The role of the Maintenance Strategy in achieving the strategic objectives at Durban Container Terminal

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Abstract

This study examines the contribution of a maintenance strategy utilised at the Durban Container Terminal in meeting in achieving the objectives of the Market Demand Strategy. An organisation's maintenance strategy needs to be aligned to the firm's chosen and followed strategy. Poorly aligned, implemented or monitored maintenance strategy, has proven to contribute in the wastage of resources due to poor foresight, poor planning, increases in overtime cost and inferior quality which could affect the customer relations.

The study aims to assess the effectiveness of the maintenance strategy as well as the alignment by concentrating on the following questions namely: 1. Determining the effectiveness of the maintenance strategy used at the terminal, 2. Comparison of the terminal maintenance strategy to others, 3. Assess the perception of the employees, 4. Synergy between the Market Demand Strategy and the maintenance strategy, and 5. Factors that may influence the maintenance strategy. Chapter 5 follows each of these questions with discussions and recommendations emanating from the answers given by respondents

The researcher adopted qualitative research approach, aiming to source as much detailed and sufficient information as possible from the respondents. The study targeted mainly the technicians, engineers, supervisors and managers within the maintenance department as these are individuals responsible for the implementation and maintenance strategy. Out of a sample of 50 the study focuses on 16 respondents including two expect advisers from original equipment manufacturers (OEM).

The results from the study show that the organisation lacks in communication as the objectives of the Market Demand Strategy and the maintenance strategy are not known to most people. The study also finds that there is no synergy between the two strategies and that there is management tend to focus on past data analysis and not on future improvements. The organisation needs to conduct skills and resources needed for each task, and then would have to create a framework for both.

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Introduction to the Research

1.1 Introduction

Any department in an organisation can either support the institutional strategy by being aligned to it, or block the strategy by pushing against it (Bradford, 2015). This report seeks to understand the role and the alignment of the maintenance strategy and the main strategy as used at the Durban Container Terminal. The introduction attempts to give the background to the study, to stipulate the research objectives and to declare the questions that the study aims to answer as well as to comment on their relevance.

1.2 Background

Transnet is a South African logistics company exclusively owned by the state. It is responsible for a major contribution to the growth and development of the country's economy. The company aims to be cost-efficient as well as to be an efficient service provider. It has five operating divisions responsible for handling these services, namely Transnet Engineering, Transnet Freight Rail, Transnet Pipelines, Transnet National Ports Authority and Transnet Port Terminals. The focus of this paper will be on the Durban Container Terminal (DCT), which happens to be one of the biggest in the world and it is operated by Transnet Port Terminals.

In 2012, Transnet introduced the Market Demand Strategy (MDS) across all of its operating divisions. This impacted significantly upon its normal operations as each division's targets now increase yearly, with an aim of enjoying a bigger share of the market and of making South Africa the gateway into Africa and into, the rest of the world especially into other emerging economies as illustrated in figure 1.1 below. Transnet's vision and mission is "to be a focused freight transport company, delivering a service that is integrated, efficient, safe and reliable". This is planned to be achieved by penetrating untapped markets, increasing market share, improving productivity and profitability by providing capacity to customers ahead of demand (Transnet, 2014).

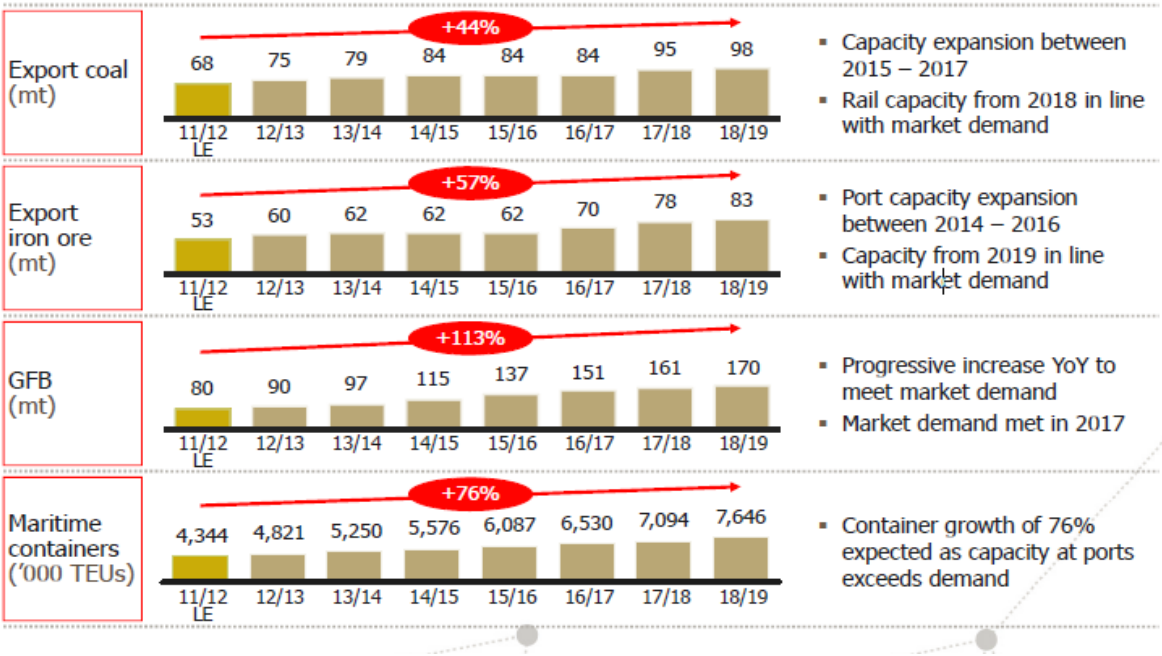

Figure 1.1: Additional capacity

Source:(Transnet, 2013)

The Durban Container Terminal (DCT), the biggest and busiest port in the continent, handles in excess of 65% of all containerised goods from and into the country. It is rated amongst the best in the world (Transnet, 2014). The geographic position of the port enables it to access different trading regions of the world. The terminal is able to move more than 3.6 million containers a year and around 18 000 each day. The terminal can accommodate in excess of 600 trucks a day and at least 4 wagons for container movement on the land side and a maximum of 8 vessels at any one time. The port's biggest customers are MSC and Maersk which are said to be the two largest container shipping companies in the world (SAFR, 2013).

DCT has deep berths able to accommodate huge vessels supported by super Post-Panamax 26 ship-to-shore gantry cranes that can service a maximum of 8 vessels at any one time. The rest of the fleet includes 7 rail-mounted gantry cranes servicing wagons, 120 straddle carriers, 78 internal haulers, 22 rubber tyres gantry cranes and 10 reach stackers all operating around the terminal. All this enables the DCT to be regarded as being amongst the best equipped in the world. It was ranked number 42 busiest port in the world by the World Shipping Council in 2012 (WSC, 2013).

The president of South Africa when he delivered his state of the nation address in 2012 and introduced the MDS he informed the nation that they would be investing R3.2 trillion in state-owned companies which included Transnet (SAnews, 2012). Amount in the region of 15 billion was reserved for DCT, using these resources and in pursuit of meeting the objectives of the MDS the terminal acquired super Post-Panamax equipment. The technical management has undergone a recruitment process to find technically astute individuals to work on this equipment. In the past Transnet had preferred to outsource maintenance of the equipment to the original equipment manufacturer (OEM) who would later transfer knowledge to the employees who would subsequently be expected to do maintenance on the equipment).

The number of major ports around the world still operated by state-owned companies has hugely reduced. Most of these have been outsourced and are now operated by commercial terminal operators with loads of experience in the industry (Emmanuel, 2012). This is proven correct by the fact that the top 10 container terminals in the world are all operated by commercial terminal operators. This puts pressure on the other terminals to come up with strategies to be on par with the rest in the industry.

1.3 Problem Statement

Highly technical equipment depends on the effectiveness of the maintenance regime for high performance and increased reliably. This research considers the impact that the maintenance strategy has on the terminal's ability in meeting the objectives of the Market Demand Strategy and how the maintenance strategy has affected the reliability of the equipment. The perceived problem was that highly critical and extremely expensive plant and equipment owned by Transnet Port Terminals in Durban is under maintained and such research was conducted to determine if this is indeed the case.

A comparison is made of the maintenance strategy utilised at other terminals. An assessment is made of the impact the strategy has on the terminal's economic bottom lines. Identification of problem areas in formulation and, implementation of

the strategy is undertaken. It is hoped that the continuous assessment will assist in determining the direction that needs to be taken in achieving the set objectives.

1.4 Purpose of the Study

The equipment reliability at the terminal poses a problem in achieving the objectives of the MDS. The equipment has either been unavailable due to major breakdowns or constantly breaking down during operations. The quality of work performed by the maintenance team, time taken on breakdowns and the intervals between the maintenance schedules has been a constant issue between the maintenance teams and operations. This causes tension between departments when set targets are not met and especially if there was unavailability of equipment.

There have been a growing number of unhappy customers whose vessels have had unnecessary overstays at the terminal due to unreliable equipment, and the terminal failing to meet the MDS objectives. High performing organisations often initiate and lead when others would just react to the situation or feel the need to defend themselves (Mbele, 2004). A review of an existing strategy can aid in identifying shortcomings so that the organisation can take decisions that are beneficial to the organisation (Ndimeni, 2010). Successful organisations continually reassess and regenerate their strategies to stay ahead of the pack.

Some of the maintenance approaches that may be followed may be expensive to implement at first, however later they may prove to be beneficial to the organisation. A development of guidelines to achieve an effective maintenance strategy that will reduce costs and improve reliability of the equipment is thus necessary (Mansingh, 2010). Analysis of a strategy helps to gauge the existing internal and external condition faced by an organisation in its pursuit to meeting its objectives (Gopal, 2006). For the main business strategy to maintain its objectives it needs to be driven together with all other strategies developed by supporting departments (Al-Turki, 2011).

The strategies used by the supporting departments need to link in order to be effective in helping the terminal reach its objectives, Transnet could boost the economy of the country. The achievement of the MDS's objectives at the terminal relies heavily on effectively maintained equipment. Effectively maintained equipment results in satisfied internal customers and more importantly external customers, who bring in money to the business (Ndimeni, 2010).

An increase in international trade might provide the country with much needed economic growth and this, in turn might improve investor confidence and perhaps reduce the rate of unemployment in the country. The number of vessels that wait long hours and sometimes days in the sea waiting to be berthed at the terminal could be reduced and the ship turnaround time would improve. The shipping lines pass the ship operating costs incurred whilst waiting idling at sea to the terminal in the form of surcharges and hence this reduces profits (Lutchman, 2005).

1.5 Aims and Objectives

The aim of this report is to assess the impact of the maintenance strategy in assisting the terminal to reach the objectives of the Market Demand Strategy. Another aim was to assess the role of the maintenance strategy in improving the availability and the reliability of the equipment at the terminal, and to assess the existing maintenance strategy utilized at Durban Container Terminal. The purpose of this was to assess the effectiveness of the existing maintenance strategy and whether or not it is aligned to the main business strategy.

1.6 Research Questions

The aims and objectives of the research are to canvass employees for their views to:

1) Determine the effectiveness of the maintenance strategy in achieving the objectives of the MDS;
2) Enquire into the terminal's maintenance strategy and to compare this to maintenance strategies of other comparable terminals in the world, and what can be learnt from them;
3) Assess their perception of the effectiveness of the maintenance strategy;

4) Establish if there is a breakdown in synergy between the MDS and the maintenance strategy; if so to find the reasons for the breakdown; and
5) Identify factors which may prevent the maintenance strategy from achieving its objectives.

1.7 Significance of the Study

Improvements to the maintenance strategy can be brought about by anyone of the stakeholders and not just the maintenance personnel involved in its execution (Ntshangase, 2010). The study determines the impact the maintenance strategy has on the overall business strategy. The study will then help to establish if there are any changes that need to be adopted for the main business objectives to be met. This research further investigates if there is any difference between the maintenance strategy used at the Durban Container Terminal and those employed by other comparable terminals in the world.

1.8 Limitations of the Research

This research concentrated on the maintenance departments possible at the expense of considering the impact of other departments within the terminal. The time devoted to the study was not long enough to gather sufficient information. The study relied on the respondent's perception of the strategies which does not represent the sentiments of the whole population. There is no input to the study coming from the shipping lines to give comparisons to the way the terminal operates as compared to others. The study doesn't cover the cost of poor maintenance and optimisation of such.

1.9 Methodology

Research methods used for a study could be qualitative, quantitative or a mixed type and form. This study utilises qualitative research, aiming to acquire more than the expected answers to research questions.

1.10 Chapter Outline

This research paper was broken down into 5 chapters as outlined below:

Chapter 1 gives a background to and motivation for the study. The study problem is articulated in full, whilst the aims and objectives of the study are explained. The chapter outlines all the research questions. Lastly the limitations of the study are declared.

Chapter 2 presents the theoretical literature regarding strategy, maintenance strategy and other maintenance strategy related matters. The chapter touches on benchmarking, performance measurement, employee perception and customer satisfaction.

Chapter 3 describes the general research methodology to be employed in this study. The chapter outlines the research design, sampling and data collection. The pilot study conducted prior to the study, the validity and reliability of a study will also be discussed in this chapter. Finally the chapter outlines the ethical considerations taken when conducting a research study.

Chapter 4 presents the results from the study. The collected data is presented in graphical format using, tables with the provision of descriptive discussions.

Chapter 5 contains the conclusion and recommendations of the study. The chapter summarises each finding against each research objective and suggestions for future research are provided.

1.11 Chapter One Summary

It was explained that the study attempted to determine the effectiveness of the maintenance strategy operant at the DCT. The introductory chapter is a summary of the research the study aims to undertake. The next chapter will review the relevant literature concerning the subjects to be covered in the investigation.

Chapter Two
Literature Review

2.1 Introduction

Zengyong, Peng and Aimin (2012) state that strengthening and improving equipment maintenance management, the equipment maintenance activities promote the total quality control. However, existing maintenance strategy has to be investigated extensively before meaningful improvements can be implemented and the benefits and effectiveness of the maintenance strategy need to be measured against the organisation's strategic objectives.

This chapter's objectives are to examine the relevant extant literature on maintenance performance analysis, benchmarking, and measuring performance of a strategy when compared to others, customer satisfaction, employee perception, and the types of maintenance strategies and to look at the importance of strategic alignment. This chapter will aim to create a strong foundation on which the results of the study are going to be based.

2.2 Strategy

Business strategy is what organisations create as a plan to gain competitive advantage (Shavarini *et al.,* 2013). MacIntosh and Beech (2011) suggest that strategy is more concerned with controlling of future business conditions and they claim that it puts the focus on what the organisation needs to do to be in a better position to claim a strategic advantage. A well-executed strategic plan can result in high performance and success (Antonio, 2013). Mpungose (2011) stated that the executive of an organisation designs, plans, executes and indirectly controls the implementation of such within an organisation.

Mintzberg, Quinn and Ghoshal (1999 cited in Solenen, 2011) state that strategies need to have clear and unambiguous objectives. In order to be effective, formal strategies should:

- Contain three essential elements: goals, actions to be taken and a plan of action;

- be developed around a few key concepts and issues;
- deal with the unknown and unpredictability; and
- be underpinned by supporting strategies.

According to Louw and Venter (2006 cited in Fitzsimmonds, 2012) the following are common elements of a strategy:

- Strategies assist in sustainment of organisational purposes;
- Strategies are created to attain competitive advantage, by using the organisation's external and internal environment for assessment and improvement;
- Strategy determines the contributions to be made by and for stakeholders;
- Strategy has an impact on and is affected by the organisation's daily operational activities;
- Strategy is driven by the aims and vision of an organisation; and
- Strategy is influenced by the long-term direction of the organisation.

For any organisational strategy to be effective the organisation needs to assess its weaknesses and needs to identify where improvement is needed, what its strengths are and how these can be enhanced, what opportunities to grasp and what threats there are to guard against. Strategies must be adaptive. They should keep pace with change with an aim of maintaining strategic fit, using both internal and external analysis (Antonio, 2013). Organisations must select a distinctive strategy, based on its internal and external analysis, performing activities that are different, if possible to those of their competitors (Shavarini *et al.*, 2013). However change doesn't have to take place if there is no real tangible reason for change (Fitzsimmonds, 2012).

