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Systems Approach to the operational challenges in marine services within the port of Durban

By

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The dissertation submitted in partial fulfilment of the requirement for the degree of Master of Commerce

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DECLARATION

I, Sphiwe Eugene Mthembu, hereby declare that I am familiar with the University's policy on plagiarism, and that any work done that has been relied upon in the research report has been duly acknowledged and properly referenced. The work has been thoroughly checked to ensure it contains no instances of plagiarism.

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Date

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I wish to acknowledge and appreciate assistance from a few individuals who have committed their time and energy into making this work a success. Without their belief in the work being undertaken, possibly, this research report would have not come into existence.

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- Recognition goes to all the respondents that dedicated their time by participating in the interviews during the field study.

DEDICATION

This dissertation is dedicated to all mariners in the port system, mariners who strive to improve marine services for the betterment of our economy. It is also dedicated to the captains of the industry and marine services leadership at large.

ABSTRACT

Modern problems are complex and are characterized by the existence of multiple actors, multiple perspectives, conflicting interest as well as key uncertainties. This dissertation aims to explore the operational challenges of marine services in the port of Durban. The researcher was interested in exploring marine operational challenges and their impact on the maritime industry as well as stakeholder benefits from the operation of marine services. The purpose of employing systems thinking was to recognize relationships and interconnectedness between elements at play in the marine services operations. Understanding behavior of marine services systems was critical for gaining insight into the behaviors and patterns underlying these complex systems. The research questions related to the operational challenges being experienced within the port of Durban; the stakeholders who are impacted by these challenges; and the recommendations that can be made to mitigate the impact of these challenges. The research objectives aimed to explore the dynamics of the marine services' system. Furthermore, the research aimed to look at how the current levels of offering can be improved within the port of Durban. The research problem statement presented the level of connection between the South African economy and the port of Durban, acknowledging that the port of Durban is the gateway to international markets. Marine systems are complex and dynamic requiring the system thinking approach to understand the structure of the problem situation. A conceptual model of a dynamic marine service system was developed by employing a qualitative paradigm. Data was collected via interviews and observations from purposive marine employees who possessed knowledge and expertise of the global maritime industry. Using a thematic analysis the findings indicated that investment in infrastructure is the main marine services operational challenge confronted by the department. The volume of cargo triggers ship evolution where ship builders begin to build bigger size vessels to cater for volume throughput in international ports. The ship size evolution leads to the gap in the shipping industry and port infrastructure which require huge investments to close the gap.

Keywords: Marine services, Shipping Liners, Systems Thinking, System Dynamics, Qualitative.

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ACRONYMS AND ABBREVIATIONS

APE	-	Africa Port Evolution
APE	-	Africa Port Evolution
CT	-	Complexity Theory
DBN	-	Durban
DPC	-	Durban Port Committee
GDP	-	Gross Domestic Product
ICC	-	International Conversion Center (ICC)
IMO	-	International Marine Organization
IRS	-	Integrated Resource Systems
MIT	-	Massachusetts Institute of Technology
PLM	-	Principle of Logistics Management
PCC	-	Port Consultative Committee
SASSOA	-	South African Association of Ship Operators and Agents (SASSOA)
SA	-	South Africa
SF	-	Safety Factor
SSM	-	Soft Systems Methodology
SCM	-	Supply Chain Management
SADC	-	Southern African Development Community
SAMSA	-	South African Marine Safety Authority
ST	-	Systems Thinking
TPM	-	Total Production Maintenance
TNPA	-	Transnet National Port Authority
TEU	-	Twenty Feet Equivalent Unit
TSCM	-	Total Supply Chain Management

CHAPTER ONE: INTRODUCTION

1.1 Introduction

The marine service within the port system is a critical component of the maritime industry. It is the pivot of economic growth in that all ships visiting the port need to be handled by marine services. The efficiency of marine services determines the flow of cargo imports and exports of the country (Moon and Woo, 2014). This operation impacts directly on the economic growth of the country by means of maneuvering of ships on time, and reducing the time that ships spend on anchorage. The study of marine services' operational challenges will add on knowledge about challenges confronted by marine services and shipping industry.

The study of marine services within the port of Durban seeks to explore challenges that impact the marine operations. It also answers the question of how these operational challenges can be alleviated, and offers a strategy to be employed in mitigating the impact to marine services' stakeholders (Song, 2012). The shipping industry has highlighted the challenge in marine services, citing the absence of efficient marine services in the port of Durban. This challenge was further elaborated by presenters during the Africa Port Evolution 2016 held at the International Conversion Center (ICC). South African media have also touched on the issue of efficiencies in the port of Durban. Organs like the South African Association of Ship Operators and Agents (SASSOA) presented their views on the efficiencies of Durban marine services, citing the lack of required equipment and skills.

The port of Durban was once ranked number one in Africa but there has been a drop in its ranking from position one to position three. Internationally, the position of the port of Durban dropped from number 54 to number 58, some of the contributing factor is lack of enough water depth to accommodate bigger vessels and inadequate resources to be split amongst the ships requiring services (Pupuma, 2016)

The aim of the study is to explore operational challenges confronted by marine services within the port of Durban in order to learn of key areas that require improvements within the marine services' department. The broad objective of the study is to highlight areas of improvement and recommend actions to be taken to improve the system. The research was conducted in the port of Durban with

the understanding that port of Durban is the gateway to international trade. The research was conducted qualitatively to gain flexibility in data collection through in-depth interviews with participants. Interviews were recorded, transcribed and analyzed thematically. The groups of highly qualified marine services' employees were selected to participant in the research study so that they can share their knowledge and experience.

1.2 Background to the Study

The research project was conducted in the port of Durban as an instrument to understand marine services' operational challenges that have a potential impact on the shipping industry. The port of Durban marine services provide safety of navigation to ships destined for the port of Durban and those that require assistance while sailing the oceans surrounding South Africa. Marine services include tugs services, pilotage services, bunkering services, and security and navigation technologies of ships entering and departing the port of Durban. Ensuring safe navigation and mooring of vessels on berth become the key function of marine services. For the port to be attractive to the industry, the need for efficient and effective service of ships becomes vital (Valentine et al. 2013). The port aspires to achieve navigating, docking, and cargo operations that are executed on time and efficiently. Ships' turnaround times are one of the key indicators of marine services' effectiveness, which is closely monitored by the shipping industry. Longer ship stays in the port, either on anchorage or alongside berths, discourage shipping liners in bringing vessels to the port. The port of Durban has recently been under pressure from the industry, due to delays associated with marine services, as industry views the delays as the biggest cost factor in the port of Durban. The Durban marine services are perceived by the shipping industry to be below global standard. The marine services' department operates a fleet of tugs for assisting vessels from anchorage to berths, deploys berthing crews to ensure that shipping is moored, provides pilots to navigate ships through the entrance channels of the port, and provides bunkering services to the ships (International Transport Forum Report, 2013). These services are to be provided to the shipping industry on a 24-hour basis. Adherence to the schedule time, and ensuring the availability of infrastructure for handling ships fall under the jurisdiction of marine services. The perception of the shipping industry is negative about the port of Durban's marine services. The study examines the marine services' operational challenges and their impact on the shipping

industry so that the perception can be managed. A holistic approach in understanding these operational challenges will assist in mitigating the impact to the shipping industry and managing the industry perception. At the end of the study, implementation strategies will be presented to assist the port to perform at it agreed service levels.

1.3 Problem Statement

The port of Durban is the largest port in the Southern African Development Community (SADC) region, handling, on average, 4 000 ships per annum (International Transport Forum Report, 2013). The port of Durban is the hub of Africa, the true gateway to international trade. Being the pivot of the South African economy, it's imperative that ships are handled effectively and efficiently to reduce the country's cost of logistics chain. The port of Durban is the global icon, maintaining South Africa's reputation at higher levels toward international community. Malfunctioning of the port system producing inefficiencies in vessel handling could jeopardize the country's economic growth and reduce employment opportunities (Hsu, 2012). The country's GDP is directly impacted by the port of Durban's marine operation efficiencies. Being an emerging economy, South Africa requires effective and efficient marine services to unlock the bottleneck in cargo flow between South Africa and global markets.

1.4 Aim of the Study

The aim of the study was to understand operational challenges confronted by marine services in the port of Durban. The study identified stakeholders who are impacted by these challenges experienced by marine services so that perceptions about the port of Durban can be managed. In so doing, operational planning of marine services can be improved and benchmarked against global best practices, as understood by the shipping industry.

1.5 Research Objectives

The broader objective of the study is to highlight marine operational challenges impacting on the shipping industry. It is imperative to identify the gap between what is perceived by the industry to

be the best practice in marine services' offerings to what marine services offer to the industry. Furthermore, it is important to understand global practices so that perceptions can be managed. This study addresses the following research objectives:

a) To identify operational challenges confronted by marine services within the port of Durban;
b) To understand operational challenges that impact on the shipping industry and environment within the port of Durban;
c) To examine the impact of marine services' activities to the environment; and
d) To make recommendations directed towards mitigating the impact on shipping industry.

1.6 Research Questions

The following research questions have been formulated in line with the research aim and objectives to ensure that the study achieves it goals to explore operational challenges within the marine services:

1. What are the operational challenges confronted by marine services within the port of Durban?
2. What is the impact of these operational challenges on the effectiveness of the service offering aimed at the shipping industry?
3. What is the appropriate strategy that can be employed in ensuring successful mitigation of these challenges?
4. What recommendations can be made to both marine services and the shipping industry in an attempt to mitigate the impact of these challenges?

1.7 Research Methodology

The qualitative research method was employed in this study. This method is largely deductive (Carroll, 2003). This approach is effective in undertaking an exploration of marine services' operational challenges, gaining an in-depth understanding into these challenges and understanding their impact to marine stakeholders. The research approach employed open-ended questions during

the interview process (Scott-Baumann, 2008) in which the participants shared their experience and knowledge on the subject (Snelson, 2016).

This approach is appropriate for investigating and evaluating the problem situation at marine services accurately and obtains tangible evidence. According to Engle (1999) qualitative research is an exploratory approach utilized to gain an in-depth understanding of the problem situation being investigated. There are no set boundaries to limit respondents. Open-ended questions were utilized to ensure free expression by participants (Lewis, 2015). Marine services' operational documents were also reviewed and observations were made of the actual operations conducted. Marine services maintains complex systems characteristic that involves human activities. Soft systems methodology approach was employed for the purpose of reducing complexity. Soft systems methodology is a methodology providing a platform for employment of methods that help unpack ill-structured problem situations, most importantly where relationship management is as important as goal seeking (Jackson, 2000). Where stakeholder involvement is unavoidable, soft systems methodology intervention becomes the best approach to bring about harmony (Checkland, 1994). The purpose of soft systems methodology was to produce a systems methodology capable of dealing with soft problems. The approach seeks to alleviate ambiguity, disagreements and conflict associated with work of people (Green, 2013). Soft systems methodology compliments qualitative research strategy employed by the researcher, both approaches are interpretive in nature. A further elaboration of soft systems methodology is found in the forthcoming chapter three.

1.8 Structure of Dissertation

The research study comprises of six chapters arranged as follows:

Chapter One

This chapter presents the roadmap to the research study covering the background to the study, the problem statement, aim and objectives of the study, research questions, the methodology followed in conducting the study and limitations to the study.

Chapter Two

Chapter two presents literature reviews related to the analysis of maritime industry and marine services' operational challenges. This chapter also examines the international maritime industry, the local port performance and global trade trends that affect the performance of the ports.

Chapter Three

This chapter provides a discussion on the theory of systems thinking. The chapter examines the tools used in a systems approach and concludes with the theoretical framework of the study of marine services operational challenges.

Chapter Four

This chapter presents the research strategy employed in conducting the research. The following aspects are discussed: research methodology; target population; sampling technique and data collection methods; plans for data analysis; and ethical issues.

Chapter Five

This chapter discusses findings from both literature and primary data that were collected through interviews as well as observations. Analyses are informed by the research questions, aim and objectives. The data are analyzed on the bases of themes that emerge from data analysis which forms the platform for recommendations.

Chapter Six

Chapter six presents the analysis of objectives by providing a background on the question of how the study objectives were achieved. The researcher also revisits the systems approach as a framework for the marine services study. Towards the end of the chapter, the researcher presents limitation of the study and makes general recommendations. The chapter concludes by suggesting future research areas and making concluding remarks.

1.9 Conclusion

This chapter discussed the introduction to the study as well as the background giving essence of the research. The chapter provided the aims and objectives of the study with clear a problem statement, the presentation of research methodologies employed and structure of the dissertation. The following chapter will discuss the literature review.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

In today's global economy, businesses are struggling to achieve and maintain competitive advantage as the markets are dynamic and turbulent in nature. Operational challenges, which are a day-to-day phenomenon, compel managers to develop techniques, strategies and processes to deal with such challenges (Gumede and Chasomeris, 2015). The adoption of the systems thinking approach in dealing with operational challenges at the operational level could be the positive initiative towards remedying challenges without further destabilizing organizations (Caldwell, 2012).

Dynamic capabilities and resource-based operational strategies have been employed towards achieving competitive edge. In previous studies, suggestions were for firms to develop adaptive systems in building up their dynamic capabilities in order to respond quicker to customer requirements. Flexible and agile operational behavior has been widely considered as crucial in achieving sustainable advantage. Dynamism and a turbulent environment require an approach of sensing and responding accordingly to market challenges. Strategies of responding to a wave of global competition has been classified at different levels of responses, including reactor, analyzer, prospector and defender (Yang and Regan, 2013). Setting and communicating strategic objectives becomes the pinnacle in directing every one's effort within the organization towards a common goal.

This dissertation is designed to explore, in detail, marine services' operation and its challenges. Due to the rapid growth in global trade over the past few decades, ports have seen an increased flow of cargo between markets globally. The rapid spread of information systems has resulted in the ease of doing business in international markets. The increased flows of cargo between countries in different continents have resulted in increased competition between ports situated in different regions (Gumede and Chasomeris, 2015). This increase calls for changes in business processes, policies and technologies to keep up with global competitors. Change in management skill must be a company's disposal to avoid the negative impact of poor change management. Change can be presented by change in organizational leadership. The critical element of implementing change is that of understanding how to create a better work environment and keep employees' focus in the

mist of rapid change. Environmental management becomes the new leadership attribute or competency that is sort after skill. Clear goals and frequent communication between an organizational leader and functional teams can see an organization surfing through a chaotic state. All employees in the organization have to be clear of what is expected from them. Marine environment is faced by rapid change both at policy and process levels. Rapid change in environment calls for an organization to adapt and move with the times or risk losing its market share. During the change process, firms change their organizational organogram, making their structures flat with a view to enhance quick turnaround time in decision making. As a result, reporting lines become blurry and the level of accountability is compromised. This creates a scenario where, when employees raise concerns, managers don't feel compelled to take the initiative in resolving issues (Ali and Ivanov, 2015).

The growing need for organizations to adopt soft systems, as opposed to the traditional approach that looks only at hard systems, is the contemporary topic. The traditional approach focused only on systems like push vs. pull, seven waste, standard works, Kanban, Total Production Maintenance (TPM), and load leveling. New operation strategies look at soft systems such as employee empowerment, change management, and systems dynamic in attending to operational challenges faced by an organization (Marley et al., 2013).

The purpose of the study is to explore literature in marine services' operation with the view to understand challenges facing the maritime industry. The previous studies in maritime environment and development will be discussed. Conclusions will be drawn thorough analysis and new interpretations of the previous literature.

2.2 Development in Maritime Industry

The development of maritime industry is of fundamental importance to economic growth and development. Since economic activities remain low, particularly in emerging economies, port efficiencies and port competitiveness become vital in ensuring an increased volume of goods to the region (Woo et al., 2013). Understanding maritime supply chain is important in bringing about a seamless flow of goods from water to the hinterland. The flow is supported by marine services in ensuring movements of vessels from anchorage to the designated terminal for cargo operation.

The principle of logistics management plays a vital role in ensuring success of maritime operation execution. The logistic process is a process of planning, organizing and controlling the movement of materials from supplier to the end customer (Dong, 2012). Valentine et al. (2013) suggest that 85% of international trade flow goes through maritime transportation utilizing the ocean, seaways and inland waterways. The understanding of the trends in cargo flow between nations is the important part of the study observation and understanding container traffic which brings about port traffic resulting to maritime activities, marine service operations challenges (International Transport Forum, 2013). As international trade increases, the port activities simultaneously increase, necessitating the need for investment in port infrastructure. Figure 2.1 depicts two decades of volume trends globally, as well as the history of container growth and projection.

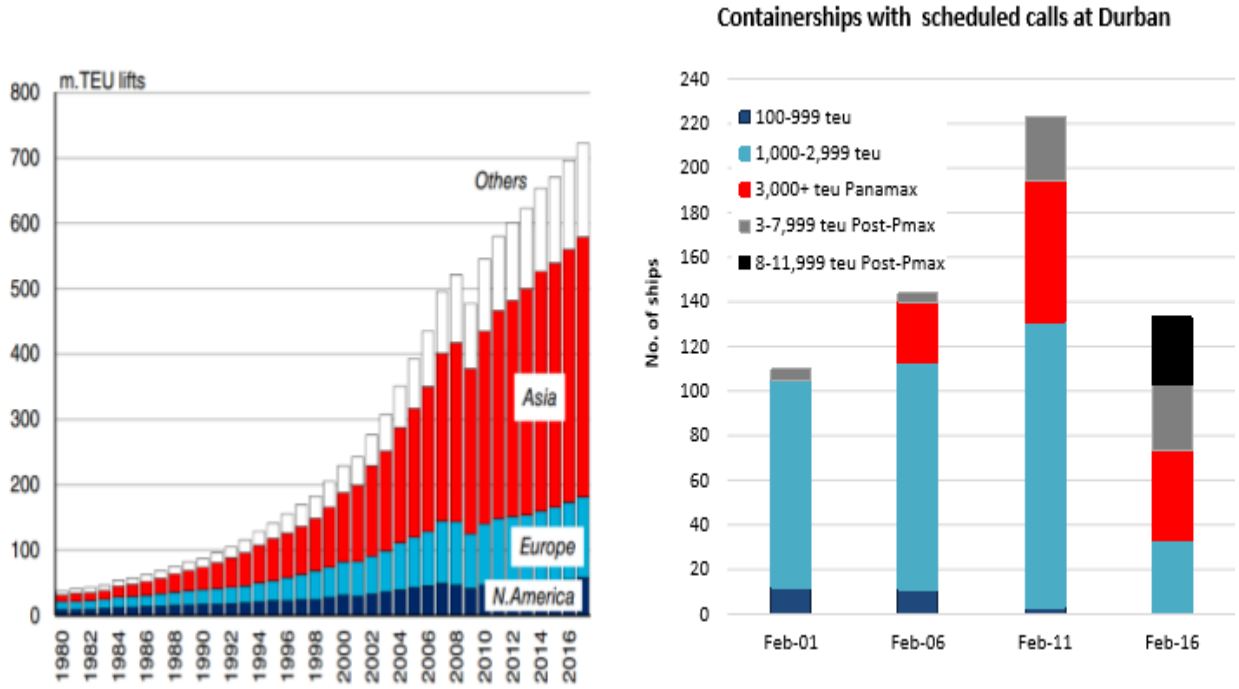

Figure 2.1 Container Growth (Source: Van Niekerk, 2016:10)

Figure 2.1 indicates the growth in global container volumes passing through the port of Durban. Maritime transport is directly driven by global activities. Figure 2.1 indicates growth since 1980 and project a further growth to the future. As indicated earlier, volume growth comes with operational challenges which will be discussed further in this chapter. This means that global

economic growth directly affects all activities in the port's systems. This phenomenon has a direct impact on the seaborne trade volumes around the world. The demand for containerized cargo has a fundamental impact on challenges faced by the marine services' department. Figure 2.2 depicts global growth in international volumes of bulk cargo tonnage which is similar to that of containerized cargo.

