An Investigation into train cancellations and delays at the Transnet Engineering Locomotive Diesel Depot in Wentworth, Durban

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DECLARATION OF CANDIDATE

I, Vishal Mohunlal, student number 19752289, hereby declare that this dissertation is my own work and has not been previously submitted to any Institution.

_____ 15 November 2021

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SUPERVISOR'S STATEMENT

This dissertation is submitted with my approval.

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ABSTRACT

The South African economy has experienced a decline in Gross Domestic Product (GDP) over the past years. Additionally, South Africa's State Owned Enterprises (SOE) have contributed to this decline- Transnet being one of those enterprises.

Hence, the researcher has conducted this study to investigate the inefficiencies in Wentworth Diesel depot resulting in excessive train delays and cancellations. This study has been conducted using a Qualitative Research Methodology approach. Additionally, literature from worldwide sources was extensively researched. Acclaimed gurus' insight into this study illustrated and debated the opposing and supporting theories. The theories were elaborated and compared with the environment of the South African Railways. Despite the theories of different literature being both, contrasting and corresponding theories, the literature was intensely compared, resulting in suggestions and recommendations

Concurrently, interviews were conducted to gain insight into the reasons for train delays and cancellations at Wentworth Diesel Depot. Subject Matter Experts from Transnet were interviewed for the purpose of finding root causes for delays and cancellations at Wentworth Diesel Depot. Subsequent thematic analysis was conducted with the data collected, which resulted in certain findings. Validation of data was also performed to ensure the credibility, transferability, dependability and confirmability of this study.

The core findings of this study were:

- Faulty locomotives.
- Unavailability of locomotives.
- Delayed or no loads from the customer.
- Defective radios and telemeters.
- Breakdowns and derailments of locomotives.
- Vandalism or theft of railway tracks, cables and overheads.
- Recurrence of train crew's unplanned leave.

The study conducted resulted in proposed recommendations:

- The need for proper planning.
- Improving maintenance processes.
- Loads to be prepared on time.
- Improving the availability of locomotives.
- Procuring new locomotives.
- Awareness of the abuse of unplanned leave.
- Security to monitor and patrol stations.
- Improving communication between Transnet Engineering and Transnet Freight Rail.

The purpose of the study, to find possible recommendations to reduce train delays and cancellations, has been accomplished. The researcher is adamant that these Recommendations, if implemented, will result in a drastic decline in train delays and cancellations at Wentworth Diesel Depot.

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ABBREVIATIONS

ANC	African National Congress
ASAWU	Academic Staff Association of Wits University
ATC	Automatic Train Control
BCEA	Basic Conditions of Employment Act
BU	Business Unit
CI	Continuous Improvement
COO	Chief Operating Officer
COSATU	Congress of South African Trade Unions
CRRC	China Railway Rolling Stock Corporation
CS	Customer Satisfaction
CSM	Customer Service Manager
CSSF	Communication Systems, Transponders, Faults of signals
CTC	Centralised Traffic Control
CTCS	Chinese Train Control System
DMAIC	Define, Measure, Analyse, Improve, Control
DPE	Department of Public Enterprise
DSB-S-tog	Train Company of Copenhagen Suburban Rail Network
DSS	Decision Support System
EM	Executive Manager
ERA	European Railway Agency
ET	Engineering Technician
FCFS	First Come First Served
GDP	Gross Domestic Product
GM	General Manager
HSR	High Speed Railway
ILP	Integer Linear Program
IMS	Integrated Management System
ISO	International Organisations for Standardisation
ITP	Integrated Train Plan
KCS	KELOIS Commuter Service
KH	Copenhagen Central
KS	Kolmogorov-Smirnov
LCFO	Last Come First Out
MBV	Michael Brookes Vision
MDEF	Master Diesel Electrical Fitter
MDS	Market Demand Strategy
NCC	National Command Centre
NCR	Non-conformance report
NUMSA	National Union of Metalworkers South Africa
ORIE	Overall Railway Infrastructure Effectiveness

OTD	On Time Departures
OTMD	Ongoing Time Management Drive
PRASA	Passenger Rail Agency of South Africa
QA	Quality Assurer
RCA	Root Cause Analysis
RM	Resource Manager
ROI	Return on Investment
RSA	Republic of South Africa
RSR	Railway Safety Regulator
SACP	South African Communist Party
SAFTU	South African Federation of Trade Unions
SAH&R	South African Harbours & Railways
SAPS	South African Police Services
SATS	South African Transport Services
SLA	Service Level Agreement
SM	Section Manager
SME	Subject Matter Expert
SOE	State Owned Enterprise
SOP	Standard Operating Procedure
SPRINT	Software Program exclusive to Transnet
SRN	Swedish Rail Network
STA	Swedish Transport Administration
TCO	Train Control Officer
TE	Transnet Engineering
TEMS	Train Execution Management System
TFR	Transnet Freight Rail
TNPA	Transnet National Ports Authority
TOMS	Transnet Occurrence Management System
TP	Transnet Property
TPL	Transnet Pipe Lines
TPT	Transnet Port Terminals
TTC	Technical Training Co-ordinator
UK	United Kingdom
USA	United States of America
VA	Variation Agreement
VOR	Value of Reliability
VOT	Value of Time
ZTNB	Zero-Truncated-Negative-Binomial

CHAPTER 1:

INTRODUCTION

1.1 Introduction

Global competition to be the best in the world in any and all services or products that a business offers has led to the optimization of resources and higher efficiency rates across the globe. In South Africa, Transnet has been caught in the whirlwind of ever-changing sales, marketing, customer service and international standards to reach world-class status. In an attempt to meet these standards, Transnet has implemented the Market Demand Strategy (MDS) and recently, the 2021 Strategy. The MDS and 2021 Strategy involve the maintenance of the rail infrastructure and new locomotives, the 1064 Project and up-skilling of employees. Transnet needs to keep up with world-class standards in order to provide efficient, reliable and trustworthy transport services in South Africa and neighbouring countries (MDS, 2012).

In an effort to find solutions to why the campaign has failed, an investigation needed to be conducted into cancellations and delays. A train cancellation impacts financially on Transnet, employees' jobs, customer satisfaction, a decline in the overall efficiency of Transnet and the Gross Domestic Product of South Africa as a country. The researcher has deemed it necessary to investigate the cancellations and delays in order to improve the efficiency of Transnet and provide customer delight so that tonnages can be brought back to RAIL from ROAD.

The structure of this Chapter comprises of:

- Introduction: history and background of Transnet.
- The Research problem.
- The Aim.
- The Research Question.
- The Rationale of this study.
- The Delimitations.
- The Conforms of this study.
- Limitations.
- The Shortcomings.
- Structure of the Dissertation.

1.1.1 The History of Transnet

Transnet's history began way back in 1868, when diamonds were discovered in Kimberly. The Cape and Natal were chosen to be the harbours and the railway system was started to connect these areas. The South African state railway system in the Cape was converted to government property in 1872 and Natal was converted in 1877. The basic harbours in Durban and Cape Town were completed. Nine years into the future, both harbours were extensively linked towards Kimberly, as gold and diamonds were discovered.

In 1910, a Union was accomplished with the country's authorities, such that the harbours and railways should be amalgamated. This developed into the South African Railway and Harbours organisation (SAR&H) becoming part of the government. Twenty years later, the union was created in 1930 and South Africa became a mobile nation. This resulted in the opening of the proficient main line passenger links and remarkable network of city and municipal train services.

In 1970, government decided that SAR&H should restructure along the lines of business, and name changing was fundamental. In 1981, the country's railway, harbour, road transport, aviation and pipelines changed their name to the South African Transport Services (SATS). Simultaneously, the company was restructured into units and divisions. At the end of 1989, the objective was to manage SATS as a private entity. After 80 years of government control, SATS was given a new ranking. A limited liability corporation was born, named Transnet SOC Ltd. After 1994, Transnet has had multiple changes to keep abreast of the ever-changing global markets (Transnet SOC Ltd. Transnet, 2019).

1.1.2 Background

Transnet is a State-Owned Enterprise (SOE) solely owned by the government of the Republic of South Africa (RSA), majority owned by the Department of Public Enterprise (DPE) and comprises of rail, ports and pipelines. Transnet is responsible

for being the largest rail and logistics entity, which has the largest infrastructure to move remarkable volumes.

Post-1994, Transnet being a state owned company was considered a government parastatal. An understanding of the parastatal is that the government is a major shareholder of Transnet and is on the board of trustees. Like any other investment, the government expects the Return on Investment (ROI) to be positive. Transnet is the largest in South Africa and also services the neighbouring countries in Africa (Transnet SOC Ltd. Transnet Annual Report, 2016).

In recent years, there has been a decline in revenue, sales and profits. This is a cause for concern as Transnet needs to be self-sustainable and profitable. Transnet Annual Reported losses of over fifteen billion rands in the last five years, but this was also due to the global recession (Transnet SOC Ltd. Transnet Annual Report, 2016).