There appears to be insufficient focus placed on the people tasked with the execution of the strategy (MacIntosh and Beech, 2011). During strategic planning every individual in the organisation must adopt and live the strategy from management down to the shop floor (Al-Turki, 2011). This ownership of the strategy could be achieved by spreading the word among employees, with the aid of information sessions or workshops. Employees that feel part of the strategic planning

process will behave and make decisions based on strategic impacts and global, local and national objectives.

2.3 Alignment of Strategies

Alignment of multiple strategies is one of the most critical tasks to be undertaken by an organisation (Balmer, Stuart and Greyser, 2009). Porter (1996 cited in Kalili *et al.,* 2013) suggests that alignment involves coordination of various facets of an organisation. For any organisation to succeed it would normally develop strategies for corporate, business and for functional aspects of the enterprise. In most cases the relationship between these levels is non-existent and co-ordination is needed to get maximum output from all of them (Khalili *et al.,* 2013). Therefore the starting point before anything can be said about a Departmental strategy must be with an assessment of the business strategy (Smith, Mckeen and Singh, 2010). If the functional strategy develops its own capabilities in opposition to those of the business and corporate strategies then there will be a great misalignment (Balmer, Stuart and Greyser, 2009).

Senior management craft the corporate strategy, from planning to implementation, however execution of the strategy is left to the functional levels of the organisation (Bosua and Venkitachalam, 2013). In most cases the strategies don't tie up or even support each other, each pulling in a different direction. This could then affect the organisational strategy which may result in a failure to produce the desired output (Wilson, 2012). This in turn could lead to the business rejecting new strategies and returning to the older tried and tested strategy that worked for it in the past (Khalili *et al*., 2013). This could affect the organisational performance as the older strategy was a product of conditions that applied in the past. The rejected newer strategy might have been attempting to address current and more relevant conditions.

Hough and Gamble (2011) suggest that there could be elements like work culture in a Department that could present pitfalls in pursuit of the strategic objectives. Assessing the role played by operation, the way the Department is managed could have a great impact on customer's perception and attractiveness of the organisation. Operations inefficiency will affect the customers' business by creating a tainted

image of the organisation which would make it difficult to achieve its desired objectives (Bradford, 2015). He then suggests that organisations need to share strategies with each Department so that they can support the main strategy and, each Department should note what they could do to assist in meeting the objectives of the main strategy.

The main strategy could then be strengthened if the organisation already knows the possible shortfalls and pitfalls (Bosua and Venkitachalam, 2013). The organisational, business and functional strategies need to co-exist as they each shape each other. Each function needs to develop a strategy that talks to and aims to support the corporate strategy and vice versa (Rezende, 2011). To see this materialise Iyer, Srivastava and Rawwas (2014) suggest that Departments measure themselves financially, since all functions contribute to the bottom line. The corporate strategy cannot aim to achieve objectives whilst it has not supported the functions or Departments with expertise and resources not knowing the core competences that are required to execute the corporate strategy (Leme Fleury and Correa Fleury, 2005). A strategy that is fully supported by the functional strategies results in a better performance (Khalili *et al.,* 2013).

The AC³ID Test can be used to diagnose and work at resolving the identified misalignment that could be hampering their achievement of the strategic alignment (Balmer, Stuart and Greyser*,* 2009). The test is based on six identity questions which need to talk to each other as seen in figure 2.1. Each is linked to an organisational issue, namely actual, communication, conceived, covenanted, ideal and desire (Balmer, Stuart and Gryser*,* 2009). The organisation's management needs to make sure that there is a relationship between the identity type questions.

Balmer's AC³ID Test of Corporate Brand Management

Critical Concern	Identity Type	Concept	Time Frame
What we really are	Actual	Corporate Identity	Present
What we say we are	Communicated	Corporate Communications	Past/Present
What we are seen to be	Conceived	Corporate Image	Past/Present
What the brand stands for	Covenanted	Corporate Brand	Past/Present
What we ought to be	Ideal	Corporate Strategy	Future
What we wish to be	Desired	CEO Vision	Future

Figure 2.1: Balmer's AC³ID Test

Source: (Balmer, Stuart and Greyser, 2009)

Richmond (1997) suggests that organisations should utilise a strategic forum in pursuit of a more feasible strategy. The forum should be conducted off site and should include representatives of all relevant functions and Departments. The forum should last for a period of 2 to 3 days. The aim of the forum is to enable the cross-functional management team to adopt the strategy, build capacity for systems thinking and make it possible for the strategy to yield its stated performance objectives (Richmond, 1997).

Khalili et al. (2013) introduced the Conceptual model comprising business strategy, area of operational decisions and their strategies for forging alignment. The model recognises that the relationship between the strategies is bilateral where each strategy determines the success of the other. The process starts with determining business strategy and ends in the functional strategy (Khalili *et al.,* 2013). The state of alignment is produce by comparing performance data with the alignment type of the two strategies classified into four groups.

2.4 Formulation of a Maintenance Strategy

An implemented maintenance strategy is not meant to only give directions but it needs to function as a road map and allows alternatives in case of a failure or improvements, it ought to remain flexible and move with the situation around it (Fredriksson and Larsson, 2012). Al-Turki (2011) stated that the process for formulation of a maintenance strategy has the following steps:

- Identification of all relevant stakeholders;
- Drawing up of the mission statement;
- Coming up with strategic maintenance objectives;
- Analysis of the current strategy and its effectiveness on the current situation;
- Putting strategic issues into perspective;
- Setting up a plan to achieve the strategic objectives;
- Selecting an appropriate strategy;
- Developing performance measures; and
- Execution of the plan.

According to Salonen (2009 cited in Fredriksson and Larsson, 2012) it is important to consider the following points when formulating a competitive strategy:

- The company's strengths and weaknesses: Internal analysis, the organisation examines itself regarding what it does best and what could be improved on to become better at what they do (Paley, 2006). The organisation needs to improve the resources of the organisation in equipping the organisation to maintain the strategy otherwise the organisation could face failure;
- The key implementer's personal values: Internal look at within, for the strategy to bear fruits, it needs to be supported by effective plans for planning, implementation and execution, without a solid plan there might be no idea as to what to do when there are obstacles;
- Opportunities and threats from the industry: External assessment and identification of the organisation's market opportunities, threats that could be ahead of it in perusing the organisation's growth; and
- Expectations: the strategy needs to be flexible, there needs to be a constant assessment of the external factors, allowing improvements to meeting the constant requirement changes from the customers.

Strategy needs to be formulated with an aim of meeting all relevant factors that could affect and improve its execution (Al-Turki, 2011). The selection and implementation of a maintenance strategy must be made and taken considering the equipment used as well as the resources at hand. Organisations will need to consider all their internal and external factors in crafting a maintenance strategy designed for the organisation, capable of taking it to the next level (Braglia, Castellano and Frosolini, 2013).

2.5 Maintenance Strategy

According to Kister and Hawking (2006 cited in Fredriksson and Larsson, 2012) maintenance gained momentum just after World War Two (WW II). Our lives are becoming more and more dominated by technology and business today is highly dependent on technology which needs to function reliability (Murthy *et al.,* 2002). The nature of competition amongst organisations has raised the importance of the maintenance function to ensure this reliability (Tsang, 2002). An effective maintenance strategy for business is one that would have a significant information system, data collection capability, a planning and maintenance schedule and a training programme to support it (Moeko and Visser, 2013). At design stage, equipment is presumed to be reliable. Weaknesses will enter later on due to a host of reasons, and to reinstate reliability the equipment needs asset care (Narayan, 2012).

For maintenance management to be effective it must be viewed as a strategic organ within an organisation needing continuous maintenance management improvements (Murthy, Atrens and Eccleston 2002). The cost for maintenance is increasing across the world at around 20% to 40% of the total factory operating costs (Tsang, 2002). The easiest way to reduce these costs would be to permanently stop doing maintenance. This however, will produce very costly end results (Horner, El-Haram and Munns 1997). The need is to come up with a strategy that will ensure that the organisation delivers high quality and dependable quality service at a reasonable cost by optimising resources to meet expectations and agreed service levels (Moeko and Visser, 2013).

The objectives of a maintenance strategy are mainly driven from the business strategy (Raouf *et al.,* 2006). In adopting a maintenance strategy that would be effective and produce results, the user needs to be aware of the potential failures, of the equipment so that he or she can plan to avoid them (ReliabilityEdge, 2014). A successful equipment maintenance strategy ensures that the life-span of the equipment vital to the operation of the business is increased and rendered more efficient (Fitzsimmonds, 2012, Munteanu and Nemes, 2012).

Maintenance could account for a sizable portion of the production cost of an organisation, yet it plays an important role in ensuring that production is improved. However, the maintenance costs could affect the price of the goods (Mjema, 2002, Salonen and Bengtsson, 2011). On the other hand, having an efficient and responsible maintenance team performing effective maintenance produces the required level of product quality.

Solonen (2011) listed the following as factors that could affect the maintenance spend:

- Operator time lost: The time taken by operator to report the failure, response time and the time taken to recover the equipment;
- Costs of repairing the equipment: The cost of the replacement, together with the time it takes to repair the equipment;
- Loss of production: Due to the non-availability of the equipment on breakdown or due to the equipment working at half capacity;
- Cost of scrapping due to maintenance action: Poor maintenance could shorten the life span of equipment, poor diagnostics of a problem would mean that equipment is damaged and changed before it could perform its intended purpose;
- Non-availability of spares: Could lead to the equipment being left idle as it would be non-operational, even affecting workers who would have worked the equipment;
- Lack of training: Poorly trained or untrained employees could cause unnecessary lengthy unavailability due to not knowing what has to be done to reinstate the functionality of the equipment.

Not all implemented maintenance strategies deliver desired effects. Some might look and sound like they should be effective but they might still produce failure after implementation (ReliablePlant, 2014). In most cases this failure is costly for the organisation as resources would have been used in planning and execution and the equipment in some cases would be unavailable for a significant period of time. To counter this there should be measures instituted to assess the effectiveness of the strategy (Fredriksson and Larsson, 2012). Al-Turki (2011) on the other hand feels that the maintenance strategy is mainly made up of activities related to maintaining a certain level of reliability of the equipment and maintain a standard level of quality.

Simoes, Gomes and Yasin (2011) suggest that maintenance has advanced leaps and bounds and now has included components like risk management and other tools. The issues now also considered include: equipment selection, asset care, spare parts inventory, and the equipping of available human resources (Al-Turki, 2011, Mkandawire, Ijumba and Whitehaed, 2011). The main aim being to improve reliability and availability, by performing maintenance (Mkandawire, Ijumba and Whitehaed, 2011). For the strategy to be seen as being effective it must be seen as working hand in hand with the production processes as illustrated in figure 2.2 below.

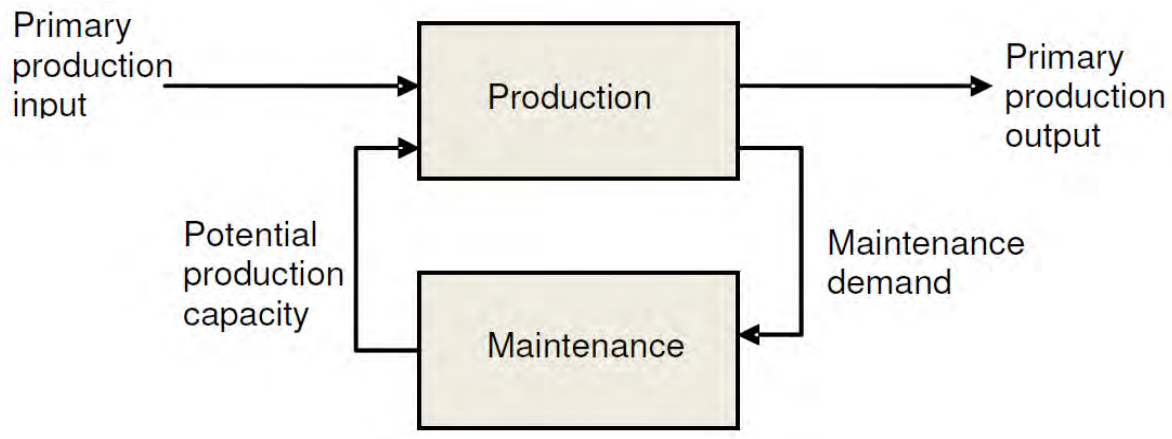

Figure 2.2: Maintenance and production relationship
Source:(Solonen, 2011)

2.5.1 Reactive or Corrective Maintenance

According to Horner, El-Haram and Munns (1997) reactive maintenance is the simplest type of maintenance strategy, the equipment is allowed to run and maintenance only happens if there is a failure or if the user requests maintenance to be undertaken. There could be replacement of equipment or a repair. The equipment runs in use until it breaks down. In most instances, when the equipment fails it has to be repaired before the designer's intended life span is reached (Sullivan *et al.,* 2011). Starr (1997 cited in Solonen, 2011) suggests that reactive maintenance is suited for noncritical equipment, with no safety risk if it fails and it should be possible quickly to identify the cause of failure. Information used for predictive maintenance is developed from data acquired from reactive maintenance (Horner, Al-Haram and Munns, 1997). Better asset care and the introduction of preventative maintenance reduces the amount of reactive maintenance (Mobley, 2002). Moeko and Visser (2013) stated that reactive maintenance is expensive since it causes downtime.

2.5.2 Planned or Preventative Maintenance

Preventative maintenance was introduced to address limitations of corrective maintenance. This involves the planning of maintenance to be undertaken at predetermined intervals (Horner, A-Haram and Munns, 1997). Sullivan et al. (2011) define it as a type of maintenance performed on schedule that can detect component defects with an aim of extending its useful life. Preventative maintenance can prevent unnecessary breakdowns that could be costly to the organisation (Mobley, 2002). According to Dhillon (2002) equipment is kept in a satisfactory condition through constant inspection and through performing repairs during early stages of signs of failure. Mobley (2002) state that all preventative maintenance programmes have scheduled time lines, when maintenance is performed. According to Moeko and Visser (2013) a reduction in failures, increases the utilisation of equipment and reduces the cost of maintenance.

2.5.3 Predictive Maintenance

Predictive maintenance measures and detects degradation of equipment performance and measures are taken to control the degradation before it deteriorates further (Sullivan *et al.,* 2011). Mobley (2002) suggests that predictive maintenance should monitor the behaviour of equipment using an analysis instrument, to detect potential problems, to minimise the number of unproductive outages and to prevent the equipment from avoidable costly repairs.

Mustakerov and Borissova (2013) state that it is more than just monitoring; it's the means to improve availability and to improve productivity. When effectively using predictive maintenance an organisation can plan for maintenance activities to minimise overtime costs, minimise the need to carry spares and only ordering parts ahead of time when needed (Sullivan *et al.,* 2011). As illustrated in figure 2.3 below organisations aim to move toward world class facilities where organisations will only realise growth (SKF, 2006). The figure show that fire reactive maintenance is synonymous with overtime and fighting, planned maintenance is equated to avoiding failures and surprises and optimisation is represented by uptime, competitive advantage, efficiency and world class operations. Mustakerov and Borissova (2013) state that maintenance methods were devised to compensate for shortcomings in maintenance by introducing components like total productive maintenance and reliability centered maintenance.

