4.3.2.3 What are the strategies currently used by port of RBDBT management to reduce VTAT?

(Abijath & Kokila, 2017), (Cahoon, 2015), (Gayathma, et al., 2015), (Premathilaka, 2018)

Some participants opined that the port has a standby team which operates 24 hours/7 days a week attending to breakdowns and carry out maintenance of equipment used in between the vessels, creation of requisition for belt splicing and rigging whenever there is a breakdown. The team is also involved in the testing of equipment on route before loading/offloading, maintenance and asset care improvement through introduction of better maintenance, planning and execution of shutdown. However, some participants mentioned that there is nothing in place as there are too many breakdowns.

4.3.2.4 What are short-term plans which port management needs to be put in place to reduce VTAT?

(Abijath & Kokila, 2017), (Cahoon, 2015), (Gayathma, et al., 2015), (Premathilaka, 2018)

Some participants think that the port should do away with the month-to-month pay loading contract and have 6/12 months' contract. Some participant believe that TPT should train their staff to do their jobs properly. Operations are to give technical the plant to carry out proper maintenance, have mini shutdowns. Some participants think that there is no need to focus on short term but long term. Most of the participants thinks that the port should put in place the following:

- Equipment upgrades
- Training of employees
- Proper maintenance
- Proper planning
- Buff up maintenance team
- Conduct root causes analysis and implement corrective actions
- Implement hot seat change
- Renew contracts for splicing, rigging and condition monitoring
- Better coordination between planning, technical and operations
- Co-manage all national contracts within the port and ensure that service providers are held responsible and liable for any non-adherences to contract obligation
- Focus on route cleaning as a daily activity, route walks/inspections
- Daily scale calibration
- Monthly scale maintenance
- Adhere to trains schedule and provide two trains per week
- Use OEM for repairs or maintenance
- Expose technical team to other skills i.e. knowledge sharing with OEMs
- Require specialised skills for equipment
- Technical manager be accountable for their department
- Have allocated teams for equipment
- Create maintenance plan and strategy for a year and signed off to create alignment in industry.

4.3.2.5 What are long-term plans, which port management, needs to put in place to reduce VTAT?

(Abijath & Kokila, 2017), (Cahoon, 2015), (Gayathma, et al., 2015), (Premathilaka, 2018)

Participants believe that the port should put the following in place;

- Insource pay loading – purchase own pay loader and hire to operators to operate them – this will assist to reduce the inefficiencies in the port
- Insource rigging and splicing
- Midlife Refurbishment
- Fill up vacancies and stop acting of critical positions
- Improve supply chain/procurement in the accusation of spares and external services that are required for effective plant maintenance
- Port needs to install weather-monitoring device to ensure that all vessel planning to load or offload are cleared. Any sensitive cargo vessel to be only berth when weather is cleared
- Implement a four shift system where staff can work four days in and 3 days out. This will eliminate fatigue, absenteeism and long tea breaks. Employees will work 12 hours shift rather 8 hours shift.
- Ensure that pilots have reliable means to get to vessels and back. TPT need to keep pressure on their licences holders (TNPA) to manage their VTAT more efficiently
- Quarterly scale testing and calibration
- Purchase two more trains to meet supply and demand
- Adhere to TOG (Terminal Operating Guidelines).

4.3.2.6 What strategies are needed to be put in place in order to improve the vessel turnaround time?

(Abijath & Kokila, 2017), (Cahoon, 2015), (Gayathma, et al., 2015), (Premathilaka, 2018)

Participants think that port need to put in place the following:

- Replace aged equipment
- Train workforce on how to operate and maintain the new equipment
- Have Service Level Agreement (SLA) with Original Equipment Manufacturer (OEM) for support during equipment breakdown
- Have training centres

- Procure new tugs
- Purchase new helicopter
- Employ skilled operators and artisans
- Implement route walker who will stop route plant if there are any spillages and load them onto the conveyor belt
- Put in place scrapper maintenance contract for 24 months
- Long-term strategy in terms of cargo storage with weather condition designed into enable working wet cargo. Equipment upgrades to replace aging infrastructure, fit for purpose in line with future technologies
- Culture change across the board to have sense of urgency
- Succession planning
- Revert back to first come first serve strategy
- Purchase stacker reclaimer and get rid of pay loaders
- After every completion of each vessel debrief meeting needs to be held by TPT tech, ops, commercial, planning, shipping agent and stevedores to discussion challenges face on the vessel and corrective actions
- After end of every vessel TPT needs to clean the route
- Recruit people for cleaning
- Privatising quayside operations at some of the berths like Durban Port
- Proper supervision and management of scales
- Implement a penalty system for poor performance
- Have SLA with Transnet as whole not only TPT
- Carry out daily maintenance
- Align shuts together with TFR so that proper maintenance of berths, routes and tipplers can be done completely not here and there like what is currently happening that's why there is so much breakdowns
- Purchase equipment for cleaning
- Have dedicated routes
- Review life span if equipment
- Major refurbishment on critical equipment
- Conveyor Belting Strategy – all belts to be upgraded or changed
- TNPA - To look at demand vs resources

- Expansion strategy – quayside length and number of berths
- Rail Strategy - Increase rail infrastructure.

4.3.3 Discussion of Findings from documentary data

The summary of findings from the study showed that VTAT at RBDBT is affected by the poor reliability of equipment, which keeps on breakdown down now and again. It is also affected by the poor services provided by external service providers (i.e. shortage of pay loaders, unreliable pay loaders, poor workmanship), shortage of cargo in the port, weather delays, too many draft surveys, incompetent operators and technical staff which cause incidents that lead to equipment breakdown. Figure 4.25 showed time series plot of vessel turnaround time data from 01 June 2018 – 31 November 2018, which were used for doing the analysis. It can be seen from the figure that VTAT at Richards Bay Dry Bulk Terminal is way out of the set target of 96 hours. VTAT (dependent variable) shows minimum, mean and maximum of 96 hours, 122, 2 hours, and 236 hours over a period of six months.

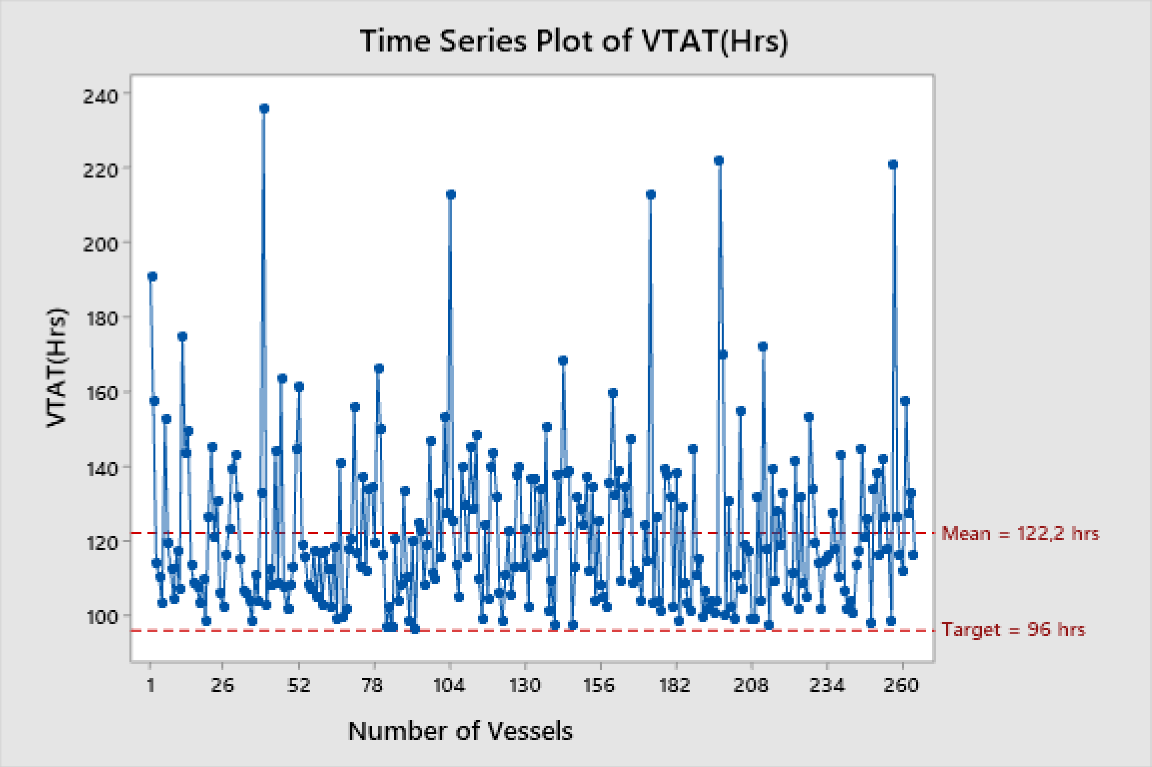

Figure 4.25: Time Series Plot for VTAT from June - November 2018 of RBDBT

Figure 4.26 shows the normality test of VTAT of RBDBT. Its shows that VTAT has a mean of 122,2 hours, standard deviation of 22,54 hours, number of data sample is 264 during the six months, Kurtosis skewness of 0,130 and Pearson value of less than 0,010.