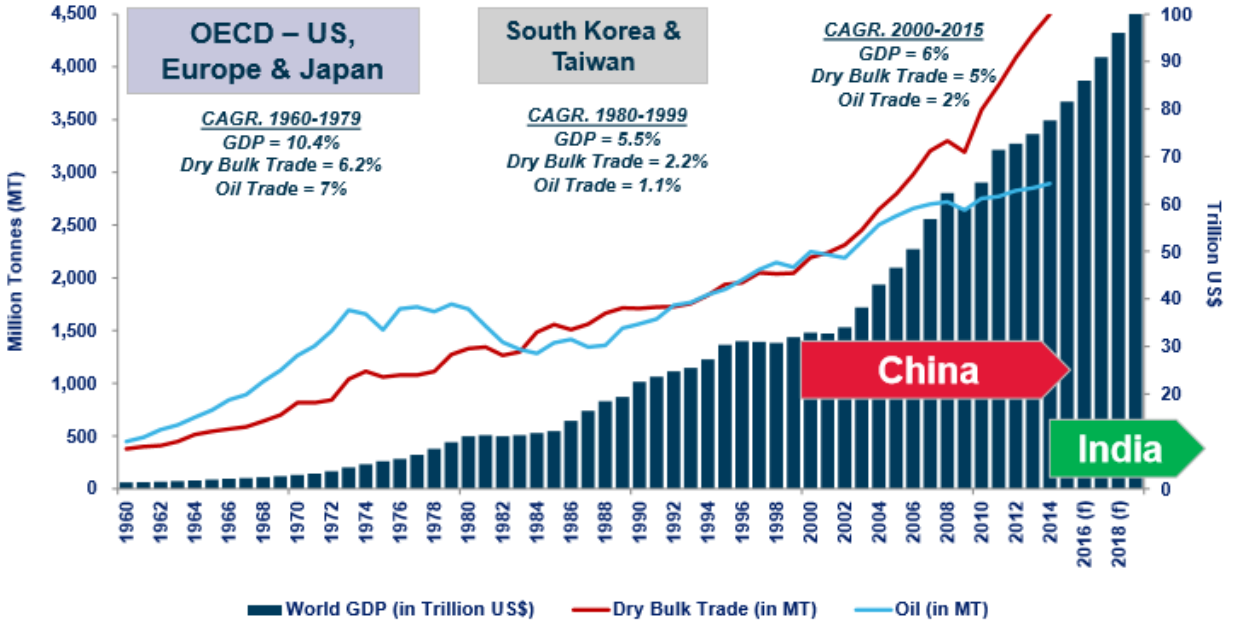

Figure 2.2 Bulk Cargo Growth (Source: Van Niekerk, 2016:4)

Notteboom et al. (2013) argue that the flow of volume is influenced by economic conditions and how well the countries are connected to global shipping networks. Some other influencing factors are the number of ships, capacity of the ships, maximum vessel size, number of services, and number of companies generating cargo traffic deploying container ships to the ports. The growth in volumes around the world increases the port activities. As a result, ports are forced to invest on infrastructure to accommodate growth in global volumes. As the vessel size increases and the number of vessels calling in ports increase, marine services' challenges ultimately increase.

2.3 Marine Services Pollution

The world's busiest ports are adopting logistics management principles in improving their effectiveness in managing port activities and achieving efficiencies in their vessel/cargo handling operations. Savings, in most operations, can be derived from the effective management of the maritime logistics system. The implementation of the logistics principle increases the opportunity for organizations to improve profits and enjoy greater savings on operational costs. Logistics-based strategies are the corner stone for building partnerships within an organization's supply chain. Implementing and maintaining the logistics approach in port operation could improve relationships between marine industry partners and maritime operations. Maritime transportation underpins a country's economic activities and supports economic growth. A well-developed maritime logistics chain can become the competitive edge for the country and also improve the agility of the country's total supply chain (Drohomeretski et al., 2014). There has been a seamless flow of imports and exports in and out of countries, increasing a country's economic activities as a result of economic growth. Most international ports have adopted logistic principles to support and improve operational effectiveness and improve efficiencies within maritime space. Developing intermodal systems, and connections of road, rail and air transport support a country's economic activities and improve supply chain logistics. Linking port, road, rail and airport supports delivering a seamless flow of cargo across borders. With the introduction of the logistics principle, ports authority have transformed their role from that of landlord to ports to one of logistics facilitators of maritime industry logistics chain (Panayides and Song, 2013). The concept of logistics management leads to the development of a maritime corridor and networks which allow better control of maritime transportation and cost associated with industry.

According to Psaraftis and Kontovas (2011) a significant marine services' operational challenge to be managed is that of pollution (air, water, soil and noise). Gas emission pollution, resulting from vessels calling in ports around the world, is the most prominent (vessel greenhouse emissions). Policies have been developed by government and port authorities in an effort to limit the impact of emissions on environment and communities surrounding ports. These policies are regulated through organs like the South African Maritime Safety Authority (SAMSA) and monitored to manage marine services-related pollutions. The South African government has implemented reforms through governmental organs like port regulator and port authority in introducing and implementing maritime policies. The introduction of a tax on emissions, which is

in line with global trends, is an example of one such governmental reform. Emission tax laws have been introduced to reduce the impact of pollution (manage externalities). The shipping industry has introduced innovative ideas such as the hull designs geared to reduce ship emissions together with efficient propulsion systems and alternative fuel cells or biofuel with less emission to the environment.

The global trend is that sea transportation should become the vital element in boosting global trade. As the biggest and largest carrier of cargo around the world, sea transport has necessitated environmental friendly operations in maritime and marine services' space. This emerging maritime phenomenon is also called the blue oceans economy. Stakeholders are embarking on research earmarked for the reduction of carbon footprint and fuel consumption in maritime and marine services' operations. This phenomenon has become the topic for regular discussion in the marine cluster (Mansouri et al. 2015). This calls for environmental responsible practice that contributes responsively to maritime and marine services' performance. Implementation of sustainable operational management practices will determine the success of maritime and marine services' departments.

The growth in marine activities must be supported by efficient marine services' operations. This growth presents operational challenges for marine services. The rapid growth in maritime activities presents risks and renders the operations prone to incidents which may cost ports hundreds of billions of rands if there are fatalities. Due to the dynamism of maritime operations, marine services are complex in nature. The systems thinking approach becomes relevant to this type of operation. Marine services' incidents, if not managed, may lead to loss of lives and major damage to vessels in port or port infrastructure (Novo-Corti et al. 2015). The interaction between marine services' activities, biological and human systems produces higher risk which may very well result in catastrophic incidents. The closure of a port due to ship grounding and submerging inside the entrance channel could mean economic disruption for the country and all activities connected to the maritime system. Policies designed to regulate marine services are earmarked for the reduction of marine operational incidents. Prediction and anticipation of what could go wrong (risk assessment systems) are fundamental in mitigating the impact. Marine services must be supported by operational risk assessment, and the management of operational incident processes designed

for the future. The ability to respond swiftly to environmental incidents becomes a crucial component in an organization's survival mission as these incidents can be expensive.

Aydogdu and Aksoy (2015) support the view that suggests that growth in volumes of cargo results in an increase in marine services' risk. The growth in vessel size necessitates investment in terminal operating systems which are evidently lagging the development in maritime industry developments. Maritime developments must be in line with port infrastructure upgrades. Within the port system, different operations exist to support the free flow of cargo through the port system. The alignment and collaboration of port authority, terminal operator, shipping companies, brokers, customs offices, and other stakeholders within the chain is critical for sustainable growth of the industry. The developments within the port must be coordinated towards delivering an efficient port system. The researcher argues that efficiency within the port system is directly linked to an increase demand for vessels calling in the port for discharge or load operations. Operational bottlenecks and information flow could be the main contributors to the increase or decrease in port efficiencies. The suggestion is for players in the port system to collaborate to avoid bottlenecks associated with marine services' operations and terminal operations. Communication between port stakeholders could increase the level of integration and decision making within the marine chain (Aydogdu and Aksoy, 2015). One must recall that ships and cargo information required by ports' communities have commonalities. The challenge is that of duplication in information results in waste of resources and increases data inaccuracy. It is imperative that the port system has electronic data so that the access to information becomes easy to all port communities (integrated resource system). This necessity advocates automation of information transfer between maritime environments with a view to provide real time information to all stakeholders requiring information. Maritime stakeholders include shipping agents, cargo owners, harbor masters' offices, customs office, customs directorate, marine policies office, port commercial office, marine services and pilot stations.

Gibbs et al. (2014) support the notion that suggests that port activities are the generator of pollution, especially in congested port areas. The authors argue that the environmental issues associated with vessels in ports have been long viewed as problematic to the environment and mankind's existence within the port boundaries. There is collaboration between the increases in port activities and the negative impact on the environment, hence, the development of a legal

framework by authorities. Pollution includes air, water, soil, biodiversity, and noise pollution; these are mostly found in port space due to terminal and marine services' activities. The most common of them all is noise and air pollution, which are due to concentration of activities within the port's boundaries. The challenge is the appropriate application of policies to deal with greenhouse gases, emissions, and air quality for the port area as a result of port activities.

Pollution is probably the key challenge for marine services (Lättilä et al., 2013). Maritime operation is well known for its emissions, new regulations, policies governing emissions, and the amount of greenhouse gasses emissions that can be allowed. The challenge is that of reducing emissions which ultimately lower the cost of externalities. Once managed, the amount of pollution concentration around the port area can be mitigated. From the hinterland, efforts have been directed towards reducing gas emissions and they have been implemented. The rollout of such initiatives to port operation is critical. A coordinated effort towards reducing emissions and pollution-related activities from the total maritime supply chain is required. Policies adopted in the ports, together with those for the hinterland, must be integrated in one document and be implemented across the entire supply chain.

Hall and Jacobs (2012) pose the question of why most ports are urban? They argue that fifteen coastal cities all have in their vicinity a well-functioning sea port. Containers are associated with the source of cargo demand which is found around the city area. This phenomenon can be associated with manufacturing houses. The growth in container volume around the world is depicted by the demand for container versus that of bulk in shipping. This is due to the emergence of a global supply chain necessitating the standard container for easy of handling. Coupled to the standard containerization is the need of just in time systems in moving these containers around the world. Container flows through the port system necessitates the implementation of just in time in all port operations. Treating marine services' operations as an extension of the countries hinterland may lead to the fast adoption of the systems thinking approach. The link of the port and hinterland activities is indicative of the convergence phenomena of hinterland activities with that of ports. Consequently, transnational terminal operations link local marine activities to that of global economy markets. Marine services are a strategic partner of the global network. As a result of the increase in traffic volumes, congestions are inevitable and pollution, as a result of greater activities in the port space, is evident. The position of the port to the city becomes an attraction to cargo

volume flow. Port and city relationship need to be understood from the point of volume attraction. The marine challenge is that of managing volumes of vessels calling at ports while reducing pollution. One other benefit of a port situated in the city is that of employment creation for city dwellers (Ng et al., 2014). Marine services' obligation is that of increasing efficiencies so that the port continues to attract international volumes for sustainability of the port system. In summary, marine challenges become that of pollution, congestion and other port externalities which affect the city. Co-operation between the city and the port becomes very crucial. It is encouraging to note that there is collaboration between port of Durban and EThekwini municipality towards implementation of smart port concept.

Homsombat et al., (2013) emphasize the issue of growth in international trade as an element that affects marine services and challenges marine services to benchmark against the best in maritime transportation between countries. Cargo going across the sea requires marine transportation, with ships needing to be loaded/ unloaded in preparation for departure. In this regard, marine services bring about economic benefits associated with employment, cargo flow, and ship operations. While all that is positive, port activities create a negative impact on the surrounding environment, especially the port catchment area, which, in turn, impacts negatively on communities surrounding the port. Ships in port generate gases such as carbon dioxide (CO2), carbon monoxide (CO), sulfur oxide (SO2), etc. These gases pollute the air. Ships and marine tugs are regarded as the main sources of pollution in ports followed by marine equipment.

Regulations on air emissions become the tool to control pollution while reducing the operational challenge related to operational activities (Homsombat et al., 2013). These emission controls assist in reducing externalities at ports. Pollution related to vessels and marine service equipment range between oil spills, ballast water disposal, dredging issues, ship scrapping and waste disposal at sea.

One might look at the change in global weather conditions as something that has less to do with maritime industry. What is well known is that weather conditions are affected by human activities. Human activities are the drivers of change in weather patterns that one sees today. This is due to human invention that produces greenhouse gases or emissions. Human activities impact on the ecosystem, marine life and human systems. This can occur in one region but end up being propagated across regions. The change in weather conditions has a measured impact on economic

and social systems in that when draught hits the region, vessel traffic tends to increase transporting tones of foods imported from other countries (Carmack et al., 2012).

The constant growth in international trade has led to a strong demand for international logistics. Maritime transportation remains the only affordable solution for moving cargo across the ocean. In the process of transporting cargo across the seas, marine employment increases and creates a positive impact on the regional economy. Such benefits bring about their own challenges related to the issue of port pollution. Ships burn fuel, Pollution becomes inevitable as vessels continuously produce gas emissions. While marine craft requires tight monitoring, unplanned events do occur, causing operational disruption and delay in service. The control both emissions as well as the movement of marine craft requires the installation of information technology and enterprise resource planning system to monitor business operations (Homsombat et al., 2013).

2.4 Marine Services' Efficiencies

The latest development in the maritime transportation is that of the shipping industry focusing more on efficient vessel turnaround time in ports. Nowadays, shipping liners and the shipping industry focus mostly on efficiencies in port operations. The focus is on ship time at sea, and ship stay in port which includes anchorage time, cargo operation time, berthing time and sailing time. Efforts are being made to reduce time and improve efficiencies (Song, 2012). The drive towards cost efficient operations is imperative. Efficient port operations influence savings to the shipping industry, saving in fuel consumption, sailing and tug operation. Ships' stay in port affect operating cost, environmental impact, and the level of port externalities which affect port surroundings (Hsu, 2012). Shipping liners select a port of call on the basis of port productivity. High productive ports attract larger volumes of vessels calling in port. Very long stays in port have a negative impact on port branding and the cost of running maritime transport. If the ship is delayed in port, shipping liners are forced to make up time by increasing vessel speed on their journey at sea, which increases emissions. When a vessel arrives at anchorage, it should become everyone's priority in the ports' system. According to Li et al., (2014), knowing the span of time associated with vessels calling at a particular port assists in prioritizing vessels over internal port politics. This span of time consists of ships arriving at anchorage, and ships departing from anchorage. This amount of time consists of waiting time, maneuvering time, berthing time, productive time, and idling time.

Changes in any of these times affect the overall vessel stay (ship turnaround time). Emphasis must be placed on waiting time and idling time on berthing as they have a great influence in a ship's stay. Improvements in cargo handling time will also reduce ship turnaround time. Inefficient cargo handling operations result in port congestions, customer complaints and unexpected incidents (Moon and Woo, 2014).

Unreliable hinterland connectivity and an inadequate transport system are bound to produce inefficiencies associated with slow cargo movements. These result in increases in the cost and reduction of service levels. The most highlighted challenge is that of port congestion. It is either congestion on anchorage, on berths, in the yard or during rail operation. Inefficiencies and port delays reduce operations' capacity resulting in capacity constraints and increased levels of customer dissatisfaction (Hsu, 2015). The inefficient utilization of port infrastructure impacts negatively on a country's economy. This is marine services' operational challenge; marine is not immune to such inefficiencies. Maritime operation directly affects the performance of a country's economy. Ease of port access also impacts on port congestion and delays in ships at berth. Rationalizing the transport system in ports and optimizing port terminal operation of loading and unloading of vessels have an impact on the economy. A holistic view of maritime operations, together with port operation, will give management a better understanding of the entire port operation (Lima et al., 2015). A use of agent-based simulation may provide a solution in minimizing traffic congestion at a port's entrance.

Container ports around the world form part of the container transport network connecting global markets. These terminals perform functions related to receiving of container vessels, storage of cargo, staging of containers, loading and unloading of vessels. Container terminals play a role of providing an interface between road, rail, and sea going vessels. Due to the complexity of marine services, it becomes a challenge to take a decision in the midst of dynamism. Decisions in the marine environment are uncertain and complex. Therefore, decision making becomes a complex task for managers in container terminal operations. Challenges are characterized by unpredictable activities related to ships, vessel arrivals, and difficulty in predicting the weather and swell, which all impact on operations. Management need to provide policies on decision making during times of turbulent operations. To support the decision making process in uncertain environment even

though it's not part of this research, Markov's model of decision making in an uncertain environment is proposed to optimize the decision making process (Rida, 2014).

Economic growth has triggered the transformation of the maritime industry, resulting in the growth in cargo flow between ports. The growth in cargo volume saw shipping industry players build much greater vessel sizes. The growth in vessel size saw a much greater challenge for ports around the world in that deeper berths are required, wider port channels become the necessity and investment on bigger tugs is inevitable (Sánchez and Perrotti, 2012). Álvarez-SanJaime et al. (2013a) support the notion that growth in vessel size is the most recent challenge for marine services and the maritime industry. Bigger vessels require high levels of ports' efficiencies, specifically marine services operational efficiencies as that are the biggest factor contributing to port-related costs (Gumede and Chasomeris, 2015). Costs are one of the highly considered elements in deciding which port to visit. There is big gap between the infrastructure and the growth in vessel size as a result of slow investments in ports. Now, some ports are becoming redundant as they are not in a position to handle new generation vessels. Figure 2.3 illustrates the evolution of ship size.

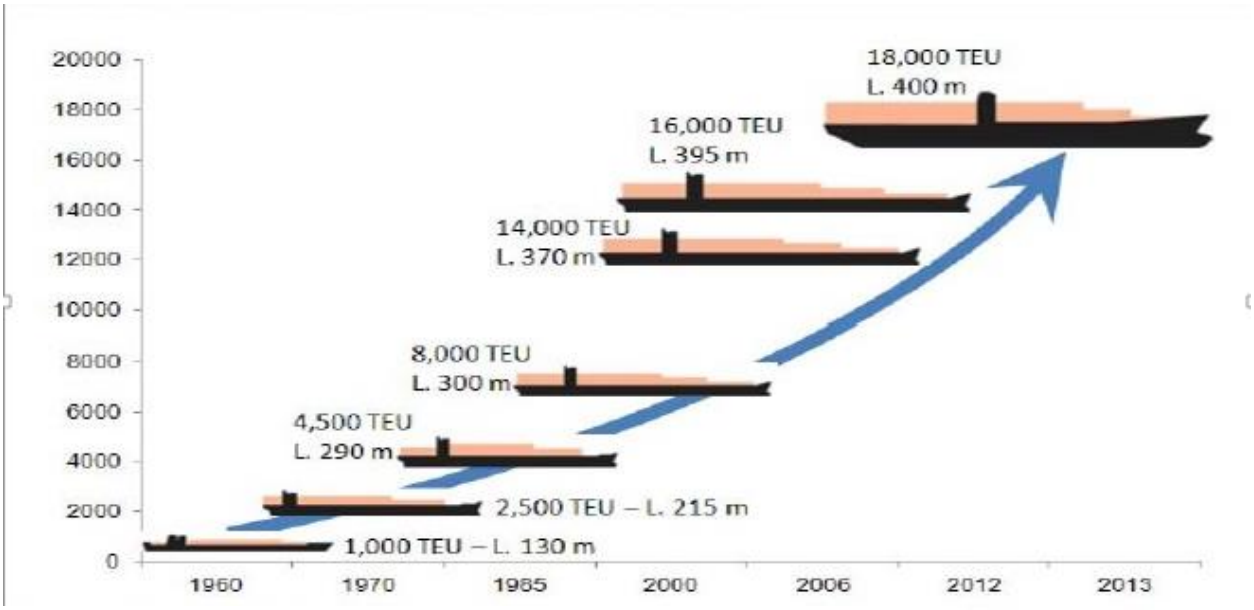

Figure 2.3 Ships' Evolution, Dutch Bank and Sector Data (2012:24)

The increase in ship size is triggered by the growth in economic activities between major global economies. The increase in freight flows is a critical component of economic activities between global markets. The increase in cargo flow has a direct relationship with economic growth of

countries. There is evidence that supports the notion that an increase in a country's activities indicates healthy economic conditions. It is important to view the port activities in terms of logistics management, linking waterside activities to that of the inland activities. Inland activities are highly supported by waterside operations in the form of marine services, terminal operations and network of rail and roads linking ports to inland depots. Marine services are the anchor of global supply chain, linking port activities to hinterland activities. Efficient handling of vessels becomes the key concept to be achieved in an endeavor to increase a country's economic activities. Cargo must move quickly from the port to the hinterland and vice versa to support local economic activities. A port's efficiencies present the opportunity to reduce the cost of supply chain logistics in a country. The overall efficiency of the total supply chain from hinterland to ports is what all supply chain players must strive to achieve. Marine services are critical in ensuring a reduction of the supply chain cost. This can be achieved through the application of skills and knowledge in the marine services' process (Bask et al., 2014).

Ports around the world are recognized as nodes in transportation and logistics network. Movements of containers around the world are a pivot in economic growth. Flow of cargo around the world creates competition between ports around the world. Creative and efficient marine services can be a competitive edge for the port. Such services include the latest marine technology, high levels of marine skills, and the latest port infrastructure. Attracting a large volume of vessels in ports is central to stay in business for the ports (Notteboom et al. 2013). The researcher believes that, for the port to attract ships, its marine services' operation efficiencies and effectiveness must match the level of the international benchmark. Port efficiencies are strongly supported by favorable geographic locations of the ports. The challenge is to consistently deliver an efficient marine service operation that entices current customers and attracts new vessels into the port.

The International Transport Forum (2013) elaborates on global consensus in which issues of economic benefits and potential value created by blue oceans economy are critical in creating jobs. The discussion pertains to maritime industry job creation through fishing, aquaculture, coastal and marine tourism as well as marine services and the shipbuilding sector. There is a great challenge in creating and sustaining employment, especially in a turbulent economic climate. The presence of global recession poses greater economic instability around the world, reducing employment opportunities for communities. This may also result in the decline in cargo movements around the

globe. Ships being decommissioned pose a challenge in sustaining higher levels of employment. Marine services around the world's port system is not immune to these global phenomena (van Wyk, 2015).