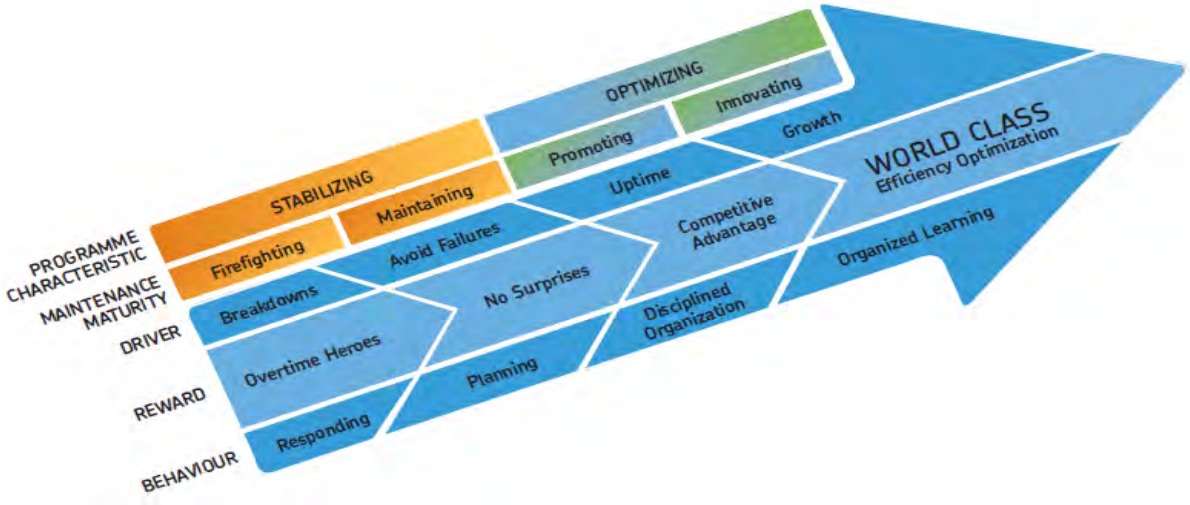

Figure 2.3: Phases of maintenance maturity

Source: (SKF, 2006)

2.5.4 Reliability-Centered Maintenance (RCM)

Prasanna, Akula and Desai et al. (2011) suggest that reliability centered maintenance is an approach that assesses equipment condition and determines the maintenance requirements for that equipment. They further state that a maintenance programme should be structured on the prioritised needs of the equipment. This approach attempts to balances the relative needs of both preventative and reactive maintenance on the equipment in an attempt to reach the most cost efficient solution (Nilsson and Bertling, 2007, Sullivan *et al.,* 2011).

Moubray (1997 cited in Rastegari, 2012) defines reliability-centred maintenance as a process of identifying steps to be taken to ensure that equipment continues to perform its activities as expected by the user. Reliability-centered maintenance favours predictive maintenance, as it allows the equipment to meet the operational requirements while improving reliability and decreasing costs (Sullivan *et al.*, 2011, Mobley, 2002).

Dhillon (2002) lists the following as important goals of reliability-centered maintenance:

- To develop design associated priorities that can facilitate planned maintenance;
- To gather information useful for improving the design of items with proven unsatisfactory, inherent reliability;
- To develop planned maintenance related tasks that can reinstate reliability and safety to their inherent levels in the event of equipment or system failure; and
- To achieve the above goals at minimal cost.

Solonen (2011) and Dhillon (2002) both suggest that reliability-centered maintenance is applied by asking the following questions:

- What are the functions and associated performance standards of the asset in its present operating context?
- In what way does it fail to fulfil its functions?
- What causes each function failure?

- What happens when each failure occurs?
- In what way does each failure matter?
- What can be done to predict or prevent each failure?
- What should be done if a suitable proactive task cannot be found?

According to Dhillon (2002) once the above questions have been addressed, the following steps are then followed:

- Identification of important maintenance items;
- Gather failure data;
- Develop fault tree analysis data;
- Apply decision to critical failure modes;
- Classify maintenance requirements;
- Implement decisions taken regarding reliability-centered maintenance;
- Apply engineering on the basis of field experience.

2.5.5 Total Productive Maintenance (TPM)

This maintenance strategy was introduced by Deming in the 1950's. It put emphasis on the adherence to basic maintenance such and visual inspections and adoption of universal best practices (Mobley, 2002). TPM describes a cooperative relationship between all functions in an organisation, but mainly between maintenance and operations with an aim of improving the quality and improve the efficiency of the operation plant (Jostes and Helms, 1994). The operations personnel help the maintenance team when repairing the equipment to optimise effectiveness and together they perform process improvements in team activities through small group activities, on a company wide basis (Cigolini and Turco, 1997, Ahuja and Khamba, 2008).

Venkatesh (2007) suggests that total productive maintenance could be considered as the medical science equivalent for equipment. Its aim is to boost production whilst increasing employee morale and job satisfaction. He goes on to say that maintenance is put under the microscope as an important component of the business, unlike before when it was regarded as a non-profit activity. TPM brings

maintenance into focus as a necessary and important part of the business (Ahuja and Khamba, 2008).

Companies in different industries adapt and implement TPM according to their needs (Cigolini and Turco, 1997). The same authors suggest that there are two methodological tools representing TPM in operation namely the eight pillar and the five pillar models. The entire structure of TPM in terms of the first model is built and stands on eight pillars, paving the way for excellent planning, organising, monitoring and controlling practices. Sangameshwran and Jagannthan (2002 cited in Ahuja and Khamba, 2008) stated the eight pillars as follows:

- Autonomous maintenance;
- Focused improvement;
- Planned maintenance;
- Quality maintenance;
- Education and training;
- Safety, health and environment;
- An office of total productive maintenance; and
- Development management.

While Yeomans and Millington (1997 cited in Bamber, Sharp and Hides, 1999) suggested that the elements of any TPM programme should aim to provide five pillars of TPM development namely:

- Increase equipment effectiveness;
- Training;
- Autonomous maintenance;
- Early equipment management; and
- Planned preventative maintenance.

Total productive maintenance has been classified as a manufacturing strategy that has the following steps (Suzuki, 1992) and (Ahuja and Khamba, 2008):

- Maximising equipment effectiveness through optimisation of equipment availability, performance, efficiency and product quality.

- Establishing a preventative maintenance strategy for the entire life cycle of the equipment.
- Covering all Departments such as Planning, Operations and Maintenance departments.
- Involving all staff members from top management to shop-floor workers; and
- Promoting improved maintenance through small group self-directed activities.

According to Bamber et al. (1999) the obstacles that a few organisations have encountered after introducing TPM could be attributed to the following:

- Lack of management support and understanding;
- Lack of sufficient training; and
- Failure to allow sufficient time for the evolution.

Naguib (1993 cited in Ahuja and Kumar, 2009) suggests a five phase roadmap for a successful implementation namely:

- Institution of an awareness programme throughout the organisation from management to shop floor employees;
- Restructuring of the manufacturing organisation to, integrate maintenance
- Planning maps to cover activities related to maintenance management and workplace improvement;
- Implementation process based on the work of cross-functional and self-directed teams; and
- An assessment process to bridge the gap between the implementation process and the direction is defined for continuous improvement.

2.6 Maintenance Management

According to Moeko and Visser (2013) companies aim to achieve and then maintain World Class maintenance which is rounded to 80% proactive maintenance and 20% reactive maintenance. Venturing to preventative maintenance data and information regarding the condition of equipment becomes very important. Organisations are looking at a reliable solution to keep data safely and make it accessible to everyone (Selvi *et al.*, 2013). To improve equipment maintenance management we need to

investigate the equipment maintenance activities and promote equipment quality control (Zengyong, Peng and Aimin, 2012). Kelly (2006 cited in Solonen, 2011) stated that maintenance management's objectives are to maintain agreed operating pattern, providing availability and maintaining product quality. Establishing operational targets maintenance would be in a better position of determining the sufficient amount of needed resources.

According to Gupta (2009 cited in Fredriksson and Larsson, 2012) maintenance management consist of the following:

- Setting aims and objectives;
- Means of achieving the set aims and objectives;
- Making decision.

Khairy (2008 cited in Rastegari, 2012) states that processes of maintenance management consist of the following:

- Planning of equipment maintenance;
- Scheduled maintenance;
- Managing of maintenance execution;
- Assessment of continuous improvement.

2.7 Maintenance Performance Analysis

Maintaining equipment is not only meant for the prevention of equipment from failure but it's also for improving the quality of productivity, reducing inventory and lowering operational costs (Khan and Darrab, 2010). Decision makers in maintenance tend to be efficient and they spend resources measuring the performance of the organisation's maintenance (Parida, 2007). He goes on to state that to manage performance it needs to be measurable and an implemented performance measurement system should ensure that actions are aligned to strategic objectives.

As the equipment starts to age the performance will deteriorate (wear-out stage), the same performance deterioration can be experienced with new equipment when it has teething problems (start-up). This can best be explained using the bathtub curve as shown in figure 2.4. The performance of each piece of equipment needs to be

measured using the bathtub curve. The infancy stage might be brought about because of installation problems during the first period of operation, after the normal operation period the failure rate increases yet again. A strategy should be developed and analysed with the aid of the bathtub curve to get the utmost from the equipment and to have a reduced failure rate at each stage (Mobley, 2002, Parida *et al.*, 2015).

Organisations aim to improve maintenance performance since it plays an importance role in the organisation's long term profitability and could improve operational performance (De Groote, 1995). However it is sometimes hard to measure and hence to perform the assessment, the existing problems need to be identified first so that suggested measures of improvement can be implemented and classified in priority form and a plan of action can be created.

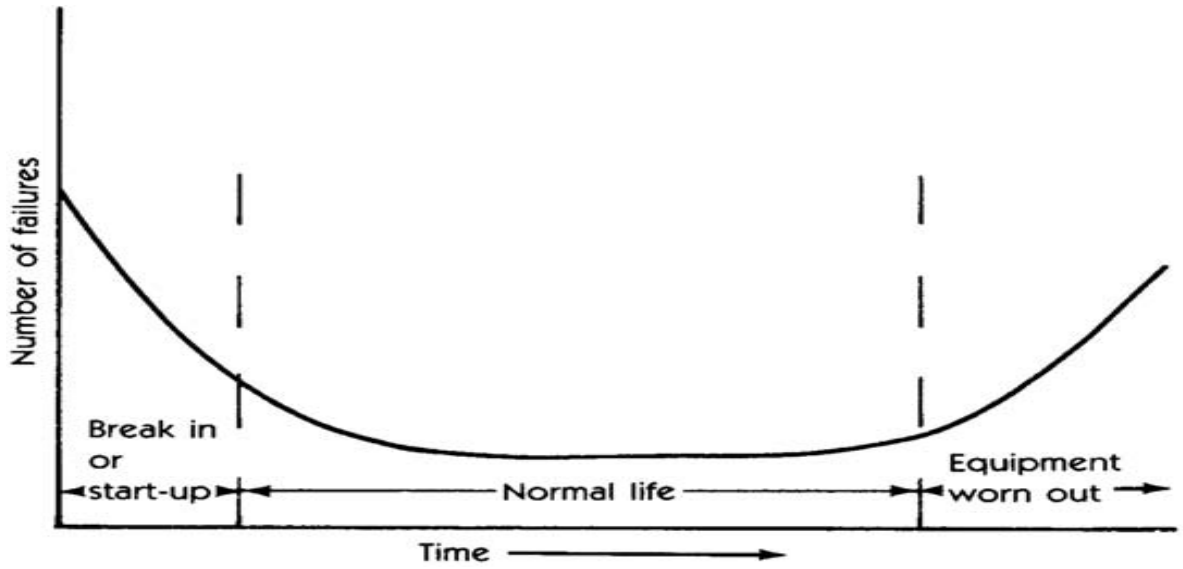

Figure 2.4: Typical bathtub curve
Source:(Mobley, 2002)

Labib, O'Connor and Williams (1998) introduced the concept of an analytic hierarchy process (AHP) in developing a model for making maintenance related decisions and for maintenance strategy formulation. They state that the method is used when comparing general criteria of criticality such as frequency of calls, down time and costs or when there is no quantitative data. They aimed to develop a maintenance system that would use existing data and which could assist in making decisions (Parida *et al.,* 2015).

AHP is designed to work in three stages:

- the first one is identifying criteria used to formulate a maintenance strategy;
- the second one is to differentiate and then implement the criteria in order of importance; and
- logging all failures giving an in-depth detailed and focused analysis of each failure (Labib, O'Connor and Williams, 1998).

This method is said to have an impact on the productive maintenance as it is focused on details.

De Groote (1995) on the other hand introduced the concept of a maintenance quality audit, containing four stages namely maintenance survey of the situation at hand, the analysis of the acquired information, setting of priorities and to do list and lastly cost benefit. The audit is carried out by a form of questionnaire which is directed at the maintenance personnel from the manager down to the shop floor workers in the organisation. The production personnel are also included as well to give basic knowledge of the items to be maintained.

Once an idea regarding the condition and operation of the production equipment together with the production requirements is conceived, the analysis begins starting with the existence of a maintenance master plan. The analysis also looks at the people factor and cost management involved in the study (De Groote, 1995). Using the answers from the questionnaire together with the interviewer's impressions a conclusion can then be drawn up, preferably in the form of a tabular summary. The recommendations are thus subdivided under production equipment, organisation and management of maintenance, material resources, human resources and work environment. Priorities are then established which determine the plan of action in the short-term, medium-term and the long-term.

Maintenance performance indicators (MPI) are used to measure the impact of maintenance on the process performance (Wireman 1998 cited in Parida, 2007). These are linked to downtime, costs and quality comparative performance indicators and required conditions. A detailed discussion and study of the problem area is conducted where interviews are held with personnel from that area as well as from

the process study. Failure causes, costs and failure patterns are studied to determine the effectiveness of the total maintenance process and to understand the process. These are collected using the reporting system used at the plant. The MPIs are studied and allocated to hierarchical levels of priority and are classified as internal or external before deciding on the relevance levels for the maintenance performance measure (Parida, 2007).

A good maintenance strategy would lead to improved equipment reliability and equipment effectiveness that should positively impact upon quality (Khan and Darrab, 2010). Looking at these mentioned measurement indicators a common factor emerges where maintenance is related to quality, productivity and profitability. The importance of data collection is placed high on the list of priorities as well as the classification of the acquired data in sequence of execution. More maintenance results in smooth uninterrupted operation of machinery. If this is not then there is a need to revisit the strategy.

2.8 Performance Measurement

Strategies need constant assessment and improvement when necessary to yield good results. Performance measurement is an essential contributor to the overall evaluation. The business competitive conditions faced by organisations change rapidly and hence the need for continuous strategy analysis and performance measurement (Acur and Englyst, 2006). These assessments are about managing the future and about strengthening the effectiveness of the implemented strategy. Sometimes this assessment can even create a new direction to be taken, completely changing the initial implemented strategy. There is a need for the strategy and performance measurement always to be aligned to produce positive results (Dyson 2000 cited in Johnston and Pongatichat, 2008). The effectiveness of the strategy can only be assessed if one can identify and evaluate the strategy (Raouf *et al.*, 2006).

Roberts (1994) suggests that performance measurement is there to monitor and, control activities and to motivate strategic changes to management if things are not going as planned. Effectively implemented performance measurement systems should assist an organisation to meet strategic objectives (Dixon, Nanni and

Vollmann, 1990 cited in O'Mara, Hyland and Chapman, 1998). However developing an effective performance measurement system poses problems in giving reliable and validated measures (Eddy, 1998 and Palmer, 1996 cited in Lied, 2001). Performance measurement is used to direct resources to where they are needed the most and assess and communicate progress made towards achieving strategic objectives (Radnor *et al.,* 2005).

The way performance measurement systems are used can differ from application to application. Some might be reporting on mechanisms while others might be for controlling product or, employee performance (Feurer and Chaharbaghi, 1995). If performance measures are not aligned to the strategic objectives there will be lingering validation issues and reliability could be questioned (Lied, 2001). Skinner (1971 cited in Johnston and Pongatichat, 2008) suggests that the criteria for assessing the output of an organisation should not only be based on cost but that other factors should be included to make the strategy competitive. Performance measurement could be employed to understand and measure the internal and external competitive position of an organisation and could lead to strategic change or improvement.

Continuous organisational performance measurement reviews help to ensure that there is a proper alignment to the objectives of the strategy. However if this is not done then performance measurement might be seen as irrelevant (Johnston and Pongatichat, 2008). They further suggest that the operational performance measurements must be derived from and need to support the strategic objectives. A strategy aligned performance measurement system facilitates and supports the implementation of a strategy of an organisation (Pongatichat and Johnston, 2008). Lillis and Veen-Dirks (2008) emphasise the importance of constant alignment of the measurements since measures meant for low-cost strategies will not have similarities with those used on differentiation strategies.

Choong (2013) presented three features of performance measurement systems namely data or variables, measuring attributes and measurement methods. Data needs to be non-financial for instance the use of customer data as suggested by (Grant, 2011 and Choong, 2013). Measuring attributes are developed by the

organisation itself, described as both financial and non-financial. Whilst measurement methods will be financial and quantitative, (Nelly *et al*,. 1995) and (Kaplan and Norton, 1996) suggested the usage of the balanced score card, whilst (Dumond, 1994) suggested the use of statistical techniques (Choong, 2013).