The government has warned that “they cannot rescue” the parastatal like other state owned entities that needed “rescuing”, namely, Eskom, South African Airways and the South African Post Office (Transnet SOC Ltd. Transnet Annual Report, 2015).

Transnet also needs to compete against other world-class organizations from different countries in order to sustain itself (Transnet SOC Ltd. Transnet, 2015). The import and export of goods needs to be of exemplary service and standards. However, Transnet is lagging behind and this is a cause for concern not only in South Africa, but globally as well. Transnet in South Africa is the major shareholder in the ports, air, rail industry and pipelines. Transnet is also responsible for servicing neighbouring countries. The inefficiencies in service delivery impacts on other countries and relations with business. Moreover, it indirectly influences the exchange rate of the rand and also productivity. These losses are actually indirectly passed on to the consumers (Transnet SOC Ltd. Transnet Annual Report, 2015).

Transnet consists of six core operating divisions: Transnet Freight Rail (TFR), Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT), Transnet Engineering (TE), Transnet Pipelines (TPL) and Transnet Property (TP). Transnet Freight Rail is the largest division of Transnet, which hauls heavy freight and light freight all over South Africa and links to other rail networks in the sub-Saharan region, with its rail infrastructure representative of about eighty percent of Africa. Transnet Engineering (TE) is the support structure to the rest of the Transnet group. TE is

responsible for the maintenance of rolling stock, modifications, design and providing spare equipment. TNPA is assisting government's importing and exporting through maritime logistics. TPT operates the container terminals and is responsible for the control of containers for importing and exporting. TPL is also known as Petro-net, and is in authority for transporting petroleum and gas throughout the country. TP is responsible for groups' infrastructure, buildings, workshops and assets. However, this department is undergoing restructuring (Transnet SOC Ltd. Transnet, 2019).

TE and TFR will be the focal point of this dissertation. TE and TFR are the departments directly responsible for train movement. Therefore, the researcher finds it apt to investigate these two departments. In a separate article, Jan de Villiers informed the *Transport Forum* that the South African rail sector is not able to compete effectively against other modes of transport. De Villiers stated that the new policy through the National Rail Policy will focus on improving rail investment by adding one hundred and seventy billion rands over the next ten years. He elaborated this will be done to position rail as South Africa's transport backbone by 2050 to support the United Nations' responsibility to reduce greenhouse gas emission. This supports the South African government's continuous plan to move from road to rail (Liedtke, 2018).

In an article from Railway Technology, Eva Grey (2015) discussed South Africa's biggest railway deal and how it is predicted to propel the economy to prosperity. Transnet's Market Demand Strategy (MDS) from 2012 has a 7-year R300 billion investment to rejuvenate Transnet. A large portion of R50 billion will be dedicated to rail recapitalisation. China North and South Rail won the major contract tender, followed by Bombardier Transport and General Electric. It is the third year and the plan looks positive. Transnet secured R13 billion from funders and financial institutions, including Barclays Africa, Investec, Standard Bank, Old Mutual and Export Development Canada. Although Transnet has embarked on ventures to move freight from road to rail, in 2013 about 734 million tons of freight was moved in South Africa, of which 71% was moved by road, despite railways making up 80% of Africa's infrastructure. The national infrastructure plan is to invest R4.3 trillion d towards new infrastructure and upgrading existing networks. Increased tonnages by railway will improve the country's efficiency. Transnet aims to lower the cost of doing business in South Africa. In an address at the 2011 Railways and Harbour Conference, Jeremy

Cronin (2011) stated that about 60% of the rail network was being used at 50% of its capacity (Grey, 2015).

In an article, Siyabonga Gama (2017) stated that Transnet will continue to grow through the expansion and modernisation of ports, rails and pipeline infrastructure. Transnet has invested R145 billion over the past 5 years to achieve the government's National Development Plan. Gama stated that Transnet faces strong competition from road transport, and has lost large amounts of tonnage to the road over the previous 20 years. Mr Gama stated that it is of utmost importance that rail development be met and road to rail initiatives remain at the forefront of the strategy (Transnet SOC Ltd. Transnet Online Integrated Report, 2017).

The researcher explains how the 24 Hourly Locomotive Positioning tool is used by Transnet Freight Rail and Transnet Engineering to monitor locomotive positioning. The following Figure 1.1 illustrates the locomotive positioning at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

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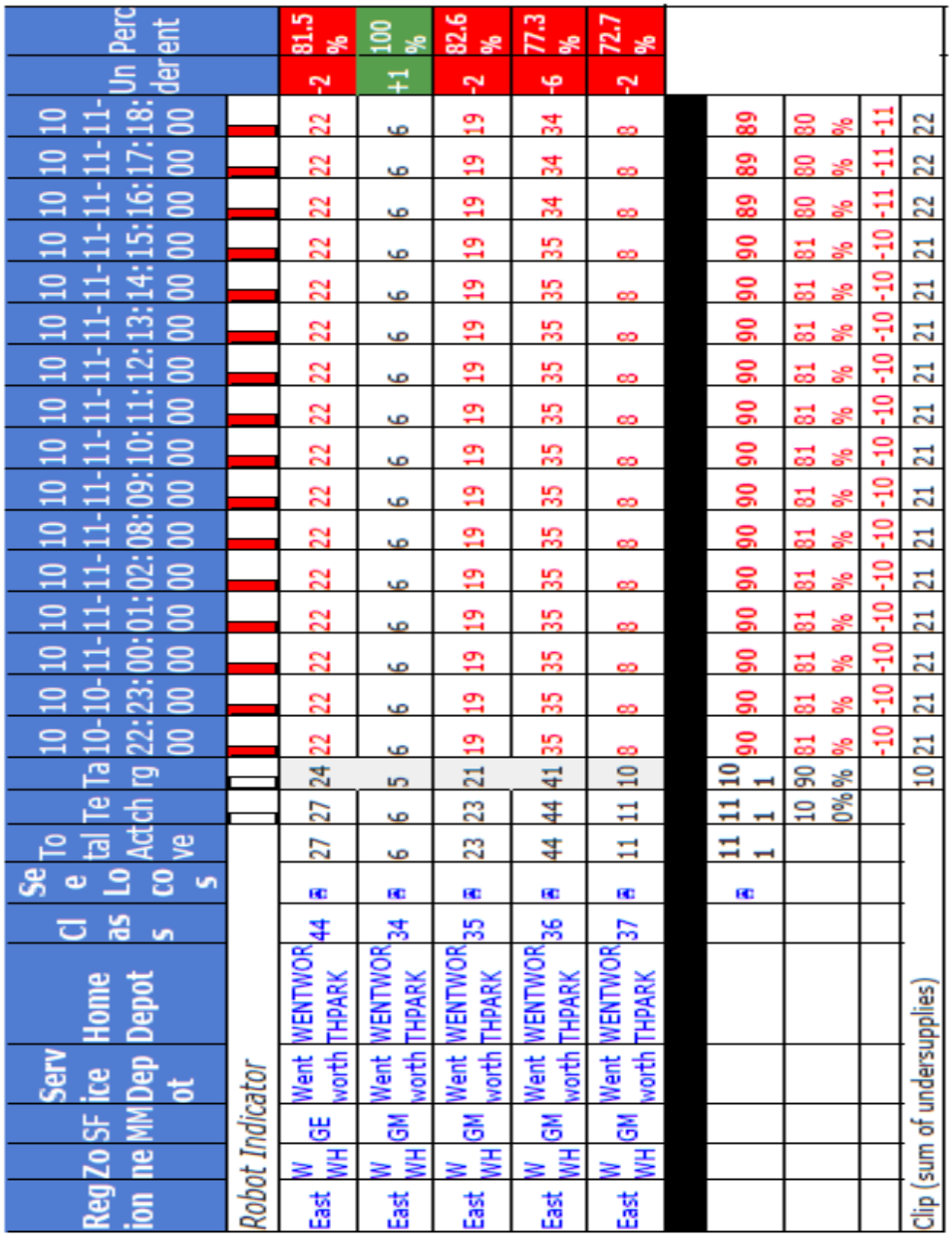

Figure 1.1: 24 Hour Locomotive Position of Wentworth Locomotive Depot as at 11 October 2017 (Locomotive 24-hour Position. Transnet, 2017)

The above figure represents a snapshot of the locomotive position of Wentworth Diesel Depot on 11 October 2017. The figure reads as follows:

- The first column represents the region. In this case, the Eastern region.
- The second column represents the *zone*, which is also known as the *area*. In this case Wentworth.
- The third column represents the fleet engine type. In this case, GE represents General Electric and GM represents General Motors.
- The fourth and fifth columns represent the service and home depot. In this case it is Wentworth Diesel Depot.
- The sixth column represents the class of diesel locomotive. Wentworth has the following classes: 44, 34, 35, 36 and 37 class diesel locomotives.
- The seventh column, when clicked on the locomotive icon, gives you the actual locomotive number of the entire fleet.
- The eighth column represents the total active fleet. The total active fleet of 44 class locomotives is 27; the total active fleet of 34 class locomotives is 6; the total active fleet of 35 class locomotives is 23; the total active fleet of 36 class locomotives is 41; and the total active fleet of 37 class locomotives is 11. The total fleet of locomotives for Wentworth Diesel Depot is 111.
- The ninth column represents the technical allowance, which is the same as the active fleet for Transnet Freight Rail.
- The tenth column represents the target that Transnet Engineering can supply at a minimum for Transnet Freight Rail to be able to run all trains as per the Integrated Train Plan (ITP). The difference between the technical allowance and the target is the number of locomotives that are allowed to be out of service for repairs and maintenance. The technical allowance of 111 locomotives is represented at 100%, and the target and 101 locomotives is represented at 90%. Therefore, the locomotive position is favourable when it is at 90% and above, and unfavourable and when it is below 90%.
- The eleventh to twenty-sixth columns represent the hourly locomotive position, meaning the number of locomotives available at each hour.
- The twenty-seventh column represents the under-supply or over-supply of the fleet of locomotives. In this case, the 44 class of locomotives is under-supplied by 2, the 34 class is over-supplied by 1, the 35 class is under-supplied by 2, the

36 class is under-supplied by 6 and the 37 class is under-supplied by 2. This means that there is a total under-supply of 11 locomotives. This translates to 90 locomotives available at 80%.

- This illustrates that Wentworth Diesel Depot is under-supplied by 11 locomotives, which is 80% availability. This implies that Transnet Freight Rail are 11 locomotives short to run the required number of trains as per their Integrated Train Plan. This will result in the cancellation of trains. The supply of locomotives cannot meet the demand (Locomotive 24-hour Position - Transnet, 2017).

The 24 Hour Locomotive Positioning is available per depot, per region and nationally for Transnet. Each depot, regionally and nationally, needs to constantly monitor and proactively rectify locomotive unavailability when required. This tracking tool is used on an hourly basis to measure Transnet Engineering's performance. The researcher is confident that an implementation of this tool will reduce the unavailability of locomotives, thereby improving the availability of locomotives and oversupply of locomotives in the event of failures. The current availability of locomotives seriously impacts Transnet Freight Rail in committing to customer demands. This has a knock on effect of poor service delivery and reduced revenue, impacting on the overall Gross Domestic Product (GDP) of South Africa. Hence an improvement in the availability of locomotives will result in improved service delivery and ultimately an increase in the Gross Domestic Product of South Africa.

The data and records have been used from the Transnet database with permission. A letter of consent is attached to the appendices.

1.2 The Research Problem

The continuous movement of tonnages from rail to road has resulted in Transnet's loss of sales, which has resulted in Transnet having to downsize and undertake budget cuts. Furthermore, employees have been retrenched and vacancies have not been filled (Transnet SOC Ltd. Transnet, 2017).

Transnet cannot continue in this downward spiral as it plays an important role in job creation in South Africa. Transnet is one of the largest companies providing jobs to

over 49078 employees in South Africa (Transnet SOC Ltd. Transnet Annual Report, 2016). Train cancellations and delays, if not remedied, will cause more job losses and a decline in revenue.

In an article in the Daily Maverick titled *South Africa's shocking unemployment rate remains unchanged*, Stats SA stated that the labour markets cannot absorb new entrants as many were seen at robots, loitering, doing tricks, begging at robots or as car guards for extra cash. The International Monetary Fund noted that South Africa's unemployment rate is too high, even by emerging market standards. The emerging markets' average is single digits, whilst South Africa's is close to 30%. Additionally, the South African unemployment rate of the youth is greater than 50%, whilst emerging markets is 15%. Unemployment is South Africa's source of a lack of wider economic and social skills. Unemployment is the prime cause of poverty, inequality and other scourges and it also contributes to social unrest (Stoddard, 2020).

Sambo (2019) stated that the high unemployment rate in South Africa has a huge impact on the extremely poverty-stricken citizens. More than 13.38 million people are living below the R441.00 per month level (Sambo, 2019). Due to minimal or no education, this results in minimal or no skills or development, which results in poor living conditions, no education and no food. This socio–economic decline leads to unwanted pregnancies, sexually transmitted diseases, as well as alcohol and drug abuse. This gives rise to violence, which further promotes turning to crime for survival (Sambo, 2019).

The researcher has used the figures and interviews from News24 (2018), Statistics SA (2018), Kekana (2019), Stoddard (2020) and Sambo (2019) to emphasize that the unemployment rate in South Africa has deteriorated. Sambo and Stoddard state that the unemployment rate causes socio-economic and psychological deterioration in unemployed citizens, which leads to crime, violence and unruly behaviour. The researcher is of the opinion that Transnet has the ability to reduce the unemployment rate by providing skills and development which will result in job creation, thereby assisting in improving socio-economic and psychological standards.

The literature from European Railway Agency (ERA, 2011) suggests that rail network systems are indeed important to a country's local and global productivity. The European Railway Agency (ERA, 2011) argues that using information technology and

computer software programs like the Real Time model in the United States of America is the solution to resolving delays and optimizing resources.

The researcher argues that the aftermath of the inefficiencies at Transnet will inevitably result in unemployment. The reasons for this argument is that an increased number of train cancellations has resulted in poor customer satisfaction of the rail network system in South Africa. The delivery of freight is not timeous and results in customer dissatisfaction, which results in rail freight moving to road freight. The passenger sector is also affected, resulting in customers being late for jobs, appointments and scheduled meetings. This also has a negative impact on the customer satisfaction of commuter rail transport. Sometimes resulting in employees losing and suffering job losses or financial losses.

The researcher will share evidence of the above in Chapter Two.

The researcher addresses the problem of the unavailability of locomotives at Wentworth Diesel Depot, and the recommendations can prove to be fruitful if adhered to by all departments concerned.

1.3. The Aim

The aim of this study is to explore the reasons for cancellations and delays with a view to assist in reducing the cancellations and delays at the Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

1.4 The Objectives

- To explore reasons for cancellations and delays at the Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.
- To recommending suitable strategies that will minimise train cancellations and delays at Transnet Engineering Locomotives Durban Diesel Depot.

1.5 The Research Questions

- What are the reasons for cancellations and delays at the Transnet Engineering Locomotive Diesel Depot, Wentworth Durban?
- What can be done to assist in reducing the number of cancellations and delays?

1.6 Rationale of the Study

The rationale for this study is to provide possible solutions to reduce the cancellations and delays in Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. The researcher will therefore accentuate reasons for the cancellations and delays and provide recommendations to reduce the cancellations and delays in Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

In an interview conducted between Finance 24 and Transnet Chief Executive Officer, Siyabonga Gama (2011), Gama stated that *"we are in search of volumes"*. Transnet needs to move volumes from road to rail in order to assist the economy in increasing revenue and this will also result in reducing the carbon footprint. It is economical, faster and environmentally friendly to use rail (News24.com, 2011).

In this dissertation, the researcher acknowledges that there are other modes of transport, namely air and sea, which can be used. However, that is not the scope of this topic. Sea transport is impractical in moving commodities inland and therefore will not be considered. Air freight will be too expensive to move such volumes of the commodities, namely iron ore, coal, cars, general freight and containers.

In an article by JBT Transport, debates that transporting goods in Canada and the United States is very important to the countries' economy. The article compares the advantages and disadvantages of rail and road transportation (Bogdanski, 2017).

The researcher has constructed the following table to show the differences:

Table 1.1 – Advantages and Disadvantages of Road and Rail Transport (Bogdanski, 2017)

	ROAD	**RAIL**
ADVANTAGES	Flexibility in terms of the destination and volumes.	Much more faster
	Available 24 hours a day	More reliable
	More affordable	Least affected by weather conditions and traffic jams
	The services are not specialised meaning you do not have to differentiate frozen, fresh, heavy and small objects	Carry larger volumes over greater distances
		Making it more economical and quicker
DISADVANTAGES	There are restrictions caused by traffic and speed limits	Lack of flexibility and convenience – routes and times cannot be adjusted
	Unpredictability of weather conditions.	Does not provide door to door services – as it is tied to a railway track.
	Unpredictability of accidents, road blocks	

In a debate, Mescht (2006) debated the redundancy of rail. The points that were debated were:

- That the railway infrastructure was becoming technologically redundant.
- Rail freight was not an effective investment.

- The flexibility and adaptability makes it possible to carry different size consignments, over varying distances in accordance to customer service requirements.
- A rail operator hauls bulk loads over relatively long distances to remain profitable.
- Modern technology in the form of powerful trucks combined with good road infrastructure enables haulers to provide punctual door-to-door services which rail cannot. This makes it the preferred mode of transport for time-sensitive goods and just-in-time deliveries.
- Termination of general freight services on South Africa's rail network is not a sensible option, although suggested by some professionals.
- The socio-economic development in the African context has been overlooked, such as rural poverty, unemployment and the widening gap between urban and rural economies (Mescht, 2006).