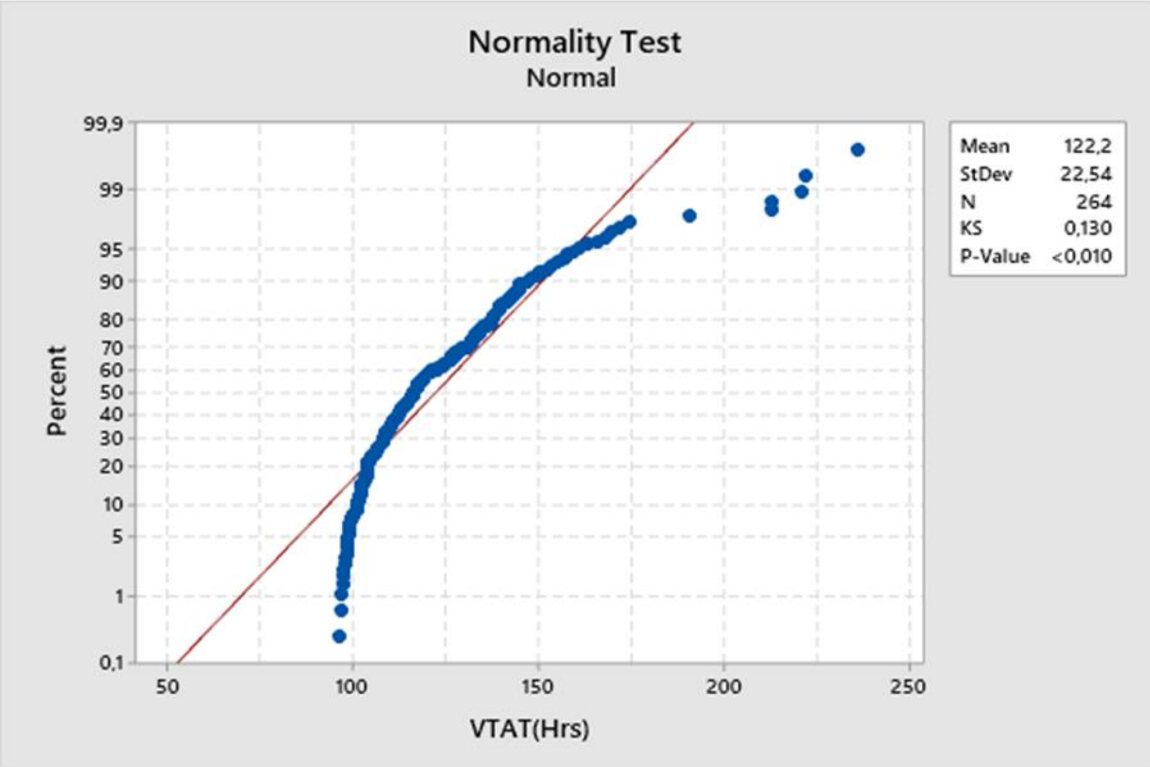

Figure 4.26: Normality Test of VTAT

4.3.3.1 VTAT vs Individually Independent Variables

4.3.3.1.1 VTAT vs Draft Surveys

The draft surveys are done to check how much cargo is loaded or offloaded and they determine how long a vessel still need to stay in the berth loading or offloading. Too many draft surveys result in a vessel staying longer on berth than planned. In normal operations, draft surveys are done twice before the vessel commence to load/offload and completion of the vessel. This only happens when the scales on the conveyor belt are reliable which are used to indicate the daily performance. The scales at the port are not reliable as results draft surveys need to be done now and again to compensate the scales, which are not reliable. Figure 4.27 demonstrates the association between VTAT and draft surveys. The figure illustrates also that there is affirmative association between them. Correlation test between the two variables was carried out at 95 confident level, p value = 0, Pearson correlation value is 0,065 which is not close to 1 and indicate that there is no durable association between the two variables, hence linear regression is shown as VTAT = 120,3 + 0,7105 Draft surveys.

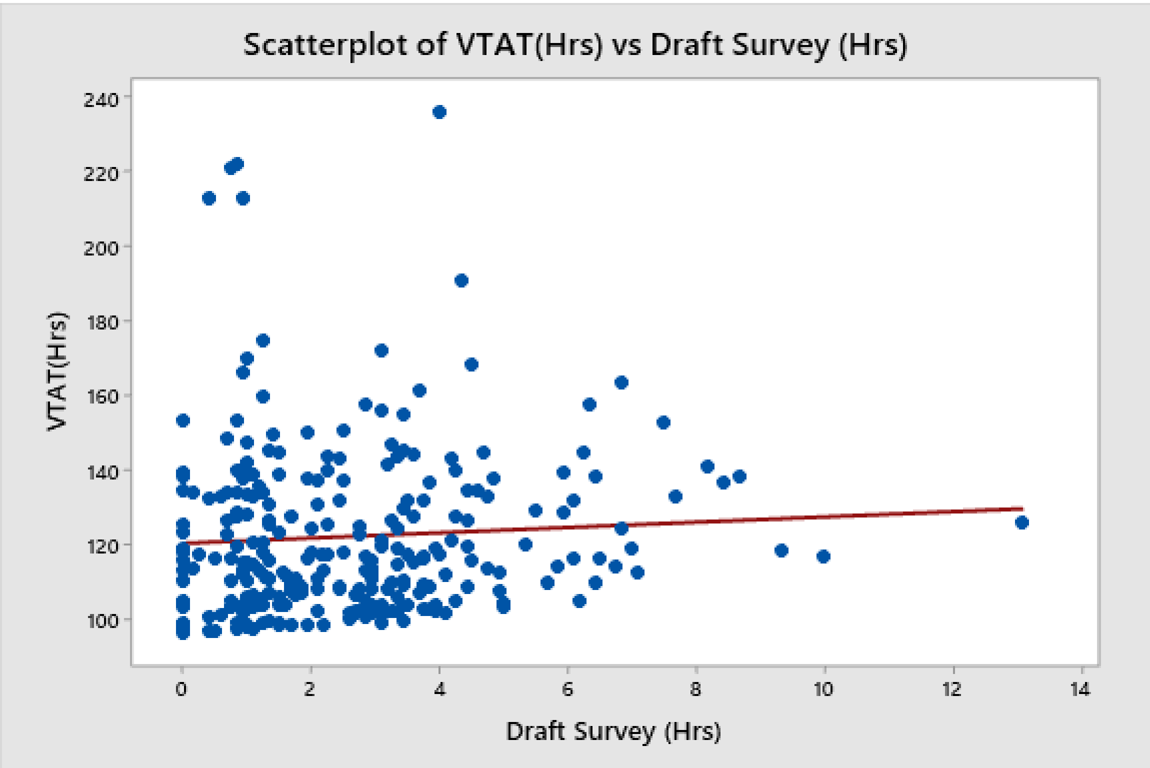

Figure 4.27: VTAT vs Draft Surveys

4.3.3.1.2 VTAT vs Shift Change

Port of Richards bay operates 24/7 hours a day with 8 hours shift. Shift changes are done to relief the workforce to go and rest however in between this shift changes most of the time is lost as operators would be attending to shift indaba and at some port, there is only one vehicle to take operators to their relevant workstations. Some walk to the loaders. These shift changes as a result affect the vessel turnaround time because during that time the vessels are unproductive. Figure 4.28 demonstrates the association between VTAT and shift change. The figure illustrates also that there is a slight affirmative association between them. Correlation test between the two variables was carried out at 95 confident level, p value = 0, Pearson correlation value is 0,047 which is far from 1 and indicate that there is weak connection between these two variables, hence linear regression is shown as VTAT = 122 + 0,6092 Shift Change.

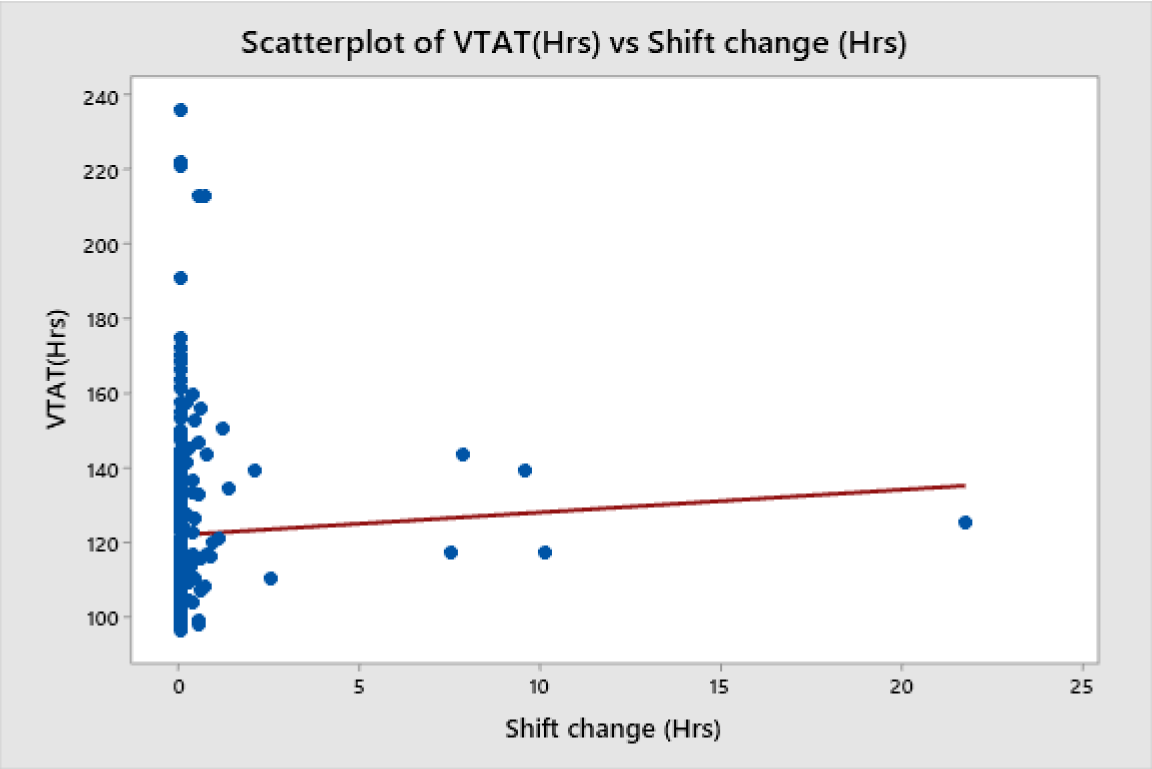

Figure 4.28: VTAT vs Shift Change

4.3.3.1.3 VTAT vs Weather –Rain

VTAT is also affected by rain and during this time vessels loading chloride, rutile and offloading alumina and pet coke needs to wait, as result production is lost. Weather is uncontrollable and changes at any time. When it rains heavily, all vessels at the port wait still as it unsafe to load or offload any commodity. Figure 4.29 demonstrates the association between VTAT and weather-rain. The figure illustrates also that there is affirmative association between them. Correlation test between the two variables was carried out at 95 confident level, p value = 0, Pearson correlation value is 0,517 which is close to 1 and indicate that there is durable association between these two variables, hence linear regression is shown as VTAT = 119,2 + 1,266 Weather – Rain.