Maritime industry is the critical element of the world economy. The maritime sector supports all movements of cargo across seas, supporting other sectors of the economy with movement of cargo abroad. Imports and exports are channeled through port systems. Without ports, there will be no cheaper mode of transportation that links international markets. The manufacturing sector (automobile, and fast consumer goods' manufacturers), energy sector (energy generation and mining) rely on maritime services in their quest to transport products across borders. Marine services play a pivotal role in ensuring ship maneuvering through port channels, and that vessels are moored onto the wharf (Ng et al., 2014). They argue that marine services are the catalyst to a country's economic growth. The challenge is the management of marine services' equipment, infrastructure, and human capital as it proves to be of a complex task for operations management. As mentioned earlier, the uncertainty in decision making and changes associated with dynamism of activities remain the biggest challenge. Competition among international ports on the basis of port efficiencies in marine services have been growing over the years (Ng et al., 2014). The developments of inter-ports' competition have led to ports' specialization.

The global network of ports links all hub ports situated in the east, west, north and south bound. There are very few ports that are able to capture most market share. Most of those ports are hub ports in their region. The Durban harbor is the biggest global hub in southern Africa servicing many different destinations around the world. Hub ports are connected to measure global ports around the world. The need for hub ports to be in position to handing bigger vessel size is growing rapidly. Shipping liners strategize around hub ports in their attempts to consolidate cargo movement for better capacity management (Asgari et al., 2013). This phenomenon gives rise to more hub ports being developed. Competition between ports becomes a fundamental area for port management. Shipping liners are interested in port reliability, terminal handling charges, marine services efficiencies, port connectivity to the hinterland, physical and technical port infrastructure and geographic location of ports to be considered for vessel routes. Other factors include the number of berths and their availability, draft restrictions, access to the source of cargo and development geared towards the reduction in costs related to marine services. Full co-operation

between ports and liners become a key success factor for the region towards redirecting the flow of cargo to the port (Asgari et al., 2013).

The increase in freight flow revitalizes the economic system, either locally, regionally or globally. The flow of cargo is directly associated with the volumes of ships visiting the country. Marine activities act as a catalyst between the maritime economy and the land economy to make up a country's total supply chain. Globalization calls for the integration of the local business supply chain to that of the international market chain needing a multimodal transport system for the seamless flow of cargo. For the success of the global supply chain, the country requires an efficient port system, with marine services being the engine driver to the global supply chain determining the success or failure of the chain (Bask et al., 2014). Better efficiencies in the marine services impact on the total cost of marine transportation. There is a need for sophisticated skills and knowledge to support marine operation for the system to yield high service levels for stakeholders in the chain. Benefits could be either through on-time delivery of goods or cost related benefits.

Paulauskas and Paulauskas (2011) explore the topic of increasing the size of vessels. The writers argue that an increase in a ship's parameters requires more assistance from tugs to increase the ship's maneuverability as well as mooring and unmooring operations. Bigger vessels have been built in the past few decades while port infrastructures have stagnated. Ports entrance channels and water places, including berths, have not improved whilst industry has increased its vessels' size. The availability of suitable tugs plays a role in coupling both water and land operations. Tugs close the gap between the growing size of vessels and outdated port infrastructure with their ability to steer vessels through narrow ports channels, thereby saving and upholding marine services status (Moon and Woo, 2014). Remarkable progress has been made in the propulsion systems of tugs. Consequently, tugs are more flexible in maneuvering and require less space to maneuver. As part of marine services, navigational systems at ports assist marine equipment in navigating the port using real time kinematics. Availability of powerful tugs and intelligent work methods for mooring vessels are fundamental for marine services' operation. Nowadays, tugs are equipped with an azipod system of propulsion for push/pull maneuvers, assisting big vessels, especially, those with no bow thrusters. Traditional tugs were not as flexible as the new model of tugs. Marine services must keep up with new methods to ensure safety of navigation of vessels in ports. Ports are basic links of global trade (international supply chain) in the creation of sustainable international trade.

The new trend is that of ports housing manufacturers within the port area, thereby increasing a port's activities. This new trend creates jobs for communities around the major ports. Such a trend is supported by the type of port management policy relating to the occupation of port areas. Different ownership status exists in different ports. The most common status is that of state-owned ports. The policies guiding port ownership have an influence in the attraction of players inside the port boundaries (Lam, 2011).

Marine customer service levels are key drivers towards the attraction of customers and building royalty. In most countries, marine management faces the challenge of investment funding for infrastructural projects. The decision to invest is affected by risk and uncertainty. The researcher proposes the stochastic multi-criteria acceptance analysis to assist in facilitating the investment decision making process (García-Morales et al., 2015). The model assists in dealing with complexity associated with marine-related decisions. Simulation is proposed for assisting as an alternative support to the stochastic model.

2.5 Marine Service Infrastructure Investments

Sea transport is a major part of international cargo transportation mode. The world has seen rapid growth in cargo flow between countries in different continents. This is evident in ports in figure 01 which was presented in chapter one. Ports play the role of being cargo channels between international markets, supporting volume throughput and ensuring a seamless flow of cargo. To achieve this, the efficient and effective handling of ships is vital in support of the initiative aimed towards volume increase (Sánchez and Perrotti, 2012). The growth in port activities, doubling approximately every 6 years, necessitates the need for port expansions with projects required to meet the increase in demand of vessels visiting ports. Technological development and increase in ship size have delivered challenges to ageing ports' infrastructure. The increase in ship size demands infrastructure upgrades and port technological enhancement within port systems around the world. Due to the increasing volume of cargo onboard vessels, efficiencies are non-negotiable. Restrictions are likely to result in bottlenecks in delivering marine services within the port system. These restrictions include transport infrastructure, port infrastructure, delays in port reforms, institutional and reginal policy shortcomings. The gap between growth in ship size and that of port infrastructure upgrade has been blamed squarely on the lack of investment. Ports that have failed

to upgrade their infrastructure stand to lose the opportunity to handle cargo as bigger ships will not be able to enter ports with constrained channels (Pagano et al. 2013). The delay in bigger vessels to call in most developing countries' ports' systems is due to the above identified gap in infrastructure and that of technology required by these vessels. This gap has damaging implications for regional economy and competitiveness. The increased sizes of vessels necessitate huge investment into marine services' resources and infrastructure to accommodate such big vessels. It includes investment in quay wall upgrade, widening of port entry channels, deepening of berths and upgrade in ship handling equipment as well as required navigational technologies (Pagano et al., 2013).

According to Álvarez-SanJaime et al., (2013b), marine environment has seen growth in activities related to sea transportation and stevedoring functions associated with loading and unloading of ships. It is necessary to have a faster transit time of vessels, increase marine efficiencies, and increase the need for the total global supply chain. This necessity introduces complexity in marine services' operations as a result of increased variability associated with increased activities under restricted infrastructure, thereby increasing competition between ports and shipping liners. Port operations are divided into three sections, marine services, terminal operation and hinterland services of pulling cargo from the port to hinterland depots. Marine services must ensure that ships are navigated from anchorage to berths and from berths back to break waters for them to be sailing to their next destination. Terminal operations, on the other hand, must ensure that cargo is offloaded/ loaded onto the vessels and that temporal storage is provided for cargo discharged from the vessels and provide a buffer area as an interchange area between ships, haulers and wagons. Hinterland operations must be logistically suitable to be able to pull cargo from ports to the destination in the hinterland or inland storage areas (Álvarez-SanJaime et al., 2013a). The challenge is that of managing delay and congestions either on berths, at anchorage, storage yards or the countries' roads. Álvarez-SanJaime et al., (2013b) favor the privatization of marine services in ports. They argue that privatization of some operations will generate a source of funding for port developments. The argument suggests that with an increase in privatization, investment flow will match the growth in vessel size.

2.6 Marine Services' Safety

Safety awareness cultures to marine-related incidents have gained momentum in recent years. Safety of navigation is one of the most written about topics in maritime articles. The marine industry poses a history of incident occurrences, yet it remains under researched in areas of safety. Most marine services' incidents are attributed to crew onboard marine crafts (vessels and tugs). These incidents occur due to human error, as well as technical and mechanical failures. The Author highlights that the main problem is human fatigue resulting from long working hours associated with the industry. These incidents include vessel groundings, vessel collisions, tug/vessel collisions, and vessels or tugs colliding with port infrastructure. However, these incidents are not frequent in the port of Durban (Akhtar and Utne, 2014). Investigations on most grounding incidents around the world reveal that watch keepers either misjudge or fall asleep during vessel maneuvering operations. The topic of physical and cognitive fatigue is prominent in the marine industry. While physical fatigue is related to muscle failure, it causes a decline in the level of alertness on the marine crafts. This can be as a result of excessive workload, confined spaces found on marine equipment, or poor thermal conditions found in marine craft environment (Woo et al., 2012). Most marine employees work beyond the point at which they feel confident and comfortable to perform tasks efficiently.

In line with global trends, shipping companies are continuously building bigger ships for moving cargo around the world. Ships have not only become larger and faster but their increased carrying capacity impacts on different areas within the maritime space. With increase in speed and depth, narrow and shallow port channels increase the risk of vessels running aground. The most prominent risk is that of ships colliding with quay walls, ships running aground, and ships colliding with smaller vessels (Hsu, 2015). These incidents result in expensive losses (human casualty, port facility damage, cargo damage, and vessel damage). These damages have a potential of damaging a port's reputation on safety. Ship damage in ports may also lead to oil spills or dangerous cargo spills resulting in environmental pollution and other catastrophic incidents (Hsu, 2015). To prevent marine services' incident in ports, intensive training of marine crew is vital in topics related to vessel safety. The development of policies directed to the management of maritime incidents and in port vessel berthing is critical for sustainability of the industry. To zero down on the understanding of marine services incidents, Hsu proposes the fuzzy analytic hierarchy process model. The model consists of two weights, i.e., safety factor (SF) and frequency weight. Seven

dimensions are examined by the model. These include pilot skills/ experience, ship factors related to maneuverability, suitability of marine tugs to vessels calling, dock operation employees' attitude, port management policies with regards to vessel operation, operating staff healthiness and resting between shifts. One of the safety measures of ships in port is the availability of suitable tugs to provide assistance to vessels in port. Adequate skill, training and sufficient marine services' resources required to support vessels in port are fundamental. Sufficient training of pilots, tug master, marine engineers and general purpose ratings become the foundation for the maritime industry. Adequate marine skills and knowledge will ultimately prevent marine incidents (Murai et al., 2011).

The demand for marine skills is proportional to the growth in marine services' activities. The challenge is finding the right skilled personnel to support marine services. This is due to the turnaround time required for mariners to qualify. The duration required for marine engineers and tug masters is proven to be problematic (Bernacki, 2014). The growing trend is that of skilled marine employees crossing boarders to work in foreign countries due to different pay scales. Finding appropriate skill for marine operation is difficult as no skill is readily available for marine services. More research is required in the field of maritime to increase knowledge in the field.

The integration of global markets affects the port system directly and indirectly. The increase in marine activities increases the number of vessels calling at ports, and the risk also increases dramatically. Marine industry has become attractive when compared to other transportation modes due to the low cost of transporting cargo across countries. Different marine stakeholders have different interests on the marine process. These stakeholders include cargo owners, ship owners, stevedoring services, shipping liners, government organs, communities and municipalities surrounding the ports. This industry contributes immensely to a country's employment and in boosting the Gross Domestic Product index. Marine services is a determining element of economy activities in the country (Viederyt, 2014).

2.7 Summary of Literature

Global trade is fundamental to global economic growth; as such, global maritime transportation is the pivot to global trade. Developments in technologies, global practices, and business ventures in

global environment are unavoidable. Therefore, maritime industry must evolve in line with global trade to be able to sustain cargo volume flow (Valentine et al., 2013). The disproportionate flow of cargo around the globe requires sustainable and efficient maritime and marine services' operations so that the cost of shipping can be reduced. These operations involve ship time at sea, ship stay in port, which includes anchorage time, ship berthing time, cargo operations and ship un-berthing times. Efforts and investments must be made in reducing ships' circle times (Song and Parola, 2015). Akhtar and Utne (2014) emphasize the importance of understanding the time associated with vessels calling in ports, particularly ships arriving at anchorage, waiting time on anchorage, ships departing from anchorage, maneuver time, berthing time and cargo operation. The authors emphasize the reduction in idling time in between these operations to ensure seamless vessel operations. The study focuses on the challenges confronted within anchorage time, maneuvering time, berthing time and un-berthing time which are the core of marine services' operations. Pagano et al., (2013) focus on the gap between the infrastructure and the growth in vessel size, resulting in the ineffectiveness of the marine services. The investment in infrastructure becomes the priority if ports are to be efficient in supporting global trade. In the maritime industry, pollution is one of the biggest challenges. Efforts have to be made by the industry player to reduce the impact of vessels and ports activities to the environment (Psaraftis and Kontovas, 2011). One of the most important elements in maritime industry is that of skilled personnel to operate vessels, tugs and boats. The most prominent incidents in ports or open sea recorded by the maritime international community is that of vessels grounding, vessels colliding with other vessels, vessels colliding with port infrastructures. These accidents are caused by watch keepers, who either misjudgments or fall asleep during vessel maneuvering operations. Their misjudgment or sleepiness could be caused by fatigue or inadequate skills of employees in the marine industry (Panayides and Song, 2013).

2.8 Conclusion

Literature reveals the fact that with increase in global trade there is an increase in the flow of cargo through the port system that increases port activities. The scenario transforms to an increase in vessels calling into country ports. Competition between ports is inevitable as shipping liners direct vessel traffic to preferred efficient ports around the world. Efficiencies become the biggest element

in attracting global volume. As a result, ports' specialization becomes imperative within the marine service environment (Woxenius and Bergqvist, 2011).

The emerging trend in maritime transportation is that of increase in ports' activities calling for the need for bigger size shipments. As the flow of cargo increases, it necessitates bigger vessels to allow for the consolidation of cargo. Bigger vessels present challenges for ports in developing countries due to irregular investments in port infrastructure. Bigger vessels, like panamex and post-panamex, and new-panamex require wider entrance channels, deeper drafts, and bigger marine tugs in facilitating maneuverability of vessels inside the port area (Song 2012). With most ports struggling to receive funding to upgrade infrastructure projects, it is inevitable that some ports will become redundant as they will not be able to handle new generation vessels.

Availability of maritime training facilities and marine knowledge and expertise in a developing country is also an issue in sustaining marine operations to improve the blue ocean economy. The absence of required knowledge and expertise forces the industry to import skill from other developed countries resulting in an increase in the social downgrade in developing countries due to higher levels of unemployment. The maritime industry's shortage of expertise gives rise to longer working hours for those that work in the industry. Shortage of skills leads to fatigue, which ultimately lead to marine incidents due to employees' lack of concentration. Greater access to hinterland and source of cargo are the major contributors to increase port activities (Gumede and Chasomeris, 2015). The following chapter discusses the marine services theoretical framework applicable to the study.

CHAPTER THREE: MARINE SERVICES' THEORETICAL FRAMEWORK

3.1 Introduction

Chapter three presents a thematical perspective of systems theories, methodologies, methods, and models to gain an understanding of different systems available in the field. The presentation of systems theories is also to gain technical knowledge and understand their applicability in different settings. The general definition of systems thinking is important to be discussed as a point of departure in implementing systems thinking in this study. The chapter begins with theory of systems, capturing different types of systems available in the area of systems thinking and practices. Comparisons of hard versus soft systems thinking approaches are presented as a discussion. Systems paradigm is discussed with a view to gain an understanding of the influence and perspective of different systems available. The chapter continues to elaborate on soft systems methodology concepts involved in the systems approach. Critique of soft system methodology and detailed discussion of rich pictures are part of the chapter as well as discussion of systems dynamics and its criticism. The chapter concludes with a conceptual framework of marine services. In the conceptual framework, the researcher employs a systems thinking approach to understand marine services operational challenges.

3.2 Theory of Systems

Holwell, (2000) regards the systems approach as a means of viewing a problem situation holistically as opposed to the reductionists approach. Systems thinking differentiates itself by employing a holistic approach to view a system; through studying the whole system as a way to understanding its component parts (Jayaratna, 2000). This is in reaction to "reductionist" thinking which attempts to understand an entity by studying its parts. According to Checkland, (1994) the philosophical basis for systems thinking was coined by Greek philosophers, such as Plato, who observed that a ship is steered in the same way as the state. The first two systems approaches emerged in the early 1940s (general systems theory and cybernetics). General systems theory emphasis is on open system and emboldens the importance of understanding system interaction with its environment (Flood, 1995). Later cybernetics was introduced as the science of communication and control in animals and machines. The focus of cybernetics is in the control

process, which requires a system with a goal orientation as well as negative feedback loops (Jackson, 2006). Cybernetics emphasizes the need for communication since information needs to be transferred between the systems and its controller. The concept of variety was also introduced by Ashby in 1956, presenting the law of variety which states that, the controller must have some degree of variety as the controlled system in order to be able to control it (Jackson, 2006). During the time of World War II, operational research was introduced to improve the performance of the military operations, on the bases of mathematical techniques. Operational research was subsequently utilized in organizational processes as a means of improving the performance of the process (Denning, 1994). Subsequently, in the 1950s systems engineering was introduced as a toolkit to assisting in the lifecycle of a designed system. Later in 1970-1980s a number of systems were introduced to deal with modern era problems (Denning, 1994). Systems that were able to deal with greater complexity and change by looking at the relationships that impacts on the system, investigating the structures that give rise to the behavior of the system, these are fundamental to systems behavior (Jackson, 2006).

Systems Dynamics introduced by J. Forrester in 1969 were aimed at studying the relationships between positive and negative feedback loops that give rise to architypes of the system behavior (Jackson, 2006). In the case of organizational cybernetic as discussed earlier, Beer (1979) contributed cybernetics laws for the system to be more effective in improving organizational design (Vidgen, 1998). Complexity theory was introduced presenting strange attractors that have to be adjusted to ensure the edge of chaos state is achieved. Gleick, (1987) who popularized complexity theory argued that 20th century science will be remembered for three things; relativity, quantum mechanics and chaos (Denning, 1994). According to Jackson, (2006) what relativity, quantum mechanics and chaos have in common is a revolutionary transformation in the nature of modern science. Ackoff (1974) introduced soft systems approach by looking at the softer side paradigm of problem situation. according to Holwell, (2000), Checkland also introduced social systems design as a system underpinning investigation of complex social problems. Soft systems approach addresses pluralism by introducing the platform for ensuring sufficient accommodation between differing and conflicting views to be addressed (Gerwel Proches and Bodhanya, 2015). Soft systems methodologies support a systemic learning process in which participants in the problem situation can appreciate alternative views and find common solutions (Jackson, 2006). In 1983 Ulrich formulated emancipatory systems approach to help with interventions in problem

situations associated with coerciveness, since decisions on the system are likely to be taken on the basis of greater power (Jackson, 2006). Ulrich further presented systems heuristic to assist with questions to be asked about the balance of benefits to empower those who are affected by decisions. An introduction of team syntegrity allowed for a platform of open and democraticallized debate. Taket and White (1997) advocated postmodern practice and methods, their contribution helped in addressing complexity and coercion. Evolution in systems approach is aimed at addressing complexity that is presented by modern era problem situations. Understanding systems as a complex whole, the function of which depends on its parts and interactions of parts help managers to choose correct methodologies in tackling complex problems arising from these systems (Gerwel Proches and Bodhanya, 2015). These are systems of different types, including physical systems, biological systems, designed systems, social systems as well as human activity systems. Following is a discussion of hard versus soft systems.

3.2.1 Hard Versus Soft Systems

According to Holwell, (2000) hard systems are characterized by clearly defined processes and structures which could be readily quantified. Hard systems apply to man-made and physical systems such as operational research, systems analysis and systems engineering to name a few. Hard systems seek to optimize the performance of the system, pursuing clearly defined goals. Hard systems emphasize the application of systemic methodologies based on established goals and objectives. Such hard systems are able to pin point problems that hinder optimization and rectifies them through the employment of scientific models, rational testing, implementation and evaluation of processes. This was a breakthrough in applying systems in real life problems. However, these systems lack the ability to handle complexity, cope with plurality and deal with issues of politics and power (Jackson, 2000). Other hard systems include decision science, cost benefit analysis, planning-programing -budgeting systems and policy analysis to name the few. Today managers are confronted with environments that are complex, turbulent and more often subject to change, making the process of modeling difficult as reductionist become impossible. Hard systems face difficulty in dealing with multiple perceptions as different stakeholders have diverse opinions, interests and beliefs about the systems they are involved in (Gerwel Proches and Bodhanya, 2015).

Soft systems on the other hand deal with ill-defined, fuzzy and difficult phenomena to quantify. Soft systems largely concern human and social activities. These systems try to deal with divergent views of various stakeholders about the definition of the problem situation within the system. Such is achieved through discussions and exploration of those divergent views in a series of interactive learning loops. The decision makers arrived at a number of feasible changes to accommodate different stakeholder's views. Soft systems make it possible to arrive at a consensus amongst all stakeholders about the desired solution (Green, 2013). These systems assume a diverse number of customers with multiple expectations from the system and apply action learning methods to find optimal solution.