In an article by Railway Pro 365, Stafie (2010) stated that in Romania the rail passenger network failed to provide:

- An efficient transport system;
- A sufficient number of trains, with a timetable that satisfies the customers' demands;
- Low tariffs; and
- Reduced travel time.

Simultaneously, the import of motor vehicles increased. This created a knock-on effect on congestion and high accident rates. It is a known fact that the railway transport pollution levels are ten times lower than road transport. This has created chemical pollution mainly due to the number of motor vehicles. There is also strong competition between the modes of transport. However, the revenue of the state owned companies decreased because of the low number of customers. The rail network received state subsidies that cannot ensure a minimal survival. The infrastructure is old and has speed restrictions, which is a safety regulation to reduce derailments. The Romanian railways need to reduce the technological differences with road transport. The

Romanian railways also need to have efficient railway administration and major efforts need to be made at decisional and executional level (Stafie, 2010).

In an article, Fin 24 states that the South African unemployment rate rose to 27.5 % at the end of the third quarter of 2018. News24 announced that the unemployment rate at the second quarter of 2018 was 27.2 %, an increase of 0.3%. Additionally, according to the Quarterly Labour Force Survey for the third quarter, there are 16.4 million employed people and 6.2 million unemployed people between the ages of 15 to 64 years old (News24.com, 2018).

In a comparison between the third quarter of 2017 to the third quarter of 2018, mining has shown the biggest percentage decrease. In the 2017 third quarter, there were 446 000 people employed in the mining industry. In the third quarter of 2018, it had fallen to 406 000 people. This resulted in a decrease of 8.9%. Economists from First National Bank stated that they anticipated that this number will remain stable (News24.com, 2018).

In an article from the Mail and Guardian, it was stated that according to Stats SA, South Africa had 38.1 million people of working age, which is between 15 to 64 years old. Of this, 16.5 million were employed and 6.1 million were unemployed, whilst 12.6 million are not economically active due to various reasons, mainly due to being discouraged by seeking for jobs to no avail (Kekana, 2019).

The following table represents the unemployment figures in South Africa from statistics.com (2018). The article shows a steady increase in the unemployment rate in the five years from 2014 to 2018. The unemployment rate in 2014 was 25.20% which rose to 26.92 % at the end of 2018 (Kekana, 2019).

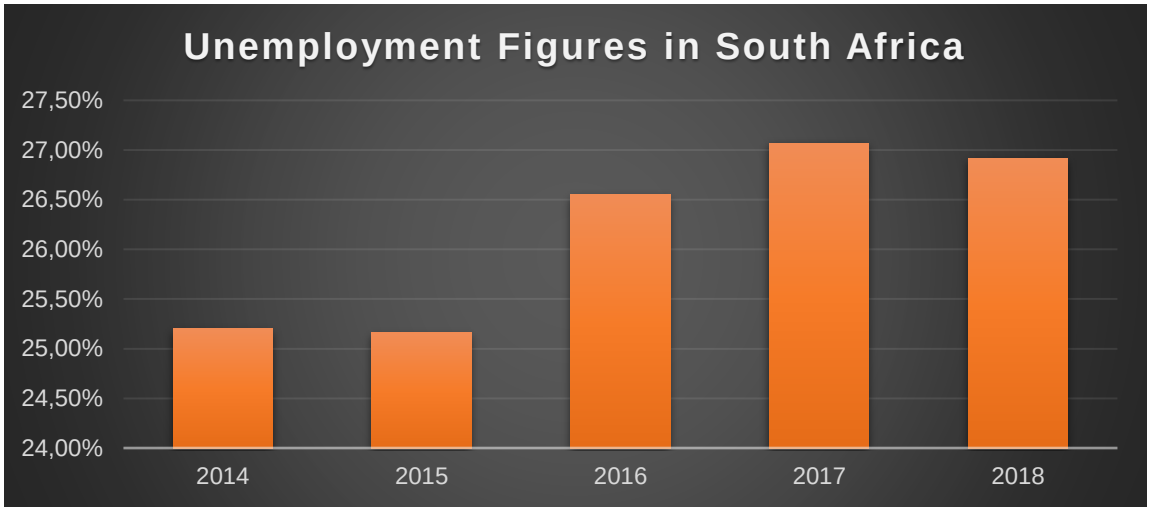

Figure 1.2 – Unemployment Figures in South Africa (News24.com, 2018)

The researcher postulates that the rail mode of transport can be more efficient, reliable and economically viable and environmentally friendly than road, which will be discussed further in Chapter 2 in Literature Review.

This dissertation intends to provide possible strategies for improvement, after the data is analysed, also provided possible recommendations to reduce cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

1.7 Delimitations

The geographical location was Transnet Engineering Locomotive Diesel Depot, Wentworth. The organisational location was Bayhead in Durban. Only skilled subject matter Experts, employees of Transnet Engineering and Transnet Freight Rail were interviewed. This dissertation is limited to the freight sector, diesel locomotives, Transnet Freight Rail and Transnet Engineering, and not the passenger sector, Passenger Rail Agency of South Africa (PRASA), both of which are State Owned Enterprise (SOE). This dissertation is also limited to the socio-economic, technological, political, legal, cultural and demographic environmental factors.

1.8 What are the confines of the study (boundaries?)

This dissertation is limited to one company, one province and one depot in Durban**.** The study was conducted with a sample of the population and it cannot be generalised to all Transnet depots.

1.9 Limitations

This study cannot be generalised because it is exclusive to Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. Constraints in terms of resources are the number of staff and availability of time. Certain employees were non-responsive to participate in this study. One participant, after starting the interview, felt he or she would incriminate himself/ herself and requested to end the interview. This was done by the researcher even though the participant was fully aware of the confidentiality and non-disclosure agreement. Thus, only twenty participants participated in this dissertation.

1.10 What are the shortcomings?

- This study cannot be generalised to other companies nor can the research be generalised to the whole of Transnet as it is limited to Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.
- The respondents may not have been honest due to the sensitivity of the topic. Employees may also be sensitive to divulging too much information about their jobs.

1.11 Structure of dissertation

The dissertation has been structured as follows:

Chapter One: Introduction

This is an introduction to the dissertation assisted by a background, history, the research problem, the aim, the objectives, research questions, rationale of the study, delimitations and chapter summary.

Chapter Two: Literature Review

The second chapter provides a discussion of previous research studies related to train cancellations and delays in a railway system. This chapter also provides details of how other railway systems in different countries manage and mitigate train cancellations and delays. Chapter Two introduces the literature, discusses the method of searching, the orientation of the study, train cancellation and adopted systems in other countries, different strategies of robustness, technological advancements and chapter summary.

Chapter Three: Research Methodology

In this chapter, the researcher provides insight into the qualitative research methodology used for this study. Chapter Three includes an introduction to the research methodology, the purpose, the research question, the research design, the population, the target population, sampling procedure, the measuring instrument, data collection, data analysis, pretesting, delimitations, scope, boundaries, shortcomings, credibility, transferability, dependability, confirmability, anonymity, ethical considerations and chapter summary.

Chapter Four: Results and Findings

This chapter presents the findings and results of this study in conjunction with the research methodology and literature review. The chapter shows the data gathered and the way in which the data was studied.

Chapter Five: Summary, Conclusions and Recommendations

Chapter Five is a summary of the study conducted by the researcher. It also details the conclusions and recommendations derived from the study.

1.12 Chapter Summary

This chapter introduced the significance of this dissertation, which is to reduce the cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. Transnet's Market Demand Strategy was introduced and the investment the South African government has made in Transnet was described. The Market Demand Strategy is to support and improve the rail infrastructure, locomotive and overhaul of Transnet. The researcher has explained that train cancellations and delays result in job loss, poor service delivery and inefficiencies in Transnet. The loss of freight tonnages from rail to road is also highlighted. Transnet remains a state owned enterprise that specialises in logistics, which is moving freight throughout South Africa and the rest of Africa. The 24-hour locomotive positioning dashboard gives a snapshot of locomotive availability.

The dissertation explores the reasons for the cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. The dissertation also provides recommendations to reduce cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

CHAPTER 2:

LITERATURE REVIEW

2.1 Introduction

Chapter Two offers a review of the literature. There is a discussion of previous research studies related to train cancellations and delays in a railway system. Furthermore, it also provides details of how other railway systems in different countries manage and mitigate train cancellations and delays.

Equally important, Chapter 2 also discusses the Standard Operating Procedure (SOP) of Transnet Freight Rail and Transnet Engineering. The process of cancelling a train is explained. Most importantly, the researcher also highlights the inefficiencies in Transnet.