Kaplan and Norton (1992 cited in Domanovic, Jaksic and Mimovic, 2014) introduced a balanced score card to evaluate a strategy, using four perspectives namely financial, marketing or customer, internal processes and learning and development. The strategic goals of the organisation are classified according to measures on the four perspectives. Financial perspective measures financial performance, growth, profitability and risk control of the organisation (Hough and Gamble, 2011).

Marketing or customer perspective measures of how customers perceive the organisation, are like customer satisfaction, customer loyalty and market share (Hough and Gamble, 2011). Internal processes measure the organisation on what the organisation needs to perform to satisfy customers (Hough and Gamble, 2011). Finally the learning and development involves the people factor. Does the organisation have the required resources and are the personnel adequately enabled to perform their duties (Hough and Gamble, 2011) and (Domanovic, Jaksic and Mimovic, 2014).

An increased quantification of performance measures yielded desired results in measuring the performance of a strategy. In their study, Hough and Gamble focused on Contingency-Based Indirect Alignment Path which has three factors, namely quantification, scope of work and timeline (Perego and Hartmann, 2009). Finally the timeline, measures the time taken to report back (Perego and Hartmann, 2009). According to Fredriksson and Larsson (2012) key performance indicators can be classified as lagging and leading, lagging being indicators that indicate after the occurrence and leading a measure of performance before an occurrence.

According to Ntshangase (2010) measures can be categorised as follows:

- Equipment performance (reliability and availability);
- Cost performance (labour, material, service and overhead); and

- Process performance (emergencies, unplanned work).

2.9 Benchmarking

Wireman (2004) makes a comparison between benchmarking and competitive analysis, stating that the former is when one researches for information and the latter shows where the company is placed when compared with competitors. He goes on to say that competitive analysis doesn't show a company's short comings but only gives ranking. On the other hand benchmarking takes a company a step further in understanding and achieving better performance by understanding the processes and the need for bettering of skills.

Moriarty (2011) suggests that the main goal of most businesses is to establish and maintain a competitive advantage, achieved by constantly comparing oneself with counterparts. Benchmarking might be viewed as imitating whoever it is who has successfully initiated innovation (Dattakumar and Jagadeesh, 2003). This is done by adopting the best industry practices, in an attempt to improve productivity, quality and competitiveness. Benchmarking works better if one uses the industry leader and is aware of the company's strengths and weaknesses. Madu (2000) states that benchmarking could help an organisation better understand their products and those of the competitors.

Wireman (2004) suggests that there are three types of benchmarking that can be used when conducting the process namely internal, competitive and best practice. Internal benchmarking is employed when different departments within an organisation benchmark each other. Competitive benchmarking deals with companies from the same industry but from different companies. Best practice benchmarking is when a company bases their approach on someone who is an unquestionable leader in any process and uses their approach as a benchmark.

Chen (2002) quoted David Kearns the former Xerox CEO explaining benchmarking as "…to continuously improve the product and service in order to compete with the best one and the leadership in the industry". He further states that performance evaluation coupled with benchmarking are important qualities of total quality

management. Even today Xerox still utilises benchmarking as a legitimate aspect of their organisational quality programme and to learn competitive practices from other organisations that have more to offer (Fernandez, McCarthy and Rakotobe-Joel, 2001). Whilst performance evaluation is used to measure productivity benchmarking is for competitive evaluation used as a reference point in comparing one entity over the other (Chen, 2002).

For benchmarking to be successful there has to be a buy-in from management; a need, willingness and acceptance for improvement and continuous development (Stonehouse, Hamill and Purdie, 2000 cited in Chen, 2002). Having taken a step in benchmarking the organisation needs to plan the way ahead. Existing processes need to be analysed. There is a need to identify what works and where assistance is needed; integration of goals will be required to take the organisation to success; and finally there is the action phase where the goals are put into action. Madu (2000) suggests that data could be sourced from the process manufacturer for tolerances and reliability of the components so that potential problems can be identified.

Allan (1993 cited in Fernandez, McCarthy and Rakotobe-Joel, 2001) describes benchmarking as a technique that measures and compares a product against those of a recognised best in the field. This comparison could be done within the company or externally. They further state that it could be seen as a quality measuring tool that is used to institute processes and technological improvements that other organisations are already utilising. When benchmarking is linked to strategic planning it bears fruit in terms of quality and customer satisfaction. According to Fernandez, McCarthy and Rakotobe-Joel (2001) benchmarking follows five stages namely planning, analysis, comparing, change and verification.

On the other hand Saunders, Mann and Smith (2007) introduce the 12 step process of Codling, which is divided into three areas namely project selection, benchmarking and application. During the selection stage the research topic considered has to be practical and has to determine best practices for strategic implementation. The benchmarking involves a facilitator leading a small group of individuals. The group discuss important research topics and is mainly made up of senior managers within the organisation who are involved in strategic implementation. The group members

are encouraged to share ideas and to provide information and answers to relevant questions with the facilitator leading the discussion and making sure that everyone's ideas are taken into consideration. Finally in this stage the best practices and performance gaps are identified (Saunders, Mann and Smith, 2007). During the final stage the members set future performance targets, communicate the information and implement changes. These changes are constantly reviewed and goals are adjusted if there is a need.

A while back SKF introduced Client Needs Analysis a performance benchmarking process with a goal of helping clients achieve returns by improving reliability (SKF, 2006). The analysis is carried out by an experienced SKF technician by conducting a questionnaire with the company's employees. Once an analysis has been completed a host of reports are generated one showing the company's performance when compared to the industry average.

2.10 Employee Perception

Robbins et al. (2009) explain perception as a process by which individuals organise and interpret their sensory impressions in order to give meaning to their environment. They mentioned that it is important because people's perception shapes their behaviour. Employee's perception serves as the link between them and their employers, and action taken by both parties (Hutchison, 1997). He mentions that employees with high levels of perception regarding their organisations are more likely to carry out their responsibilities well compared to those that with low levels. However each and every employee has a different relationship with the employer (Oosterhof, 2005). Psychological empowerment, on employees involves a motivational concept of self-worth (Greasley *et al.,* 2005).

Initiating change within an organisation will not come to pass if there is no buy-in from the employees (Seijts and Roberts, 2011). Before implementation or change in any project within an organisation, managers need to create structures that will help increase awareness from the employees and make them feel part of the decision making process. If the employees do not believe in an initiative from the organisation the project is destined for failure regardless of how compelling the vision from

management might be. Thus a strategy developed and communicated is not always equal to the strategy perceived by the employees (Oosterhof, 2005) and (Nohammer, Schusterschitz and Stummer, 2013).

Employees need to believe that they are there to make it work. Cunningham et al. (2002 cited in Seijts and Roberts, 2011) suggest that employees show a sense of self-confidence and organisational change if they feel empowered. Employee empowerment, improving people management practices and thus their perception, is said to be a possible problem with some managers who may perceive it as losing power (Greasley *et al.*, 2005). This fear is imminent in industries facing job losses, as well as in industries where previously there has been a disempowered employees, who might fear increased levels of responsibility and accountability (Johnson, 1994 cited in Greasley *et al*., 2005).

Where employee's relations are concerned, on the one hand you have the kind of employee that is focused on achieving for the organisation. This employee is highly committed to the objectives of the organisation and wants to see the organisation succeed (Ntshangase, 2010). On the other hand there are employees that are only concerned with the execution of the task at hand, this employee is self-centred and only has a short-term relationship with the organisation (Tsui and Wang 2002 cited in Oosterhof, 2005). An employee that that has the welfare of the organisation at heart will value long term benefits more than the employees that are just focused on the job. The latter, will only be happy with short term goals (Oosterhof, 2005 and Ntshangase, 2010).

To measure perceived perception from employees Parasuraman, Zeithaml and Berry (1988 cited in Ramseook-Munhurrun, Naidoo and Bhiwajee, 2010) suggest the utilisations of the five dimensions of service quality which is made up of responsiveness, reliability, assurance, empathy and tangibility. A questionnaire is developed, with goals to assess organisational internal quality from a sample made up of employees. It measures the expectations, perceptions satisfaction with the organisation and loyalty towards the organisation (Ramseook-Munhurrun, Naidoo and Bhiwajee, 2010). Seijts and Roberts (2011) suggested using a questionnaire with seven variables related to change management namely personal competence,

commitment, co-worker satisfaction, satisfaction with management, opportunity to participate, growth opportunity and respect in the workplace.

2.11 Customer Satisfaction

In any industry the customer is the king. Having a satisfied customer is important for any business success. Working hand in hand with customers an organisation can achieve mutual benefits. Customer satisfaction is a psychological state of pleasure felt by the buyer after having received the product (Hung, Cheng and Hsieh, 2015). Morganosky (1986 cited in Lundberg, Ohman and Sjodin, 2014) suggests that a customer seeks to accomplish tasks within a short period of time without putting in too much energy. Kashif et al. (2015) suggest that in this competitive environment service providers are constantly seeking to satisfy their customers in a bid to gain competitive advantage.

Kursunluoglu (2014) suggests that for an organisation to craft loyalty and customer satisfaction they must provide some kind of competitive advantage. Forging rapport by creating a service encounter with customers is important in a service business, building a relationship between customers and service contact employees (Zeithaml Parasuraman and Berry 1985 cited in Fatima and Razzaque 2013). Consumer service providers that have an understanding of and an efficient response to customers' specific needs will contribute to the organisation better serving their customers (Mattila *et al.,* 2013). Customer involvement in planning through to execution is indispensable for satisfactory service encounters and adds an interpersonal dimension to the relationship (Fatima and Razzaque, 2013).

According to Islam et al. (2014) employees that meet with customers now and again could influence the perceived quality of the service. Quality service delivered by an organisation is a driver to total customer satisfaction which could manifest itself in customer loyalty (Headley and Miller, 1993 and Hossain and Leo, 2009 cited in Izogo and Ogba, 2015). If an organisation succeeds in performing according to or exceeding the customer's expectations the customers are certain to talk about this and this grows the clientele and possibly grows the clientele and possibly grows the business. Vitasek et al. (2012 cited in Töytäri, 2015) suggested that an organisation

that creates value for its customers holds a key to success, and is more likely to create profitability for itself.

Liu et al. (2008 cited in Kashif *et al.,* 2015 and Nabavi *et al.,* 2014 stated that there are a few factors that can influence consumer satisfaction namely:

- Information quality: Communication with the customer is essential. For example, there is no need for a customer to proceed with planning when the organisation is not ready to process the order (Kursunluoglu, 2014).
- Website design: In the highly technical environment where most people and businesses have access to the internet, it is imperative for business to have a website fairly understood by the customers. There could be round the clock operations and easily assessable information.
- Processing of transactions: Order taking, order processing and payment processes must be relatively straight forward (Töytäri, 2015).
- Privacy: Jan and Abdullah (2014) suggest that organisations need to invest in ensuring that customer's data cannot easily be accessed by third parties. Organisations build trust with their clients by acquiring technology for information protection.
- Payment methods: The number of payment options has grown. Putting restrictions on customers' payment options might have a negative effect as it may negatively impact upon the impression of the ease and convenience of the transaction (Lundberg, Ohman and Sjodin, 2014). The customer's preferred choice of payment must be available to him or her.
- Delivery: Nabavi, Azizi and Faezipour (2014) stated that some customers might have certain expectations regarding, for instance, short-term delivery, or efficient delivery to an appointed location in an agreed condition. In this regard delivery speed could be affected by the introduction of the ISO 9001 quality management system.
- Customer service: Failure to ensure customer services and personal contact with customers could lead to ultimate overall dissatisfaction of customers with the organisation. The organisation must stay in sync with the needs of the customer (Fatima and Razzaque, 2013).

2.12 Chapter Two Conclusion

The literature review has been helpful in creating a context for the study using available literature. The chapter has detailed the key points regarding an effective departmental or general maintenance strategy. Strategies employed by an organisation need to make the most of the opportunities and strengths that an organisation has at their disposal at the same time avoiding as many threats as possible and improving wherever practicable on weaknesses. For an organisation to be able to sustain its goals, it needs to craft a maintenance strategy to blend well with the main business strategy.

The maintenance strategy needs to be developed based on the usage of the equipment and resources available to the organisation. Innovation and assessment of the strategies must be done constantly. Competitors will always copy or benchmark against the best and possibly overtake the stagnating rival organisations. When organisations are assessing themselves they need to use valid and measureable factors. The assessment must be motivated by the willingness to satisfy internal and external customers. The next chapter provides the method used to undertake the research.

Chapter 3
Research Methodology

3.1 Introduction

This chapter provides an overview of general research methods used for the acquisition and evaluation of data. Different methods available in research methodology will be considered in order to select an appropriate methodology for this study. The chapter highlights the sample size chosen, sampling techniques, reliability and validity of the research that was outlined in chapter one. The construction of the research instrument as well as the ethics involved in conducting research is visited. The methodology to be used for the study is highlighted.

3.2 Research Methodologies

According to Sekaran (2007, cited in Mbona 2012) research is a means of arriving at a needed solution of a specified problem after having completed an orderly and organised investigation involving the collection and analysis of data. It could also be an inquiry or examination carried out to arrive at the truth as perceived from different discourses. This study is not discursive, however, and the most important aspect of the research approach employed here is the methodology used for data collection and analysis (Khuzwayo, 2013). Research methodology involves the logistics used in the research. Choosing an appropriate analysis method to apply to the data depends on the complexity of the research question and the methods used to arrive at solutions (Raich *et al.*, 2014).

3.2.1 Qualitative Research

Qualitative data can be sourced from different sources like interviews from individuals, news articles, internet and more sources (Sekaran and Bougie, 2013). Qualitative research assists researchers to study complex and ambiguous problems, providing unlimited views of a situation and number of variables. It also affords the researcher considerable detail and depth to the answers (Raich, Muller and Abfalter, 2014). Trautrims et al. (2012) argued that qualitative research is sometimes accused of being easily manipulated, by researchers who can speculate on what the data

means to pursue their personal agendas. He further stated that transferring knowledge extracted from qualitative inquiry into words, could pose a problem.

Qualitative research is sensitive to factors within a set environment that relate to the relationship between individuals and to how they respond and react to each other. This would be helpful in answering open ended questions (Shamlall, 2013). It allows for detailed investigation by prompting respondents to come up with responses.

Denzin (2005 cited in Mbona, 2012 and Khuzwayo, 2013) suggests that the type of data collected and analysed by qualitative methodology as follows:

- It is mainly based on an inductive approach between theory and research;
- It puts the emphasis on how individuals perceive their surroundings;
- What happens now could have an impact on what will happen next; and
- Flexibility is required in the use of theories.

3.2.2 Quantitative Research

Quantitative research is involved in the collection, analysis and interpretation of data in numerical format. It is often collected from structured questionnaires (Rajpal, 2012). Quantitative research is defined as a form of testing given objectives accomplished by conducting a conclusive research involving a sample and data collection (Mbona, 2012). The researcher more than likely conducts research in settings not natural to the respondents. The research does not include the opinions or feelings of the respondents it aims to establish a relationship between variables. The respondents are given a set of predetermined answers to choose from, in answering the predetermined questions (Fitzsimmonds, 2012). The responses from the respondents are further statistically analysed.

Maxwell (2005 cited in Solonen, 2011) in describing goals better suited for qualitative research as follows:

- Gathering and understanding the meaning of events;
- Understanding the context within which the participants act and how they are influenced by the actions;
- Identifying unanticipated phenomena and generating theories thereafter;

- Understanding the process by which events and actions take place; and
- Developing explanations.

Matveev (2002 cited in Shamlall, 2013) lists the following as the strength to be attributed to quantitative research:

- Stating the research problem in specific and set terms;
- The investigated independent and dependent variables are clearly specified;
- Possibility of a solution that produce even more research objectives;
- Achieving high levels of reliability of gathered data due to controlled observation; and
- Reducing subjectivity of judgment.

3.2.3 Mixed Method Research

Mixed method research employs both qualitative and quantitative data simultaneously in creating an outcome stronger than what either method would yield individually (Malina *et al.,* 2011). Cameron and Molina-Azorin (2011) cite (Creswell and Plano Clark, 2007) in describing mixed methods research as a philosophy and method of inquiry, involving assumptions that guide the direction of collection and analysis of data. They further state that the process would employ both qualitative and quantitative analysis in a single study.