3.2.2 Critical Paradigm and Holism

A paradigm is a set of ideas, a perspective of looking at a phenomenon, and a new way of viewing the world. These paradigms provide us with a way of seeing developments in applied systems thinking (Saleh et al., 2015). Holism and reductionist are paradigms to be discussed for the purpose of this study. Holism as a paradigm is required in our society as complexity, change and diversity increases. Solutions are becoming inadequate to deal with present complexity. Simple solutions to complex problems become ineffective in the absence of holism. Simple solutions focus only on parts of the problem rather than the whole, but it fails to account for the interactions in between the parts. There is no one solution that fits all circumstances. Holism is a transdisciplinary paradigm which gives attention to both structures and processes (Jackson, 2006). Holism enables the researcher to link theory and practice in a learning cycle. System thinking is holistic rather than reductionist. Holism is a paradigm of learning. Reductionist paradigm is traditionally scientific methods, hard systems methodologies and a paradigm of optimization. Hard systems methodologies are still efficient in dealing with a particular range of problem situations. Jackson (2006) emphasizes challenges that are faced by managers to be complex as society continues to be complex adaptive systems, turbulent and heterogeneous. He states that problem situations arising now prove to be difficult for reductionist as a paradigm. Responding to problems of modern era require holism paradigm. Advancement in systems thinking presented systems thinkers with a whole set of new approaches, methodologies to deal with complex problems. Understanding the strengths and weaknesses of these systems as discussed in the previous section is critical for

managers and consultants (Lawton, 2005). Table 3.1 below presents systems and paradigm underpinning them.

Systems	**Paradigm**
Hard systems (operational research, Systems Analysis and Systems engineering)	Functionalist and positivist paradigm
Systems Dynamics, Organizational cybernetics, complexity theory	Functionalist and structuralism paradigm
Soft system methodology	Interpretivist paradigm
Emancipatory and postmodern systems approach	Emancipatory and postmodern sociology paradigm

Table 3.1: Systems Paradigm (Source: Jackson, 2006:652)

Holism is in favor of the soft systems paradigm, more interpretive position; the reality is viewed as a product of cognition. However, reductionist paradigm is positioned from hard systems perspective, observable hard concrete facts, and man-made systems. The researcher embarked on employing a holism paradigm to gain an understanding of the systems underlying structures that give rise to systems behaviors (Brocklesby and Cummings, 1995).

3.3 Complexity Theory

Recent development is systems thinking presented systems thinkers with chaos and complexity theory developed by Edward Lorenz while working on problem of long range weather forecast using simple computer simulation. Lorenz discovered that tiny changes in the complex system's initial state change the behavior of the system significantly in the long-term. The study of chaos and complexity is having a profound impact on thinking about management issues (Jackson, 2000). Chaos and complexity theory emphasizes erraticism and discontinuity to recognize complexity presence in systems. Complexity theory focuses attention on those aspects of organizational life that borders management all the time – disorder, irregularity and randomness. Complexity theory recognizes and appreciates instability, change and unpredictability while offering advice on how to act under these conditions (Denning, 1994). Complexity theory is presented as being applicable

to behavior over-time of complex social as well as natural systems. Critical to understanding is that social systems are not just complex adaptive systems bound by fixed rules of interaction of their parts but; they are complex evolving and adaptive systems lead to new applications constantly being found for chaos and complexity theory (Jackson, 2000). Complexity theory suggests systems and environment changes in response to one another and evolves together. Key theories to be noted in chaos and complexity theory are; sensitive dependences on initial conditions, strange attractors, self – similarity, self – organizing, the edge of chaos and fitness landscape. Complexity theory requires a mind shift from managers if they want to secure business success (Jackson, 2000).

- Managers have to accept that the long-term future of their organization is inherently unknowable.
- Long term planning is impossible.
- Managers are to accept and delight in chaos.

The above mind shift is critically imperative for managers as organization and their environment are characterized by feedback loops, which make them sensitive to small differences in initial conditions and their feedbacks are unpredictable (Forrester, 1969). It is to be noted that long term planning, rigid structures and precise task definition are dangerous as they can fix the organization on the pursuit of one's vision when uncertain world requires flexibility. Lastly, the absence of strict hierarchy and tight controls does not necessary mean things are going to fall apart (Jackson, 2006). Continuous transformation and emergent order is a natural state of systems affair. There are three stages in applying complex theory.

Stage One: understanding the attractor pattern that determines the current behavior of the organization and the reason for dominance. If patterns are perceived not to be desirable for organization, change must be introduced in order to achieve the system shift to another pattern. The change introduction is the work of Stage Two. Stage Three constitutes system stabilizing efforts to ensure new attractor pattern are implemented. Managers must be careful that new patterns do not lock the entity in routine forms of action (Mingers and Rosenhead, 2004). Complexity theory framework is employed for the purpose of this study. The principle of feedback loops are recognized by chaos and complexity theory, it is from these basis that complexity theory will be combined with systems dynamics to understand marine services. Systems dynamics positive and negative feedback loops are employed to understand the structures and behavior of

marine services. Acknowledging the social systems within marine services soft systems methodology is also employed to deal with soft systems of the problem situation through deployment of soft systems methodology tools and techniques (Jackson, 2006). Systems thinking approach employing interdisciplinary methods in a complimentary manner to understand marine services operational challenges.

3.4 Soft System Methodology

Modern problems are complex and are characterized by the existence of multiple actors, multiple perspectives, conflicting interest as well as key uncertainties. Framing and defining issues constituting these problems structure can be cumbersome (Mingers and Rosenhead, 2004). Peter Checkland the founder of soft systems methodology looked for assistance in the literature of management science which at the time was dominated by hard systems thinking, the author was disappointed by irrelevancy of the current available systems to his job. Soon after joining the Systems Department in the UK department of systems engineering established at Lancaster University, he began to research from which soft systems methodology (SSM) was born (Checkland, 1994).

SSM is a methodology providing a platform for employment of methods that help unpack ill-structured problem situations, most importantly where relationship management is as important as goal seeking. Hard systems approach could not deal with greater complexity and ambiguity of managerial problems as opposed to the engineering context (Jackson, 2000). Soft systems methodology emerged to close the gap of which hard systems thinking had become inadequate to deal with. SSM offers a different perspective to hard systems thinking, it confronts soft problems by ensuring the analysis phase is not pursued in systems way. SSM recognizes the gap in using systems early which can lead to distortion of the problem situation and jumping to conclusion prematurely (Khisty, 1995).

Checkland's soft systems build rich pictures of the problem rather than capturing it in the systems model. Soft systems methodology defines range of systems relevant to the context of the problem situation to improve them; this is done during root definition stage of the SSM but built up more in the conceptual model. Soft systems methodology affords an opportunity to construct a number

of models and compare them to the real world, contrast to hard systems approach which uses one method. Soft systems methodology represents human activities system and this is one of the breakthroughs in the development of the SSM. The methodology recognizes the fact that human activities system models are a contribution to a debate about change. While participants engage in the debate about the change they learning their way to what change are systematically, desirable and culturally feasible.

Soft systems methodology is a seven stage cyclic learning process. The SSM cycle begins when an individuals or group of individuals feel uneasiness which leads to identification of the problem situation that needs attention (Gerwel Proches and Bodhanya, 2015). The second stage of SSM problem situation is expressed in the form of rich picture. The idea is to locate a creative understanding of the problem. Rich picture is one of the successful and mostly used tools that are associated with soft systems methodology (Wang et al., 2015). In stage three human activity systems are selected to provide insight into the problem situation in which root definitions are built. At this stage of the soft systems methodology CATWOE can be employed.

- **C**-Customers: the beneficiaries of the transformation process.
- **A**-Actors: those who are responsible of undertaking the transformation process.
- **T**-Transformation process: The conversion of input to service rendered.
- **W**-World view: world view that make this transformation process meaningful
- **O**-Owners: those that have authority to stop the process of transformation
- **E**-Environmental constrains: element outside that have influence to how system performs.

After the entire actors have been identified and the impact they have on the system as well as environmental issues, participant moves on to stage four. At this stage the conceptual model is constructed on the basis of the root definition. These are key artifacts in the soft systems methodology. Proceeding to stage five of the conceptual model is then compared to the real world serving as a means to provoke debate about possible changes in the system. In stage six participants begin to converge towards agreement about the required change. When agreement has been reached, actions can be taken to resolve the systems problem (Checkland and Haynes, 1994). It must be noted that the revised version of the soft systems methodology is a successor of the first version. This revised version is sophisticated and allows for flexibility in view of the process

bringing together two points of enquiry- culture base and logical based enquiry. The version two of SSM famously known as two strands version was as a result of the original seven stage (Jackson, 2006). Soft systems still remain as a methodology and a learning system. Soft systems have a capability of being implemented in general problem solving process as well as in management of change. The principles of SSM will be utilized in the development of this study's framework. The use of CATWOE remains an interesting and vastly utilized problem analysis. Of equal importance to the study is understanding the critiques of soft systems methodology.

3.4.1 Critique of Soft Systems Methodology

Although soft systems methodology is widely applicable and extensively being employed in real world problems, there are elements of critic directed to it (Mingers, 2000). Criticism of the SSM spread from the system's ability to be applied in different circumstances to the methodological character itself. Jackson, (2000) describes soft systems methodology as having limited domain of application and sight the failure to identify such. There is a high level of criticism levelled at soft systems methodology for being unable to deal with problems where organizational design complexity is required. According to Mingers and White (2010) soft system methodology have a limited perspective on why problems have occurred.

The major shortfall of soft systems methodology is that of the methodology being unable to cater for open and meaningful debate due to it blindness to the issue of power, coercion and conflicted interest. Soft systems methodology lacks character to deal with power issues and the meaning in which the debate are distorted by presence of power influence in the debate setting. Soft systems methodology does not take serious the critical issue of cybernetics laws, these are highly important in the design of the complex systems (Flood, 1990). Soft systems methodology emphasizes participation but fails to offer ground rules for what is to count as genuine participation. The following paragraph discusses rich pictures which are used as a tool of SSM.

3.4.2 Rich Pictures

Rich pictures was particularly developed as part of Peter Checkland's soft systems methodology mainly for gathering information about a complex problem situation (Checkland and Haynes,

1994). Rich pictures are drawings that allow various features of the problem situation to be displayed. The rich picture technique assist participants in clarifying the stakeholders, actors, customers, interaction and flow of activities embedded in complex problem situation, a process of setting down a pictorial picture for all to see (Checkland and Haynes, 1994). Fundamental to the rich picture is the absence of rules as other pictures can be formal while others are cartoons in nature. Rich picture helps in creating and expressing problem situations better in nonlinear systems (Green, 2013). It is a way of sharing information to trigger debate amongst participants.

The idea of using drawings, symbols and picture in problem solving process have become common because our intuitive consciousness communicate more easily in impression and symbol (Visualization). Rich pictures are drawn as pre-analysis of the problem situation, they are an aid to encapsulate real situations through employment of cartoons, symbols and pictures. They are a process of depicting structure, processes, issues and their connectedness, an aid to present organizational climate. According to Green (2013) rich pictures show a more detailed analysis of the messy problem while serving as an excellent memory aid. For the purpose of understanding the complexity of marine services operation, rich pictures were employed for the purpose of reducing complexity in the process (Gerwel Proches and Bodhanya, 2015).

3.5 Systems Dynamics

Systems dynamics combines the theory, methods and philosophy needed to analyze the behavior of the system in different disciplines. Systems dynamics provide a common foundation that can be applied wherever we want to understand and influence how things change overtime. Systems dynamics was developed by Jay W. Forrester at MIT in the 1960s as a tool for modeling the dynamic behavior of the system (Mingers and White, 2010). The author argues that the behavior of the system at different levels result from underlying structures of flows, delays, information and feedback relations (Wang et al., 2015). Jay W. Forrester's approach was to model the relationships between various systems components, express these as different equations and then run the model as a computer simulation.

Through the work of Senge, systems dynamics is now known for its character of being a tool for learning organizations. Systems dynamics provides concepts for understanding complex systems behavior through studying underlying structures that give rise to systems behavior patterns. At its

core systems dynamics concerns the result of the interplay between two forms of feedback loops. Positive or reinforcing loops that leads to continual growth or decay and negative loops also known as balancing loops which leads to stability in the system (Fei and Meng, 2006). These loops and patterns of behaviors can be found in any system hence systems dynamics stood the test of time. Systems dynamics mainly have two stages in its process as indicated below;

- *Identify and map the causal loops and*
- *Quantify and build computer model.*

Recent development in the systems dynamics is that of generic structures and architypes (Lane & Lubatkin, 1998). Development of architype was an effort to link systems dynamics to the other discipline. Senge (1990) presented systems architypes which often explains organizational problems. These systems architypes include success to the successful, fix that which fails, shifting the burden, balancing process with delays, accidental adversaries, eroding goals, escalations, tragedy of the commons and lastly growth and underinvestment. For the purpose of this study work will stop at first stage of systems dynamics; identifying and mapping causal loops.

The theory of systems dynamic highlights four key things (Senge, 1990);

1. Most difficulties are internally caused, even though there is an overwhelming and misleading tendency to blame trouble on the outside forces.
2. The actions that member of the organization take usually in the belief that the actions are solution to the difficulties, most often they are the cause of problems being experienced.
3. The nature of dynamic feedback structure of the social system tends to mislead organizational members into taking ineffective and counterproductive actions.
4. People are sufficiently clear and correct about the reasons for local decision making, they know what information is available and how that inform is used in decision making process but people often do not understand correctly what overall behavior will result from the complex interconnections of known local actions.

According to Wang et al. (2015) it is important for managers to understand the feedback loops and systems architypes to easily identify the problem and actions to be taken directed to leverage points.

3.5.1 Causal Loop Diagrams

Systems thinking and systems dynamics have long been used as a powerful approach to explore critical sustainability question and tackling of big issues (Broks, 2016). Most critical feedback structures and envisaged solutions to tackle limits to growth date back to the 1970s are still applicable today. System dynamics uses modelling and simulation for improving human judgement and decision making process (Forrester, 1995). In doing so, it relies on specific concepts and diagramming language. Causal loop diagrams are one of them (Laurenti et al., 2016). A typical causal loop diagram consist of a set of symbols representing a dynamic systems causal structure, variables causal links with a polarity and symbols that identify feedback loops with their polarity. Delays are also indicated in the causal loop diagrams. Causal loop diagram is a visual representation of a problem that specifies what process is hypothesed to give rise to problematic behavior in a system (Lounsbury et al., 2014).

Causal loop diagrams give a broad representation of feedback structure of the system (Schaffernicht, 2010). The tool uses simple elements such as variables names, arrows representing causal links between two or more variables. The links maybe marked as positive or negative depending if the variables change in the same direction or opposite direction. If the variable changes in the same direction it is denoted with a positive (+) sign it is said to be reinforcing but if it is changing in the opposite direction it is denoted with a negative (-) sign, it is referred to as balancing loop (Lounsbury et al. 2014). Balancing loop is a loop in which all the variables act to counteract change. These variables bring the system back to a status quo. Reinforcing loops are loops in which all variables amplify the directional change by prompting either growth or decay (Lounsbury et al., 2014). Collaboration to develop causal loop diagrams begins with participants being grouped together in a specific number. Problem variables are listed, adding causes and consequences and then identifying feedback loops linking consequences and causes (Atwater and Pittman, 2006).

3.5.1.1 System Behavior

The method of systems thinking provides us with a better understanding of difficult management problems. Systems thinking allow us to move from events oriented thinking about the problem to gain focus on the systems structures improving possibilities of improving the business

performance (Walworth et al., 2016). Systems structure is often the underlying source of problems. Until the structure is corrected, it is likely that the problem will persist. Systems structure produces systems behavioral patterns. To understand systems behavior, variables of interest change overtime must be studied. The variables include cost, revenue, sales, profits, market share movements, etc. To understand systems behavior over time, it is important to study the structures of the system that produce patterns behavior (Cavana et al., 2007). Altering the systems structure changes the systems behaviors. There are four patterns of behaviors identified in the system, exponential growth behavior, goal-seeking behavior, S-shape growth behavior and oscillation behavior (Fei and Meng, 2006).

3.5.2 Critique of Systems Dynamics

The strengths of systems dynamics lies in the claims that suggest structure is the main determinant of the systems behavior and that structures can be described in terms of the relationship between positive and negative feedback loops (Jackson, 2006). If the claim is true, systems dynamics becomes a unifying interdisciplinary framework capable of seeing beyond the surface detail presented by other disciplines on the deeper patterns generating behaviors. However, there are criticisms leveled against systems dynamics as systems. Systems dynamics is criticized as a system that jumps into building models without proper homework being completed. Systems dynamics is criticized for reducing management science to a limited number of mathematical models. Systems dynamics is criticized for failing to predict the future system state rendering the system inadequate for decision making process (Lawton, 2005). One of the major shortfalls of system dynamics is that of it being unable to capture negotiation and renegotiation of meanings as social structures emerge through the process of negotiation. Systems dynamics misses the point when it tries to study social systems objectively from the outside, grasping the complexity of social reality using models built and feedback process is impossible. The system is being criticized for being a perpetrator of simplification and it fails to recognize issues of coercion and power struggles in it models (Jackson, 2006). The systems dynamics overlooks issues of mental modes and learning as being essential as it is too functionalist in nature. The issue of fairness, exploration, and diversity is not being taken serious by systems dynamics practitioners. System dynamics offers better prospects for managing complexity in the system than hard systems. System dynamics have

limitations in competently being applied to modern problems of the modern era. Due to its robustness, systems dynamic is employed in the study but combined with other systems approach in a creative manner to produce analysis of marine services operational challenges within the port of Durban. Of importance to the study is the mixing of systems methodologies and the complementarity thereof.

3.6 Complementarity

The previously exclusive utilized hard systems approach was suitable for handling certain type of problems, but have limitations when faced with complex problems situation involving multi-variables and conflict of interest (Ulrich, 1987). Systems thinking responded with systems approach that is able to cope with complexity and change. The earlier developed systems are systems dynamics, organizational cybernetics, and complexity theory, followed by introduction of interactive planning, soft systems methodology, and strategic assumption surfacing and testing to deal with pluralism. Later the introduction of critical systems heuristics and team syntegrity to empower the disadvantaged in the situation involving conflict (Jackson, 2001). Critical systems thinking also call critical management science is an approach that employs both hard and soft systems coherently (Jackson, 2001). The approach allows management to deal with both quantitative and qualitative aspects of complex problem situations. The approach employs multi-methodology approach in addressing problem at different phases of the interventions (Mingers, 2000).

The approach offers managers opportunity to use different methods as necessary in an informed and effective fashion. Multi-methodology provides bigger picture, allowing systems thinkers to employ transdisciplinary approaches to complex problem situation. The approach affords managers an opportunity to use variety of methodologies, methods and models in a coherent manner. Flood (1995) presents total systems intervention (TSI) as a solution of combining variety of systems in a complimentary way to address problem situation. The use of multi-methodology brings about increase competency in a variety of problems situation. Combining hard systems, cybernetics and soft systems in a complimentary manner increase probability of permanently resolving problems (Mingers, 2000). The approach to total systems intervention is that of creativity, choice and implementation. At creative stage, key aspect of the problem situation are

revealed through collaboration between stakeholders (Clemson, 1995). Choice stage, the suitable intervention strategies are developed around the choice of systems methodologies available. Multi-methodologies are combined in a complimentary manner taking careful consideration of their strengths and weaknesses (Clemson, 1995). At implementation stage, selected systems methodologies are implemented with a view to bring about change. To understand marine services operational challenges complexity theory, systems dynamics and soft systems methodologies was implemented in a complimentary fashion to address study objective.

3.7 Marine Services Theoretical Framework

Business success or failure is the outcome of the complex interaction between firms and the environment in which the business operates. In this environment, operational challenges continue to evolve in a more dynamic fashion. As a result of the complex interaction over time, a pattern begins to emerge due to the interaction between systems of different organizations acting in the industry (Cheng et al., 2012). Complex interactions between the organization's systems may change the structure of that particular industry. What has been noted is that most system tools tend to employ simple linear interactions without the feedback loop. As such, these tools tend to overlook the complexity of the system. The predictive value of the system is also lacking (Bohórquez Arévalo and Espinosa, 2015).

3.7.1 Applying Complexity Theory

In studying marine operational challenges, the researcher employs the systems thinking approach. Tsiotas and Polyzos (2015) believe systems approach afford the researcher a holistic view of the system. Systems thinking presents the capability to understand the complexity of systems (Clemson, 1995). Complexity tools such as complexity theory, systems dynamic as well as soft systems methodology have capabilities to conceptualize and predict the complexity of the system (Gajic et al., 2015). Although systems like the complexity theory was initially created to deal with problems in the physical and biological science, over time they have been applied to economics and management science. Complexity theory, systems dynamic and soft systems methodology are characterized by their nonlinear capability and their ability to predict complex interactions that

tend to evolve over time (Joy et al., 2015). Being in touch with complexity of the firms' structural operational challenges and the firms' environment is fundamental to the management of the organization. This is seen as having the advantage or occupying a vantage point over the organizational challenge. Organizational managers should position themselves at their vantage point. Complexity theory affords management with insight to organizational challenges within the environment. It is in this respect that marine services should seek to respond to their complex operational and environmental changes. Complexity theory will assist in understanding how systems can be adopted effectively, spontaneously and in a self-organized way with the environment (von Elverfeldt et al., 2016).