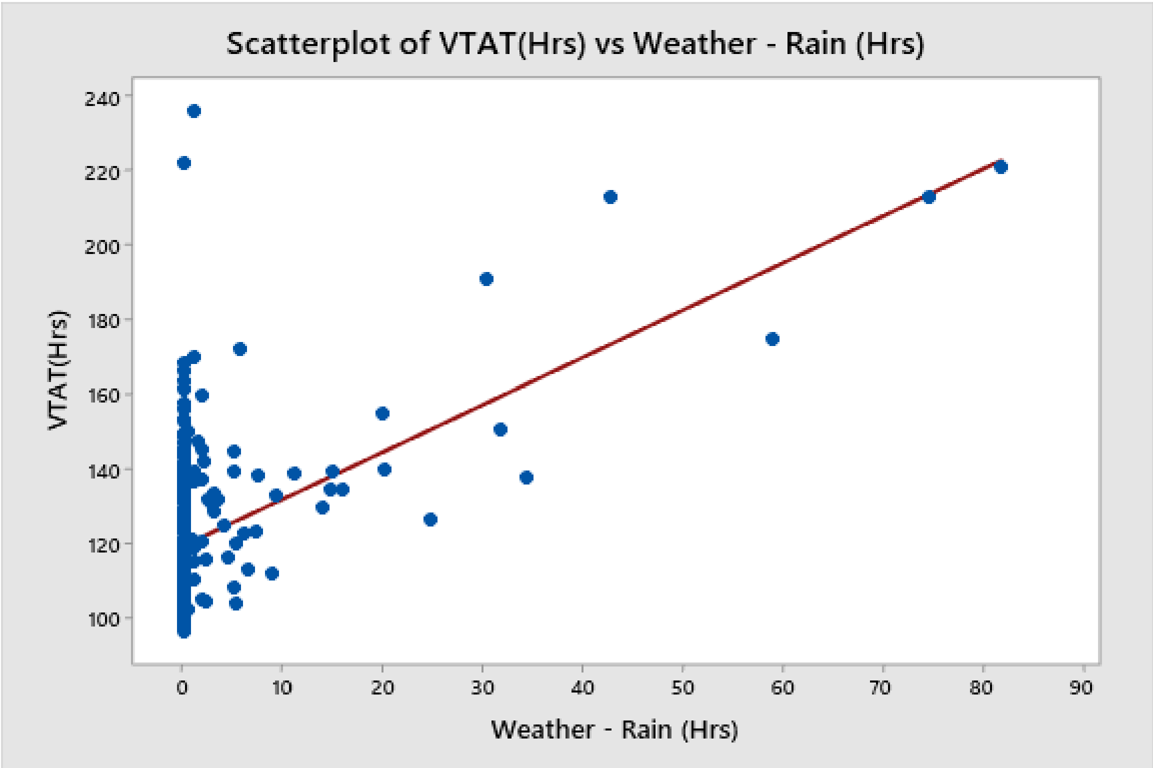

Figure 4.29: VTAT vs Weather –Rain

4.3.3.1.4 VTAT vs Weather –Wind

Wind changes at any time of the day and high wind speed results in the entire operations stopping as loaders are only designed to operate below 40 Knots. Anything above that causes the vessels to stop, and also when loading chloride which is dusty and that dust blows towards residents' area. This cause loss in production. Figure 4.30 demonstrates the association between VTAT and weather-wind. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95 confident level, p value = 0, Pearson correlation value is 0,509 which is close to 1 and indicate that there is a strong relationship between these two variables, hence linear regression is shown as VTAT = 117,5 + 1,810 Weather – Rain.

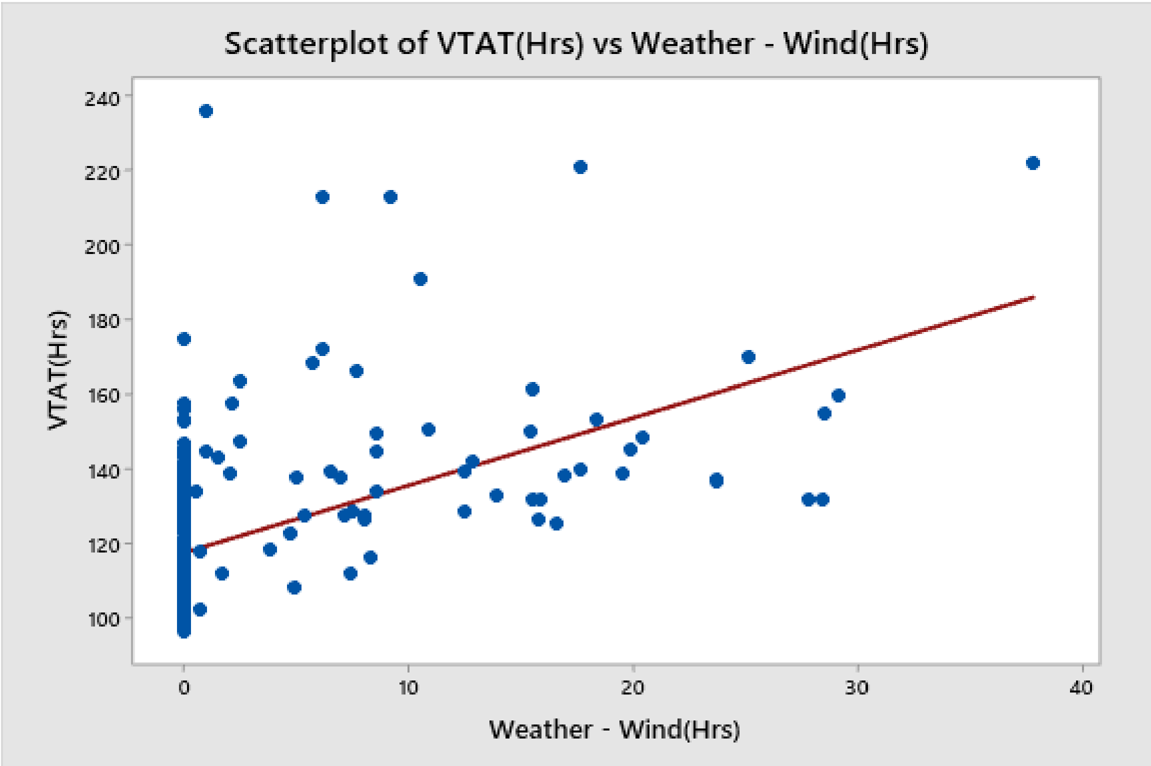

Figure 4.30: VTAT vs Weather –Wind

4.3.3.1.5 VTAT vs Berthing/Sailing Delays

Berthing/sailing delays happens when vessels arrive in the port to do transhipment and have to wait for marine services to take them to the berth or out of the port but marine services do not have either tug boats, helicopter or pilot to assist in doing that function. As a results, the vessels have to wait outside or on berth waiting for the resources to be available to take them out or in the port. Some time it happens that the vessels arrives on time but the berths planned to service those them still being used and they have to wait till those berth are free. Figure 4.31 demonstrates the association between VTAT and Berthing/Sailing Delays. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, and Pearson correlation value is 0,685, which is close to 1. The result indicated that there is strong association between the two variables. Hence, linear regression is shown as VTAT = 116, 3 + 1,357 Berthing/Sailing.

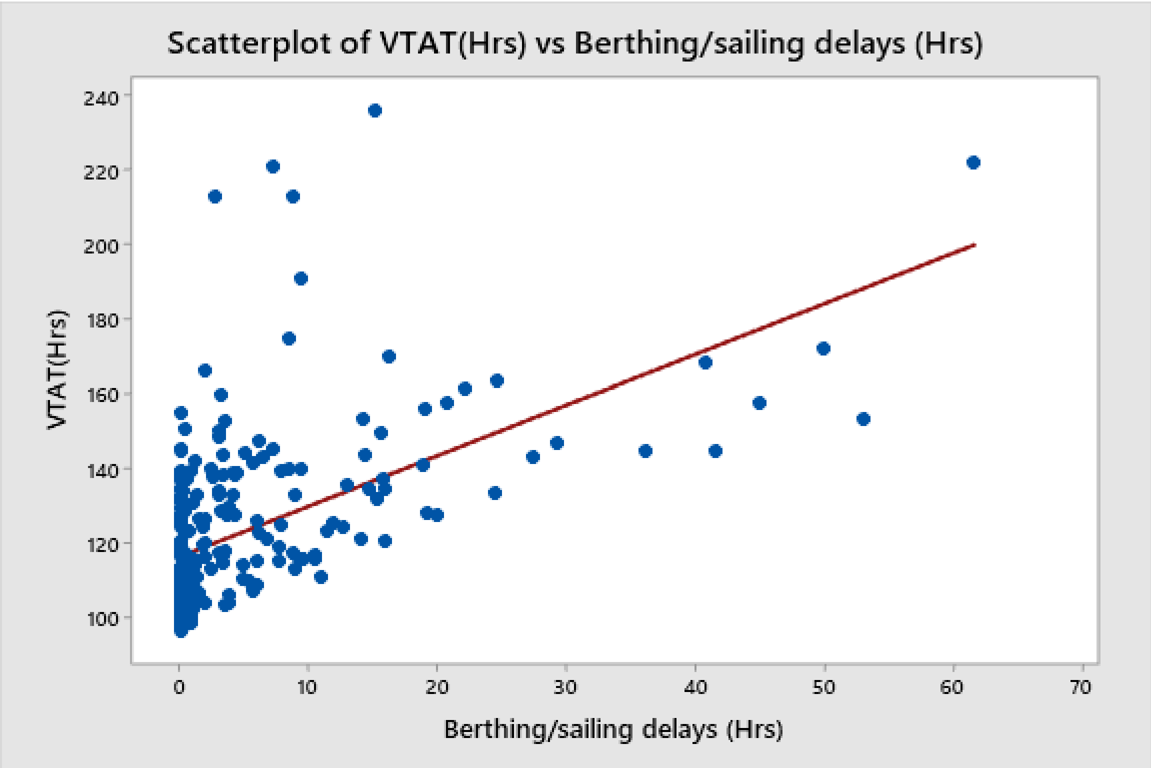

Figure 4.31:VTAT vs Berthing/Sailing Delay

4.3.3.1.6 VTAT vs Cargo Blockages

Cargo blockages happens when cargo is wet and cannot flow through hoppers or transfer chute to conveyor belt to the loader then to the vessels or from vessels to unloader to conveyor belt to transfer chute. This usually happens if it rains as some of the stockpile like for coal, magnetite and chrome that are stacked on open yard area. When hoppers or chutes are blocked, it requires operations to clear it up. The cleaning crew will clear it up but it takes longer as the crew is always busy cleaning other routes as results this affect the VTAT. Figure 4.32 demonstrates the association between VTAT and cargo blockages. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, and Pearson correlation value is 0,544, which is not far from 1. The results indicated that there is strong association between the two variables. Hence, linear regression is shown as VTAT = 116,3 + 1,357 Cargo Blockages.