Grafton, Lillis and Mahama (2011) state that what is important with mixed methods is as follows:

- The integration of the two methods; and
- The development of a single study.

Mixed methods enable exploring complex aspects and relations of human and social nature. Some aspects might be analysed better by using one or other of the three approaches (Malina, Norreklit and Selto, 2011).

3.2.4 Adopted Approach

This study used a qualitative approach in order to get depth of responses from respondents. The intention of the study is to understand both human and social problems from the sample and to discover any traces of correlation between the respondents. The approach will help in probing and interacting with respondents and source details by gaining knowledge available from different sources of information (Mpungose, 2011). Respondents are afforded an opportunity to respond in their own words and not through preapproved answers.

3.3 Population and Sample

According to Mbona (2012) population could be described as a total number of possible units or elements that are included in a given study. Whilst sampling is described as a technique used in selecting and using the analysis of a small group to study the characteristics of a population (Khuzwayo, 2013). A sample drawn from the population can be used by, the researcher to draw inferences regarding the population (Shamlall, 2013). Struwig and Stead (2001 cited in Mbona, 2012) state that the population could be made up of any of the following: units, elements or time.

According to Sekaran and Bougie (2009 cited in Khuzwayo, 2013) the major steps in sampling include the following:

- Definition of the population;
- Determination of the sample;
- Determining the design of the sampling;
- Determining the sample size; and
- Execution of the sampling process.

It would be impracticable to interview each and every person in the maintenance department together with those around them; hence a sample has been selected from the managers together with first-line managers from the Department and from other stakeholders. In this study the population was identified as 50 from the maintenance team based at the Durban Container Terminal. Only 16 respondents (32%) were willing to participate in the study. Shenton (2004) suggests that a

researcher must draw information from both the user and the professionals responsible for the service.

3.4 Pilot Study

A pilot study was used to test the developed schedule, clearing any ambiguity and confusion that could be created by the questionnaire (Khuzwayo, 2013). Shamlall (2013) suggests that a pilot study is used to measure the willingness of the respondents to participate in the research. The researcher is thus given an opportunity to interact with the respondents to clear up any misunderstandings that may arise.

The interview schedule was thus first tested on a small sample of employees at the cranes maintenance department based at the Durban Container Terminal. There were 5 employees that participated in the pilot test. Subsequently the questions were slightly changed to make them more understandable to the participants. The product of that revision was then used as a main interview schedule during this study.

3.5 Validity and Reliability

Validity is the level of accuracy of the actual situation, represented by the findings of the research (Welman, Kruger and Michell, 2008). They go on to state that a research is valid if it meets the researchers claims. If the expected measures are not met, the data will not be validated and they will be incorrectly interpreted during the findings of the research (Fitzsimmonds, 2012). According to Ndimeni (2010) the quality of a study can be measured by one of the following known as a four-test approach namely:

- Construct validity;
- Internal validity;
- External validity; and
- Reliability.

For the study to achieve validity, questions posed to respondents were relevant of each stated objectives. After conducting the pilot study each question was reviewed

and phased as clear as possible and unambiguous. The sample used in the study is representative of the population.

Reliability is defined as consistency of a measure of a concept, meaning that the same results will be produced if another researcher used the same design (Jack, 2012). It is concerned with consistently producing the same results regardless of when and by whom the study was conducted (Mbona, 2012). Further stating that the following factors are used in assessing the reliability of the research instrument, namely:

- Stability;
- Equivalence;
- Internal consistency;
- Inter-judge reliability; and
- Intra-judge reliability.

To improve reliability of the study, collected data was categorised to minimise consistency. Only the researcher observed and compiled the received responses. The interview schedules were further checked for completeness and cleaned of any present errors to verify the data. Incomplete and irrelevant responses were excluded from the analysis.

The study utilises themes and categories to improve validity and reliability, eliminating bias and increasing truthfulness through triangulation (Golafshani, 2003). According to Ntshangase (2010) the following steps need to be taken into consideration with the aim of increasing reliability and validity:

- Examination of the wording of the questions to make sure that they are all fully understood and clear;
- The questions need to consistently have the same meaning to all respondents, and should not be ambiguous; and
- Asking questions that would yield answers with higher precision.

3.6 Interview Schedule Construction

Welman, Kruger and Mitchell (2008) suggest that to conduct a questionnaire survey, carefully selected and well thought-out questions must be used. The relationship investigated needs to be clear and should guide the questionnaire design process. Pre-coding of questions should be performed prior to the interviews being conducted, producing an easily administered questionnaire (Shongwe, 2012). Once the data was collected it was then entered into Excel for analysis.

The interview schedule was constructed around the objectives that the study was set to investigate namely to:

- Determine the effectiveness of the maintenance strategy in achieving the objectives of the MDS and what it is desired to be;
- Discover where the maintenance strategy is placed when compared with those of other terminals in the world, and what can be learnt from them?
- Measure the employees perception of the maintenance strategy;
- Establish if there is a breakdown in synergy between the MDS and the maintenance strategy; if so to find the reasons for the breakdown; and
- Identify factors which may prevent the maintenance strategy from achieving its objectives.

3.7 Ethical Issues

Shamlall (2013) explains ethics as moral principles that govern people on what to do and how to conduct themselves. O'Leary (2004 cited in Jack, 2012) suggested that ethics is one of the areas that is consistently emphasised in research, since the findings of the research could have implications. The independence of respondents should always be respected by the researcher (Fitzsimmonds, 2012).

Respondents should participate in the study voluntarily, willingly, have an option of pulling out of the study at any time during the process and of maintaining their independence. The respondents gave consent before commencing with their participation in the study. Information received from the study shall be kept confidential with an aim of protecting the identity of the respondents.

According to Welman, Kruger and Mitchell (2008) ethical considerations to be considered are as follows:

- Informed consent: Permission must be obtained from the respondents prior to conducting the research;
- Right of privacy: The identity of the respondents must remain unknown;
- Protection from harm: The respondents must be afforded protection against harm; and
- Involvement of the researcher: The respondents shall be protected from being manipulated by the researcher.

Ethical clearance was applied for from the Research Office at the University of KwaZulu-Natal. The Research Office granted the ethical clearance, to the researcher on the 19 May 2015. The ethical clearance number is HSS/0434/015M, proof of which is attached as Appendix 3. The researcher followed the guidelines provided in the letter of informed consent in terms of explaining the nature of the research and research procedures to the participants.

3.8 Data Collection

Data was collected through the use of interviews using a pre drafted interview schedule with open ended questions. Interviews were conducted with individuals with the sole aim of providing valuable information to the researcher coupled with observations and document studies involving the subject. These data collection methods were carefully selected to respond to the research questions. Interviews took place at a venue selected by the respondent and they lasted an average of 40 minutes each. The current maintenance practices were explored and evaluated to identify similarities with practices from other terminals of the same size as the Durban Container Terminal. According to Leedy and Ormrod (2006 cited Maharaj, 2007) the data collection process could have an impact on the data collected since some responses could offer more questions as opposed to answers.

3.9 Data Analysis

Welman, Kruger and Mitchell (2008) suggest that for qualitative study notes made by hand, recordings, observations and notes compiled during the study need to be first processed for analysis. Tape recordings need to be transcribed and researchers hand written notes made during the interviews have to be converted into notes that can be read and edited for accuracy. In qualitative studies the overall meaning of data is more important than the meaning of its parts (Mouton, 2006 cited in Jack, 2012). Interpretative thematic analysis was used for the study, the responses were further categorised into different themes to compare and group responses. In most instances participants were quoted directly. These themes will be discussed further in the following chapter.

3.10 Chapter Three Conclusion

Research is a process of collecting data, analysing and further interpreting it, to get a better understanding of a given question. The aim of this chapter was to give an outline of the theory related to research, and the tools utilised whist conducting research. For this study qualitative research methods were applied. An interview schedule was prepared for the study and interviews were held with16 respondents to answer the drawn up questions. The next chapter has the presentation of the gathered data.

Chapter 4
Presentation of Results and Discussion

4.1 Introduction

This chapter provides an overview of the research methodology as indicated in the previous chapter. The chapter offers a brief overview of the method used to collect data and, an analysis and interpretation of the acquired results. The chapter first presents the demographic profile of the respondents. The obtained results were then condensed and presented in sub-sections in line with the objectives of the research. These presentations are illustrated with the aid of tables, bar charts and graphs in order to give a graphical picture of the findings.

The purpose of the study as previously stated was to establish the effectiveness of the maintenance strategy adopted at the Durban Container Terminal. Data to aid this assessment was collected through interviews, the examination of relevant documents and assessing recorded observations. Interviewees were a blend of maintenance management personnel, operations and outside customers. Reading of documents from multiple sources ranging from the Original Equipment Manufacturer (OEM) documents to any available material like reports, policies and plans to aid in making observations. Equipment representatives were consulted to give technical support.

4.2 Personal Data Analysis

The subsections to follow represent the respondent's personal particulars. The respondents were drawn from three sections, being the cranes, straddles and reliability sections within the maintenance departments. In addition two people from operations were interviewed, from a customer's perspective and two original equipment manufacturers representatives were interviewed to gather expertise insight. The section looks at the respondent's grade in the organisation, department employed in, and the number of years in service with the organisation. It is important to note that all respondents didn't have access to the questions prior to being interviewed.

4.2.1 Grade Respondents

The data reveals a fair spread across all grade categories, ranging from artisans to managers and this is illustrated in figure 4.1 below. The data was mostly drawn from managers and supervisors, all of whom are supposed to be the executors of the strategy at Departmental level.

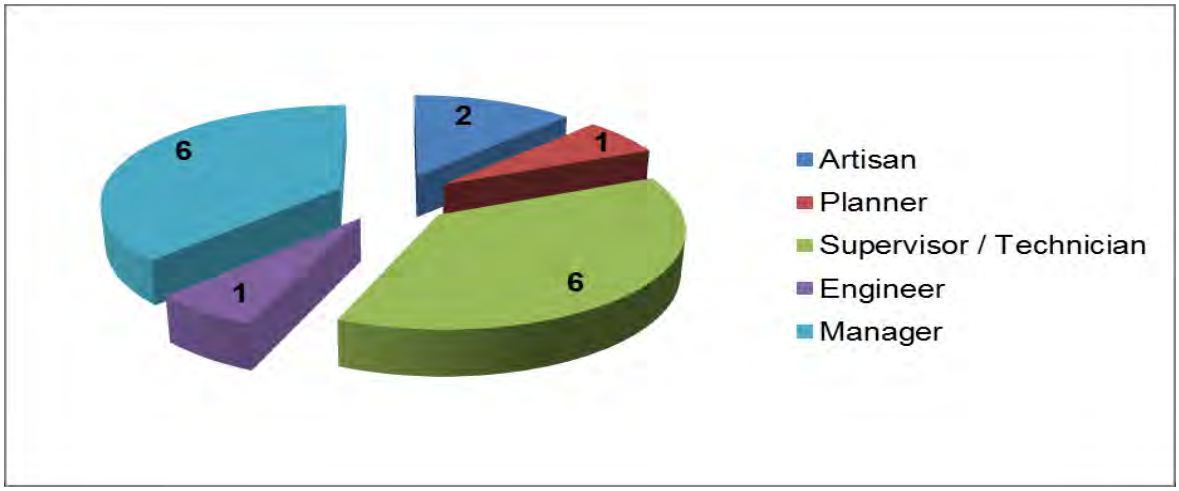

Figure 4.1: Grade at Transnet Port Terminals

4.2.2 Respondent's Department

The majority of the respondents 7 are from the cranes workshop, followed by 4 employees from the reliability, then 2 from straddles workshop as well as 2 from operations completed by 1 from other. Figure 4.2 below gives a better picture of the given information.

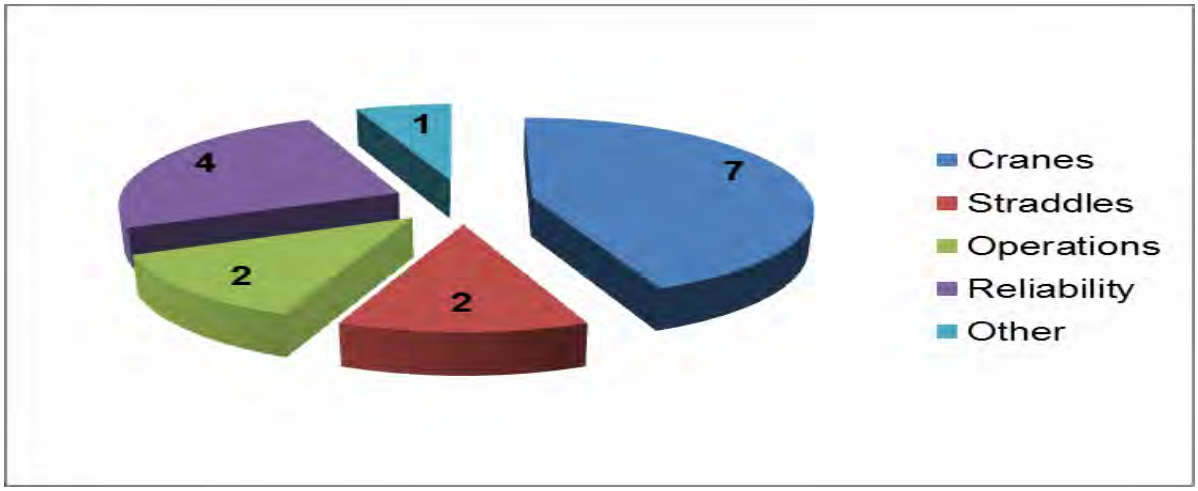

Figure 4.2: Departments

4.2.3 Experience of Respondents

This result reveals that the majority of the respondents range between 1 to 5 and then 6 to 10 years of experience with Transnet Port Terminal. Only 3 respondents have been in employment by Transnet Port Terminals for over 20 years, and only one that has more than 10 years of experience. This result could also be a sign of high turnover, inexperienced staff and the number of employees that were recruited to fulfil the objectives of the Market Demand Strategy.

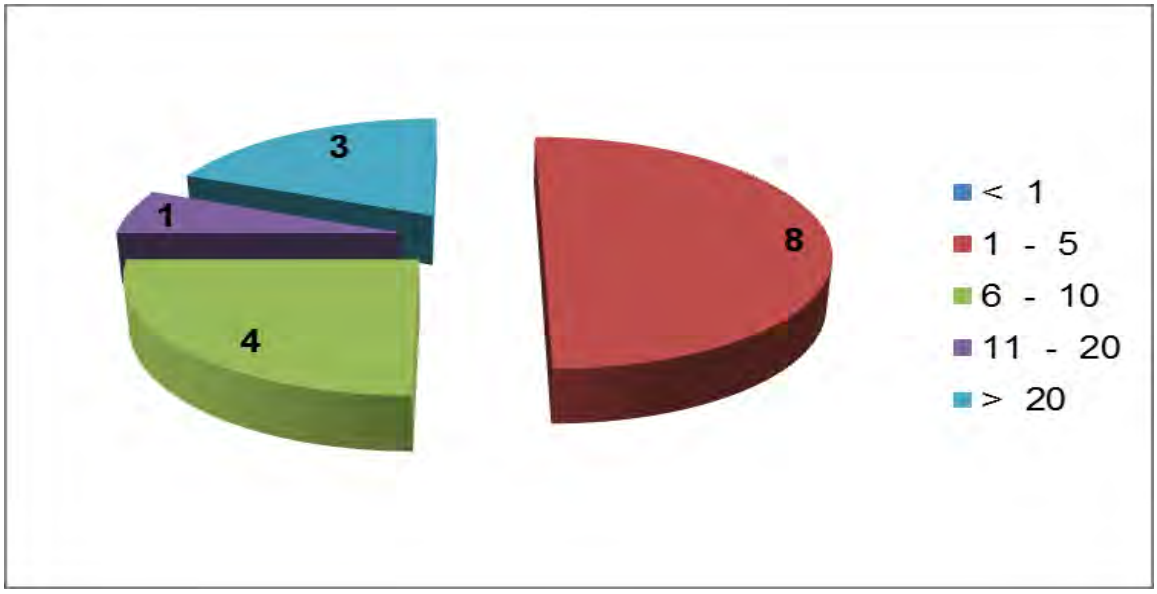

Figure 4.3: Number of years employed at Transnet Port Terminals

4.3 Determine the Effectiveness of the Maintenance Strategy

The respondents were required to indicate their knowledge of the structures of the Market Demand Strategy. They were further asked to rate, from their perspective, the effectiveness of the maintenance strategy utilised at the terminal. The respondents had to comment on the selection of the maintenance Key Personal Indicators and state to what extent these were linked to the Market Demand objectives. A summary of the responses from the respondents is illustrated in table 4.1 below. Of the 16 respondents that answered the questionnaire 14 responded to this section of the questionnaire (28% of the population of the study).