To further understand complexity theory, Mingers and White (2010) consider complexity theory as being the study of a complex, nonlinear, dynamic system with feedback effect (Bartolucci and Gallo, 2015). Complexity is the combination of both chaos and network theories. Chaos theory is the study of randomness and subtle patterns, while network theory relates to nodes. The state of nodes is the function of their connections to other nodes (Burnell, 2016). Marine services can be demonstrated as possessing the capability of being a complex system of human capital interacting with equipment and the environmental system. To further understand marine operational challenges, elements of the complexity theory will be employed in combination with soft systems methodology. By applying the chaos theory in the marine services' operational systems, the turbulent and dynamism of the system can be further understood. With the lenses of complex theory, it can be understood that small variations in initial strategies are magnified every time an alteration in the system is being introduced. This is evidenced in the case of the maritime industry. A tiny change in economic growth has a great impact in the flow of cargo across continents, and such a change greatly affects marine services. A combination of divergence and repetition of interactions produces chaotic behaviors, which are evidenced in the marine services' department. This phenomenon creates difficulty in predicting the future (von Elverfeldt et al., 2016).

The assistance of computers and simulation techniques are required to understand the structures of such problems. The dynamism of marine services' operation brings to life randomness in the outcome of similar decisions. Different variables embedded in the marine services' system render the marine system dynamic and turbulent. In such systems, conditions are not repeated at the same location, yet predicting tools can be used (Simpson and Simpson, 2011). Chaotic systems are well

known for being sudden and dramatic in nature. The decision of the shipping liners of where to sail the ship is dependent on a number of variables including efficiencies, cost, infrastructure, geographic location, weather conditions, political environment, etc. It is evident that the linear system cannot be sufficiently implemented to deal with marine services' operational challenges as it has proved itself as being a complex adaptive system. Marine systems are complex and dynamic requiring the system thinking approach to understand the structure of the problem situation. Subsystems within the maritime are self-organizing in nature (von Elverfeldt et al., 2016). There is a forum of co-ordination in the marine subsystems. Change in one section affects the other sections across the marine systems. A small change in one section of the industry has a much greater impact on the other sections. This can be seen at play in the port system. When the economic system slows down, the number and the size of vessels within the maritime systems are negatively impacted resulting in marine operational changes.

3.7.2 Applying Soft Systems Methodology

Having understood marine services' challenges from the complexity theory perspective, the study will further investigate the structure of problem situations, and the soft systems methodology to be employed. According to Caws (2015) soft systems methodology is a learning and meaning development tool born out of shortcomings of the hard systems thinking in managing complexity and pluralism of problem situations. The soft systems methodology (SSM) is an approach employed to deal with problem situations characterized with multiple goals (Clarke, 2001). SSM is a tool created with a view to compare the conceptual world to that of the real world. Soft systems methodology enables ill-structured problem situations where relationships maintenance is as important as goal seeking. Fei and Meng, (2006) argue that using systems prematurely may lead to distortion of the problem situation and result in premature conclusions. The author further proposes the seven stage approach in dealing with such problem situations, as defined above. To understand marine services' operational challenges, the soft systems methodology is implemented. Firstly, the problem will be defined to understand what is being investigated. The next stage will be to draw a rich picture to further illustrate the structure and the network of the problems. A root definition will also be illustrated and a conceptual model produced for further understanding the cause and effect of the problem situation.

The researcher looks at the real world with the view to acknowledge, explore, and define marine operation issues. The literature confirms growth in cargo flow between countries as being the input to the challenges of the marine services' experience. The growth across border trade results in the growth in vessel size which renders port infrastructure inadequate. To close the gap between vessels' size and outdated port infrastructure, huge investments are compulsory. The lack of such investments leads to port inefficiencies, congestion on anchorage, and pollution, caused by the high concentration of vessels in one area. This phenomenon is expressed in the rich picture in figure 04 to acquire the richness of the problem situation.

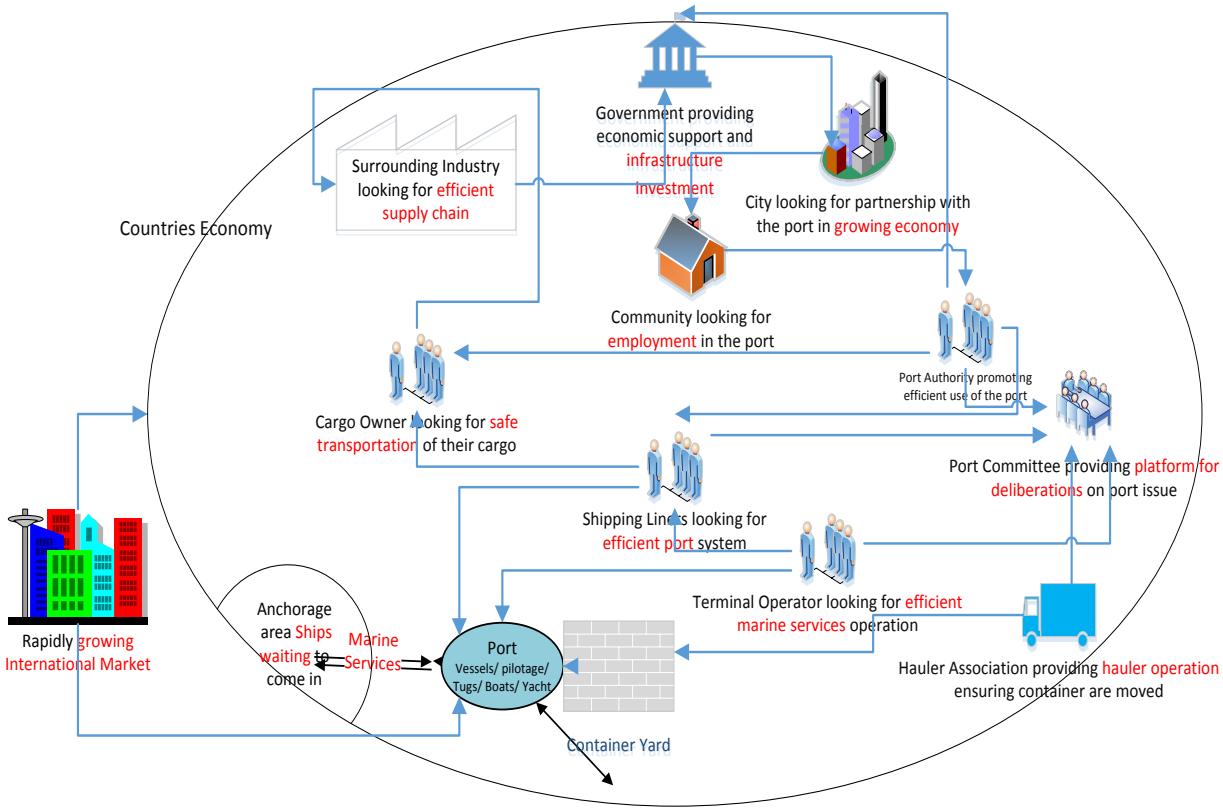

Figure 3.1 Rich Picture of the problem (Source: Own)

The rich picture in figure 3.1 above illustrates the complexity of the relationship between various stakeholders, interactions of systems, flow of information between participants. The interactions between port authority, the city, community and government give rise to conflicting interest

between stakeholders. The community expect employment from the industry, government expect dividends as Transnet is a sate own enterprise. The city wants ports to play by city rules yet generate activity for the city. The shipping industry requires port efficiencies and investment in infrastructure for the port to be able to handle bigger vessels. Haulers expect faster turnaround time in the terminal for their trucks. The port is expected to comply with international standards which are developed by international marine organizations. The ports operate in the economic conditions that keep fluctuating presenting turbulent environment for ports to operate. It is evident that there are interconnectedness of various systems rendering this process complex.

The researcher embarks on the root definition in order to identify customer, actors, transformation process, world views from the participant of the process output, owner of the process and environment having influence on the performance of the system. The researcher changes the approach to this study by rearranging CATWOE to TWCAOE. The exploration will begin with the transformation process; understand the world view, customers, actors, owners and then environment. The researcher embarked on an observation process to gather data related to CATWOE through observations of the members of the industry, participating in informal activities and observation of formal meetings and informal interviews with experts in the industry. Following information emerged:

- **TRANSFORMATION:** Efficient and cost-effective movement of vessels from anchorage to port terminals and from terminals back to anchorage as well as from berth to terminals;
- **WORLDVIEW:** Port marine services' department that provide on time service to vessels visiting the port, ensuring vessels berth on arrival and that vessels are navigated safely to berths;
- **CUSTOMERS:** Shipping liners, Cargo owner, Shipping Owners, Vessel captains, Terminal operators, and stevedoring companies.
- **ACTORS:** Transnet Port Authority, Customs Offices, Port Regulator, South African Marine Safety Authority;
- **OWNERS:** Government, Ports Authority.
- **ENVIRONMENT:** Lack of investment, adverse weather conditions, stringent port rules, rigid port act, inflexible berthing policy, and ineffective marine shipping act.

The information emerged in the observation process is supported by information obtained during literature investigations. To further elaborate on the dynamism of marine services operational challenge, in the next section the researcher employed Systems Dynamics.

3.7.3 Applying Systems Dynamics

The relationship between variables in the conceptual model characterizes the problem situation associated with complexity and nonlinearity. Systems dynamic tools are employed in proceeding chapters to further understand the structure and behavior of the marine system. Senge et al., (2014) refer to systems dynamics as a methodology for studying and managing complexity. According to Schiuma et al. (2012) systems dynamics is the tool designed to help address complex issues involving delays, feedbacks, and nonlinearities. A causal loop is used to simplify reality so that the researcher can deal with the problem situation more effectively. Causal loop assists in seeing beyond linear to understand feedback and control loops. It is a powerful approach to understand the ‘‘reality system’’ that emphasizes the relationships among the systems parts rather than the parts themselves (Bohórquez Arévalo and Espinosa, 2015). Therefore, a systems thinking approach enables the researcher to analyze the dynamic behavior of a system. This is an important feature as it is applied to assess the marine services operational challenge at the port of Durban. The next section presents the conceptual model of marine services.

3.7.3.1 The conceptual model

On the basis of root definition, CATWOE, SSM and System Dynamics the conceptual model was developed. The basic model of this type normally contains seven verbs which are taken as source of new root definition (Jackson, 2006). The model was created to generated debates about possible changes that might be made in the problem situation. The conceptual model is mirrored to the real world which is expressed in the rich picture. It was also used as a ground base for data collection process. To further provide analysis of the literature investigations, the conceptual model is presented below illustrating interactions between economic activities, vessels, infrastructure requirement and efficiencies of the port system.

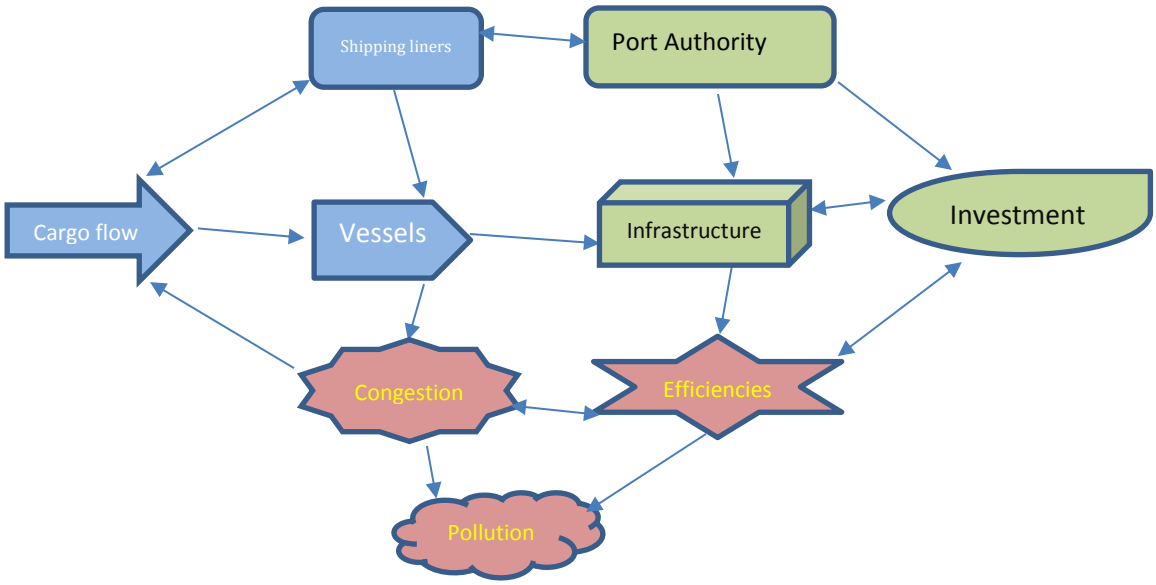

Figure 3.2 Conceptual Model: (Source: Own)

From the conceptual model, it is clear that cargo flow has an impact on shipping liners' choice of vessels to bring to port. It is also evident that port authority needs to keep up to date with vessels evolution by improving infrastructure. Cargo flow, ships sizes, port infrastructure requires huge investment from the port authority. Lack of investment in infrastructure may lead to poor efficiencies resulting in longer vessels' stay at the port, and congestion of vessels on anchorage waiting to enter the port. Concentration of port activities gives rise to port pollution.

3.8 Conclusion

To deal with the ever growing complexity in the marine environment, there is a need for understanding rapid change in technology, keeping one updated of new developments within one's work areas of technologies that have potential of producing the competitiveness. Complexity can be described at three different levels within the organization, i.e., individual, networks and systems levels. An organization involved in a complex system must have capabilities to learn faster and have tools for managing complex decision making processes. From the port systems' point of view, simulation to test different available decision options is important. As one learns to

understand the complexity associated with marine services, one is able to understand the challenges embedded in the system which includes marine pollution. Pollution in marine environment is the biggest problem as marine craft emit green gases that pollute the environment. Ships also spill oil but, most importantly, the risk of pollution is associated with marine incidents which can result in catastrophic disasters or fatalities. The following chapter addresses the research design and methodology adopted in the study.

CHAPTER FOUR: RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter discusses the approach followed and the methodology employed during the data collection process. The researcher begins the chapter with the research design, illustrating the strategy employed in approaching the study. The research methodology relates to the tools employed in ensuring data collection and the suitability of the tools to the research strategy employed. The target population is described and the sampling technique utilized to draw subset sample is identified. The list of participants is tabulated and the informed consent process is explained. Data analysis processes and ethical considerations are also discussed.

4.1.1 Study Aim

The aim of the study is to understand operational challenges confronted by marine services in the port of Durban. The study will identify stakeholders who are impacted by these challenges experienced by marine services so that perceptions about the port of Durban can be managed. In so doing, operational planning of marine services can be improved and benchmarked against global best practices, as understood by the shipping industry.

4.1.2 Study Objectives

The broader objective of the study is to highlight marine operational challenges impacting on the shipping industry. It is imperative to identify the gap between what is perceived by the industry to be the best practice in marine services' offerings to what marine services offer to the industry. Furthermore, it is important to understand global practices so that perceptions can be managed. This study addresses the following research objectives:

a. To identify operational challenges confronted by marine services within the port of Durban;
b. To understand operational challenges that impact on the shipping industry and environment within the port of Durban;

c. To examine the impact of marine services' activities to the environment; and
d. To make recommendations directed towards mitigating the impact on shipping industry.

4.2 Research Design

4.2.1 Research Approach

The study aims to explore operational challenges confronted by marine services in the port of Durban. The qualitative approach is employed as the strategy to investigate this phenomenon. This approach is the most appropriate research design to investigate and evaluate the research problem situation as the purpose is to obtain accurate and tangible empirical evidence with a view to interpret and identify operational challenges and their impact on marine services. According to Du Plooy (2014), qualitative research is an exploratory approach utilized to gain a deeper understanding of the problem situation being investigated. No boundaries are set to ensure that responses are not limited to set parameters. During the interview process, open-ended questions were utilized to ensure free expression by participants. Marine services operational documents were also reviewed and observations of the actual operations were conducted.

The study could not employ the quantitative approach due to its limitations regarding the absence of free expression by participants. Quantitative research is numerical in nature and its focus is that of controlling of components (Newman, 2014). Quantitative research limits respondents to a particular conclusion placing at risk freedom of expression. Predetermined instruments will not be suitable for this study of marine services as a statistical approach will not be sufficient. To gather sufficient data, the researcher conducted interviews with ten participants selected within the marine services' department. The purpose was to collect enough information to support the researcher's conclusion (Henning et al., 2013).

4.2.2 Research Methods

The epistemology of the study is that of critical paradigm, with the employment of the qualitative research approach. The research is phenomenology based using discursive constructionist grounding. A standardized questionnaire was utilized to enable the researcher to pose questions to

the participants in a more consistent manner (Storey et al., 2015). The standardized open-ended questionnaire was designed and implemented to ensure that the researcher gained knowledge of the marine-related operational challenges by eliciting participants' experiences, opinions and beliefs about the phenomena being explored. Face-to-face interviews were conducted with experienced mariners within the port of Durban.

Observations were made while listening to maritime forum debates on issues affecting the department's marine services around the world. Observations from the Africa port evolution seminar were made to gather information about marine services and challenges around the continent.

Documents on maritime operations were analyzed. Interviews were recorded, and themes and patterns were analyzed.

4.2.2.1 Critical Paradigm

Research process has three dimensions; ontology, epistemology and methodology. According to Bryman (2012) research paradigm is an all-encompassing process of interrelated practice and thinking that defines the nature of enquiry. Ontology assumes multiple realities, and that these realities can be explored and constructed through human interactions. Ontology takes on a stand that realities exist due to varying human experience including peoples knowledge, views and experience (Davis, 1998). Epistemology assumes events are mental process of interpretation that is influenced by interactions with social context. Inquirer and the inquiry-into are interlocked in an interactive process. Methodology means the process of data collection by text massages, interviews and reflection sessions. Bryman (2012) describes a paradigm as the research tradition or world view, i.e., a way of breaking down the complexity of the real world. Qualitative research paradigm is underpinned by three perspectives positivist, interpretive and critical postmodernist. These are contemporary social, organizational and management research perspectives. The key characters of these three perspectives include the world view, the nature of knowledge being pursued and the means to collect and assess data within paradigm. When the researcher chose a particular paradigm, he/she employs a specific approach to the study of relevant phenomena. The

study employed the qualitative research paradigm due to its interpretative nature and the richness of the data generated by this paradigm.

4.2.3 Target Population

According to Simpson and Lord (2015) target population is the population or community in which one is interested in collecting data and making inferences. Kayton (2011) defines a target population as the whole community of units possessing the attributes or characteristics which will benefit the study. It is an entire collective unit in which data are to be used to make inferences. Cox (2013) refers to a target population as a total group of community or entities from which survey data will be collected. The establishment of objectives remains the point of departure in survey design. Research objectives help to understand and define who or what would best assist in getting answers needed in the process of defining the population. Defining a target population precedes the establishment of research objectives. The study looked into marine services department within Transnet National Ports Authority where four hundred and sixty three employees are employed. These employees of marine services' department and management of the department possessing the knowledge and experience of marine-related matters. These were employees that work in marine services navigating ships entering the port of Durban. The study included employees that work in the marine environmental management department. The researcher also included ship agents' personnel that manage the ships visiting the port of Durban.

4.2.4 Sampling Strategy

Cox (2013) describes the purpose of sampling as that of making generalizations to the entire population. Du Plooy (2014) describes choosing the sample as the art of narrowing down accessible population to a more manageable size, based on time and resources. A sample is the subset of the entire population and it must be representative of the population.

A non-probability sampling strategy was used for the study. Participants of the study were not selected randomly. The inclusion of participants was based on the researcher's ability to make contact with participants. Representativeness was not the priority as the researcher embarked on the qualitative approach (Starr, 2014). The research focuses on the number of people to be

interviewed and the in-depth understanding of the problem situation being explored. The main focus was data saturation.

This study was based on the purposive sampling method. The subset chosen was based on the list of characteristics relating to marine services' knowledge and experience. Participants must have participated intensely in maritime-related activities. Purposive sampling is a sampling technique that allows the researcher to purposively choose participants that he/she wishes to select for the study based on a handful list of characteristics (Boddy, 2016). The key advantage of purposive sampling is the assurance that all participants will add value to the research. It is up to the researcher to ensure that participants met the population parameters. Purposive sampling was employed in selecting ten participants to participate in the study. Ten employees were invited to participant in the research study. Below is the table 4.1 illustrative of the levels within the marine services occupied by participants invited.

No	**Designation**	**Number**		**Total Of The Sample**
		Male	**Female**	
1.	Chief Harbor Master	1		8.33%
2.	Deputy Chief Harbor Master	1		8.33%
3.	Harbor Master	1		8.33%
4.	Port Manager	1		8.33%
5.	Deputy Harbor Master		1	8.33%
6.	Senior Pilot	1	1	16.7%
7.	Pilot		1	8.33%
8.	Marine Tug Master	1	1	16.7%
Total		**6**	**4**	**100%**

N=10 Illustration based on sample data

Table 4.1 Distribution of Final Sample by Position

Due to personal commitments from participants' point of view, not all participants invited were interviewed. From the total of ten participants invited, only seven were available to participate in the study.