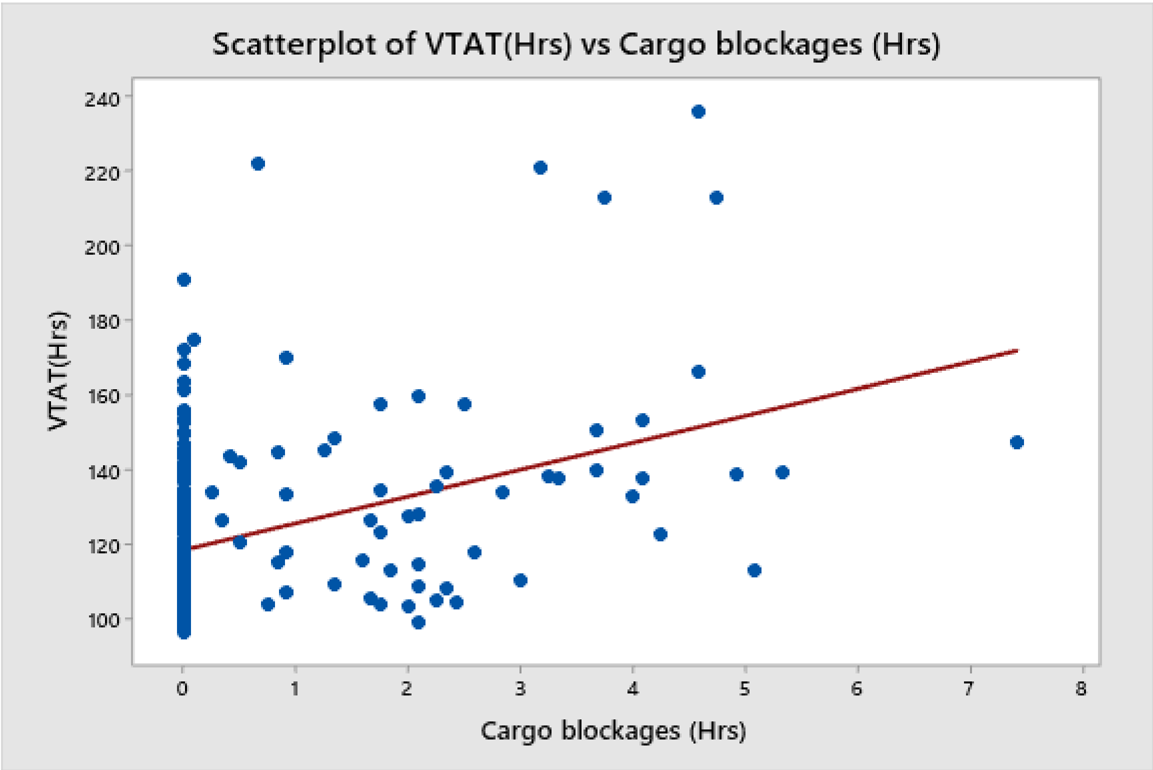

Figure 4.32: VTAT vs Cargo Blockages

4.3.3.1.7 VTAT vs Shortage of Payloaders

Cargo at RBDBT is loaded from the stockpile through the use of payloader and even sweeping of the cargo which is offloaded is done by the use of payloaders. The payloaders provided by the service provider are not reliable as they breakdown now and again. The payloaders drivers on often times are on strike hence, affecting VTAT. Figure 4.33 demonstrates the association between VTAT and shortage of payloaders. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confident level, p value = 0, and Pearson correlation value is 0,449 which is not far from 1. The results indicated that there is moderate association between the two variables. Hence, linear regression is shown as VTAT = 112,7 + 4,633 Shortage of Payloaders.

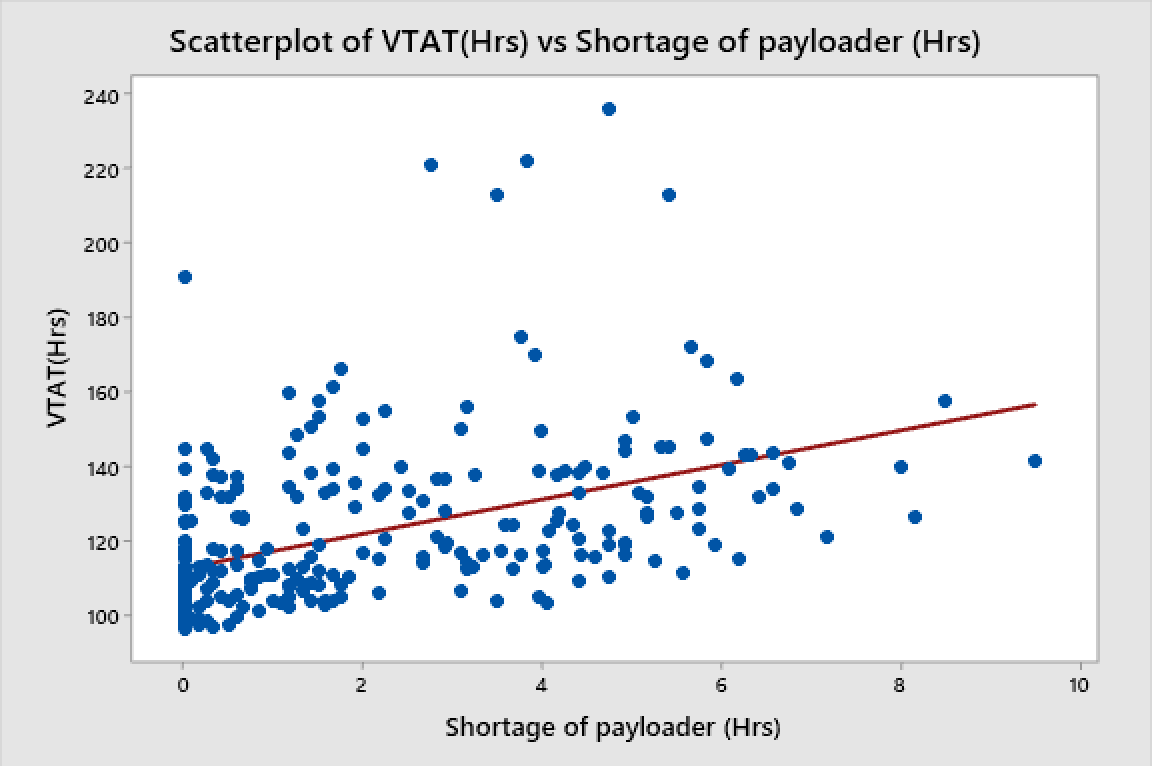

Figure 4.33: VTAT vs Shortage of Payloaders

4.3.3.1.8 VTAT vs Waiting Agent for Instruction

Normally, when there are major breakdowns on the running routes or the clients changes the commodity grade which was not part of the plan then alternative routes and stockpile are checked to see if they are available to load the vessels. TPT operations will then request the agent to change the loading instructions, and send the new loading instructions before commencing to load. These loading instructions does not come in time as result they affect VTAT. Figure 4.34 demonstrates the association between VTAT and waiting for agent's instruction. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, and Pearson correlation value is 0,227, which is far from 1. The results indicated that there is weak association between the two variables. Hence, linear regression is shown as VTAT = 120,7 + 4.029 Waiting for agent's instruction. If this is not controlled properly, it can lead to poor VTAT.

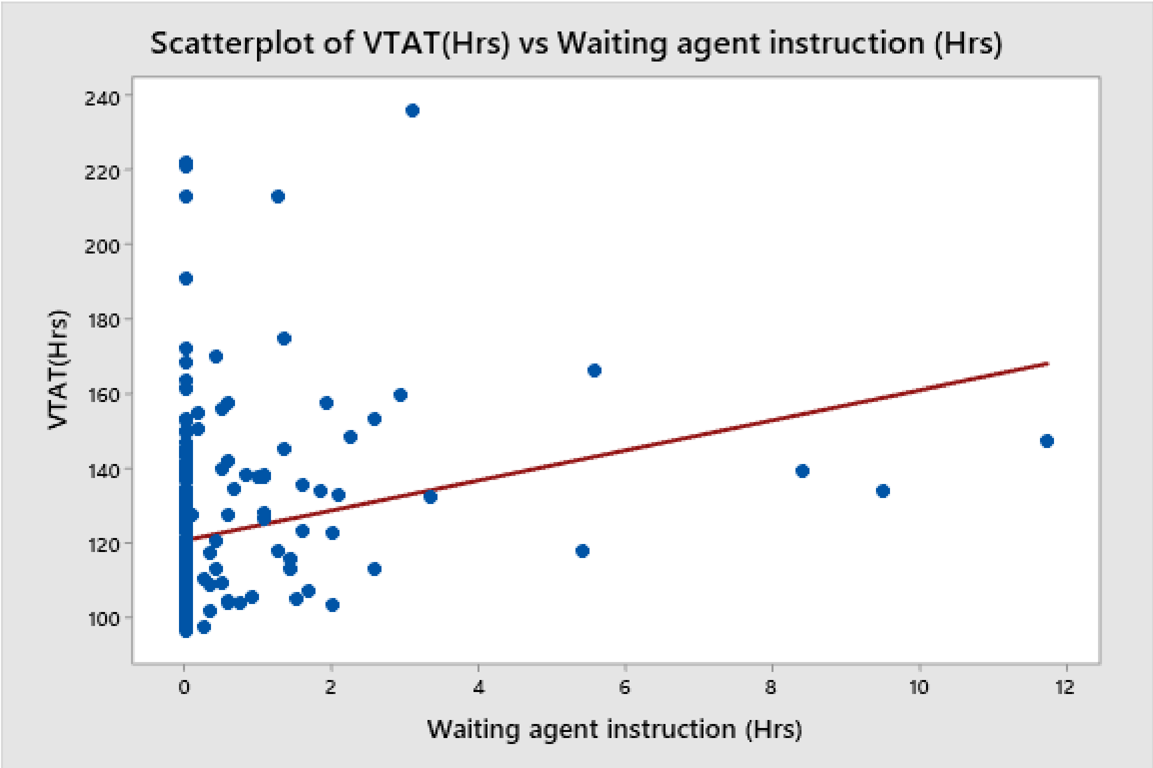

Figure 4.34: VTAT vs Waiting Agent Instruction

4.3.3.1.9 VTAT vs Tea Time Breaks

Teatime breaks happens two times per shift, which is 8 hours shift and results in between 30 – 60 minutes production loss. Tea time are planned to be 30 minutes per shift but employees take longer than planned as a result it affects VTAT. Failure to control this can result in ripple effect toward VTAT. Figure 4.35 demonstrates the association between VTAT and teatime delays. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, Pearson correlation value is 0,256 which is far from 1 indicated that there is weak association between the two variables, hence linear regression is shown as VTAT = 120.7 + 8.556 Teatime.