Table 4.1: Categorised effectiveness of the maintenance strategy according to respondents

Question		
1. Determine the effectiveness of the maintenance strategy		
Categories *Responses to the question were sorted into:*	**Resp.**	**Grade**
The strategies do tie up since the equipment is always available to operations.	1	Sup. / Tech
We have a strategy. Normally we get 100% for KPIs and fitting constituting a full quota of what needs to be done.	9	Manager
There is a highly effective maintenance strategy the problem sometimes is with operations. It is far bigger than not knowing what to do or not having a plan.	11	Manager
There is a successful maintenance strategy in place and employees are all aware of it and support it. The responsibilities are still not clear	14	Manager
The MDS and the maintenance KPIs fully tie-up. All targets are set to assist operations in reaching their targets.	15	Manager
They are fully aware of what has to be done however sometimes things are out of their control. There is no support regarding the MDS the equipment doesn't talk to the strategy.	12	Manager
There is a communicated maintenance strategy however it needs some upgrade as it is lacking in some areas.	16	Sup. / Tech
I do not think the maintenance strategy is effective enough to fully support MDS. They bring in quantity instead of improving the quality of skills	6	Engineer
We do have a strategy however the manpower to carry out the maintenance lacks the skills and knowledge to perform their duties.	7	Sup. / Tech
There haven't been any changes in the day to day activities since I have been here. Maintenance doesn't act on its own operations dictate concerning what has to be done by maintenance.	4	Sup. / Tech
The maintenance strategy has never been communicated and the daily activities sometimes happen spontaneously, reacting to a situation.	5	Sup. / Tech
The terminal is only concerned with operations and not maintenance of equipment. There is no maintenance strategy at all or it has not been communicated.	10	Planner
MDS has never been communicated to the people, they know the term but nothing else. MDS responsibilities should be clearly explained.	13	Artisan
There is no maintenance strategy, the maintenance department currently works or operates through the experience of long serving employees.	8	Manager

Although all of the respondents were aware of the Market Demand Strategy, most of them were not even aware of what it entails. Respondent 13 (a manager) when asked if there is any linkage between the Market Demand Strategy and daily work related activities he responded that “MDS has never been communicated to the people. They know the term but nothing else”. Respondent 4 (a supervisor or technician) stated that “There is no linkage between the MDS and the daily activities. It’s the understanding or lack of this regarding the MDS that might be a problem”. This is in sharp contrast to what most of the respondents felt regarding the Market Demand Strategy, respondent 14 (a manager) when asked the same question said “Day to day activities are aligned to the MDS in the sense that current performance feeds into the MDS. Respondent 6’s (an engineer) reply to the same question was: “I think there is a strong link between the MDS and the daily activities since your activities are driven by what is demanded by the business”. According to Shavarini et al. (2013) strategy is defined at corporate, business and functional levels, the organisation develops strategies for these levels however the coordination of these strategies is never straight forward.

The concerns raised on communication disregarded the respondent’s grade in the organisation. Respondent 8 (a manager) stated that “Responsibilities are clearly outlined for the executive managers, but have not been clearly cascaded or executed by the floor and MDS appear to be an executive manager’s responsibility and not the entire worker force”. The respondent further stated that maintenance strategy is non-existence or only there in paper as the business only supports the operations department. Respondent 9 (a manager) stated that there could be needed improvement in communication and that people from the floor would need to be informed of the developments within the organisation.

Lack of support has been raised as one of the factors affecting the strategies. The respondents mostly cited evidence from continuous unresolved problems regarding the strategy related issues at Departmental level. They hinted that there is no support or leadership when needed by the operating divisions. Respondent 16 (a supervisor or technician) raised an issue with the fact that new entrants into the business are not introduced to the strategy. Respondent 1 (a supervisor or technician) stated that no consultation is made when new equipment is acquired.

Some respondents raised the lack of available skills to support MDS. Respondent 6 (an engineer) stated that the maintenance strategy is not effective enough to support the MDS, he brings forth that new employees brought in for support add in numbers and not quality. A supervisor or technician respondent 7 stated that “We do have a strategy however the manpower to carry out the maintenance lacks the skills and knowledge to perform their duties”.

On Key performance indicators the respondents showed faith that they are in line with the objectives of the MDS. Respondent 9, (a manager) stated that “There is a good enough linkage and we are sticking to our KPIs”. Another manager respondent 14 stated that “MDS as well as the maintenance KPIs tie up in the sense that availability and reliability of the equipment must support operations hence advance the cause of the MDS”. Respondent 16 (a supervisor or technician) stated that “For maintenance there are demand availability targets which have to be met, and it ties up to the business’s objectives set by the MDS”. Respondent 1 (a supervisor or technician) in the same grade as the previous respondent 14 (a manager) suggested that the maintenance strategy ties up with operational strategy as well as the MDS since the equipment is always available to operation when needed.

Mpungose (2011) suggested that an organisation’s executives responsible for the crafting and implementation of a strategy would later remotely control the strategy. This was evident in the responses received. Respondent 8 (a manager) suggested “We are not tracking the MDS, it seems like it doesn’t have any custodian, it was generally issued, since it guides the spending of Billions, it must have personnel fully employed to manage it”. Respondent 4 (a supervisor or technician) further stated that “People from Transnet operating divisions (ODs) were supposed to have taken ownership of the MDS”.

In conclusion the respondents generally felt that an effective maintenance would assist the organisation in achieving its objectives. Respondents recognise that the Market Demand Strategy on paper is a strategy that could help the country grow.

4.4 Comparing the Terminals Maintenance Strategy With Others

The set of questions in this section were asked as to what extent they viewed the maintenance strategy when compared with others in the same industry. According to Moriarty (2011) as quality management short and long term performance resulting from the implementation of the strategy the projections need to be benchmarked against best practices. Respondents were adamant that the maintenance strategy at the Durban Container Terminal is not effective for long term sustainability in maintaining the equipment.

Two areas were used to benchmark the strategy with best practice, the first one being the utilisation of the original equipment manufacturers (OEM) recommendations and the equipment history. Assistance from the original equipment manufacturers removes the guesswork out of setting targets and limitations of an item of equipment, whilst the same information must be adjusted to reflect the actual installed equipment as well as its environment (Mobley, 2002). One can expect failure using the failure history of equipment, using past knowledge and past experience (Dhillon, 2002).

Without applying the mentioned measures the equipment might not operate and be unreliable most of the time. Preventative and predictive maintenance would be difficult to introduce. Equipment will only run to failure, causing long outages and sometimes having to wait for replacement for a period of time. What emerged from the responses given is that they all varied along their grades. The lower graded employees felt that storage of data needed improvement and that work done by employees and faults encountered are not stored or used to plan for the future.

As stated by respondent 15 (a manager) “data is used to improve maintenance performance with an aim of reducing the number of breakdowns”. Whilst another manager respondent 14 stated “Historical data is used to analyse recurring failures from which action plans are developed and adhered to”. Respondent 9 (a manager) stated that root-cause analysis is carried out for most breakdowns and kept for future usage and for modifying procedures.

Table 4.2: Categorised benchmarking the maintenance strategy

Question		
2. Terminal's maintenance strategy in comparison with others		
Categories *Responses to the question were sorted into:*	**Resp.**	**Grade**
We don't incorporate the experience and challenges gained from older equipment into formal maintenance activities. We don't learn from history. Data is never used effectively and efficiently.	4	Sup./Tech
We have a very long history of equipment being given stop certificates whilst dates and inspection reports are in the maintenance inspection files (defect file) which are accessible to all.	8	Manager
Recommendations and instructions are never used to the fullest. We don't even have required tools to perform maintenance as recommended by the OEM.	5	Sup./Tech
We do follow the OEM maintenance processors and recommendations but then some OEMs will refuse to revise or change their equipment operation in terms of our operating demands	7	Sup./Tech
Maintenance activities in the terminal doesn't change, we always use the same old and tested ways on all equipment even for deferent type of equipment.	6	Sup./Tech
There is no utilisation of data, we complain about the same things all the time. It's always the same breakdowns that constantly affect us making you feel that no one looks at them with a view to implementing a permanent solution.	11	Manager
We don't fully utilise the OEM recommendations. We try but it falls off the track. The breakdowns are logged there is no logging of what one does.	13	Artisan
Maintenance activities in the terminal don't change, we always use the same old and tested ways on all equipment even for different types of equipment.	3	Sup./Tech
The recommendations from the OEM get used however their recommendations get modified when necessary. The data is always used for the up keep of the equipment.	1	Sup./Tech
We use the OEM recommendations mainly for critical, safety issues. We perform root cause analysis and implement corrective actions if and when required.	9	Manager
All breakdowns are shared with all relevant people and action is determined. ajor breakdowns are corrected the same day, minor breakdowns are recorded on defect lists and corrective actions are done at a later stage.	2	Artisan

Most respondents from the lower grades felt very strongly about the lack of utilisation of the fault historical data. Respondent 3 (a supervisor or technician) stated that “We are not really learning from bad experience we always encounter the same problems”. Respondent 1 (a supervisor or technician) feels that data is stored however the reporting methods need improvements, and that reports need to be more in-depth. Respondent 5 in the same grade category as the previous respondent concurred by stating “The information cannot even be utilised as the information stored is of poor quality, we should be able to identify potential failures through inspection and we don’t keep track but we are reactive”.

Respondents were generally in agreement that original equipment manufacturers (OEM) are utilised by the terminal. Their views were not in line with the grades they occupy. Respondent 16 (a supervisor or technician) stated that the maintenance activities for all equipment are copied from the OEM user manuals to the SAP system and that historical faults data determine the behaviour of the equipment. Respondent 9 (a manager) states that “We use the OEM recommendations mainly for critical, safety issues”. However according to respondent 5 (a supervisor or technician) the recommendations and instructions are never used to the fullest. He further stated that even tools to perform maintenance as recommended by the OEM are not available to employees. A manager the respondent 11 (a manager) does not agree either that OEM recommendations are consulted, he suggested that if that was the case then the terminal would never be experiencing the kind of technical problems that it experiences.

Apart from the two mentioned factors, all the participating respondents responded positively to the measures used to monitor the Key Performance Indicators (KPI). Performance cannot be managed if there are no effective measures. All respondents stated that reliability is what drives the maintenance strategy however others mentioned time taken to repair, while others spoke of mean time between failures. This information is in line with what has been put forward by academics in the field such as (Prasanna, Akula and Desai, 2011) and (Solonen, 2011).

4.5 Employees' Perception

This section illustrates the employee perception according to the respondents. The questions directed to the respondents dealt with stereotypes and information they have on the maintenance strategy and that of the maintenance employees regarding the strategy. Nöhammer et al. (2013) stated that a developed, communicated and implemented strategy is not always the same as the strategy that is perceived by the employees. For the strategy to be successfully implemented managers and leaders need to feel empowered, create and share with other employees (Fredriksson and Larsson, 2012). The manager thus can concentrate on the strategy and create a self-managed team. Most respondents have positive perception regarding the strategy used in the allocation of tasks, work area, the ability to perform better on the KPIs, training offered and what they feel about the management.

Respondents showed a positive general impression that the strategy used and all the other activities are good for the organisational goals. Respondent 1 (a supervisor or technician) boldly stated that "There are no complaints as the work is fairly distributed and the work place is conducive to achieving results. Employees have been receiving good training recently for which they are appreciative". Respondent 2 (an artisan) suggested "As employees we have good communication channels with the maintenance management. We get good needed training but training sessions are always far in apart". Certainly these perceptions can be used as a building foundation with the rest of the employees. There were a few negative perceptions which will most likely affect their activities at work and could affect the general terminal performance. The respondents with a negative perception could have generated this due to problems related to tasks and competencies. Respondent 7 (a supervisor or technician) suggested that "All employees from maintenance are aware of what our goals are but because of the poor skills level in our department we are unable to achieve goals. Jobs have been given to contractors". Interestingly the negative perception came mostly from the same grade. According to respondent 4 (a supervisor or technician) there is a great possibility that challenges could be minimised so long as staff could be educated on the business operations. Table 4.3 below shows the categorised measures of the employee perception.

Table 4.3: Categorised measure of employee perception

Question		
3. Measure of employees' perception		
Categories *Responses to the question were sorted into:*	**Resp.**	**Grade**
There are no complaints as the work is fairly distributed and the work place is conducive to achieving results. Employees have been receiving good training recently for which they are appreciative.	1	Sup./Tech
As employees we have good communication channels with the maintenance management. We get good needed training but training sessions are always far in apart.	2	Artisan
Maintenance employees only have a view of working and completing a task at hand.	8	Manager
They feel it's possible to reduce breakdowns and improve availability and hence they have divided equally the amount of equipment amongst themselves so that they will have a better focus on the job at hand.	15	Manager
Management should improve on training of employees, creating focused teams (breakdowns, greasing and roaming teams). Training is adequate however more practical training is required.	14	Manager
The maintenance employees are clueless. Employees don't have an idea or don't care about the business needs. Training is generalised and doesn't talk to the needs of the business.	4	Sup./Tech
They don't even know how their equipment performs. They think if the amount of breakdowns reduces then there will be no need to keep them. They always believe that they require less training.	5	Sup./Tech
They are not aware of the strategic goals, if they go to the equipment and find a fault they don't fix it at the same time. They don't do proper maintenance. Training given is mostly irrelevant, what gets offered is what employees don't really need.	10	Planner
The possibilities are very high of minimising the challenges that we have, if we were to educate our staff regarding our businesses existence.	3	Sup./Tech
Allocation of work in not well strategized. A new guy must be paired with a more experienced guy to learn from. It is not impossible to reduce and improve on the breakdowns and availability respectively, however the work culture at the terminal will have to be changed.	6	Engineer
There is a perception that employee workload is not fairly distributed.	11	Manager
Improvements on availability and breakdowns is possible provided key issues are addresses such as spares availability, quality systems are in place, and equipment is available on time.	16	Sup./Tech

The themes that emerged from this section were the work load, training provided or skills, communication and the working environment at the terminal. The majority of the respondents suggested that there is an issue with the allocation of tasks. Respondent 7 (a supervisor or technician) suggested that the employees are given workload and sufficient time to complete even if they were to work at a slow pace. Respondent 1 (a supervisor or technician) is quoted as saying “there are no complaints as the work is fairly distributed amongst employees”. However respondent 2 (an artisan) stated that there are days when there is more work than the allocated employees. Respondent 13 another artisan is quoted saying “All they want is to outsource task after task either because there is too much work or because there is a skills shortage”. Respondent 8 (a manager) suggested that the training offered is not effective”. This statement is in sharp contrast to what another fellow manager had to say, respondent 14 said that offered training is adequate. This shows that there was a divide in the way individuals from the same grades assessed the impact of the offered training and skills.

Respondent 1 (a supervisor or technician) suggested that communication has improved between employees and management. This view is supported by respondent 2 (an artisan) who stated that “communication has been good under the new management when taking decisions and employees are consulted”. Respondent 10 (a planner) supports the notion that communication is good suggesting that the maintenance management is approachable and helpful to employees. This perception is positive as it comes from most respondents.

Respondent 5 (a supervisor or technician) is quoted saying “the environment is relaxed, even when they don’t finish planned tasks there is no pressure on them and they feel nothing”. Respondent 13 (an artisan) feels that there is no discipline from employees, and lazy. He goes on to say unions will go on strike if any of their members is disciplined. A manager respondent 8 feels that improvements are discussed and agreed with the employee representatives but if the employees are against the decision nothing will happen since they will not be held responsible. Employees are only willing to assist other sections if they know that they will be paid overtime otherwise they will not help this is according to respondent 5 (a supervisor or technician).