4.3 Research Process

4.3.1 Data Collection

Henning (2013) proposes that, the main tools for data collection are observations, questionnaires, and interviews. The author further indicates that publications, mass media, and company research constitute secondary sources of the data stream. The study utilized interviews, observations and document reviews as tools for data collection. Semi-structured interviews afforded freedom of expression to the respondents. Interviews were recorded and transcribed to better analyze and construct patterns and themes. Table 4.2 below illustrates interview schedule:

No	Interview Dates	Designation
1.	09/11/2016	Deputy Chief Harbor Master
2.	13/11/2016	Chief Harbor Master
3.	13/11/2016	Marine Technical Manager
4.	23/11/2016	Senior Tug Master
5.	24/11/2016	Deputy Harbor Master Nautical
6.	28/11/2016	Marine Capacity Creation Manager
7.	30/11/2016	Senior Pilot

Table 4.2 Interview Schedule

These are experts in marine services as they have been in the marine industry for a number of years. They have also travelled around the world within marine services. The researcher also attended different forums including a seminar in port evolution to gather knowledge about marine services and port system in general. Understanding observations was to contribute to the study of marine services. The observation table is discussed in chapter five. Observations enhanced the understanding of the procedures in marine services. Internal company documents were reviewed seeking connectedness of the procedures within the departments.

4.3.2 Data Analyses

According to De Vos Strydom et al., (2011), qualitative data analysis is a process of bringing order, structure and meaning to data collected. Various techniques are available to the researcher to

implement qualitative data analysis. It has been observed that most qualitative data analysis methods follow similar patterns which include reduction, organization, interpretation, and subtraction of data (Storey et al., 2015). For the process of analysis, the researcher followed the interview procedure with participants. All interviews were recorded after permission was granted by participants. Recordings were transcribed to a hard copy for easy analysis. The transcripts were than analyzed according to themes that emerged from the participants' transcripts.

4.3.3 Informed Consent

The four elements approach to informed consent process was implemented (formal notification, information, understanding and decision making ability) to ensure that participants' freedom to participate is preserved. These elements ensure that adequate information is provided to participants about the study and enhance the understanding of the participants of the study being conducted. They also look at decision making capabilities of the participants to ensure that they possess capacity to make such decisions as to participate or not to participate. Voluntariness is the last element to ensure that all participants participate voluntarily (Snelson, 2016).

In this study, all participants were made aware about their participative role in the research study. The process of formal notification to the participant was implemented by means of email and telephonic confirmation. The requirement from each participant was clearly explained and the level of protection was discussed with participants. The nature of the study was also explained to participants and all documents relating to approval to conduct the study were shared with participant to ensure that they had enough information about the study. All participants gave their consent to participate in this study.

The strategy was to select participants based on the level of understanding and expertise of the subject. This approach ensured that participants understood the topic being researched.

The ability of participants to take effective and impactful decisions was considered during the selection process. At the level in which all participants operate within the organization is the proof of possession of capacity to take effective decisions. The researcher purposively selected participants based on knowledge, expertise and level of decision making within the marine services' department.

To maintain voluntariness, participants were afforded the freedom of choosing to participate or not to participate in the study. Participants were asked to confirm their choice to participate by signing the informed consent form. According to Mayer (2015), ethical conduct is about ensuring that participant interest is not harmed as a result of research being done. The above ethical aspects were employed to avoid harm to participants.

4.3.4 Limitations of the Research Process

According to Du Plooy (2014) limitations can be described as constraints of a study which are out of one's control. Such limitations include time, finance, and access to required information. Such limitations may cause the scope of research to be redefined. The study was delimited to the port of Durban for the purpose of simplicity. The sample was purposively chosen within marine services in the port of Durban. The application of this study's findings to other environments outside the port of Durban should be done cautiously. As much as the system of marine services is identical throughout the ports' systems, caution should still be exercised.

4.3.5 Validity and Reliability

The researcher employs qualitative approach to explore operational challenges faced by marine services' department within the port of Durban. According to Snelson (2016) qualitative research utilizes trustworthiness to measure the level of validity and reliability. Validity is the process of illustrating whether the study measured exactly what was meant to be measured. The study tested two elements of validity, i.e., internal and external validity. Internally, the researcher looks at the study's ability to answer the research questions, while external validity illustrates the ability of the study outcomes to be generalized to the larger population. The ability of the research study to be applied to the population and produce similar results is vitally important. The consistency of research findings affords the comfortability that, if the study were to be repeated elsewhere, similar results can be achieved. The researcher ensures trustworthiness through obtaining statements from participants and quotations from documents as well as observations of the process. Trustworthiness is achieved on the bases of the following elements of trustworthiness. Below bulletin expand on elements of trustworthiness:

- Credibility: relates to confidence in the 'truth' of the findings. This was achieved through the process of recording interviews, and producing the transcript which was sent to the interviewed participants to confirm and agree on the content;
- Transferability: was achieved through the process of ensuring data saturation, which is the process of interviewing until respondents repeat the same themes and nothing new emanates from the interviewees;
- Dependability: was achieved through the target population and the sampling technique for selecting participants. Selection was based on knowledge and experience in the field, and the expertise that participants have in the field. Highly qualified and knowledgeable participants were selected. Analyses of themes, conducted from the transcripts, were confirmed by participants; and
- Conformability: thematic analyses were done confirming the literature review findings. Observations were done to confirm the themes that emerged during the interview process.

4.3.6 Ethical Considerations

Ethical clearance was sought and approved by the University of KwaZulu-Natal Ethics Committee (See Appendix 02). Throughout the study, the researcher ensured that ethical standards were upheld. The researcher took full consideration of the fact that the study involved interviews during the data collection phase. In this process, confidentiality was maintained and the protection of information was fully implemented. This was achieved through ensuring participants were not referred to by their names. Written documents, including interview transcripts, were not divulged to anyone. The recordings were stored in a password-protected computer device to which no one, except the researcher, has access. All other hard copy documents were destroyed. The study report is coherent and holistic and ensured anonymity and confidentiality.

4.4 Conclusion

The objective of chapter three objectives was to outline the research design and research methodology employed in this study. The strategy employed was described and the rationale for choosing the qualitative approach as a research method employed was discussed. This chapter

formed a roadmap for the study of marine services' operational challenges. It clearly outlined the procedure undertaken during the duration of the study. The chapter defined the research aim and objectives, research design, research methodology, population and sampling strategy, issues of validity and reliability, data analysis and research limitations. The following chapter will elaborate on study results and discussion, data interpretation and presentation in line with the objectives of the study.

CHAPTER FIVE: RESULTS AND DISCUSSION

5.1 Introduction

Chapter five analyses the data collected in order to address the aim and objectives of the study. The objectives are aligned to the research questions and the research focus. The background of the study is also presented for the purpose of understanding the dynamics related to the background of the environment where the study was conducted. The literature is also analyzed prior to the presentation of the conclusion and recommendations of the study.

5.2 Background

The research project was conducted in the port of Durban as an instrument to understand marine services' operational challenges that have a potential impact on the shipping industry. The port of Durban marine services provide safety of navigation to ships destined for the port of Durban and those that require assistance while sailing the oceans surrounding South Africa. Marine services include tugs services, pilotage services, bunkering services, security and navigation technologies of ships entering and departing the port of Durban. Ensuring safe navigation and mooring of vessels on berth become the key function of marine services. For the port to be attractive to the industry, the need for efficient and effective services to ships becomes vital. The port aspires to achieve navigating, docking, and cargo operations that are executed on time and efficiently. Ship turnaround time is one of the key indicators of marine services' effectiveness, which is closely monitored by the shipping industry. Longer ship stay in the port, either on anchorage or alongside berths, discourage shipping liners in bringing vessels to the port. The port of Durban has recently been under pressure from the industry, due to delays associated with marine services, as industry views the delays as the biggest cost factor in the port of Durban. The services are perceived by the shipping industry to be below global standard. The marine services' department operates a fleet of tugs for assisting vessels from anchorage to berths, deploys berthing crews to ensure that shipping is moored, provides pilots to navigate ships through the entrance channels of the port, and provides bunkering services to the ships. These services are to be provided to the shipping industry on a 24-hour basis. Adherence to the schedule time, and ensuring the availability of infrastructure for handling ships fall under the jurisdiction of marine services. The perception of

the shipping industry is negative about the port of Durban's marine services. The study examines the marine services' operational challenges and their impact on the shipping industry so that the perception can be managed. A holistic approach in understanding these operational challenges will assist in mitigating the impact to the shipping industry and managing the industry perception. At the end of the study, implementation strategies will be offered to assist the port to perform at it agreed service levels.

5.3 Purpose of the Study

The purpose of the study is to explore marine services and understand challenges faced by the department with a view to improve future planning.

5.3.1 Study Aims

The aim of the study is to understand operational challenges confronted by marine services in the port of Durban. The study will identify stakeholders who are impacted by these challenges experienced by marine services so that perceptions about the port of Durban can be managed. In so doing, operational planning of marine services can be improved and benchmarked against global best practices, as understood by the shipping industry.

5.3.2 Study Objectives

The broader objective of the study is to highlight marine operational challenges impacting on the shipping industry. It is imperative to identify the gap between what is perceived by the industry to be the best practice in marine services' offerings to what marine services offer to the industry. Furthermore, it is important to understand global practices so that perceptions can be managed. This study addresses the following research objectives:

a) To identify operational challenges confronted by marine services within the port of Durban.
b) To understand operational challenges that impact on the shipping industry and environment within the port of Durban.

c) To examine the impact of marine services' activities to the environment; and
d) Make recommendations directed towards mitigating the impact on shipping industry.

To explore objective "A" ***(To identify operational challenges confronted by marine services within the port of Durban***), the researcher examined the impact of economic growth on marine services. The researcher further discusses Objective "B" ***(To understand operational challenges that impact on the shipping industry and environment within the port of Durban)*** by understanding the players in the industry and prioritizing them based on those most impacted by marine services' operations**.** Objective "C" ***(To examine the impact of marine services activities to the environment)*** relates to examining the impact of marine services' activities on port efficiencies and the environment. The researcher addresses Objective "D" ***(Make recommend actions directed towards mitigating the impact on the shipping industry)*** in the conclusion and recommendation chapter.

Literature review reveals the importance of maritime industry in ensuring the flow of cargo around the world being high on the list. Marine services become the catalyst, coupling international trade to the local economy. The effectiveness and efficiency of marine services may determine the economic growth in the local industry as well as the local economy by providing a seamless flow of imports and exports in and out of the country. The study was conducted in the port of Durban as Durban is the hub of the global economy. Understanding marine services operational challenges from the context of marine services within the port of Durban can be beneficial to the industry. The above research objectives are presented to guide the researcher towards providing exploratory analysis of responses provided by the interviewees. The researcher conducted observations of marine services' activities in various critical areas to gain more understanding of the marine services' fraternity.

Data were collected from well experienced mariners in different levels of the organizational structure in the port of Durban. These experts shared their knowledge and experience in the field of marine services. The study employed thematic analysis from the themes that emerged from the data collected. The following sections discuss the themes as they surfaced from data collection.

5.4 Thematic Discussion

Analyses are presented on the basis of the following themes emerging from the data. The researcher arranged the structure of themes as they emerged from the review of the literature. Economy growth results in an increase in cargo flow, which then leads to ship owners building bigger ships to account for economic growth. Shipping liners demand bigger ship sizes. Consequently, the ship evolution phenomenon emerges. Investment in infrastructure becomes unavoidable; authorities must invest in port infrastructure to attract cargo traffic. There is an increase in skill requirements as a result of the change in maritime technology. Operational performances become the key competence ensuring faster ship turnaround time in ports and the reduction of environmental impacts in and around port boundaries. Table-04 below presents the themes of this study as they emerge from the literature review.

MARITIME MATRIX							
ECONOMY	**SHIPPING LINERS**	**SHIP OWNER**	**GOVERNMENT**	**PORTS AUTHORITY**	**MARINE EMPLOYEES**	**ENVIRONMENTAL AUTHORITIES**	
PHASE1	Cargo flow						**Operational Challenges**
PHASE2		Ships Size					
PHASE3			Investment in Human Capital				
PHASE4				Infrastructure Investment			
PHASE5					Efficiencies		
PHASE6						Pollution	
	CONCEPTS/ THEMES						

Table 5.1 Maritime Matrix: (Sources: Own)

The above maritime matrix illustrates the phenomena emerged from the investigation of the literature. The themes that emerge from the literature were further displayed as a conceptual model in chapter three. The matrix presents the bigger picture of interactions between stakeholders in the

maritime industry and marine services operations within the economic environment. The heading of the matrix displays a number of stakeholders involved in the maritime industry; shipping liners, ships builder, ships owners, government of the country, Transnet National Ports Authority as the arm of government having authority over ports, and marine services employees. The phases 1-6, indicate the levels of cascading activities which give rise to marine services challenges within the port.

Phase 01: in phase one the flow of cargo between continents increases as a result of economic upswing. Shipping liners respond by putting pressure on ship owners to provide them with bigger size vessels to achieve economies of scale. By doing so, shipping liners aim is to consolidate shipping into one big load so that cost of shipping can be reduced. Rather than deploying a number of ships, they are able to load the entire shipment on one vessel (Murai et al., 2011). These demands in phase one leads to phase two challenges where ship builders begin to build bigger ships to accommodate the demand from market. These new generation vessels are wider, heavy and deeper in drafts and due to the cost of building them, it becomes important to receive returns on investment. Phase one and two problems leads to phase three and four, the gap between the vessels size and infrastructure to handle these new generation vessels. Narrow channels, shallow waterways, shallow drafts on berths, smaller bollard pull of tugs, inadequate berthing infrastructure as well as lack of resources to load and unload cargo quicker to achieve acceptance global ship turnaround time. This phenomena results in widening the gap between port infrastructure and vessel evolution, compelling government and port authority to look for investment in infrastructure and human capital skills. It is known that for government to find investment and building infrastructure takes a while (Paulauskas and Paulauskas, 2011). In the interim ports becomes inefficient, creating buildup of vessels on anchorage, delays and high concentration of activities leading to pollution around ports area. The following discussions indicate each theme identified in data collection process.

5.4.1 Economy Generating Cargo Flow

Countries are linked by a network of global trade. The growth in one country's economy affects other countries around the world. This is the system of global trade network. Other factors that influence an economy and the flow of cargo is the number of ships, capacity of ships, maximum

vessel size, number of service liners, and the cargo generating industries (Lam and Notteboom, 2014). In most of the interviews, participants cited the impact of the economy to global trade. This volume of cargo is the direct result of economic growth. Economic growth has a bearing on the port systems. *This statement is supported by* Clarkson's graphical representation of global container volumes in chapter two depicts the increased volume supporting the notion of growth in global containers as a direct result of the growth in economic activities. The growth in cargo flow is disproportional to that of port infrastructure.

Participant-01 cited the growth in economy not being proportional to the developments in the marine services in ports. Participant-01 elaborated the point citing capacity of ships visiting the port of Durban compared to the port infrastructure to handle these volumes. It is evidenced where you observe the container terminal that the economy is affecting the volumes or cargo flowing through the terminals. Participant-02 talks about how employees have to be fast tracked through the training system so that the port can begin to cope with the volume of vessels coming to visit the port, reiterating the impact of global trade and economic growth.

Participant-06 who emphasized the fact that the port of Durban and the port of Cape Town operate twenty four hours, seven days a week to create capacity to support the ever growing economy. Participant-05 pointed out that there is a large number of vessels on anchorage waiting to come inside the port of Durban which indicates that the demand in the global market is being felt by the port system.

According to Valentine et al. (2013), 85% of global trade cargo flows through port systems. According to Notteboom et al. (2013) flow of volume is influenced by economic conditions, and how well the countries are connected to the global shipping network. This idea is supported by Sánchez and Perrotti (2012) in their paper "looking into the future: Big full container ships and their arrival to SA ports" that economic growth has triggered a transformation of the maritime transport sector, ports and logistics. The researcher cites growing container ships as being the new phenomenon impacting on strategic issues of ports.

5.4.2 Shipping Industry Evolution

The shipping industry is continuously evolving; this is evident in the vessel fleet size around the world. The increased volume flow results to an increase in the number of ships, and the increase in the size of vessels around the world. The shipping liners' decision lies on the port's efficient marine services and port technologies to support bigger vessels reducing their port stay. Port efficiencies, are a major factor in the decision to select the port of call.

Participant-01 talked about the initial port design which did not cater for bigger ships that are being manufactured now. This participant also emphasized the point that the gap between ship size and current infrastructure has widened over time and the port is now at the point of redundancy.

Participant-05 commented on the need for ports to have enough waters to accommodate the bigger vessels visiting the port of Durban. In support of this point, the participant brought into the conversation the issue of marine incidents as a result of the port not having adequate infrastructure to handle the bigger vessels. Participant-05 also elaborated on the fact that port infrastructure becomes a tool to attract vessels towards visiting the port of Durban.

Participant-06 stated that it was a challenge for the ships to visit African Ports, including the port of Durban. The participant referred to marine services including ships' water needs, ships' need for dry-docking, etc. The picture painted by the participant is that of a shortage of necessities for bigger vessels. The participant identified the lack of readiness for the handling of the big size vessels. Participant-06 compared the vessels visiting the port of Singapore with those calling at the port of Durban.

Participant-07 discussed the issue of crafts required to service bigger vessels which visit the port now, citing the shortage of these crafts to support of bigger vessels. These crafts include the current fleet of tugs and pilot boats.

Participant-07 supports Paulauskas and Paulauskas (2011) who suggests that the increase in parameters of ships requires more assistance from tugs to increase maneuverability as well as mooring and unmooring facilities. According to Celik and Kandakoglu (2012), marine services play a role in ensuring ships' maneuverability through the port channels and the fastening/ mooring of vessels on berths. The lack of infrastructure to support bigger vessels calling at ports

is a challenging phenomenon which impacts negatively on a country's economic position. Bask et al. (2014) discuss this point from the view point of vessel size, making port infrastructure redundant. The authors argue that the increase in vessel size renders port infrastructure outdated in that vessels are getting bigger and require wider and deeper port entrances, deeper berths, bigger and more maneuverable tugs and highly skilled mariners. Notteboom et al. (2013) elaborate that ports are having to keep up with the trend in the shipping industry, To provide efficient marine services, the author emphasizes the need for ports to have the latest marine technology, high levels of marine skills and knowledge, as well as the latest port infrastructure. Moon and Woo (2014) emphasize the impact of port operations on efficient ship operation from both economic and environmental perspectives.

5.4.3 Human Capital Investment

Investment on workforce skills and knowledge levels is critical for the success of marine services within the port of Durban. From the systems point of view the phenomena requires a shift in focus from the hard systems to soft systems approach. Most companies place their attention on hard systems and tend to forget about soft systems, such as employee empowerment and change management. The introduction of technology and team-based activities has resulted increased levels of complexity in our operations. Managing chaos and complexity becomes one of competencies that managers must possess. This is evident in marine services as there is a skills gap and process complexity which were identified by participants and also supported by literature.

Participant-01 cited the importance of focusing on training. The quality of training being provided has being deteriorating over time. This participant believed that current seafarers have an inferior level of knowledge. The participant emphasized the need of having an efficient recruitment process to select suitable candidates. The absence of such a system in marine services has degraded the industry's capacity to provide such a service.

Participant-02 emphasized the need for the organization to ensure that the entire workforce improve their skills continuously. The participant further indicated that the merchant shipping act of South Africa is outdated. This participant emotionally brought across the point that South

African cadets are trained for a longer duration in comparison to their counterparts. As a result, the difficulty in closing the skills gap becomes impossible.

Participant-3 dwelled on the difficulty in students finding support with regards to sea time requirements. This point was further elaborated by participant-04 who cited the time frame to qualify tug masters and the chief marine engineering officer. The alignment of cadet training to the industry needs to be examined.

Participant-06 identified the shortage of South Africa seafarers, indicating the absence of South African seafarers in maritime transportation vessels. The critical area to look at is that of training institutions, as, currently, there are institutions in Durban and Cape Town only.

Flexible and knowledge-based employees are needed to ensure organizational competitiveness (Marley et al., 2013). Gunasekaran and Ngai (2012) suggest that advancement in technology requires a high level of employees education within the organization.

5.4.4 Port Infrastructure Investment

The investment in port infrastructure has been lagging behind. The authorities and government officials need to understand the trends in the maritime industry so that the gap between vessel size and infrastructure does not widen. Authority must revisit the approach in dealing with question of infrastructure investment as these are in the state of neglect.

Participant-01 discussed the need for investment inside the ports elaborating on the port's shallow berths, and navigational technology required by the shipping industry. Participant-01 substantiated the point by providing evidence of big ships colliding with quay walls, and ships not being able to cross each other in port channels.