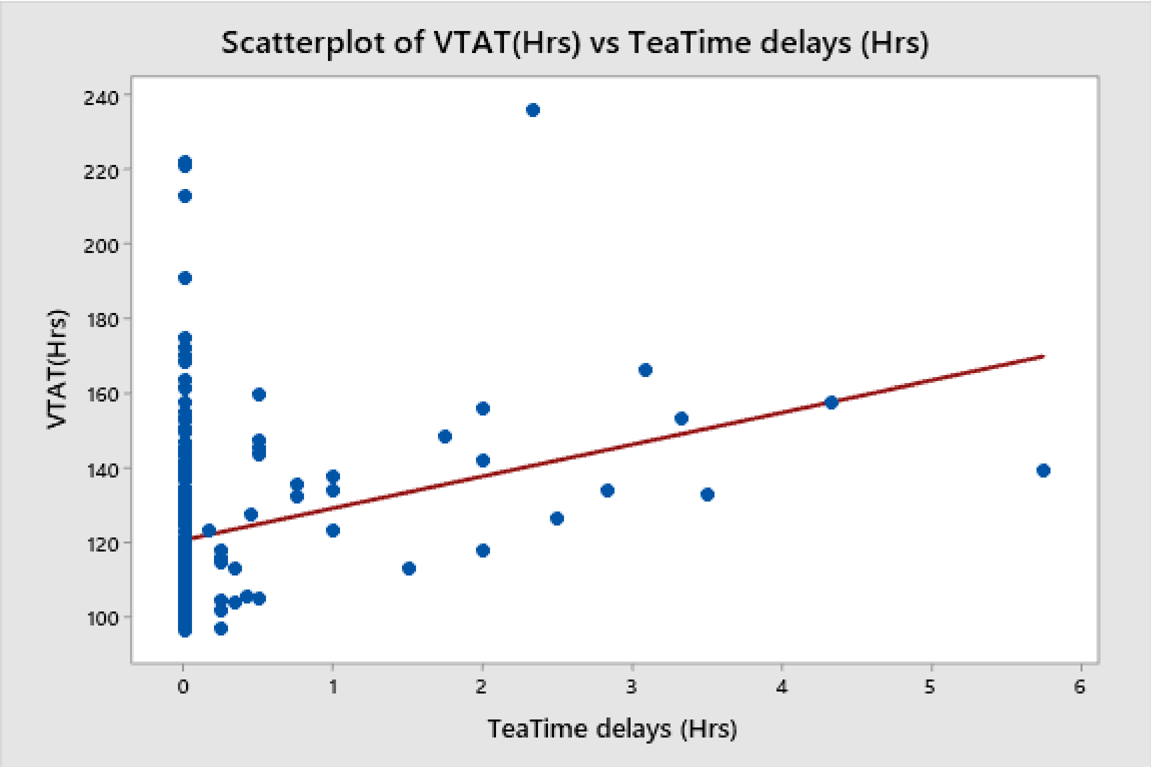

Figure 4.35: VTAT vs Teatime Delays

4.3.3.1.10 VTAT vs Equipment Breakdown

Equipment breaks now and again at RBDBT. One of the reasons for this is due to the lack of maintenance culture. The port is focused on pushing volumes and maintenance is parked aside. Opportunist maintenance is done to allow operations to load or offload cargo as a result the equipment breaks now and then, and becomes unreliable. Figure 4.36 demonstrates the association between VTAT and equipment breakdowns. The figure illustrates also that there is a positive association between them. Correlation test between the two variable was carried out at 95% confidence level, p value = 0, Pearson correlation value is 0,602 which is close to 1 and indicate that there is strong association between the two variables, hence linear regression is shown as VTAT = 113 + 1.507 Equipment Breakdowns.

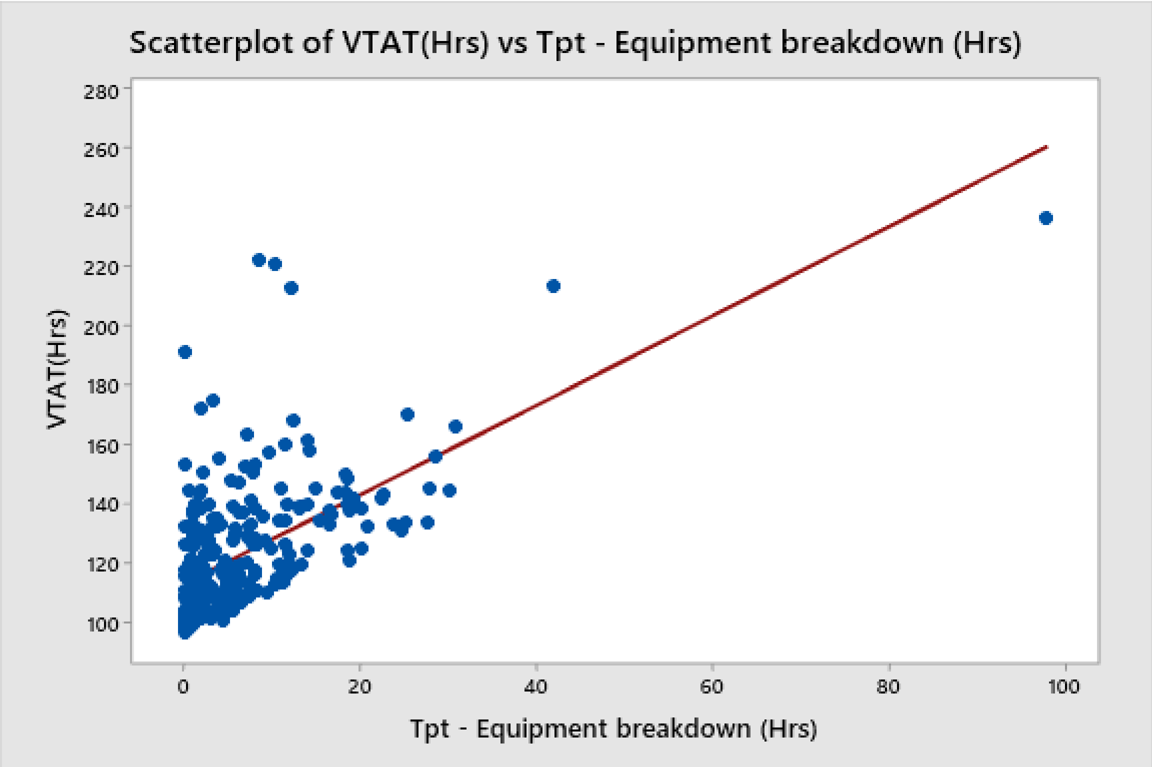

Figure 4.36: VTAT vs Equipment Breakdowns

4.3.3.1.11 VTAT vs Dust/Cross Contamination

Dust is created from loading/offloading a powder form commodity like alumina and chloride when it is windy. Due to health concerns, when dust blows towards residential area during loading or offloading a vessel then that vessel is stopped from operations until wind direction changes so that it blows away from the residential area. Sometimes when there is a different cargo loading or offloading next to this dusty cargo, it may contaminate the other cargo resulting in both cargo and production losses. Both vessels are stopped so that the contaminated cargo can be removed from the vessels. The vessel which came first will be given first priority to complete loading or offloading while other one is standing to avoid cross contamination. This stoppage affects VTAT. Figure 4.37 demonstrates the association between VTAT and dust/cross contamination. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, Pearson correlation value is 0,500 which is close to 1 and indicate that there is strong association between the two variables, hence linear regression is shown as VTAT = 116 + 1.812 Dust/Cross Contamination.

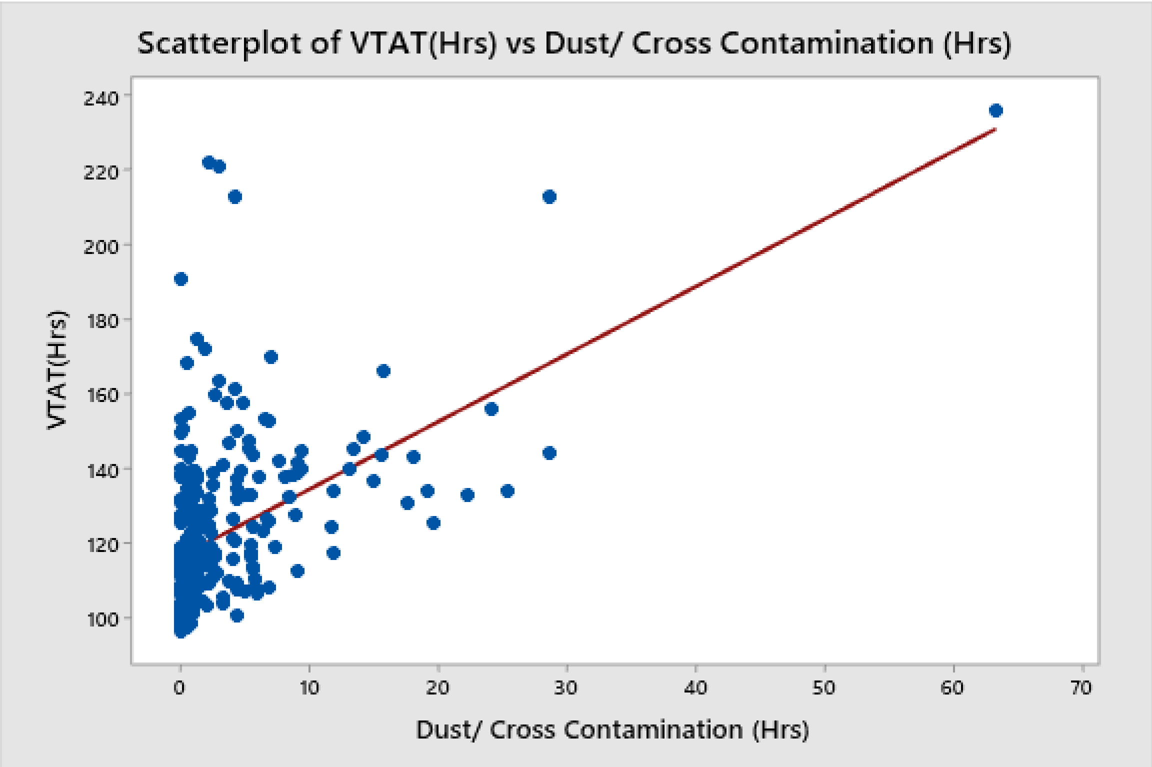

Figure 4.37: VTAT vs Dust/Cross Contamination

4.3.3.1.12 VTAT vs Route Preparations

Route preparations is done prior to loading or offloading of every vessel to ensure that there is no cross contamination of vessels/cargoes. Route preparations happens after completion of every vessel. There is 4 hours allocated for cleaning while TNPA is sailing and berthing the vessels. However, due to cargo spillages on the transfer points and shortage of cleaners, it sometimes takes more than 8 hours. As a result, this affects the VTAT. Figure 4.38 demonstrates the association between VTAT and route preparations. The figure illustrates also that there is a positive association between them. Correlation test between the two variables was carried out at 95% confidence level, p value = 0, Pearson correlation value is 0,568 which is close to 1 and indicate that there is strong association between the two variables, hence linear regression is shown as VTAT = 114.6 + 3.577 Route Preparations.