4.6 Synergy Between The MDS and the Maintenance Strategy

The questions in this section looked at whether there is a link and alignment between the maintenance strategy and the Market Demand Strategy, if so then the effectiveness or lack thereof should be measured. According to Khalili et al. (2013) for an organisational, business and functional strategies to work coordination is needed to yield maximum results. Managers need constantly to assess the alignment of corporate and the business as well as the functional strategy for the seamless implementation of what would have been planned by senior managers at corporate level.

A seamless alignment of the strategies would propel the business objectives. Respondents were asked to assess the correlation between the maintenance strategy, the corporate strategy and the Market Demand Strategy. Some respondents responded in the affirmative and said that there was correlation. Respondent 1 (a supervisor or technician) stated that “Morning meetings comprising of all departments discuss the past day’s performance and plans for that particular day which is in line with the MDS. Employees get awards for improvements on projects. Maintenance employees are encouraged to come up with improvements that better the daily activities because they want recognition, awards and the experience that comes with it”. This position is supported by another (supervisor or technician) by stating “these meetings impact positively on the business as operations and technical work hand in hand”.

Respondent 15 (a manager) suggested that the organisation balances the running of daily maintenance activities to assist the maintenance strategy. The culture of holding one another accountable has been nurtured in support of the objectives of the MDS suggests respondent 14 (a manager). An artisan respondent 2 stated that there is an exchange in information between operations and maintenance department in trying to bridge the gap.

On the other hand there was a strong view that the alignment of the strategies needs some improvements. Another portion of respondents felt that there are some improvements needed on the alignment of the strategies. A supervisor or technician respondent 5 stated that instead of sharing information during information sharing activities departments fight amongst each other. It's the organisation that suffers from service delivery and not the individuals that have been involved in the fight. According to Makadok (2001 cited in Khalili *et al.*, 2013) information sharing between departments improves the productivity of the other resources.

The rest of the respondents were not enthusiastic about the alignment of the strategies. There seems to be an unfair reliance only on operational matters and a neglect of other departments. Respondent 15 (a manager) stated "Pressure from operation when they have less number of equipment to perform planned work affects scheduled or planned maintenance, delaying daily maintenance activities for later". This further affects the reliability of the equipment as it would have possibly missed its routine maintenance. Respondent 5 (a supervisor or technician) suggested that operations have lost trust in the poor quality of work performed by the maintenance department because of the increasing number of breakdowns and the increasing number of projects failures they would rather use the equipment until it fails. Respondent 6 (an engineer) quoted saying "equipment will only be given if operations don't need them and not when needed by maintenance"

When Transnet Group Chief Executive Brian Molefe introduced the Market Demand Strategy he stated for the plans to succeed there would be a requirement for equally profound changes in how the organisation operates by continuously improving the product offering (Transnet, 2014). However most of the respondents outlined the lack of continuous improvements. Respondent 11 (a manager) said "There are initiatives but there are no results. The implementation of ideas meets resistance from labour, once they are in disagreement then one knows nothing will ever happen". Respondent 10 (a planner) says that there is no continuous improvements and equipment is scrapped still in the same condition as when acquired. Table 4.4 gives a summary of respondents' views on the alignment of the strategies.

Table 4.4: Categorised alignment of strategies

Question		
4. Synergy between the MDS and the maintenance strategy		
Categories *Responses to the question were sorted into:*	**Resp.**	**Grade**
The MDT meetings have in-depth information sharing sessions. Employees get awards for improvements on projects.	1	Sup./Tech
We have multiple meetings to schedule maintenance of equipment without affecting operation and share challenges. We brainstorm and report on performance.	7	Sup./Tech
We do exchange information well with the operations department, although sometimes we feel that operations say things that are not true or what is not happening to our equipment. Maintenance developments make for good relations with operations because fewer breakdowns enable operations to achieve their goals.	2	Artisan
Pressure from operations when they have an insufficient amount of equipment to perform planned work affects scheduled or planned maintenance, delaying daily maintenance activities for later.	15	Manager
There is no platform for information sharing unless it is when they are fighting. The organisation is only chasing daily activities there are no long term plans.	4	Sup./Tech
There is no balance, no one is looking at long term goals, and everyone looks at the breakdowns. Operations have lost trust in the poor quality of work performed by maintenance.	5	Sup./Tech
Bringing in more people doesn't help the rest of the experienced guys as long as they are not fully equipped. There are no continuous improvements. Engineers and technicians should be used as the drivers of change.	6	Engineer
Communication is bad when operations need something done they demand equipment even when planned for and if maintenance needs equipment they are not considered. There are no continuous improvements; equipment is scrapped in the same condition as when it was bought.	10	Planner
There are initiatives but there are no results. The implementation of ideas meets resistance from labour.	11	Manager

4.7 Factors Which May Influence the Maintenance Strategy

Parida et al. (2015) state that maintenance systems should be able to use existing data as assistance in making decisions. This data could be anything from downtime, costs and quality to compare performance and required conditions (Parida *et al.*, 2015). The questions in this section were drawn up to look at causes that could affect the successful execution of the strategy.

4.7.1 Work documentation

Table 4.5 gives an illustration of the measured general critical components of the execution of maintenance strategy. A question was asked how well the maintenance Department's responsibilities and work were documented and if the documentation was easily accessible. The following data was recorded, 55% felt that the work is documented and fairly accessible. Respondent 15 (a manager) said: "The maintenance department's responsibilities and work are documented and there is a storage facility where information is kept or stored". On the other hand, 45% of respondents felt that the storage is poor. Respondent 1 (a supervisor or technician) said regarding the storage that "Not all maintenance procedures are written down some of the work would only be known by fewer employees".

Table 4.5: Influences to the Strategy in Numbers

Theme	Number of Respondents			
	Work documents	Quality and sufficiency of resources	Root cause analysis triggers	Performance and costs discussion
Poor	45%	45%	56%	80%
Fair	55%	55%	44%	20%

When a new recruit joins a company he needs to be given his responsibilities and at the same time past data needs to be kept if needed for any analysis. According to Sullivan et al. (2011) the duration of data storage should be carefully considered during the design and the implementation stages. The duration of the stored data must be known by all to limit storage of old and unwanted data.

4.7.2 Quality of resources

For any task to be performed reasonable there need to be a sufficiency of tools, skills and procurement of needed spares (Mobley, 2002, Dhillon, 2002, Solonen, 2011). The respondents were asked to comment on the quality and sufficiency of tools and equipment needed to support their work. Responses were as follows, 55% of respondents felt that there was a fair amount of needed resources whilst 45% disagreed. Of the respondents that responded in the affirmative respondent 9 (a manager) stated “There are sufficient tools and equipment but the need for more is growing due to new equipment. We are trying to meet the demand with the inclusion of new equipment”. Whilst respondent 13 (an artisan) totally contradicted this by stating “There are no tools at all. It’s just thumb suck when checking what’s needed”.

Zengyong et al. (2012) suggest that tools used on improvements must be readily available when needed, to improve or to retain quality of work performed. He further stated that they would need to be quality inspected for any malfunctioning and replaced if they are not in order.

4.7.3 Root-cause analysis

According to Solonen (2011) all repetitive failures that require solution are expected to be taken through a rigorous test to identify the root cause of the problem. The information established from the root-cause analysis (RCA) exercise is then used to avoid the reoccurrence and to minimise the effect of failure (Fredriksson and Larsson, 2012). Respondents were thus asked to discuss the triggers for root-cause analysis and if they were clearly identified.

As illustrated in table 4.5 a majority of respondents responded negatively to the question, 56% stated that the quality of root-cause analysis was poor and 44% stated that it was fairly used. One of the respondents that reacted negatively was respondent 16 (a supervisor or technician) who commented: “It is a challenge to perform root-cause analysis since not all information is shared with the factors leading to the need for root cause analysis”. Whilst respondent 15 (a manager) rebuffed that statement by stating that “The triggers of RCA are clearly identified. It’s repetitive or lengthy breakdowns and accidents”.

Table 4.6: Categorised influences to the strategy

Question				
6. Factors which may influence the maintenance strategy				
Theme		**Categories** *Responses to the question were sorted into:*	**Resp.**	**Grade**
Work documentation	Poor	Employees do take their jobs seriously but the documentation is very poor and some of the work would only be known by a few employees.	1	Sup./Tech
		Everything needs to be accessible to everyone. Company policies are not there for everyone to see.	13	Artisan
	Fair	All maintenance work is captured on SAP and anyone can log on and view the information.	7	Sup./Tech
		Plan to meet responsibilities has been shared.	8	Manager
		There are well documented maintenance activities and these are easily accessible.	9	Manager
Quality and sufficiency of tool and equipment	Poor	The usage is very poor employees don't have tools at all and what they have is "make a plan".	4	Sup./Tech
		The bare minimal tools are there however the rest is just not there. Management don't see value in acquiring a tool that will not have an immediate contribution.	6	Engineer
		Spares audit is never done (spares shortages occur much too often).	3	Sup./Tech
	Fair	All equipment and tools are of good quality.	16	Sup./Tech
		There are sufficient tools and equipment but the need for more is growing due to new equipment.	14	Manager
Root cause analysis triggers	Poor	We don't have triggers based on the nature of our operation.	4	Sup./Tech
		They hide inefficiencies through RCA to protect themselves.	13	Artisan
		It is a challenge to perform root-cause analysis since not all information is shared with the factors leading to the need for root cause analysis.	16	Sup./Tech
	Fair	Breakdowns that are reoccurring are used as triggers for root cause analysis.	1	Sup./Tech
		Most of the RCAs are clearly identified and proper corrective action is taken.	9	Manager
Performance and costs discussion	Poor	Supervisors never discuss performance and cost factors with the employees.	16	Sup./Tech
	Fair	They claim to do discuss the performance, however it might not be that detailed.	15	Manager
		Performance is discussed however cost is not discussed due to the fact that senior management have an oversight on cost. This is relevant to employees.	14	Manager

4.7.4 Reporting performance

According to Parida et al. (2015) the supervisor is expected to give a detailed report to his team, that will include details of maintenance and operational performance, failure stops, likely failures and observations. Day to day performance together with the costs incurred should be reported on a day to day basis (Khan and Darrab, 2010). These could be used to analyse certain situations in detail or to establish budgets for forecasting purposes (Parida *et al.*, 2015).

Respondents were asked to explain the extent to which supervisors share performance and cost factors with their teams. Most respondents felt very negative regarding the communication, 80% stated that there were poor discussions. Respondent 1 (a supervisor or technician) stated “Supervisors never discuss performance and cost factors with the employees, we would be happy if they could discuss those things so that we could see how we are performing as a team and as the business”. Respondent 14 (a manager) however stated that performance is discussed and costs are only discussed once a month instead of daily. All respondents were in agreement on the relevance of information sharing. Table 4.6 above gives a summary of responses in a categorised table.

4.8 Chapter Four Conclusion

This chapter presented the findings of the research that was conducted guided by the research objectives as well as the questions that are outlined in Chapter 1. The questions utilised as a research instrument were grouped together in accordance with each research question. Responses were each analysed and discussed in terms of the research questions. Respondent’s general attitude to each question has been shown in the form of figures and categorised tables. There appears to be a gap between the best practice and the utilised strategy to date, when using respondent’s feelings. The feelings in some cases differed sharply showing that there might be a missing link to connect the differing opinions. The next chapter will discuss in detail the recommendations to improve the maintenance strategy and cohesion between employees.

Chapter 5
Recommendations and Conclusions

5.1 Introduction

The study aimed to establish the effectiveness of the maintenance strategy utilised at the Durban Container Terminal in assisting the terminal to reach its objective goals. This chapter aims to discuss the results presented in the previous chapter and further offers conclusions and recommendations in relations to the research objectives and questions. The recommendations are based on the presented findings as illustrated in Chapter 4 of this study. Each research objective generated a conclusion and recommendation originating from the research findings.

5.2 Objective 1

Assess the impact the maintenance strategy has at the terminal in reaching the objectives of the Market Demand Strategy.

5.2.1 Discussion and Conclusion

This objective focuses on the impact of the maintenance strategy in helping to drive the terminals business objectives as set out in the Market Demand Strategy. The efficiency of the strategy is assessed to see if it has any link to the business strategic objective. This was done by establishing the following information from the study:

- The alignment between the Market Demand Strategic objectives and the maintenance strategy.
- The KPIs used for the maintenance personnel and their links to the MDS objectives (Business and Operations).

According to Khalili, et al. (2013) strategy is a comprehensive master plan developed by an organisation to achieve results. This plan would be crafted at the corporate level and filtered down to functional levels. All levels have to be aligned to each other for the strategy to work. According to Bosua and Venkitachalam (2013) there is evidence to suggests that strategies crafted at senior levels get modified, sabotaged and do not get support from the lower levels in the organisation. The alignment and having cohesive strategies allows the business to concentrate on the application of

the Departmental duties and at the same time the business concentrates on successful implementation of the business strategy, leading to greater profitability (Bradford, 2015).

As illustrated in Chapter 4 of this study a majority of respondents affirmed that the existing maintenance strategy is effective, a few of them disputed. Most of the respondents however complained of the lack of consultation and assistance coming from senior management sitting at head office in supporting the MDS implementation at the terminal. Respondents regardless of their position within the company complained of the lack of communication regarding changes and the implementation of the strategy from the senior leadership.

Iyer, Srivastava and Rawwas (2014) suggest that strategic alignment comes in two categories: the social dimension and the intellectual dimension. The social dimension is the state at which the organisation's executives together with Departmental heads understand the needs of the business and commit to them and hence create an alignment. The intellectual dimension is more concentrated on the plans and implementation that mostly done at executive levels.

The social dimension of the strategies has been adopted and owned by the Transnet Group as well as Transport Port Terminal. Through the respondents it has been revealed that the maintenance strategy was updated when Transnet implemented the new strategy. The maintenance department came up with a strategy to assist the new Market Demand Strategy. The respondents' plea for assistance and consultation regarding the Market Demand Strategy proves that organisational strategies are planned at senior management level and hence the feeling that there is no ownership or assistance coming from that level.

According to Bosua and Venkitachalam (2013) successful alignment of strategies is achieved when various components within an organisation are linked to each other. These could include and yet may not be limited to decision making mechanisms, management processes and performance indicators. For one to measure the impact of the alignment one would have to assess the impact that the Department has on the running of the business and its output. Results from the strategic alignment show

that companies could implement different strategies, namely financial goals, the creation of value to customers, and the willingness to take risks by being innovative (Wilson, 2012).

The perception from the majority of the respondents was that key performance indicators are heavily linked to the strategy. A respondent even stated that employees are reluctant to meet their targets as they fear that the targets will be further stretched, making it impossible for them to reach. It is however unfortunate that there is a perception that the organisation doesn't support continuous improvements since the majority of the respondents are certain that there is no continuous improvement plans in place.

5.2.2 Recommendations

The organisation as a whole would have to promote employee involvement and support employee empowerment from all levels within the organisation. The leadership of the organisation should refrain from passive leadership and be more active in the problem within the organisation. The leaders would have to be seen taking charge and being available to assist when needed by the employees, to curb the wariness from employees when new ideas or strategies are implemented. Employees would have to be kept focused on things under their control. The senior leadership within the organisation should hold regular, honest and consistent communication with the rest of the employees irrespective of what the organisation is going through good or bad.

The mission and vision developed for the maintenance strategy would need to be displayed in all workshops for all the maintenance employees to see and identify with. They would need to spell out who the maintenance personnel are, what they do and what they aim to achieve. It must be a product of brainstorming from employees who will be responsible for the implementation. Maintenance completed on equipment must go through quality inspection and must always achieve a level adequate to fulfil the vision and mission of the organisation.

5.3 Objective 2

Assess the role of the maintenance strategy in improving the availability and the reliability of the equipment at the terminal.

5.3.1 Discussion and Conclusion

This objective focuses on the terminal's ability to improve availability of the equipment offered to operations. Maintenance department will have to offer operations the required quantity of equipment, which will be reliable and offer minimal number of breakdowns. This was done by establishing the following information from the study:

- Improving availability and reducing the amount of breakdowns.
- Factors affecting equipment maintenance.