Further elaboration on the interaction between private and state-owned companies created a profitable economy. The strategies to maintain a competitive edge are discussed.

Deliberations about the decline in revenue, sales and profitability is discussed. The loss and profit margins incurred by Transnet, year on year were discussed. The top 10 railway companies of the world were weighed.

Exploring the market value of railway companies and the market value of Transnet are further elaborated on. Thereafter, there is also a discussion of how the inefficiencies in business reduced revenue and profits. In addition, the researcher then considers the use of computer software and technological advancements.

The Basic Conditions of Employment Act and the Variation Agreement of Transnet is highlighted. Government's intervention to correct pricing through regulations and fiscal policies were also considered.

A discussion scrutinising how union meetings, shift work and gender equality hamper production in Transnet.

The impact of vandalism and theft of rail infrastructure is highlighted as a contributing factor to the cancellations and delays of trains.

A discussion on how KELOIS Commuter Service (KCS) in Boston, United States blamed new locomotives for delays and cancellations is also done (Dungca, 2017). An analysis on how bad weather conditions in the United Kingdom (UK) resulted in train cancellations and delays due to snow and icy winds that created hazardous travelling conditions.

Thereafter, the *Queueing Model* is explained on the First Come First Served (FCFS) and Last Come First Out (LCFO) principles.

European Railway Agency (ERA) uses cameras in conjunction with signals and computers to reduce train cancellations and delays.

In a case study in Sweden, it is shown that the Swedish Rail Network (SRN) uses a model for certain sections of the railways (Ahren & Parida, 2009). The researcher then discusses Brian Molefe, Chief Executive of Transnet at that time, who publicly stated that he would ensure that trains run on schedule. The researcher further explains the Mixed Integer programme and Sliding Window algorithm to prevent cancellations.

A study conducted in Sweden indicated that there was a switch from rail to road resulting in a 3.2% decline in freight movement. The researcher then deliberates the Markov Chain Model algorithm to forecast delays based on the past day run.

In the UK rail infrastructure, lacking maintenance has led to accidents, deaths, injuries and derailments. The relationship between good maintenance and reduced asset failure is emphasised.

Eskom's poor planning and reduced maintenance resulting in load-shedding is explained. Inefficiencies in State Owned Enterprises are highlighted and possible recommendations for privatisation are provided.

In the UK, a report explores how robustness in train planning can reduce delays and cancellations. In another article in the UK, inefficiencies were reduced when the railway network was divided and privatised by different competing companies.

The labour unions and social communists' political parties in South Africa opposed privatisation or part privatisation of state owned entities are discussed.

Subject matter experts who reinforce that privatisation will improve inefficiencies in State Owned Enterprises were presented.

A demonstration on how more delays are caused during rush hour and uses a model to estimate delays and reroute trains was illustrated.

In the UK, Southern Railways had to reduce their train service, resulting in cancelled trains due to high numbers of staff being off sick.

The parameters passengers use to measure the performance of the train was showcased. Robustness of train travel time saw the price being a trade-off between the two, and the researcher agrees that a robust train system is an effective method.

The difference of opinions on how providing information to passengers about changes in their train timetable can assist passengers to make informed alternative arrangements is argued. Attention is drawn to an article on how customers place cost against the reliability of trains, and uses it as a measurement for reliability. An article in New Jersey where problems with the technological advancements on locomotives resulted in delays and cancellations was considered. Alternative views on energy supply to locomotives to reduce reliance on Eskom was explored.

A study illustrating on how conflicts were resolved by using the value of reliability as a parameter was explained.

Delays in the Hungarian Railways compounded the loss of time attending to faults, due to bad weather conditions.

A discussion on the Swedish prioritisation rule for conflict which has to be combined with some sort of monetary compensation was presented. The recovery strategy of robustness in Copenhagen Central was explained. The Swiss Research Conference illustrated that minimising delays tends to have more impact on passengers, outweighing freight.

The Chinese High Speed Railway is still confronted with disruptions are deliberated. In another study in China, faulty signals also attributed to delays and cancellations. In Australia, railway networks use social media platforms to communicate with commuters. In research published in the Netherlands, the aspects of train length, density of traffic and gradients were taken into consideration and allowed extra time for their journey.

Overcrowding is a result of unavailable and unreliable rolling stock, which leads to the overcrowding of trains in South Africa. A robust transport system eliminated overcrowding. Emphasis on the effect of punctuality on trains and how certain seasons attribute to delays due to bad weather conditions was researched. An investigation into how traffic control has difficulty when weather forecasting does not correspond with the plans was conducted.

In the Slovakian Republic, the six sigma methodology is used to find the root cause of delays and improve on them. The quality of maintenance is explained. In a separate article, *Critical Failure* modes are analysed.

Vandalism of the railway lines has resulted in delays of trains due to signal cables being stolen.

In a separate analysis illustrated in Figure 2.12, locomotive failure is the third highest reason for delays and cancellations in Locomotive Diesel Depot, Wentworth Durban.

Attention is drawn to the critique of Transnet's policies and procedures.

An explanation of how the change in senior management affects the policies and procedures of Transnet is provided.

The structure of Chapter Two is as follows:

- The Methods of Searching and orientation of the study.
- The Scenario of train delays and cancellations at Transnet Engineering, Wentworth Diesel Depot.
- Train Cancellations and adopted systems in other organisations.
- The Pareto Principle - theory
- Ishikawa Fishbone Diagram of cause and effect.
- The three different recovery strategies of the robustness simulation model.
- Technological advancements.
- The Critique of Transnet's policies and procedures on train cancellations and delays.

2.1.1 Methods of Searching

An intense study into train delays and cancellations was led by the researcher. The researcher focused on local and international publications. Databases that were used included Google Scholar, SAGE Journals Online, ProQuest and Summons. Main exploration terms included the words: train cancellations, train delays, reasons for delays and investigations into delays.

2.1.2 Orientation of the study

The following Standard Operating Procedure (SOP) was extracted from the Transnet Freight Rail (TFR) portal, called the Train Execution Management System (TEMS). The Cancellations and Clearing House Processes in Transnet operate on an Integrated Management System (IMS), known as the Transnet Occurrence Management System (TOMS). All incidents are captured on TOMS 24/7/365 days a year throughout the whole country as this is a live system. If a TOMS incident is going to cause a delay or cancellation, the following procedure is followed:

The Transnet Occurrence Management System will now become a Train Execution Management System. The Train Execution Management System will be generated by the Train Manager (TM) on duty and requests for a cancellation from an incident are captured via the Integrated Management System. There are various reasons that a Transnet Occurrence Management System is created and a train can be cancelled. The pie chart below will illustrate further the next step in which the Corridor Manager (CM) recommends the cancellation request. The Corridor Manager must by all means try to save a potential cancellation and if it cannot be saved, then requests the next step.

The next step is when an Executive or General Manager (EM/GM) on duty at the National Command Centre (NCC) authorises and approves the cancellation request. It is important to note that only an Executive or General Manager can cancel trains. It is at this point that the Train Execution Management System switches the train off in the Integrated Train Plan (ITP) and updates Yard Countdown Tool. Thereafter, the ITP system switches of the train in SPRINT (a software program exclusive to Transnet).