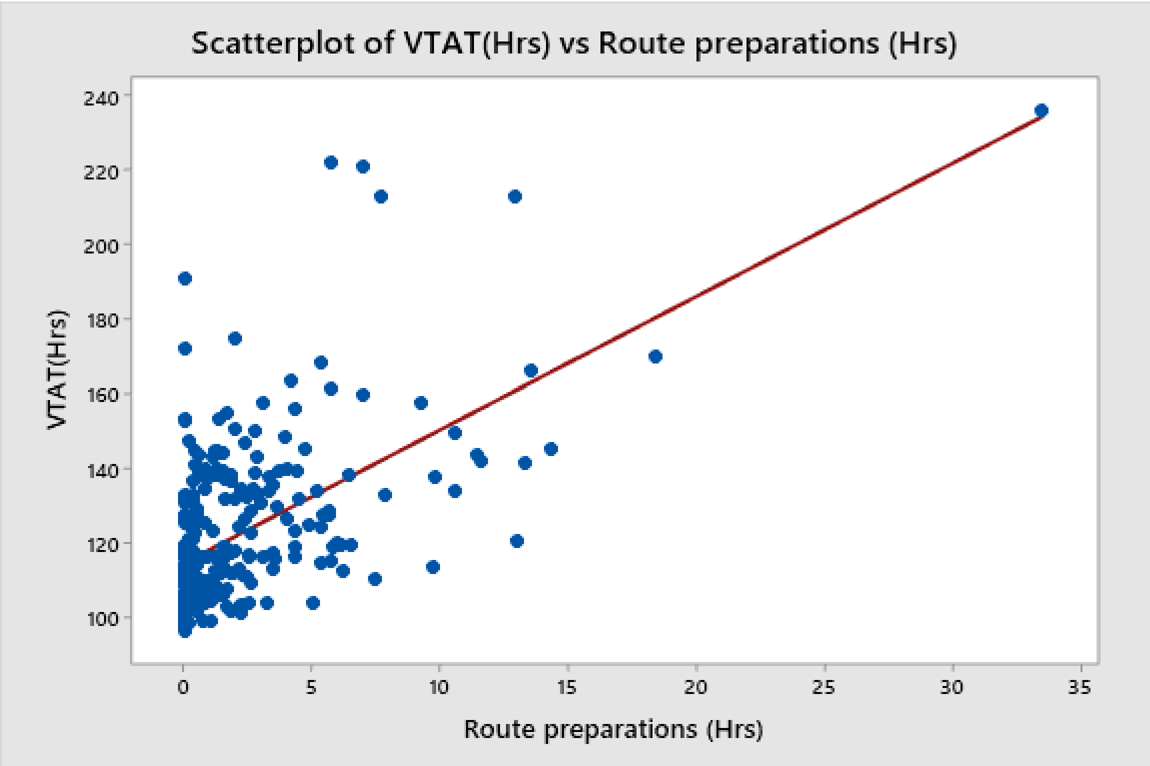

Figure 4.38: VTAT vs Route Preparations

4.3.3.1.13 VTAT vs Route Inspections

Route inspections are done and passed by certified surveyors. They are done after route preparation. It is a requirement that before any vessel load or offload, a surveyor inspects the route to ascertain its cleanness to load or offload. When the route is in a good state, the surveyor will pass it immediately and if it is not, they will fail it. This failing of route affect the VTAT as more time is required to clean the route while vessels are waiting to load/offload. Figure 4.39 demonstrates the association between VTAT and route inspections. The figure illustrates also that there is a positive relationship between them. Correlation test between the two variables was carried out at 95 confident level, p value = 0, Pearson correlation value is 0,213, which is far from 1. The results indicated that there is a weak association between the two variables, hence linear regression is shown as VTAT = 120.6 + 1.086 Route Inspections.

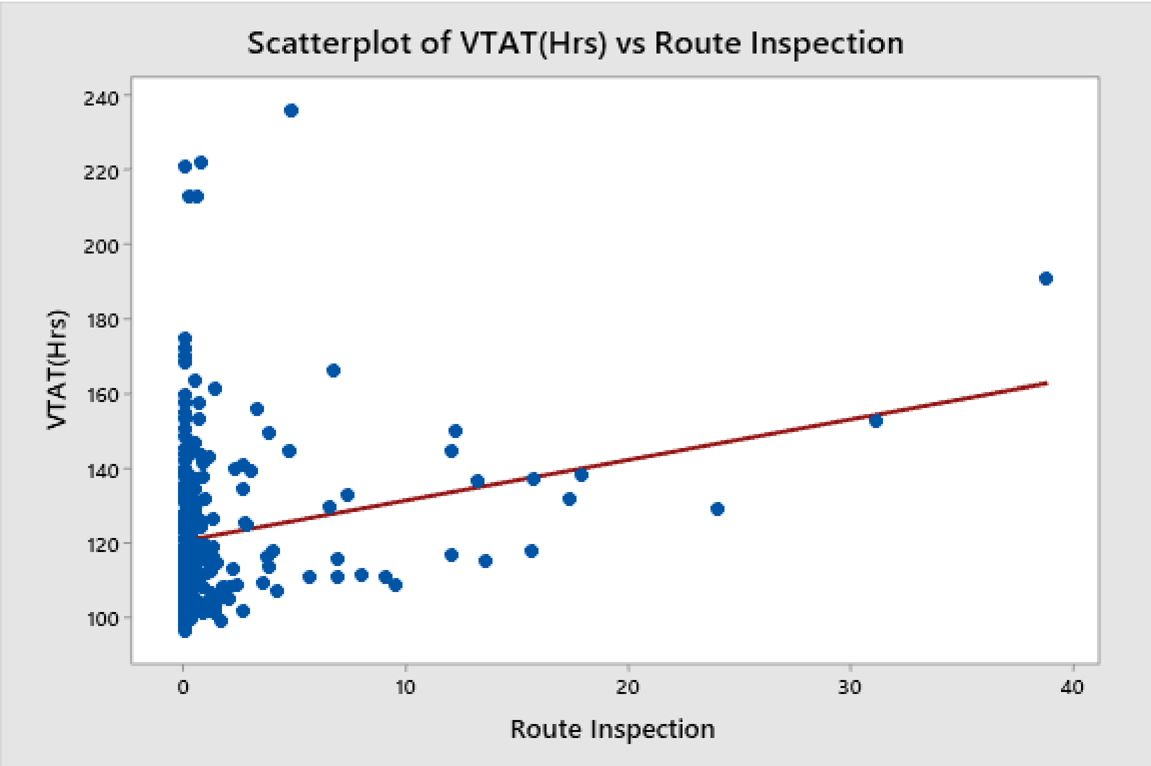

Figure 4.39: VTAT vs Route Inspections

4.4 Discussion of Questionnaire, Interview and Documentary Results

In questionnaire, interview and documentary results it was found that vessel turnaround time at Richards Bay Dry Bulk Terminal is bad. Questionnaire results reveal that 39.8% of participants assessed VTAT to be bad, while documentary results reveal that the mean of VTAT is 122.2 hours against target of 96 hours over a period of six months. This is way out and it indicates that VTAT indeed at RBDBT is bad. Questionnaire results reveal that 65.7% of the participants strongly agree that equipment breakdowns causes poor VTAT, while documentary results showed that there is strong relationship between equipment breakdowns and VTAT. Pearson correction value between the two variables is 0.602, and it is close to 1. This shows that equipment breakdown is one of the factors affecting VTAT. At times equipment breakdowns take long to resolve due to competency of technical staff and unavailability of spares.

Questionnaire results reveal that 63.9% of the participants strongly agree that route preparations causes poor VTAT, while documentary results reveal that there is a strong relationship between route preparations and VTAT. Pearson correction value between the two variables is 0.568 which is close to 1. This shows that route preparation is also a factor affecting VTAT. Questionnaire results reveal that 53.9% of the participants strongly agree that too many draft surveys causes poor VTAT, while documentary results reveal that there is a weak relationship between draft surveys and VTAT. Pearson correction value between the two variables is 0.065, and it very far to 1. However, interview and observation results reveal that too many draft surveys affect VTAT. Therefore, it can be concluded that too many draft surveys are also a factor affecting VTAT at RBDBT.

Interview results reveal that shortage of payloaders during loading/offloading affect VTAT, while documentary results reveal that there is moderate relationship between VTAT and shortage of payloaders. Pearson correlation value between these two variables is 0.447, and it is not close to 1. This implies that shortage of payloaders is also a factor affecting VTAT at RBDBT. Questionnaire results reveal that 53.7% of participants strongly agree that cross contamination of cargo causes poor VTAT, while documentary results reveal that there is a strong relationship between cross contamination and VTAT. Pearson correlation value between these two variables is 0.500, and it is close to 1. This implies that cross contamination of cargo is also a factor affecting VTAT at RBDBT. Questionnaire results reveal that 70.4% of participants strongly agree that berthing/sailing delays causes poor VTAT, while documentary results reveal that there is a strong relationship between berthing/sailing delays and VTAT.

Pearson correlation value between these two variables is 0.685, and it is close to 1. This indicate that berthing/sailing delays is also a factor affecting VTAT at RBDBT. Questionnaire results reveal that 60.2% of participants strongly agree that wet cargo causes blockages at transfer points and in turn causes poor VTAT, while documentary results reveal that there is a strong relationship between cargo blockages and VTAT. Pearson correlation value between these two variables is 0.544, and it is close to 1. This indicate that cargo blockages are also a factor affecting VTAT at RBDBT.

Questionnaire results reveal that 47.2% of participants strongly agree that changing of loading instructions causes poor VTAT, while documentary results reveal that there is a weak relationship between changing of loading instructions and VTAT. Pearson correlation value between these two variables is 0.227, and it is not close to 1. This indicate that changing of loading instructions does not affect VTAT at RBDBT. Interview results reveal that shift changes and tea breaks affect VTAT, while documentary results reveal that there is weak relationship between tea breaks/shift changes and VTAT. Pearson correlation value between these two variables is 0.256, and it is not close to 1. However, through observation the research found that too many shift changes and tea breaks affect VTAT. Therefore, it can be concluded that too many shift changes and tea breaks are other factors affecting VTAT at RBDBT.