According to Rastegari (2012) companies are moving away from reactive maintenance where they would be fire fighting and are introducing proactive maintenance for protection of investments a company would have made in acquiring an expensive set of equipment. Rezende (2011) noted that asset availability and reliability have become a critical issue in operations that are volume driven and hence the importance of having a maintenance strategy equipped to maintain the equipment.

According to Khairy (2008 cited in Rastegari, 2012) total asset life cycle optimisation stretches the equipment to maintain better availability and improves reliability to produce the desired output and quality. According to Prasanna, Akula and Desai (2011) there is a need to come up with a strategy that integrates different maintenance methodologies and come up with one that will maximise availability and reliability at optimum cost. The measures for the effectiveness of maintenance and reliability or availability are measured in mean time before failure (MTBF), and mean time to repair (MTTR).

A majority of respondents emphatically stated that the terminal can improve both availability and reliability of equipment. The majority however noted the dire state of skills shortages at the terminal. Without trained personnel no matter how good your strategy is it is destined for failure. Respondents raised concerns that employees are unhappy because of the limited amount of overtime they are allowed to work. The phase of maintenance maturity which is illustrated on Chapter 2 of this study showed that when employees are still seeing themselves as overtime heroes, then the maintenance maturity is still on the level of fire fighting or performing reactive maintenance.

Most respondents felt that in most cases equipment is never released to the maintenance teams for periodic maintenance on time. They felt that operational issues are given higher priority over the maintenance of the equipment and equipment is only given back once it starts giving problems. Operations will then be affected and sometimes this will affect their ability of reaching set objectives or they may miss targets. This affects the ability of moving from reactive to preventative maintenance.

Some respondents felt that the training offered to employees is of no value to them. Some stated that in most cases they get trained and never get a chance to apply their newly acquired skills. One of the respondents stated that management go for quantity and not quality when sourcing new talent and recruits for the organisation. Another respondent stated that the organisational drive to cut cost has hampered and compromised the quality and retention of skilled employees. Respondents stated that the lack of experience from the employees has increased the number of outsourced tasks which should easily be done by the employees themselves.

5.3.2 Recommendations

A lot of effort is needed from all stakeholders to improve and sustain equipment reliability in order to reach world class standards. The organisation should adopt a business centered maintenance management approach where maintenance tasks will be seen for their importance by the business and not only by the maintenance personnel. Management should improve the communication channels between

operations and maintenance where the operators of the equipment would be educated on the do's and don'ts of the equipment that could affect the equipment's reliability.

The usage of the original equipment manufacturer practical training would be of value to the organisation. This type of training could be done yearly and attendees should be subjected to assessments and only allowed to work on the equipment if they have been deemed competent by the training instructor. This exercise will however require time and a lot of money but the organisation will do well to invest in programmes that will enhance employee's ability to perform their allocated tasks. More and frequent maintenance focused training could contribute to efficiency and improve the quality of the maintenance work.

The organisation needs to conduct an audit on the resources needed for each task as well as training needed per employee. Using the audit findings a framework would have to be drawn up to ensure the equitable and fair distribution of each task. Training offered to employees would have to be on needs basis, an employee would have to be trained on aspects that he lacks on and not be generalised for all employees. Each supervisor or line manager has to be trained on effective work load management. Employees as a team need to be consulted when planning and reviewing each allocated task. Employees will need to communicate to line manager or supervisor if they have concern regarding allocated tasks. This could also reduce the number of overtime hours worked as work will be equally shared.

The short-term goal would be the introduction of mentoring and coaching between employees. More experienced employees would be used as mentors and they should be financially compensated for their efforts. Management would need to facilitate and encourage teamwork by reducing individualism. New ideas of enhancing the performance of maintenance would need to be encouraged by management. They would have to communicate and advocate to employees the good stories coming from the maintenance department. Performance records of equipment would have to be placed on the noticeboards for everyone to see. The employees responsible for the better performing equipment could be given rewards, not necessarily money, but perhaps time off from work or awards.

5.4 Objective 3

Assessment of the existing maintenance strategy utilised at Durban Container Terminal.

5.4.1 Discussion and Conclusion

This objective focused on the maintenance strategy to emulate the best maintenance scenario. The section dealt with the comparison of the terminal maintenance practices with the best in the same industry. This was done by establishing the following information from the study using OEM recommendations:

- The utilisation of the new equipment in terms of the manufacturer's maintenance recommendations; and
- The utilisation of collected data.

According to Fredriksson and Larsson (2012) factors that are critical for successful maintenance strategy are competent personnel, effective management and flexibility in having continuous improvements. Phelan (2006 cited Ntshangase, 2010) states that original equipment manufacturer recommendations can provide better information pertaining to the equipment they supplied, which would indicate better operational requirements. According to Rastegari (2012) data collection is important in any maintenance strategy as data is used to improve the performance of a strategy. Data collected relating to the failure, repairs due to breakdowns, spare parts used and general maintenance faults would provide the means to better maintain the equipment and not always wait for failure (Mustakerov and Borissova, 2013) and (Selvi *et al*., 2013). The OEM strategy must be modified and improved at sufficient intervals to gain value from it (Fredriksson and Larsson, 2012).

A respondent from Liebherr, an OEM representative of one of the equipment types used at the terminal, suggested that to prolong the life of equipment one has to concentrate on the recommendations they have given in the manuals. Stating that they have better experience and know better than the users what is expected from the equipment. A Shanghai Zhenhua Industries Company Limited (ZPMC) respondent, who was also an OEM representative, stated that the user needs to comply with given recommendations and the usage of collected data needs to be

stored and analysed every now and again to gain better understanding of the failure rate. Both respondents stated emphatically that the maintenance routines must never be copied from different equipment as the commissioning and designs were never the same and the usages of the equipment somehow differ.

The majority of respondents stated that the maintenance strategy is inferior when compared to others. The maintenance routines are copied from one type of equipment to different type of equipment while changes are mostly triggered by reaction to an incident. A respondent stated that the Department even lacks tools recommended by the OEM to perform maintenance activities. The data collection is performed but the data is not used effectively. Equipment is withdrawn from operation because there are issues that need attention and have been provided in the equipment file and yet not done in time. A few respondents however felt that the OEM recommendations are used and get modification to suit operations.

5.4.2 Recommendations

There need to be a strong emphasis on proactive maintenance, improve root cause analysis improve emphasis on employee training and on instituting continuous improvements. A data base of all faults must be created and serviced at set intervals. There would need to be a trigger point that will instruct the maintenance personnel through the issuing of a job card to look at particular item of equipment once the trigger has been set. Management could initiate monthly maintenance audits to be performed by other Transnet terminals, where shortcomings would be identified and corrected before becoming a problem. A Continuous Improvement Department could be introduced to look at aspects in the terminal needing improvements to enhance operations and improve reliability. Logically you cannot control what cannot be measured. KPIs used for the maintenance department must be the same as what are used by other competitors, and these measures must always be reviewed against those of competitors. Targets must meet the industry norm and not what will ensure that maintenance personnel's KPIs are met.

Literature on maintenance strategy doesn't provide for aspects that have to be included in the maintenance strategy based on the industry needs. What is mostly emphasised is the efficiency and the effectiveness of the maintenance in improving reliability and availability of equipment. For this sector it would be advisable to include both OEM specifications as well as the usage of data collection in a strategy and having a well-trained work force. A well-structured and formulated strategy would enhance the business in achieving a return on investment from what would have been spent on maintenance related expenses. Equipment needs to be maintained and need to be modified from time and again to improve its efficiency and effectiveness. These improvements can only be achieved with the utilisation of technology, and having a well-trained, skilled and a wealth of technical skills to specify remedial actions. Management would need to encourage and support these efforts.

5.5 Suggestions for Further Research

Due to time constraints there were issues that materialised that could not fully be evaluated in this study. One was the remuneration of the maintenance employees at the terminal. It seems that most of the employees are not happy with their packages. The mandates given to the technicians and the engineers and their integration into the maintenance team at the terminal tend to be very poor. There appears to be a poor work culture. Analysing data, there is unhappiness with the Unions being too strong and sometimes impacting on managerial decisions. These could greatly affect the efficiency of the Maintenance Department.

Researchers could gather data from the shipping lines and to obtain their feelings regarding their experience when they are at the terminal as compared to other terminals in the world. Further investigation on the performance of maintenance against that of operations could shed light on whether or not there is a link between the performances of the two Departments. A study on cost of poor maintenance and what could be identified as poor maintenance could improve and optimise maintenance.

5.6 Concluding Remarks

The conclusions drawn from the literature and the interviews conducted show that the objectives of this study have been researched and met. It has been shown that there is a dire need for a developed maintenance plan to be crafted specifically for certain equipment and it's not one size fits all. Much of the equipment is critical to the effective functioning of the container terminal and as it is in effect purpose made, it makes no sense to have a maintenance schedule that operates at a lower level than that as specified by the manufacturers. Doing so puts expensive, valuable assets such as heavy plant at huge risk and shortens its lifespan. This has led to the terminal being exposed to "fire-fighting" instead of being proactive to maintenance in order to reduce potential problems. It also appears that there is a need for the maintenance activities together with the strategy to be monitored and reviewed at intervals. There appears to be considerable potential for the maintenance department to improve on its performance by implementing a few pro-active, inexpensive initiatives that should drastically reduce downtime, lessen stress causing breakdown workloads and vastly improve efficiency thereby creating client satisfaction and better team morale at the terminal. Management should use the wealth of knowledge available mostly from the engineers and technicians and encourage new ideas that would benefit the organisation and save it a huge amount in terms of breakdown repair costs and downtime costs.

This research was only conducted at one port terminal and as such the findings and recommendations cannot be generalised with any degree of confidence. Having said that the findings are in accordance with the literature and as such though the sample size was too small for the findings and recommendations to be generalised with any degree of certainty they most certainly can be implemented in similar situations in the knowledge that they should reduce breakdowns and improve terminal efficiency, provided that they are closely monitored.

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Appendix 1: Informed Consent

Dear Respondent

I am a student at the University of KwaZulu-Natal doing Master of Business Administration. I'm conducting a study based on the maintenance strategy utilised at the Durban Container Terminal, with the view of completing the program. I therefore request assistance from you to conducting my research, by affording me about 20 minutes of your time.

Humbly note that your participation is voluntary, you may refuse or withdraw at any time from the project without any negative consequences. Please be informed that all the collected information from respondents will remain private and be treated with the highest confidentiality it deserves. There will be no monetary gain from participating in the study.

Should you have any questions or concerns regarding the questionnaire or participation in the study, you are free to contact either me, my supervisor or the research office on the numbers listed below.

Researcher: Thabani Mthembu (082 394 5917)
Supervisor: Alec Bozas (082 334 4477)
HSSREC Research Office: Mariette Snyman
Tel: +27 31 260 8350
Fax: + 27 31 260 3093
Email: snymanm@ukzn.ac.za
Email (HSSREC): hssreclms@ukzn.ac.za

Sincerely

Thabani Mthembu

Signature: _____

Date: _____

Consent Form

I _____ (full name of the participant) hereby confirm that I Understand the contents of this document and the nature of the research project.

I understand that I am at liberty to withdraw from this project at any time, should I so desire.

Signature of Participant: _____

Date: _____

Appendix 2: Interview Schedule

Questionnaire

1. Personal Questions

1.1. Grade at Transnet Port Terminals

Artisan	Planner	Supervisor/ Technician	Engineer	Manager

1.2. Department

Cranes	Straddles	Operations	Reliability	Other

1.3. Number of years employed at Transnet Port Terminals

< 1	1 - 5	6-10	11 – 20	> 20

2. Determine the effectiveness of the maintenance strategy

2.1. What do you think of the linkage between the Market Demand Strategy objectives and the day to day activities across all levels in the organisation?

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2.2. How well are the responsibilities defined in the strategy and is there enough support for a successful implementation of Market Demand Strategy at departmental levels?

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2.3. In your own opinion does the maintenance department in your section, have a clearly communicated strategy, to guide maintenance improvement, linked to the organisational strategy?

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2.4. To what extent do the KPIs for the maintenance team tie-up to the MDS objectives (Business and Operations)?

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3. Terminal's maintenance strategy in comparison with others

3.1. Explain how the effectiveness of the maintenance strategy is assessed and monitored by internal and external customers.

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3.2. Discuss the measures that are used for both maintenance and also for operations (in your opinion do they relate to both maintenance and operations and to the strategic goals?)

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3.3. Discuss to what extent does the terminal make usage of the new equipment's manufacturer's maintenance recommendations? (How often do they get revised, for the unique operating environment demands?)

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3.4. Elaborate on the maintenance department utilisation of fault historical data or results from maintenance inspections?

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4. Employees' perception

4.1. Explain to what extent do the maintenance employees know and relate to the strategic goals of the maintenance department and how are they affected by the strategy?

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4.2. Explain the general opinion amongst maintenance employees concerning the allocation of maintenance work? (Regarding the workload, workplace, work pace delays etc.)

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4.3. According to maintenance employees, explain how possible and achievable are the goals of improving availability and reducing the amount of breakdowns at the terminal?

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4.4. From your knowledge how have the maintenance employees experienced working under the guidance of the maintenance management?

- What has been good?
- What could have been done better?
- Have there been any difficulties?

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4.5. Explain the feelings of the maintenance employees regarding granted training, authority and if they are fully equipped to carryout allocated tasks? If not what support do they need?

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5. Synergy between the MDS and the maintenance strategy

5.1. Discuss how the maintenance and operations departments exchange information? Does the information sharing have any impact on the business?

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5.2. How does the organisation balance the running of daily maintenance activities with activities to achieve long term MDS strategic objectives?

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5.3. Discuss how the maintenance developments have changed the relations between the maintenance department and the operations department?

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5.4. Explain how the organisation supports continuous improvements efforts? How well do the maintenance employees work with continuous improvements?

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6. Factors which may influence the maintenance strategy

6.1. In your opinion how well are the maintenance department's responsibilities and work documented? Are they easily accessible?

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6.2. What comments can be given about the quality and sufficiency of tools or equipment supporting maintenance work?

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6.3. Discuss the triggers of root cause analysis and if they are clearly identified?

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6.4. Explain to what extent do supervisors discuss the performance and cost factors with their work teams? Is it relevant to the employees?

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……

Appendix 3: Ethical Clearance Certificate

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

19 May 2015

Mr Thabani Mthembu (213569348)
Graduate School of Business & Leadership
Westville Campus

Dear Mr Mthembu

Protocol reference number: HSS/0434/015M
Project title: The role of the Maintenance Strategy in achieving the Strategic Objectives at Durban Container Terminal

Full Approval – Expedited Application

With regards to your application received on 30 April 2015. The documents submitted have been accepted by the Humanities & Social Sciences Research Ethics Committee and **FULL APPROVAL** for the protocol has been granted.

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 Shenuka Singh (Chair)

/ms

Cc Supervisor: Mr Alec Bozas
Cc Academic Leader Research: Dr Muhammad Hoque
Cc School Administrator: Ms Zarina Bullyraj

Humanities & Social Sciences Research Ethics Committee
Dr Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
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Website: www.ukzn.ac.za

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100 YEARS OF ACADEMIC EXCELLENCE

Appendix 4: Gatekeepers Approval

TRANSNET

23 March 2015

Student Name: Mr. Thabani Mthembu
Student Number: 213569348
Institution: University of KwaZulu-Natal
Degree: Masters in Business Administration

Dear Mr. Mthembu

PERMISSION TO CONDUCT RESEARCH - THE MAINTENANCE STRATEGY AT DURBAN CONTAINER TERMINAL

Transnet Port Terminals (TPT) grants you permission to contact our employees with a view to conduct interviews with Transnet Port Terminal employees. This is in respect of the research you are conducting for the completion of your MBA dissertation entitled "The role of the maintenance strategy in achieving the strategic objectives at Durban Container Terminal".

Should you require any further information, please do not hesitate to contact me.

Thank you

Yours sincerely

Sabelo Mzimela
Chief Engineering Manager: Durban Container Terminal
Tel. No.:031 361 6351
Email: Sabelo.Mzimela@transnet.net

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Directors

*Executive

Group Company Secretary [illegible]

Appendix 5: Turnitin Report

Turnitin Originality Report
Thabani by Thabani Mthembu
From Dissertation Final Chapter - Part 1 (Moodle 33111945) (2015 GSOB8FDW1 MBA Dissertation F/T (Moodle 9700032))

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