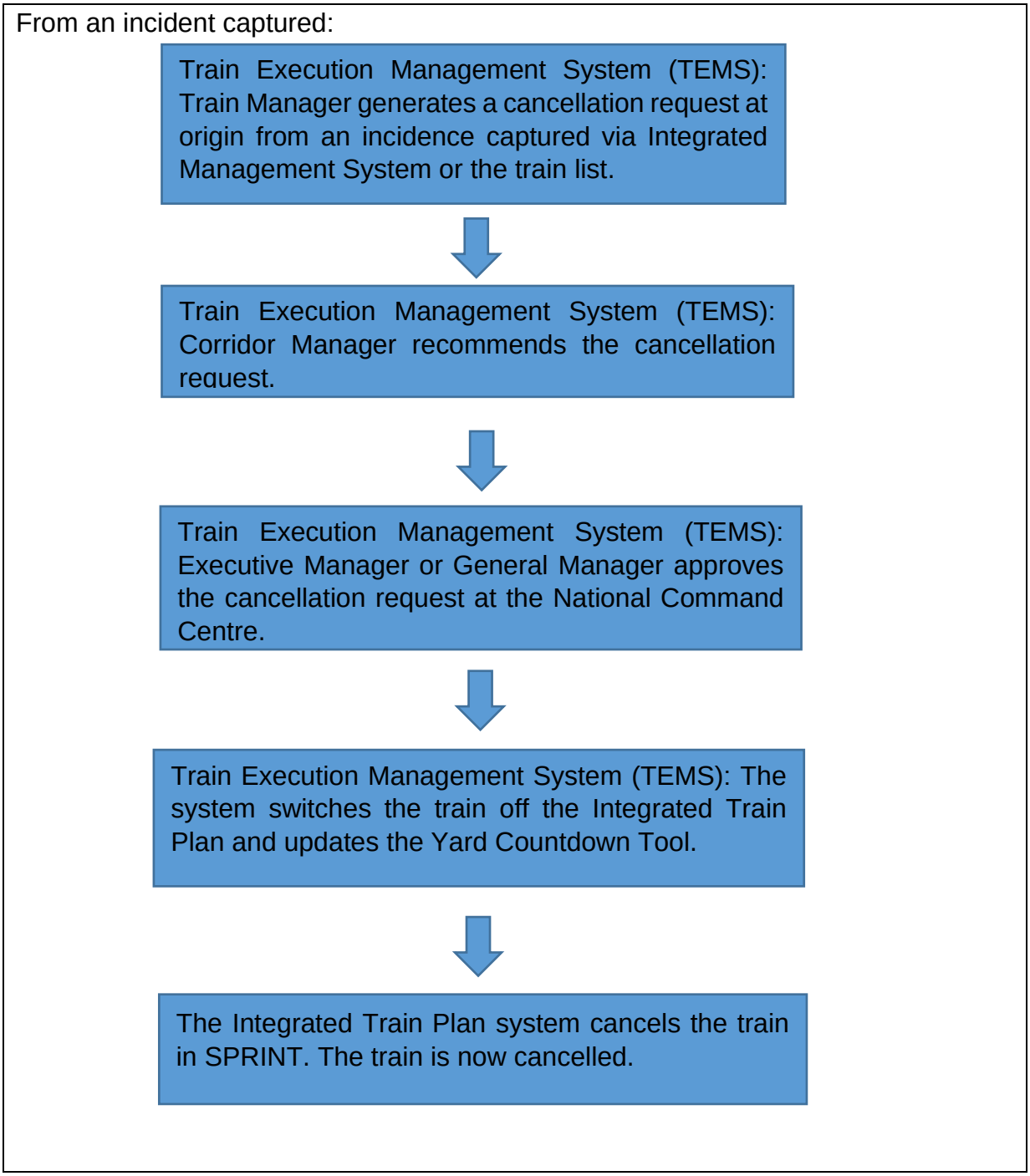

Figure 2.1: Train Execution Management System train cancellation process (Transnet SOC Ltd. Transnet, 2018)

This chapter will provide insight on the reasons for train cancellations and provide a framework for standard operating practices that will aid in reducing the number of cancellations. In a study concluded by Pieterse, Farole, Odendaal and Steenkamp (2016) that transport and logistic infrastructure determines the level of competitiveness of a country's producers. The interaction between private and state owned companies is critical to the economy of South Africa (Pieterse et al., 2016).

In South Africa, constraints in access, pricing, reliability and network infrastructure, especially in port and rail networks, are eroding the competitiveness of South Africa with other countries.

In an article by Dieude (2016), the author suggested that the following guidelines should be implemented to improve an organisation's competitive edge:

- **Refine your target market**: target a specific market that can convert larger volumes of commodities into larger revenue. Customers like doing business with people they know, create an environment of trustworthiness and of mutual benefit.
- **Understand the 80-20 rule**: 20% makes up the organisation's best customers. Therefore, focus on satisfying the 20% of customers who will ultimately allow you to achieve 80% revenue.
- **Don't race to the bottom**: do not sacrifice revenue by undervaluing the product or service. Be patient and build a reputation with customers.
- **Embrace digitalization**: continually update the firm's internet and social media status. Embrace the digitalisation and internet platforms for shopping online.
- **Keep investing**: re-invest in skills, infrastructure, technology and machinery (Dieude, 2016).

2.1.3 Pareto Principle of Management

According to Lamarre (2019), a Pareto Chart is a graph that indicates the number of defects, as well as their total impact. Pareto charts are useful to find defects to prioritize, in order to obtain the best overall improvement:

- A Pareto Chart is a combination of a bar graph and line graph (see Figure 2.2 below)
- Each bar represents a defect or problem. The height of the bar represents the unit of measure.
- The bars are presented from highest to lowest, i.e. descending order.
- The line represents the cumulative percentage of defects. If this line is steep the defects have a significant cumulative effect.
- A Pareto Chart is a quality tool which is used to analyze and prioritize issue resolution. The idea is that the few most significant defects make up most of the overall problem.
- Pareto Charts can also be analyzed with the Pareto principle, which is also known as the 80/20 principle (Lamarre, 2019).

The Pareto Principle states that 80% of the results are determined by 20% of the causes. Therefore, trying to find 20% of the defect types and rectifying the defects can result in an 80% improvement (Lamarre, 2019).

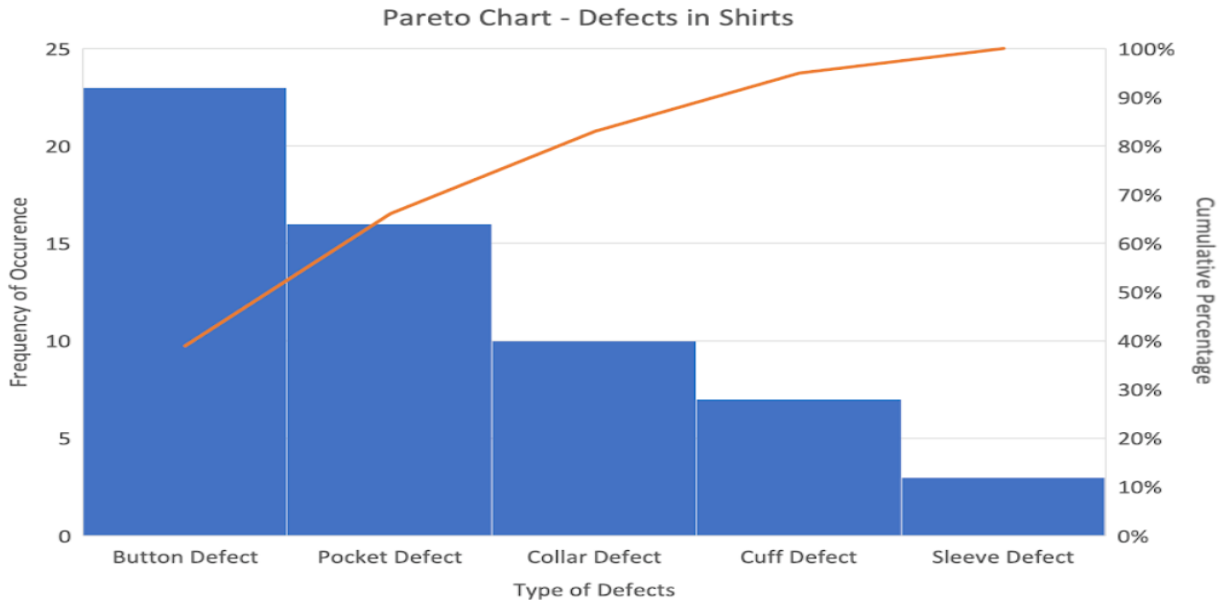

Figure 2.2: Pareto Chart (Lamarre, 2019)

In an article by Kaziro (2019) stated that in order to gain a competitive edge over competitors, the following areas should be focused on:

i. **Customer services**: excellent customer services results in delighted customers, which results in repeat future business.
ii. **Correct pricing**: prices should offer value for money whilst simultaneously allowing the business to make a profit.
iii. **Niche**: create a niche by offering something different from other businesses in the same market (Kaziro, 2019).

In an article by Patel (2019), the author stated that the following, if implemented correctly, can increase the competitiveness of an organisation:

i. **Charge more**: this creates value in the higher prices.
ii. **Online influencer**: more people respecting and knowing the company results in better publicity, which will create more customers.
iii. **Speak at an event in the Industry**: use media briefings to market the company and create awareness amongst potential customers.
iv. **Create one's own data**: use one's own internal data, use statistics in marketing to create authority and credibility in the organisation.
v. **Niche down**: do not try to please all the customers all the time. Rather keep existing high value customers satisfied and create a niche market.
vi. **Leverage new technology**: use new technology that is currently number one in the market to stand out. Go digital, go paperless, creating an awareness on environmental issues, resulting in customer satisfaction.
vii. **Delighted customer**: customer satisfaction is the main goal. It is a simple and cheap option to satisfy customers.
viii. **Invest in deeper customer relationships**: be impersonal, create relationships with customers as this will create a competitive edge.
ix. **Create a killer culture**: customers should buy into the company's culture, which means that if the company treats the workers well, customers will be satisfied knowing that the company has happy workers. A happy worker is a productive worker (Patel, 2019).

2.1.4 Ishikawa Fishbone Diagram of Cause and Effect

The Ishikawa Diagram also know as a Fishbone Diagram. It is a visual tool used to find the root cause analysis, by linking the cause-and-effect relationship.