Questionnaire results reveal that 66.7% of participants strongly agree that high wind-speed/rain causes poor VTAT, while documentary results reveal that there is a strong relationship between high wind-speed/rain and VTAT. Pearson correlation value between these two variables is 0.517, and it is close to 1. This implies that high wind-speed/rain is also one of the factors affecting VTAT at RBDBT

4.5 Conclusion

The chapter discussed the findings from questionnaire and interviews. It discussed short and long term plans which the port management need to put in place in order to reduce the vessel turnaround time. Secondary data from delay sheet and daily performance were analysed to for determine the factors affecting vessel turnaround time at Richards Bay Dry Bulk Terminal. The chapter discussed the impact of each factor separately and all the factors combined in relation to vessel turnaround time.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provided the conclusion and recommendations about the research study. The research study investigated the factors affecting VTAT at RBDBT. Critical literature review associated with the research topic helped the researcher to link and relate factors from other research area’s findings.

5.2 Conclusion

This study investigated the factors affecting VTAT at RBDBT. The study used both secondary and primary data. Primary data was attained from workforce working at TPT, TNPA, stevedores, shipping agent and cargo owners. Secondary data was sourced through the statistical information of monthly vessel turnaround time for DBT, daily action centre, daily shift report, weekly performance report and weekly plant availability report. The study asked four questions, which were; What are the factors that affecting VTAT at DBT and relative significance of each factor towards VTAT?; What are the reasons for the increase of VTAT at DBT?; What is the impact of factors affecting VTAT at DBT?; What are the ways in which VTAT could be decreased?

5.2.1 Factors affecting VTAT

It was found that the factors affecting VTAT are equipment breakdowns, weather (in the sense of high wind speed and rain), too many draft surveys, route preparations, cargo shortage, unavailability of spares, berthing/sailing delays, unavailability of pilot and tug, shortage of payloaders, among others. Other factors included too many shift changes and teatime breaks, changing loading instructions, dust/cross contamination, route inspections, route preparations, cargo spillages, incompetent workforce, poor vessel scheduling, wet cargo/cargo blockages, non-adherence to standard operating procedure and incidents. The study found that berthing/sailing, unavailability of tugs, pilot, and payloaders, equipment breakdowns, incompetent workforce, route preparations, poor vessel scheduling and weather were rated the highest factors affecting VTAT.

Wet cargo, non-adherence to SOP, incidents, route inspections, cargo spillages, too many shift change and tea breaks were rated moderate while dust/cross contamination and changing of loading instructions are rated low as the happens occasionally.

5.2.2 Reasons for the increase of VTAT at DBT

It was found that the reasons for the increase of VTAT is due to lack of maintenance of the aged equipment and infrastructure, no contract in place for payloading, splicing, and rigging and the process to get these services is long. Unreliable tugs and helicopter. Employees are taking long tea breaks and shortage of staff, cargo and payloaders. Employees are also not motivated. There is also non-adherences to terminal operating guidelines for vessel planning.

5.2.3 Impact of factors affecting VTAT at DBT

Weather was found to have a huge impact with Pearson correlation was 0.517 which is not far from 1, and it indicated that there is strong relationship between weather and VTAT. It was found that when it is windy or rainy vessels stands for days without loading or offloading. Equipment breakdowns had Pearson correlation of 0.602 which is not far from 1, and it indicated that there is a strong relationship between the VTAT and equipment breakdowns. The impact was found to be huge due the fact that the more the equipment is not maintained properly, the more it breaks down and further delays vessels from loading/offloading. Route preparations was also found to have a Pearson correlation of 0.568 which is close to 1, and it indicated that there is a strong relationship between VTAT and route preparations. It was further found that the impact of poor vessel turnaround time at DBT are loss of revenue/profit, loss of customer trust and business, customers having less confident in shipping their cargo through the port, and causes port to loose competitive edge.

5.2.4 Ways to decrease VTAT

The following action items were found to be solutions to reduce vessel turnaround time at DBT:

- Insourcing of pay loaders – purchase own pay loader and hire operators to operate them – this will reduce the inefficiencies in the port;
- Insourcing of rigging and splicing;
- Carry out a proper maintenance and midlife refurbishment;
- Fill up vacancies and stop acting of employees in critical positions among others;
- Improve supply chain/procurement in the acquisition of spares and external services that are required for effective plant maintenance;

- Install weather monitoring devices to ensure that all vessels planned to load or offload are cleared. Any sensitive cargo vessel to berth only when weather is cleared;
- Implement four shift system where by staff can work four days in and 3 days out. This will eliminate fatigue, absenteeism and long tea breaks. Also, employees should work 12 hours shift rather 8 hours shift;
- Carry out quarterly scale testing and calibration, as well as the purchase six additional scales to have back up in case the other scales are out;
- Replace aged equipment and train the workforce on how to operate and maintain the new equipment;
- Have a service level agreement with Original Equipment Manufacturer (OEM) for support during equipment breakdown;
- Have training centres to train employees;
- Purchase new helicopters and tugs as well as the employ skilled operators and artisans;
- Implement frequent route inspections by both technical and operations personnel;
- Have route walkers on the route whom will stop route plant if there are any cargo spillages and load them onto the conveyor belt;
- Put in place a 24 months contract for maintenance of scrappers in order to reduce carry backs on the return side of conveyor belts;
- Put in place long-term strategy in terms of cargo storage with weather condition designed to enable working wet cargo;
- Carry out equipment upgrades to replace aging infrastructure, fit for purpose in line with future technologies, culture change across the board to have sense of urgency;
- Have Succession planning strategy in place in case employees resigns there are others to fill the post;
- Revert back to first come first serve strategy when planning to load vessels;
- Purchase stacker reclaimers which can do both stacking and reclaiming at the same time, and get rid of pay loaders;
- Have debrief meeting after completion of every vessel which need to be attended by Transnet Port Terminal technical, operations, commercial, planning, shipping agent and stevedores staff to discussion challenges faced during loading/offloading of the vessel and corrective actions which need to be implemented in order to prevent reoccurrences;
- Cleaning of the route after completion of the vessel;
- Privatising quayside operations at some of the berths like Durban Port;
- Proper supervision and management of scales;

- Implement a penalty system for poor performance,
- Clients need to have service level agreement with Transnet as whole not only Transnet Port Terminal (TPT).

5.3 Implications of the Research

The outcomes of this research would have positive impact on Richards Bay Dry Bulk Terminal as a whole. It will help the port to change how they are currently doing things and improve vessel turnaround time at DBT. This study will assist terminal management to see the challenges they are faced with and ways in which they can improve in order to overcome those challenges. Consequently, the research will help the port to have competitive edge and contribute positively to economic growth to the country.

5.4 Recommendations

Based on the finding and analysis of this study it is recommended that more focus need to be put on equipment breakdown to ensure that planned daily and monthly maintenance are done and to reduce the number of breakdowns which in turn will reduce vessel turnaround time at the port of Richards Bay Dry Bulk Terminal. Moreover, carry out midlife refurbishment of critical equipment and do annual shutdowns to improve performance. This will help to dramatically reduce the number of breakdowns and extend the lifespan of the equipment used. The results of this will improve the VTAT. The port was noted to have aged equipments which are still used to load/offload cargo and it is suggested that the port invest money in replacing these equipments as not only the cause poor VTAT but also put the lives of the employees at risk.

It was also noted that RBDBT loses time during shift changes and teatimes and it is recommended that the RBDBT management implement hot seat change right away. Moreover, the port needs to implements 12 hourly shift system instead of the current 8 hourly shift system to reduce the time lost during shift changes and tea breaks. The benefit of having 12 hourly shift system is that more tonnages are loaded/offloaded as there is less tea breaks and shift changes. It was also noted that RBDBT has high absenteeism rate. This is due to employees not have enough time to rest as they work three weeks including weekends without rest. It is recommended that RBDBT management implement four days in and three off system in order for employees to have enough time to rest. It is further recommended that the port develop new policies and procedures in line with the new shift system.

The port has policies and procedures for three departments which are technical, operations and planning to work together and have planning meetings on a weekly basis however, they are not being followed. It is therefore recommended that all these policies and procedures are adhered to. This will help to improve communication amongst TPT departments. Currently, TPT is using slot system to plan vessels that is customers book a slot in advance to load/offload vessels and most of the time those vessels booked do not come on time as a result no vessel can berth during that time. Other vessels which came early have to wait for those vessels that booked a slot to come and load/offload before they can be serviced and this affect VTAT badly. It is therefore recommended that the port implement first come first serve system to service the vessels. This will reduce waiting of vessels at the port to be serviced. It was also noted that TNPA has unreliable and shortage of equipment, it is recommended that TNPA refurbish their current equipment and purchase more equipment to replace the aged ones to enable them to service both RBCT and RBDBT at the same time because as it stand equipment are shared and vessels have to wait for long time waiting for the other one to sail or berth. It was noted that both artisans and operators responsible for fixing and operating machines are incompetent, and it is recommended that they are send to proper trainings. This will help them to quickly resolve breakdowns, and also not to damage equipment. It was noted cleaning and route inspections also causes poor VTAT, and it is therefore recommended that RBDBT management needs to employ cleaning people to ensure that cleaning is carried out immediately after completion of vessels and route inspections will take less time to carry out as the route will be clean at all times. This will result in improvement of VTAT.

Lastly, shortage and unreliable payloaders are the major issue in the port. It is further recommended that the port purchase their own payloaders and employ drivers to operate them. This will assist port to reduce the cost of hiring and improve the VTAT as drivers will be managed from TPT.

5.5 Future Studies

The researcher wishes that future studies investigate the causes of equipment breakdowns at DBT, The interface between Transnet Port Terminal (TPT), Transnet National Port Authority (TNPA) and Transnet Freight Rail (TFR) in reducing vessel turnaround time, and the impact of yard capacity on vessel turnaround time.

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Appendix A: Introductory Letter to Respondents

Appendix A: Introductory Letter to Respondents

Re: Data Collection

Dear Research Participants

I am a student pursuing Master of Business Administration (MBA) at University of Kwazulu Natal. Currently I am undertaking a research study on **''FACTORS AFFECTING VESSEL TURNAROUND TIME AT THE PORT OF RICHARDS BAY DRY BULK TERMINAL''** in partial fulfillment of the requirement for the award of the degree of Master of Business Administration.