Participant-02 emphasized the need for investment and the difficulty in convincing the authorities to invest in ports. The participant elaborated on the investment requirement for tugs in port and the need to have the port deepened. This participant emotionally presented the fact that, by the time investment is approved, the maritime industry would have already surpassed the approved level of investment.

Participant-03 alluded to the fact that port of Durban, by design, should be operating with eight tugs but the port is currently operating with five tugs. The participant placed the blame solely on the lack of investment on port infrastructure citing the leadership disconnection to the trends in the maritime industry.

Partcipant-05 referred to tugs having to utilize maximum power when assisting the vessels and indicated the need of investment in upgrading port infrastructure. The amount of sediments entering the harbor renders berths out of depth quicker due to the shallowness of the port's waters. Comparison was made between African ports to European ports and the participant used the word embarrassing to express the state of our ports when compared to international ports.

Participant-06 supported the idea of the lack of investment in port infrastructure citing the need for more craft, deeper crafts and technology to efficiently handle new generation vessels.

Paulauskas and Paulauskas (2011) elaborate on port infrastructure losing its suitability. The author states that, as vessel size grows bigger, the port channels and water places shrink. According to Luo et al. (2012), the decision on port development and marine services infrastructure is the responsibility of government bodies. Capacity expansion in ports has the potential of reducing the marginal variable cost which can lead to lower prices and high market share. (Moon and Woo, 2014).

5.4.5 Port Efficiencies

The growing economy and growth size of vessels require efficient port operations. The shipping industry's main attractor to certain ports is port efficiencies. Marine services are the most important pillar in ensuring that ports are efficient. Ship time on anchorage, berthing time and ship time in port are cost measures for shipping liners. The marine services performance is measured against these key indicators. Failure to perform in these area may result into ships being diverted to other port around the world.

Participant-01 linked the demand for quick turnaround time to the need for resources, and highlighted the fact that, with shortage in resources, efficiencies are hard to come by. The participant further elaborated on the shortage of marine resources. In the South African

context, these include shortage of skills and marine crafts when compared to global ports. Being a member of the international harbor association, the participant discussed in detail the common marine challenges, such as training, mooring techniques, weather patterns and drafts on berths. In his words, the availability of marine resources will enable the delivery of efficient services to marine customers.

Participant-02 discussed in detail the importance of marine services' efficiencies in turning the vessels around quicker. The participant highlighted the lack of infrastructure for marine services to handle two ships at a time. Such a technique will improve efficiency of the port. The size of the Durban port is huge. The focus from the customer's point of view is making decisions that will increase port efficiencies. Decision support systems are critical due to the complexity of marine services' operations. For the port to increase it efficiencies, a leader must understand the mechanics of port operations by highlighting the need to master the nuts and bolts of marine services. Participant-02 elaborated on the importance of marine services' efficiencies to reduce cost of running marine services.

Participant-04 talked about delays in the marine systems and the impact to maritime industry. She attached the lack of efficient operations to inadequacy of marine resources, highlighting the lack of resources (berthing gangs, tugs and skills to operate these crafts). The reputation that comes with providing effective and efficient service to our clients outweigh the amount of investment required.

Participant-05 compared the port of Durban to ports in Singapore. The speed in which Singapore moves ships around is amazing. The port of Durban should learn from the efficiencies of Singapore. Vessels do not wait on anchorage, the amount of tugs deployed is amazing and there are no delays to get the ship alongside berths. That is what we called efficient marine services.

Participant-06 emphasized the importance of teamwork to bring out the best workmanship which could be noticeable by our client. The number of grounding makes me not to sleep at night, where is this workmanship we crying about. Commitment from the side of employee is not there, no learnings are shared to improve marine operation especial when vessel grounding

occurs in the same spot more than two times. Evidence of communication breakdown between members of marine services have been evident.

Participant-07 highlighted the need for speed of delivery in the port of Durban in all areas including marine and cargo operations. The number of bigger vessels being service in port around the world compared to what port of Durban handles is the evidence of lack of efficiencies on our side. She also cites the issue of communication absence, without proper communication we will not able to deliver effective and efficient service to our clients. There is a common understand that if port of Durban can turn vessels around quicker more vessels will visit the port.

Port efficiencies remain the measure element in attracting volume (Moon and Woo, 2014). Moon and Woo (2014) emphasize the monitoring of time in terms of the vessel's arrival at anchorage, maneuvering time, berthing time, productive time and idling time as well as the change in any factor that might result in change in port time.

5.4.5.1 Privatization

In achieving efficiencies, privatization of some port's operations is the strategy which could assist the port to achieve high standards of service delivery. Most participants agreed with this notion but there is also consensus that South Africa is not ready to privatize marine operations citing the need to keep high levels of employment.

Participant-01 strongly disagreed with privatization for the purpose of increasing port efficiencies, citing the low levels of transformation. Once privatization is implemented there will be less community base investment by the private sector.

Participant-02 strongly disagreed with privatization of marine services highlighting that the private sector is concerned about profits and less about the issue of transforming our communities. He highlighted that privatization is the nice to have concept.

Participant-03 also disagreed with privatization of marine for the purpose of gaining efficiencies. The participant elaborated on the possibility of marine employees to get more

salaries income as a benefit from privatization but still maintained her stance that South Africa is not ready to privatize.

Participant-04 strongly disagreed with the concept of privatization highlighting the lack of employment and the fact that if we privatize more people will be out of employment. She strongly thought that all sectors that have been privatized should be returned under the control of government.

Participant-06 agreed that, with privatization, more competition occurs and efficiencies will improve, but South Africa is not ready indicating that the country should wait until the skill level in the country has grown.

Only participant-07 agreed with privatization citing the benefit as improved efficiencies for the port and improved commitment from the employee's side. The participant discussed the complacency from the employee leading to lack of efficiencies.

Based on the analysis above, privatization of marine services is currently not the strategy to be employed. According to Pagano et al., (2013) a privatization strategy can be an effective strategy in attracting investment to the port.

5.4.6 Environmental Pollution

Port activities are the main generator of pollution, especially in congested port areas. Concentration of activities around the port create pollution of different forms, air pollution as a result of gas emissions coming from ships in port, water pollution as a result of bunker services, and soil pollution from spillages coming from equipment servicing the vessels. Environmental issues associated with ships in port have become a concern for port regulatory bodies. This notion is supported by most participant interviews.

Participant-01 referred to the issue of pollution as risk appetite, bringing into the subject the size of vessels and the damage they do on environment. Investments were made decade ago but catered for smaller ships. Big ships bring about impact to the environment. He alluded to the issue of soil and emissions.

Participant-02 discussed marine impact on environment under the umbrella of regulation by SAMSA citing the investment required to ensure less impact of marine services to the environment. He alluded to the issue of emissions. Participant-03 was quiet on issues of environmental impacts.

Participant-04 referred to environmental issues in the main where she spoke about littering in surrounding communities but such being washed down the river to the port, polluting water and making workings in the port harder. She also alluded to environmental pollution in the form of smoking ships and tugs polluting the air. Ships' emissions are a big challenge for marine.

Participant-05 supported participant-01 in the point of bigger vessel challenge emphasizing on the size of vessel and the amount of power required by our marine tugs to push vessels along narrow channels resulting to air pollution. She supported the idea of environmental impact through air emissions but also brought into the subject the negative impact on soil.

Participant-06 referred to environmental impact by marine in terms of air emissions from tugs and large volume of vessels entering the port of Durban giving off emissions to the air.

Participant-07 felt that there was very little impact on the environment touching on new technologies that have been purchased to minimize issue of environmental impact.

According to Gibbs et al., (2014) emission regulations are being introduced to control and reduce challenges related to diseases related to smoke inhalation. According to Homsombat et al., (2013) emission control assists in reducing port activities' externalities and reduces the amount of air pollution. The International Marine Organization, as a body regulating the global marine industry, also increases the drive for the reduction of emissions by vessels in port.

5.4.6.1 Stakeholders

A holistic view of maritime operations from end to end will provide port management with a better understanding of challenges. Collaboration between maritime stakeholders sharing information on maritime operations using one platform may yield better performance of the maritime industry. One platform for information sharing can yield great result when it comes to information sharing exercise. The port need to drive towards one platform for information sharing amongst all port

stakeholder. This will see stakeholder receiving same information above port activities, port development as well as general port information. During data collection, participants were asked to identify key stakeholders of marine in the order of importance.

Participant-01 talked about marine services' stakeholders, prioritizing ship owners and shipping liners as the key stakeholders to our marine industry and marine services department. These stakeholders are highly impacted by marine services' offering.

Participant-02 cited key stakeholders as government, ship owners and ship agents but prioritized government as the regulator of the marine industry and the regulation impact on how the service will be delivered to our clients.

Participant-03 prioritized marine stakeholders as employees of marine services, ship owners, ship liners and government. She identified employees as key stakeholders in that they provide service to the customers, without employees there will be no customers.

Participant-04 referred to ship owners and ship liners as the main stakeholders of marine services as they decide to bring vessels to the port of Durban and boost our SA economy.

Participant-5 talked about ship agents, cargo owners, shipping liners as key stakeholders for marine services.

Paticipant-06 referred to ship owners, ship agents as key stakeholders for marine services communicating with the port to bring cargo into our country.

Participant-07 identified ship agents, ship owner and port authority as key stakeholders to marine services within the port system.

According to Gimzauskiene and Kloviene (2011) the overall efficiencies of the maritime industry can be viewed from the total supply chain perspective. The total supply chain must be agile to reduce costs related to efficiencies of the supply chain (Bask et al., 2014)

5.5 Observations

Observations were conducted adopting Storey et al., (2015) observation methodology to observe marine services forums at different levels of the organization. These forums observed includes, yearly Africa Port Evolution Seminar, quarterly Port Consultative Committee (PCC), monthly Durban Port Committee (DPC), and observation during actual marine operations. Below table 5.2 illustrates the observations.

Forum	Observation
Yearly Africa Port Evolution (APE)	Number of presenters expressed challenges with infrastructure, relationship with stakeholder in the ports system as well as skill availability within the industry.
Quarterly Port Consultative Committee.	Chairperson of PCC presented unsatisfactory feeling with speed of infrastructure rollout in the port citing lack of feedback on the progress exacerbating disconnect from the members of PCC.
Monthly Durban Port Committee	Members of port operators raised concern of lack of consultative process on project rollout, citing misalignment on project priority.
Daily Marine Operations	Members of marine services in different micro forum presented unhappiness on current marine fleet citing number of years these crafts have been in the system. These members further elaborate on shortage of marine skills in the department

Table 5.2 Observations (Source: Storey et al., 2015)

Observations captured during the field study are in line with evidence from the literature review as well as that of primary data collected from interviews.

5.6 Conclusion

The above analysis determines that the key marine services' operational challenge is the fast growth in ship size resulting in with the inadequacy of marine resources to handle these vessels (Berths, Draft, Tugs and Skill). There is a lack of funding available to support infrastructure

upgrade. Although a privatization strategy can be implemented as a source of funding, SA is not ready to privatize marine due to the need of redressing the challenges of the past (transformation). There is a consensus in the lack of efficiencies in the ports as a result of the shortage of skilled personnel to perform marine duties (seafarers). The volume of vessels visiting the port emits gases into the air resulting in environmental degradation. This idea, which was also shared by participants, will serve as a base line for the proposed recommendation directed towards mitigating the impact of these challenges to the stakeholders. The next chapter will focus on the conclusion and recommendations of the study.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The main objective of this chapter is to draw conclusions and recommendations based on both the literature review and the primary data collected on the research subject (marine operational challenges). The main aim of the study is to understand operational challenges confronted by marine services within the port of Durban. The purpose is to investigate and make recommendations on how these challenges can be mitigated so that a marine service improves on its service offering. Marine services are important function of the port systems. It is the department that couples international industry with local terminal operators. Based on the literature review, the marine services' department is instrumental in ensuring local and country economic growth through efficient ship handling. Seamless service to ships visiting port of Durban becomes the main goal for marine services as a department. This means less delays for ships' on anchorage, reducing anchorage time to acceptable levels. It also means efficient and quality of berthing operations for the port through carefully combining and execution of marine resources. The department main operations includes concentrating on anchorage time, maneuvering time, berthing time and un-berthing time (Moon and Woo, 2014). Reduction on ships' stay in ports could be achieved through reduction on marine-related operations times, such as analysis of the ship's arrival time on anchorage, anchor in, anchor out, and first line to pier. Once the cargo operation has been concluded, analysis of the last line let go, and the ship's departure from the anchorage buoy are important as these times demonstrate marine services' operational efficiencies. To achieve the aim of the study, clear objectives have been set and were utilized as the guidelines for conducting the research. Below is the list of the research study objectives:

a) To identify operational challenges confronted by marine services within the port of Durban;
b) To understand operational challenges that impact on the shipping industry and environment within the port of Durban;
c) To examine the impact of marine services' activities to the environment; and
d) Make recommendations directed towards mitigating the impact on shipping industry.

6.2 How the Objectives of the Study were achieved

Based on the objectives for this research study, a literature review was conducted with a view to explore these operational challenges within the marine services' department. A conceptual model was formulated from the literature review. The main themes that emanated during investigation of literature and data collection assisted the study to achieve its objectives. Following is a discussion on how each objective was addressed in the study.

Objective One: To identify operational challenges confronted by marine services within the port of Durban.

There was a wide consensus demonstrated during literature review and data collection process in support of economic environment theme being the main generator of the challenges confronted by marine services. When the economy demonstrates randomness and turbulence, producing fluctuations, butterfly effects are having high impact in marine services. The economic activities generate cargo flow between countries. The increase or decrease in cargo flow determines the type of vessels in the system. The unpredictability and randomness of the economy opens up marine services to threads of falling behind and provide substandard service to the industry. This phenomena gives rise to different issues interconnected to the outcome of the economic condition.

- Industry investment in newer technologies: to cater for growing demand of bigger vessels, new generation of vessel are brought into the system. These vessels come wider and deeper to accommodate even more cargo.
    - *Outcome:*
        - *Port infrastructure redundancy.*
        - *Absence of resources suitable to handle bigger size ships.*
        - *Shortage of skills required to management complexity of these vessels.*
        - *Inadequacy of systems available to reduce complexity.*
- The discrepancy in lead-time to take decisive investment decisions between maritime industry and government to invest in infrastructure. Maritime industry investment decisions on newer generation of vessels are taken quicker than the government decision to invest in infrastructure, skills and technology to support the industry.
    - *Outcome:*
        - *Port inefficiencies*

- *Congestions in ports*
- *Pollution around port area*

Economic environment have influence on cargo flow, the flow of cargo impacts on ship size, evolution in ship size impact on port infrastructure and skills requirement. Ultimately, infrastructure and skills level determine the efficiency of the port system and that of marine services. Economic growth generates economic activities which determine the flow of trade between countries. The literature review revealed that 85% of the cargo flow between continents is transported by sea transport (Valentine et al., 2013). The effective and efficient handling of vessels in ports requires state of the art port infrastructure. Investment in infrastructure become unavoidable if the port is to be competitive in the global arena. A well trained workforce to support economic activities is a prerequisite especially for maritime industry. This phenomenon is demonstrated by positive and negative feedback loops below.

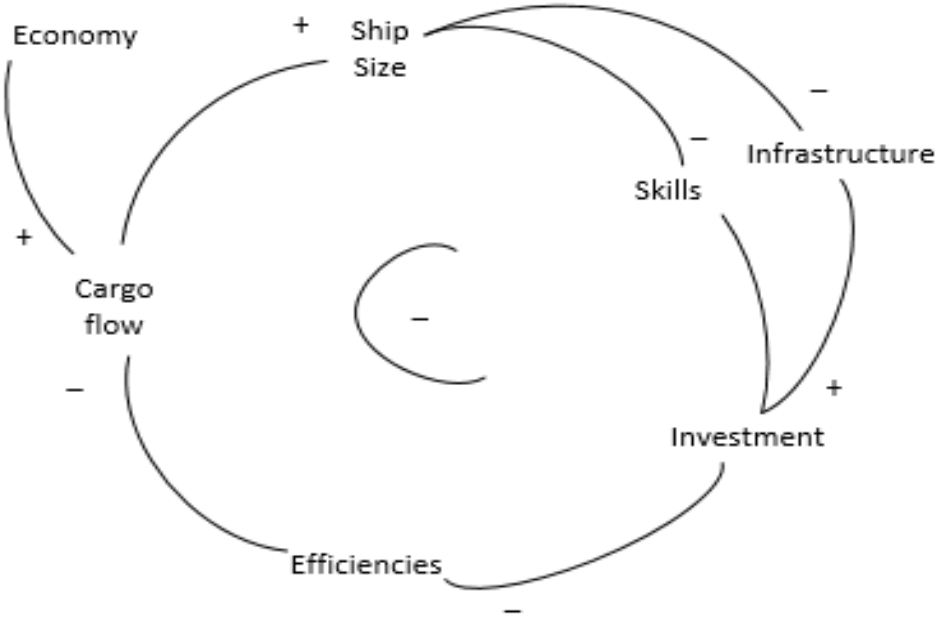

Figure 6.1 Causal Loop Diagram for Marine Services (Source Own)

The data collected fully support the structure of the marine system, as illustrated by the casual loop in Figure 6.1. The findings reveal a negative, or balancing, feedback loop for marine services. Systems that demonstrate balancing feedback loop exhibit stability but these systems resist change.

The feedback system is necessary to understand what is causing the patterns of behavior (Barton and Haslett, 2007). The figure 6.1 represents the relationships within the marine system which are difficult to verbally describe. It is evident that increased cargo volumes have a positive effect on the ship size. The ship size has a negative effect on infrastructure and skill required to service these ships. Both skills and infrastructure upgrade requirements have a negative effect on investment needs. Due to slow investment decision and lack thereof, marine operational efficiencies are impacted negatively, which ultimately slows down the flow of cargo. Figure 6.2 illustrates of patterns of systems behavior.

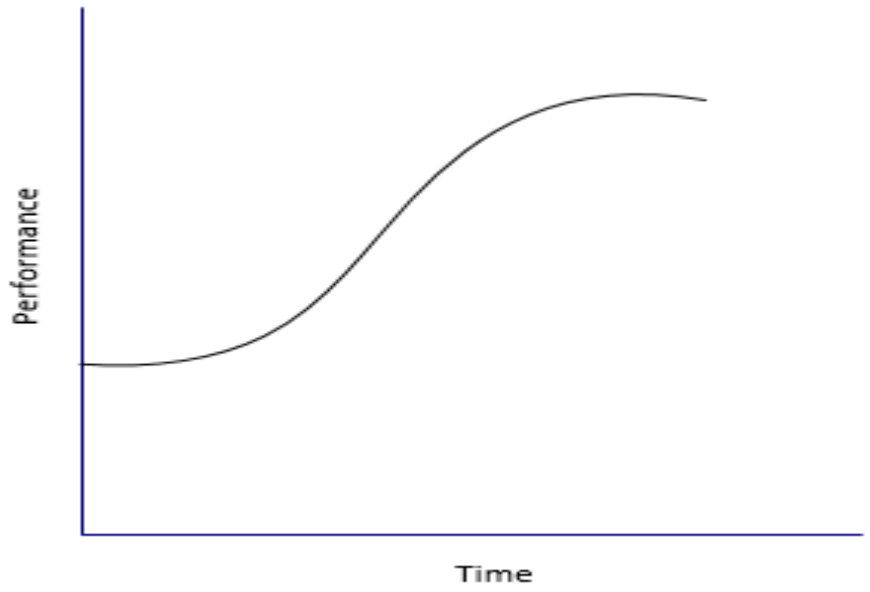

Figure 6.2 System Behavior (Source: Own)

The systems behavior illustrated above is that of an S-shape indicating growth combined with period of fluctuation (Ben-Naim, 2013). According to the literature review and primary data collected, investment in infrastructure is the main marine services' operational challenge confronted by marine services impacting on port service delivery.

Objective Two: To understand operational challenges impacting the shipping industry and environment within the port of Durban.

To achieve objective number two the researcher took on a journey to identify marine services stakeholders and how they are impacted by marine services system. Investigations on literature review and data collection process revealed a number of stakeholders benefiting from marine processes. Soft systems methodology was implemented employing CATWOE to capture root definition of the problem situation. These are also tabulated on the maritime matrix in Chapter Four. The key stakeholders for marine services are shipping liners, cargo owners/ ship owners, government, Transnet National Port Authority, marine services employees. These stakeholders are impacted by marine services activities in different. Below table 06 indicates the stakeholders and how they impacted marine services operations noting that transformation, world's view and environment has been omitted as they are processes.