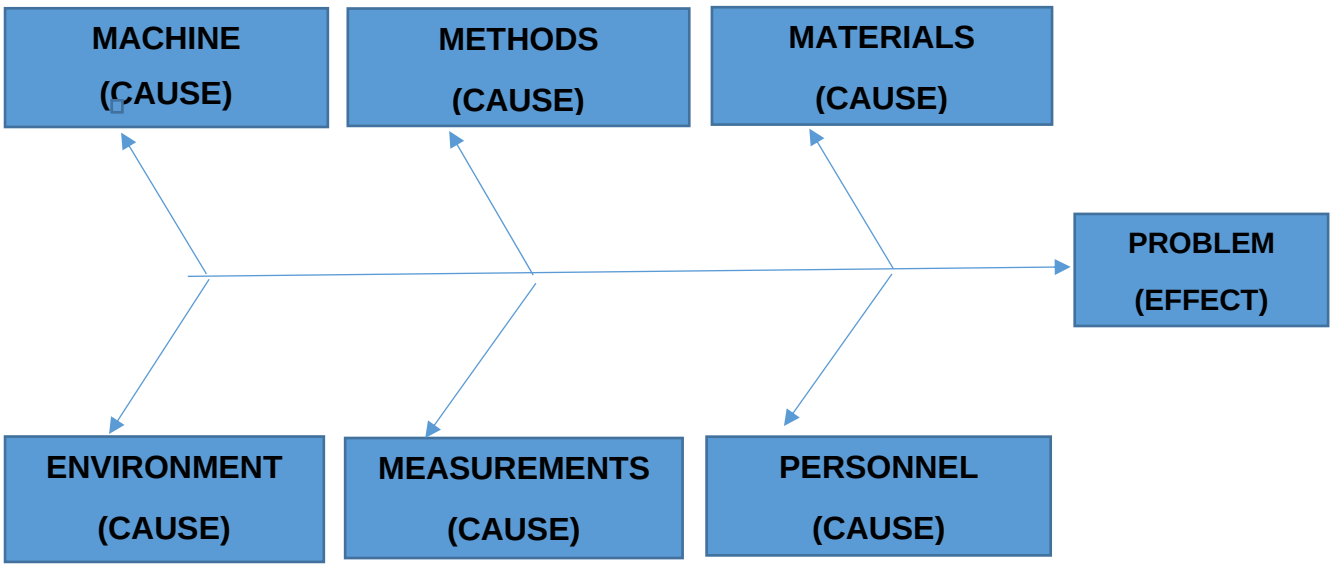

Figure 2.3: Ishikawa Fishbone Diagram of Cause and Effect (Ishikawa K, 1990)

- The Ishikawa diagram is a quality tool that was created by Kaoru Ishikawa in 1960.
- Kaoru Ishikawa popularised this process in the Kawasaki shipyards in 1960.
- This visual tool simply arranges possible causes or effect by visually detailing them.
- The alternative name is the Fishbone Diagram because it looks like the skeleton of a fish.

According to the South African Competitiveness Rank, in 2018, 140 countries participated in the Global Competitiveness Report published by the World Economic Forum, and South Africa was rated as 67th in the world. The graph shows that this is the highest that South Africa has been. However, being 67th of 140 countries needs improvement (www.tradingeconomics.com).

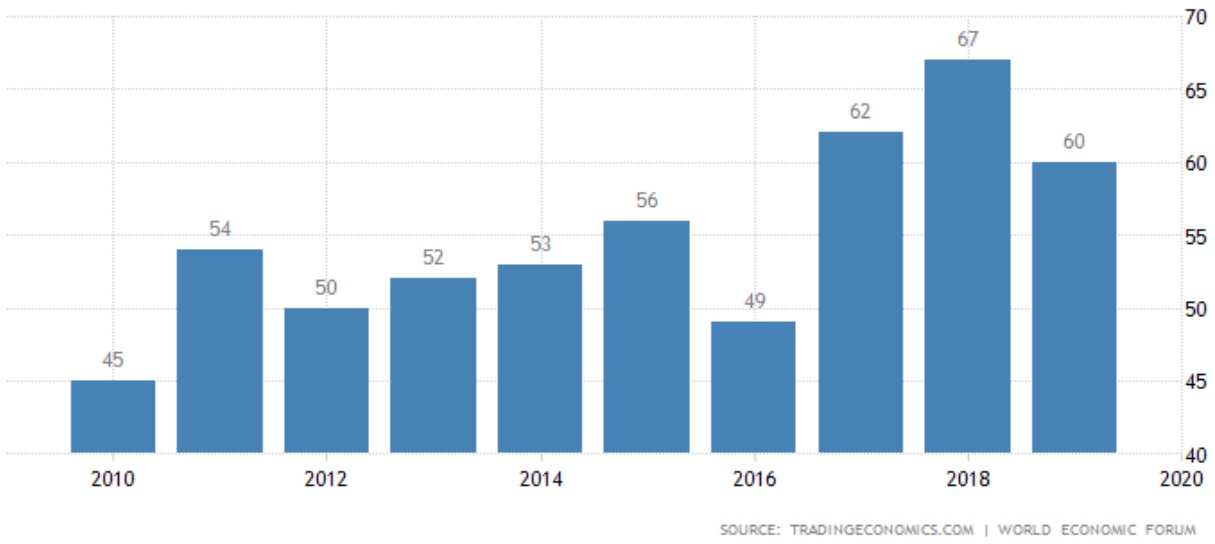

Figure 2.4: South Africa's Competitiveness Ranking (www.tradingeconomics.com)

The researcher deduced from the authors Dieude (2016), Patel (2019) and Kaziro (2019) that in order to increase the level of competitiveness of an organisation, the following should be implemented:

- Correct pricing
- Customer satisfaction
- New technology
- Niche Market

The researcher postulates that gaining a good competitive edge over competitors will result in a good bottom line.

The factors in South Africa were to improve service delivery, information and co-ordination in rail and port networks. Owing to these findings, South Africa has to turn around into a globally competitive country. One of the ways is to provide and exceed customer requirements and deliveries. This will improve productivity and increase the

overall growth in South Africa. The next section discusses the studied organisation-Transnet.

Transnet is a state owned company and post-1994, it was considered a government parastatal. An understanding of the parastatal is that the government is a major shareholder of Transnet and is on the board of trustees. Like any other investment, the government expects a Return on Investment (ROI) to be positive. Transnet is the largest railway in South Africa and services the Middle East and neighbouring countries in Africa (Transnet Annual Report, 2016). More importantly, in recent years, there has been a decline in revenue and sales. Transnet has however still managed to be profitable. The profit margin can be increased by imitating other countries. A decline in revenue and sales is a cause for concern, as Transnet needs to be self-sustainable and show higher profits.

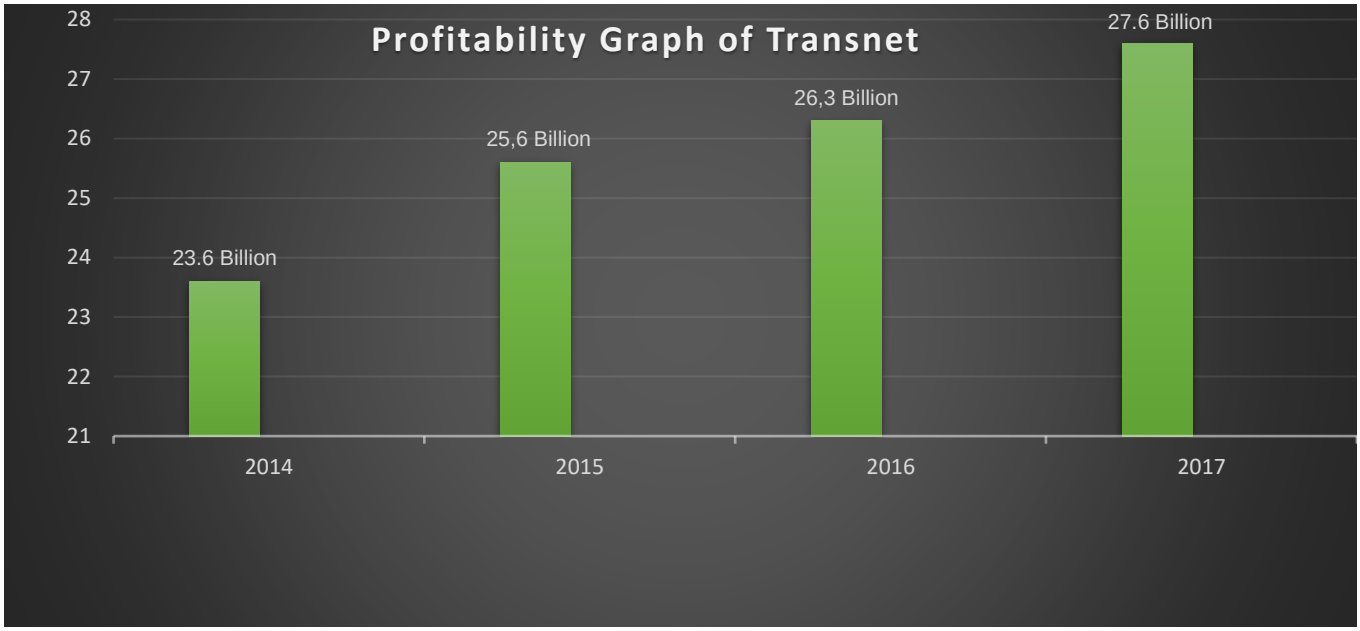

Figure 2.5: Profitability Graph of Transnet (Transnet SOC Ltd. Transnet Annual Report 2016)

Transnet Annual Reported losses of over fifteen billion rands in the last five years, but it was also due to the global recession (Transnet Annual Report, 2016). In a quote from Pravin Gordhan, he warned that “they cannot rescue” the parastatal like other state owned entities that needed “rescuing” eg. Eskom, Telkom and the South African

Post Office. Moreover, Transnet also needs to compete with other world-class organizations from different countries in order to sustain itself (Transnet SOC Ltd. Transnet Annual Report, 2015).