Please accept my invitation to participate in this research, whose output is intented to add value to the organization. It is not mandatory for you to participate, but should you choose to do so, please find attached questionnaire for your perusal and completion. The terminal management, whose facility is the subject of this research, has given consent to conduct the research after a careful assessment of both the research topic, objective and questionnaires. Therefore, no risks are foreseen and be assured that your input will be treated with utmost confidentiality. No respondent will be identified

Thank you very much for your participation, cooperation and understanding.

Yours Faithfully

Tlou Brian Mapotsi

Researcher

Appendix B: Questionnaire

Appendix B: Questionnaire

Introduction

The aim of this questionnaire is to assess the factors affecting vessel turnaround time at the port of Richards Bay Dry Bulk Terminal. Your response to this Questionnaire will serve as source of information to the research paper to be done for dissertation purpose. Any response you provide here is strictly confidential and will be used exclusively for the research purpose. Your honesty in responding the right answer is vital for the research outcome to be reliable.

Questionnaire No. ___________________ Date: ___________________

SECTION A: Profile of Respondents

Name of your Institution/ Section/Department ………………….................................

Gender (Please tick whichever is relevant)

Male ( )

Female ( )

Your age (Please tick whichever is relevant)

18-28 years ( )

29-39 years ( )

40-50 years ( )

51-61 years ( )

Academic qualification (Please tick whichever is relevant)

Certificate ( )

Diploma ( )

Degree ( )

Postgraduate diploma ( )

Master’s degree ( )

PhD ( )

Others (specify) ( )

You are in which level?

Terminal Manager	( )
Senior Engineering Manager	( )
Senior Operation Manager	( )
Engineering Manager	( )
Technical Manager	( )
Operation Manager	( )
Commercial Manager	( )
Planning Manager	( )
Chief Operation Supervisor	( )
Technical Supervisor	( )
Planner	( )
Stevedore personnel	( )
Cargo Owner	( )
Shipping Agent	( )
Port Control officer	( )
HR officer	( )
Finance officer	( )
Other (Specify)	(…………….)

How long have you been working at this organisation?

1-5 years	( )
6-10 years	( )
11-15 years	( )
16-20 years	( )
21-25 years	( )
26-30 years	( )

SECTION B:

5. How do you assess the vessel turnaround time(VTAT) at the port of Richards Bay Dry Bulk Terminal (RBDBT)

1 = Very bad { }, 2 = Bad { }, 3 = Moderate { }, 4 = Good { }, 5 = Excellent { }

Technical

6. How reliable are the equipment used to load/offload cargo at RBDBT

1 = unreliable { }, 2 = partially reliable { }, 3 = reliable { }

7. How do you assess the competency of technical employees at RBDBT

1 = Not competent { }, 2 = Partially competent { }, 3 = Competent { }

8. Unavailability of spare during breakdowns causes poor VTAT

1 = Strong disagree { },2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Operations

9. How do you assess the competency of operators at RBDBT

1 = not competent { }, 2 = partially competent { }, 3 = competent { }

10. Does route preparation affect VTAT

1 = Strong disagree{ }, 2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

11. Unavailability of cargo causes poor VTAT

1 = Strong disagree{ }, 2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Sheq:

12. Delays in stopping vessels from loading/unloading due dust causes poor VTAT

1 = Strong disagree{ }, 2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

13. Delays in loading/offloading wet cargo causes poor VTAT

1 = Strong disagree { },2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

14. Delays in stopping the vessels due to high wind speed/rain causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

15. Delays due to incidents during loading/unloading causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

16. Delays due to cargo spillage during loading/offloading causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

17. Delays due to cross contamination of cargo during loading/offloading causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

18. Delays due to not following safe working procedures causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Planning

19. Poor scheduling of vessels causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { }, 3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Vessel

20. The size of vessels affect the VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

21. Too many draft survey during loading/offloading causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

22. Delays in vessel failing hatches affect VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

TNPA

23. Delays in berthing/sailing the vessels causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

24. Unavailability of pilot causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

25. Tug breakdowns causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Client

26. Delays in route inspection prior to loading/offloading causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

27. Changing of loading/offloading instruction causes poor VTAT

1 = Strong disagree{ }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Finance

28. Long custom clearance causes poor VTAT

1 = Strong disagree { }, 2 = Disagree { },3 = Neutral { }, 4 = Agree { }, 5 = strongly agree{ }

Appendix C: Interview Questions

Appendix C

Interview Questions

1. What are the factors affecting vessel turnaround time at port of Richards bay Dry Bulk Terminal?
2. To what extent does each factor affect the vessel turnaround time
3. What are the strategies currently used by port of Richards Bay Dry Bulk Terminal management to reduce VTAT?
4. What are short term plans which port management needs to be put in place to reduce VTAT?
5. What are long term plans which port management needs to put in place to reduce VTAT?
6. What strategies are needed to be put in place in order to improve the vessel turnaround time?

Appendix D: Observations Checklist

Appendix D: Observation Checklist

In the course of study, the researcher will need to observe the following:

1. Available logistical facilities and equipment such as shiploaders, ship-unloaders, conveyor belts, payloaders, plough and reclaimer;
2. Storage Bins; Stock pile
3. Berths operations;
4. Barchart
5. Daily vessel performance report for import and export section.

Appendix E: Informed Consent Letter

Informed Consent Letter 3C

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

Dear Respondent,

MBA Research Project
Researcher: Tlou Brian Mapotsi [redacted]
Supervisor: Christoper Chikandiwa (031 260 8882)
Research Office: Ms P Ximba 031-2603587

I, **Tlou Brian Mapotsi** an MBA student, at the Graduate School of Business and Leadership, of the University of KwaZulu Natal. You are invited to participate in a research project entitled **FACTORS AFFECTING VESSEL TURNAROUND TIME AT PORT OF RICHARDS BAY DRY BULK TERMINAL**. The aim of this study is to investigate the factors affecting the vessel turnaround time at the port of Richards Bay Port Terminal and reduce them.

Through your participation I hope to understand the causes of poor vessel turnaround time at the port of Richards Bay Dry Bulk Terminal. The results of the focus group are intended to contribute to the organization as a whole.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this survey/focus group. Confidentiality and anonymity of records identifying you as a participant will be maintained by the Graduate School of Business and Leadership, UKZN.

If you have any questions or concerns about completing the questionnaire or about participating in this study, you may contact me or my supervisor at the numbers listed above.

The survey should take you about **15** minutes to complete. I hope you will take the time to complete this survey.

Sincerely

Investigator's Signature____________________________ Date_________________

This page is to be retained by participant

UNIVERSITY OF KWAZULU-NATAL
GRADUATE SCHOOL OF BUSINESS AND LEADERSHIP

MBA Research Project
Researcher: Name (Telephone number)
Supervisor: Name (Office Telephone number)
Research Office: Ms P Ximba 031-2603587

CONSENT

I…………………………………………………………………………(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.
I understand that I am at liberty to withdraw from the project at any time, should I so desire.
SIGNATURE OF PARTICIPANT DATE

………………………………………………………………………………………………

This page is to be retained by researcher

Appendix F: Sample Size Table

Required Sample Size†

Population Size	Confidence = 95%				Confidence = 99%			
	Margin of Error				Margin of Error			
	5.0%	3.5%	2.5%	1.0%	5.0%	3.5%	2.5%	1.0%
10	10	10	10	10	10	10	10	10
20	19	20	20	20	19	20	20	20
30	28	29	29	30	29	29	30	30
50	44	47	48	50	47	48	49	50
75	63	69	72	74	67	71	73	75
100	80	89	94	99	87	93	96	99
150	108	126	137	148	122	135	142	149
200	132	160	177	196	154	174	186	198
250	152	190	215	244	182	211	229	246
300	169	217	251	291	207	246	270	295
400	196	265	318	384	250	309	348	391
500	217	306	377	475	285	365	421	485
600	234	340	432	565	315	416	490	579
700	248	370	481	653	341	462	554	672
800	260	396	526	739	363	503	615	763
1,000	278	440	606	906	399	575	727	943
1,200	291	474	674	1067	427	636	827	1119
1,500	306	515	759	1297	460	712	959	1376
2,000	322	563	869	1655	498	808	1141	1785
2,500	333	597	952	1984	524	879	1288	2173
3,500	346	641	1068	2565	558	977	1510	2890
5,000	357	678	1176	3288	586	1066	1734	3842
7,500	365	710	1275	4211	610	1147	1960	5165
10,000	370	727	1332	4899	622	1193	2098	6239
25,000	378	760	1448	6939	646	1285	2399	9972
50,000	381	772	1491	8056	655	1318	2520	12455
75,000	382	776	1506	8514	658	1330	2563	13583
100,000	383	778	1513	8762	659	1336	2585	14227
250,000	384	782	1527	9248	662	1347	2626	15555
500,000	384	783	1532	9423	663	1350	2640	16055
1,000,000	384	783	1534	9512	663	1352	2647	16317
2,500,000	384	784	1536	9567	663	1353	2651	16478
10,000,000	384	784	1536	9594	663	1354	2653	16560
100,000,000	384	784	1537	9603	663	1354	2654	16584
300,000,000	384	784	1537	9603	663	1354	2654	16586

Appendix G: Ethical Clearance

UNIVERSITY OF KWAZULU-NATAL™
INYUVESI YAKWAZULU-NATALI

31 August 2018

Mr Tlou Brian Mapotsi (217071838)
Graduate School of Business & Leadership
Westville Campus

Dear Mr Mapotsi,

Protocol reference number: HSS/1294/018M
Project Title: Factors affecting vessel Turnaround Time at the port of Richards Bay Dry Bulk Terminal

Approval Notification – Expedited Application

In response to your application received 27 August 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Dr Shamila Naidoo (Deputy Chair)

/ms

Cc Supervisor: Mr Christopher Chikandiwa
Cc Academic Leader Research: Professor Muhammad Hoque
Cc School Administrator: Ms Zarina Bullyraj

Humanities & Social Sciences Research Ethics Committee
Professor Shenuka Singh (Chair)
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Website: www.ukzn.ac.za

Appendix H: Turnitin Report

MBA Thesis

ORIGINALITY REPORT

2%	1%	0%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Swiss Management Center Student Paper	1%
2	Submitted to University of Stellenbosch, South Africa Student Paper	<1%
3	open.uct.ac.za Internet Source	<1%
4	uir.unisa.ac.za Internet Source	<1%
5	Submitted to South Bank University Student Paper	<1%
6	epubs.scu.edu.au Internet Source	<1%