CATWOE	**Stakeholders**	**Type of impact**	**Description of impact**
C-customers	Shipping Liners	Cargo flow and operational cost	The inefficiencies of marine services impact negatively on shipping liners ability to move cargo around the world and increases cost of operation through idle time on anchorage and longer than plan ships stay of vessels.
C-customer	Cargo owners	Cargo flow, operational cost and loss of revenue	The delay of cargo to reach final destination results in inefficiencies on the operations in the hinterland and increases the cost of logistics. The opportunity cost related to delayed manufacturing results in loss of revenue.
C-customer	Ship owners	Ship design, cost of ships repair and loss of revenue	The designing of vessels to cater for outdated marine infrastructure in terms of tugs, mooring systems etc. increases

			cost of building vessels and loss of revenue for ship owners.
O-owner	Government	Country economic slowdown, cost of investment, and social issued	The delay of vessels on anchorage has a negative impact on hinterland operations as a result sluggish economy becomes inevitable. The delays also result in congestions on roads leading to the ports erupting societal discomfort. The need for infrastructure investment impacts on government fiscal policy reforms.
O-owner	Ports authority	Cost of investment, port efficiencies, claims and reputational damage	The need for investment into marine facilities become inevitable for port authorities. Outdated infrastructure results in marine operation efficiencies. Buildup of congestion both on anchorage and at the terminal entrances. This phenomena leads to port reputational damage.
O-owner	Marine services employees	Loss of income, health related issue and fatigue	With more outdated technologies being employed by marine services leads to marine incidents which have a negative impact on employees' wellbeing and their families.
A-actor	Environmentalist	Damage on environmental species	Water, air and noise pollution affect environment. Environmental authorities have to invest in infrastructure to monitor environmental impact around the port area due to high concentration of activities.

Table 6.1 Analysis of Stakeholder (Source: Own)

Objective Three: To examine impact of marine services activities to the environment

Marine services operations have its own impact on environment in that vessels on anchorage; vessels alongside berths, marine crafts release smoke into the atmosphere. Emissions inhalation by communities working inside the port and those communities surrounding the port has negative impact on the wellbeing of those communities. Literature investigation and data collection process supports this notion. It is in this vein that marine services activities impact negatively on the surrounding environment. The literature reveal a number of innovation implemented to mitigate this risk including policies on emissions, properties of fuels being used by ships being revisited, and consolidation of cargo to as well as new engine technologies being implemented by the industry players. Negative impact is also felt by Transnet as they need to invest in programs to mitigate the impact on the environment. Pollution has a negative impact on economy due to the countries connectedness to global market. Critical actions must be taken by port authority in ensuring monitoring of environmental impact by marine services activities with the port environment.

Objective Four: To make recommendations directed towards mitigating the impact on shipping industry

The structure of marine services' challenges indicates a number of variables demonstrating properties of complex relationships. The literature supports the notion of marine services being a complex system. Primary data collected also prove marine services to be complex operations. The system feedback loop depicts complex interconnectivity of marine services system. Marine service is a complex system displaying stability and element of resistance to change. Lists of recommendations are presented below as endeavors to reduce the impact of marine services' challenges.

1) Marine crafts; a long-term crafts investment plan must be developed and constitutionalized ensuring a continuous investment in new marine technologies.
2) Marine crafts; investigation must be conducted in search for a dynamic tugs management system allowing efficient deployment of tugs assisting the vessels.

3) Port Infrastructure; continuous debate on infrastructure investment is to be documented and coordinated by higher structures of the organization.
4) Port infrastructure; a long-term investment plan should be reviewed periodically to ensure that port upgrade is done continuously.
5) Port infrastructure; a document detailing incentives for private sector investment in port infrastructure should be formulated.
6) A long-term investment plan, directed towards building skills capacity, should be developed nationally to support the marine industry.
7) Port authority and government should collaborate with customers in finding a long- term solution for port challenges.
8) A compulsory training program should be developed for all marine services' employees directed toward getting employees to be customer centric.
9) A review of the Merchant Shipping Act will help unlock the marine skills potential in South Africa.
10) The best global practice program should be effectively applied for all port operations.

6.3 Systems Approach as a Theoretical Framework Revisited

According to Flood (1990) the importance of system thinking was firstly recognized by Churchmann in the 1960s as an improved approach to problem solving. Later in the 1980s Checkland introduced soft systems methodology to close the gap emerged out of hard systems failure to intervene in complex problems. The most recent development in systems thinking is that of chaos and complexity theory presenting adaptiveness, randomness and turbulence of problems situations faced by managers (Flood, 1990). For the purpose of this study system thinking approach was employed to gain understanding of marine services operational challenges. The researcher recognized the holistic approach of systems thinking as opposed to reductionist approach employed by hard systems thinkers. The purpose of employing systems thinking was to recognize relationships and interconnectedness between elements at play in the marine services operations. Understanding behavior of marine services systems was critical for gain insight to the behaviors and patterns underlying these complex systems. The researcher also recognizes presence of human activities which requires soft systems methodology to interpret as human system have different interest, beliefs and expectation from the system (Denning, 1994).

To conduct the study, the researcher employed a qualitative approach with interviews conducted to gain in-depth understanding of problem situation. Investigation of the literature review was undertaken which includes journals, research papers in the field of maritime studies. Interviews were conducted with experts in marine services sharing their knowledge and experience on the problem situation being investigated. Observations were conducted which included observing organizational high structure forums, management forums and maritime seminars (Newman, 2014).

The framework is based on interdisciplinary approach combining several methodologies, methods and techniques in a complimentary manner to intervene in marine services operational systems. Chaos and complexity theory underpinning systems thinking approach as it was being implemented in marine services. Recognizing complexity of marine services systems, and adaptiveness of the systems involve chaos and complexity theory afforded better perspective to understand marine services from the complexity argument (Mingers, 2000). Different ideas were borrowed from Peter Checkland's soft systems methodology to provide understanding of the problem situations. Rich picture was particularly developed to gather information about this complex marine services operation. The rich picture of marine services was drawn that presented various features of the problem situation to be displayed in a nonlinear manner for better understanding. It provides an aid for presenting of marine services organizational climate. CATWOE technique of analyzing stake holder and their interest was employed allowing analysis of customers, actors, transformation process, owners and environment within the marine services operations. The technique assisted in developing root definition of the problem confronted by marine services (Jackson, 2006). A model was developed on the bases of the root definition. Comparisons of conceptual model to the real-world conclude during data collection process. Jay W. Forrester's systems dynamic approach employed to gain an understanding of structures of flows, delays, information and feedbacks related to marine services systems. Systems dynamic process of identifying and mapping causal loops what implemented for this study. Positive and negative feedback loops was developed presenting negative or balancing loops that leads to stability in the marine services system. The patterns of marine services behavior were also presented and they are supported by literature and data collection processes. Looking at the combination of methodologies and paradigms adopted in this study, the conceptual model gains support from empirical research previously undertaken (Green, 2013; Haslett and Sankaran, 2009).

The researcher's learning from applying systems approach to management problems is that managers must have an appreciation of interconnectedness of the systems and understanding of the underlying structure of the systems that gives rise to systems behavior.

6.4 General Recommendations

National ports authorities must investigate privatization concepts as a means to catch-up on infrastructure investments. Privatization as a model, make use of private sector funding to build infrastructure. Between government and national ports authority draft of privatization policy should be investigated.

The city and port authority must collaboration on investigating a common system that will help to facilitate management of activities, the system must also be benchmarked with other systems employed internationally.

National port authority must work in collaboration with South African maritime safety authority in updating South African maritime laws. The outdated marine laws are becoming hindrances to progress in marine services.

National port authority should look at collaborating with institutes of higher learning to increase research relating to the South African maritime industry. Through research initiatives the industry will improve and benefit South Africa through job creation.

More work should be undertaken within the field of environmental management as well as pollution management as to ensure a better understanding of the impact of pollution in the areas surrounding the port.

6.5 Limitations

Cockcroft and Israel (2004) explain limitations as constraints of a study's application. The main limitation of the study is that the results are not generalizable. When in-depth interviews were conducted, generalizations about the results were not possible because a small sample was chosen and random sampling methods were not used. The study was conducted in the port of Durban. All

participants were limited to the port of Durban. As most of the participants have not had exposure to other ports in South Africa and abroad, caution must be exercised when applying the results to other ports. The reason for limiting the study only to the port of Durban was to bring about simplicity through the reduction of complexity. Considering limited resources in terms of time, the study was conducted over a period of five months from August to November 2016. Nonetheless, these limitations did not impact on the validity and reliability of the findings and conclusions presented at the end of the study.

6.6 Direction for Future Research

Illustrated below are possible areas for future research arising as a result of the limitations in this research project:

- This study is within the port of Durban, further research can be conducted which will be based on marine services encapsulating all South African ports.
- One of the recommendations made was for collaboration in decision making between stakeholders within marine industry, further research on the current collaboration status may pave the way for a formal model of engagement between players.
- Application of interdisciplinary methodology of looking at the problem of a complex nature could be attempted in other disciplines within the port system.
- Further research is required to look at South African marine laws as they are becoming a hindrance to maritime evolution.

6.7 Concluding Remarks

A marine service is a pivot for the South African economy in that inefficiencies of marine services delay ships on anchorage. The delay of ships on anchorage slows down the rate of imports and exports flowing in and out of the country. The slowdown of imports and exports leads to sluggish economic growth. Based on the analysis chapter, marine services must provide a seamless service to the maritime industry. It is evident in the literature that 85% of cargo that flows across continents also flows through the ports. Ports are channels or cargo gates into the country. Inefficiencies in

the marine services not only affect the port system but also the hinterland operations. Such inefficiencies may lead to loss of employment in the country.

Exploration of new technologies to drive marine services to the next level of technology may bring about a desirable evolution required by the industry. This can be a key strategy in reducing environmental impact as a result of outdated marine technologies currently employed. Further investigation on newer marine technology is fundamental for sustainability of marine services.

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8. APPENDICES

Appendix 1: Editing certificate

Flat 1211
Kensington
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Morningside
4001

Cell: 0822673192
Email: garbharranhl@gmail.com

14 December 2016

EDITING CERTIFICATE

TO WHOM IT MAY CONCERN

Dissertation title: "Systems Approach to the operational challenges in marine services within the port of Durban"

This is to certify that I have proofread and edited the Master of Commerce dissertation of Sphiwe Eugene Mthembu for accuracy of language and expression. After implementing changes, wherever applicable, I declare that this dissertation, to the best of my knowledge and ability, is grammatically correct and error-free.

Dr H.L. Garbharran

B.A., Honours, M.P.A., D.P.A.

Appendix 2: Ethical clearance

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

29 July 2016

Mr Sphiwe Eugene Mthembu (215056473)
Graduate School of Business & Leadership
Westville Campus

Dear Mr Mthembu,

Protocol reference number: HSS/0639/016M
Project title: Systems approach to the operational challenges in Marine Services within the port of Durban

Full Approval – Expedited Application

In response to your application received on 26 May 2016, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have 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

.....
Dr Shamila Naidoo (Deputy Chair)

/ms

Cc Supervisor: Dr Paul Green
Cc Academic Leader Research: Dr Emmanuel Mutambara
Cc School Administrator: Ms Zarina Bullyraj / Ms Eileen Mohamed

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
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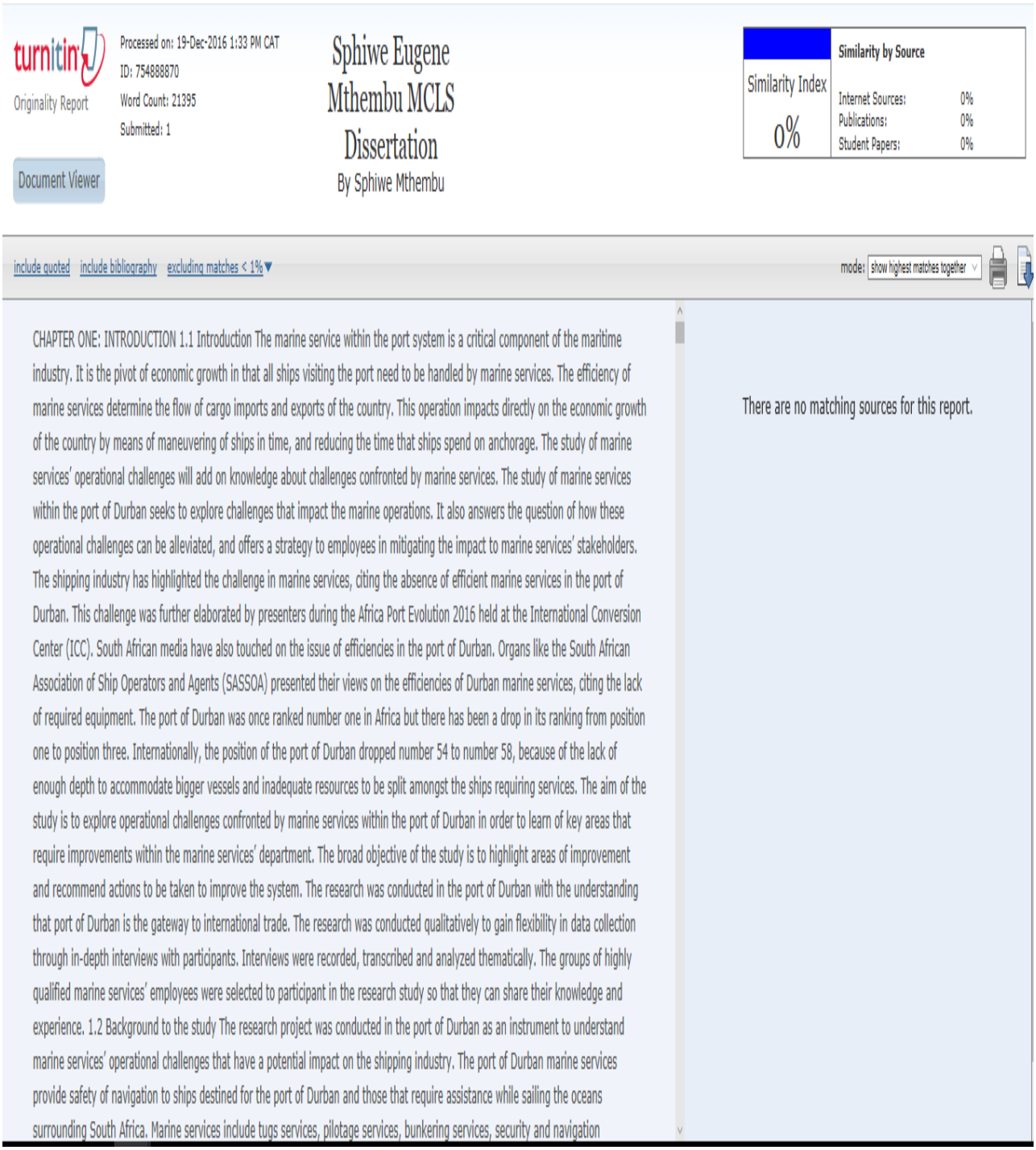
Appendix 3: Turnitin report



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CHAPTER ONE: INTRODUCTION 1.1 Introduction The marine service within the port system is a critical component of the maritime industry. It is the pivot of economic growth in that all ships visiting the port need to be handled by marine services. The efficiency of marine services determine the flow of cargo imports and exports of the country. This operation impacts directly on the economic growth of the country by means of maneuvering of ships in time, and reducing the time that ships spend on anchorage. The study of marine services' operational challenges will add on knowledge about challenges confronted by marine services. The study of marine services within the port of Durban seeks to explore challenges that impact the marine operations. It also answers the question of how these operational challenges can be alleviated, and offers a strategy to employees in mitigating the impact to marine services' stakeholders. The shipping industry has highlighted the challenge in marine services, citing the absence of efficient marine services in the port of Durban. This challenge was further elaborated by presenters during the Africa Port Evolution 2016 held at the International Conversion Center (ICC). South African media have also touched on the issue of efficiencies in the port of Durban. Organs like the South African Association of Ship Operators and Agents (SASSOA) presented their views on the efficiencies of Durban marine services, citing the lack of required equipment. The port of Durban was once ranked number one in Africa but there has been a drop in its ranking from position one to position three. Internationally, the position of the port of Durban dropped number 54 to number 58, because of the lack of enough depth to accommodate bigger vessels and inadequate resources to be split amongst the ships requiring services. The aim of the study is to explore operational challenges confronted by marine services within the port of Durban in order to learn of key areas that require improvements within the marine services' department. The broad objective of the study is to highlight areas of improvement and recommend actions to be taken to improve the system. The research was conducted in the port of Durban with the understanding that port of Durban is the gateway to international trade. The research was conducted qualitatively to gain flexibility in data collection through in-depth interviews with participants. Interviews were recorded, transcribed and analyzed thematically. The groups of highly qualified marine services' employees were selected to participant in the research study so that they can share their knowledge and experience. 1.2 Background to the study The research project was conducted in the port of Durban as an instrument to understand marine services' operational challenges that have a potential impact on the shipping industry. The port of Durban marine services provide safety of navigation to ships destined for the port of Durban and those that require assistance while sailing the oceans surrounding South Africa. Marine services include tugs services, pilotage services, bunkering services, security and navigation

There are no matching sources for this report.

Appendix 4: Gatekeeper's Letter

P O Box 30(W)
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South Africa, 2107
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MEMORANDUM

To: Colleen Du Toit, Acting GM HR

From: Sphiwe Mthembu, Manager: Marine Operations

Date: 07 March 2016

SUBJECT: REQUEST TO CONDUCT RESEARCH STUDY IN MARINE SERVICES IN THE PORT OF DURBAN.

PURPOSE:

1. The aim of this submission is to seek approval to conduct research study in marine services department within the port of Durban.

BACKGROUND:

2. I am currently enrolled for master of commerce in leadership studies with University of Kwazulu Natal. This year 2016 being my last year on the program, I am required to conduct research study and present finding in the form of thesis. The research topic has been submitted to UKZN research board, topic was accepted and approved. The approved topic is as follow; ***"Systems approach to the operational challenges in marine services within the port of Durban".***

DISCUSSION:

3. The research study is to be conducted in the port of Durban to look at operational challenges within marine services. To conduct a research, a qualitative research approach will be employed. A sample of managers, employee and port users will be selected to participate in the study with a view to collect data. Interviews will be conducted, recorded, transcribed, and analyzed using thematic system of analysis. Document review and field observations will be employed as methodology to collect secondary data.

4. At the end of the research study, research report will be presented.

PROBLEM STATEMENT

5. Port of Durban is the busiest port in the SADC region handling on average of 4000 ships per annual, the true gateway to South African economy. Being the pivot of South African Economy it's imperative that ships are handled efficiently and effectively to reduce delay which may lead to increased cost of logistics. Marine services are instrumental in ensuring the port achieves its mandate of ensuring reduced vessel turnaround time. Inefficiencies of the marine services in handling vessels will have a negative impact on South African economy and job creation. Efficient port system become catalyst for South African economy growth as import and export cargo flow through the ports.

THE AIM OF THE STUDY

6. The aim of the study is to understand the day to day operational challenges confronted by marine services while provide services to ships calling in the port of Durban. Analysis of the impact of these chalenges to the shipping industry within the port of Durban. To also provide recommendation in an attempt to reducing the negative impact. Application of the systems thinking to unpack these challenges and to close the loop in the system. An investigation of various linkages within the system will be conducted.

RECOMMENDATION:

7. I recommend that management approve the request to conduct research study in marine services within the port of Durban.

Compiled by:

Sphiwe Mthembu
Manager: Marine Operations
Date: 04/05/2016

Supported BY

Eugene Rappetti
Date: 11/03/2016

Supported By

Mesha Matladi
Date: 22/04/2016

RL

RECOMMENDATION:

7. I recommend that management approve the request to conduct research study in marine services within the port of Durban. RECOMMENDATION:

Approved/ Not Approved

Rufus Loskala
Chief Harbor Master
Date: 06/04/2016

Approved/ Not Approved

Colleen Du Toit
Acting GM Human Resource
Date:

* Not during working hours.

3

Appendix 5: Informed consent form

MARINE SERVICES DEPARTMENT RESEARCH

CONSENT FOR PARTICIPATING IN THE RESEARCH

Dear Sir/ Madam

I ……position in the organization…… hereby agree to participate in marine services department research topic as described (Systems Approach to the operational challenges in marine services within the port of Durban) as approved by Transnet national ports authority. I agree to provide information to the best of my knowledge. I acknowledge that I have a right to withdrawn from this study of marine services without any negative implication to myself. I hereby consent/ do not concert to have this interview recorded.

The duration of my participation if I choose to participate in the study will be between 30min to 1hr of interview time in one sitting.

Participant Signature……

Date:

In the event of any problems or concerns/questions you may contact the researcher at Cell 083 4040831 or 060 5446215

Appendix 6: Interview schedule

MARINE SERVICES OPERATIONAL CHALLENGES INTERVIEW SCHEDULE

Identify operational challenges facing marine services department within the port of Durban.

1. What are the most operational challenges facing marine services department, describe in detail?
2. What could be the sources of these marine operational challenges?
3. With your understanding of operations, what is common from marine operations challenges to that of other operations in different industries?

Understand marine operational challenge impact on the shipping industry.

4. Which operational challenges are mostly threatening continuity of marine operations within the port of Durban?
5. Who are the key stakeholders impacted directly or indirectly by these marine service operational challenges?

Present the plan of action to fast track implementation.

6. Is there any strategic or systems approach to implementing recommendations that could be prescribed?

Recommend action directed to mitigating the impact on the shipping industry.

7. What could be the unintended outcome which could be arising from these challenges if they remain unattended?
8. What are the external influences to these marine services operational challenges?
9. What recommendation could be presented to mitigate on the impact of these marine services operational challenges?