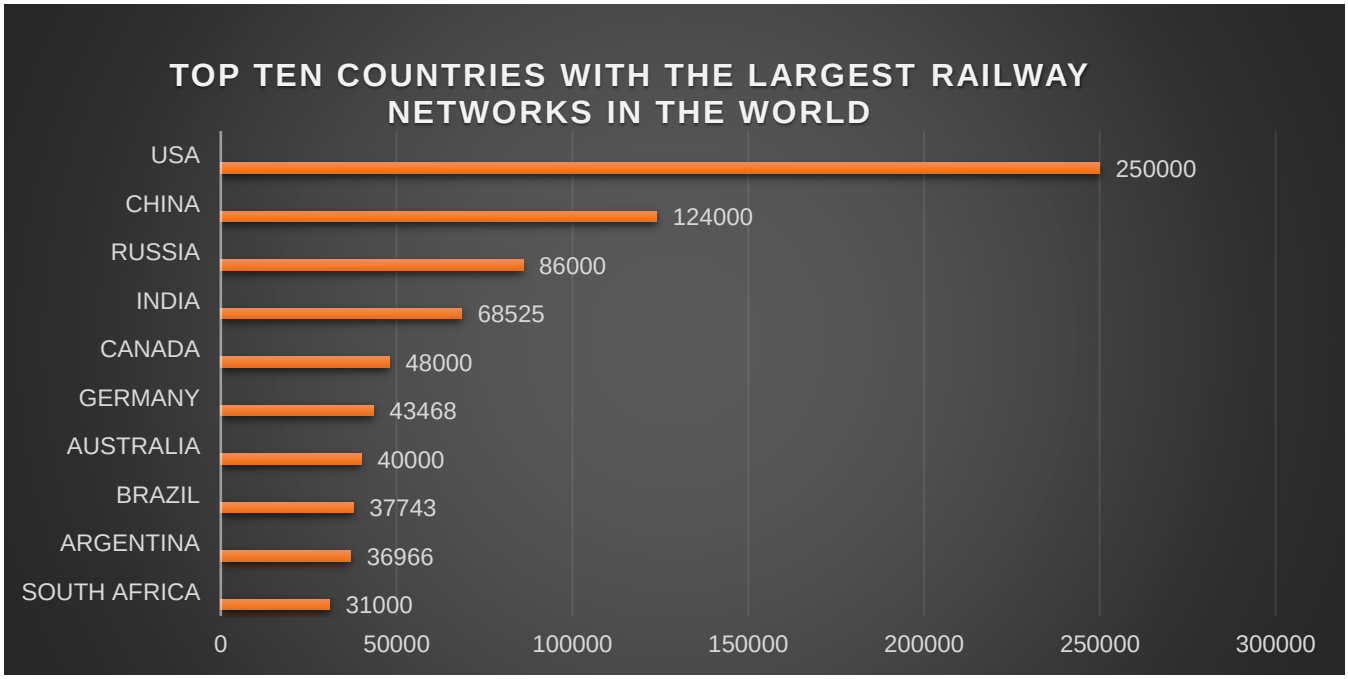

Figure 2.6: Top ten countries with the largest railway networks in the World (www.https://erail.in/blog/countries-with-largest-railway-network-in-world/50)

The figure depicts that South Africa is rated 10th in the world according to the *Top Ten Countries with the Largest Railway Networks in the World,* with a total railway line of 31000 kilometres, as compared to United States of America with 250000 kilometres. This means that the United States has 219000 Kilometres more than South Africa, therefore their market value is higher (www.https://erail.in/blog/countries-with-largest-railway-network-in-world/50).

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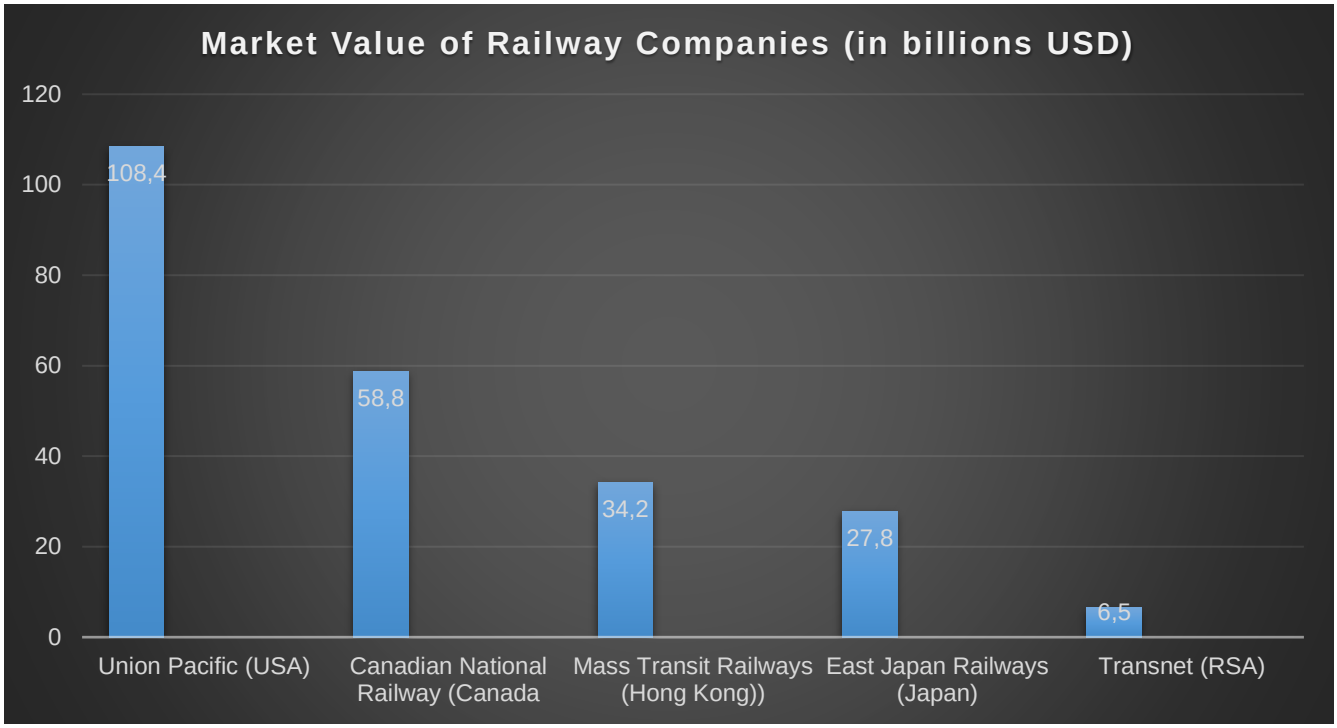

Figure 2.7: Market Value of Railway Companies (Mazareanu, 2020)

The above bar chart shows that Union Pacific is the leading railroad company in the world with an estimated market value of 108.4 Billion(bn) United States Dollars(USD) as of May 2020, followed by the Canadian National Railway at 58.8 bn USD. These are the top two Europe companies. Mass Transit Railways market value is 34.2 bn USD and East Japan Railways is at 27.8 bn USD. These are the top two Asian countries. South African Railways' (Transnet) market value is estimated at 6.5 bn USD (Mazareanu, 2020).

Accordingly, the import and export of goods needs to be of exemplary service and standards. However, Transnet is lagging behind compared to the United States and China, which is a cause for concern not only in South Africa, but globally as well (News24.com, 2011). Equally important, Transnet in South Africa is the major shareholder in the ports, air, rail industry and pipelines. Furthermore, Transnet is responsible for servicing neighbouring countries as well. The inefficiencies in service delivery impact on other countries and relations with business. It indirectly influences the exchange rate of the rand as well as productivity. These losses are actually indirectly passed on to the consumers.

In an article by Bennett (2020), titled recommends that the implementation of a Project and Resource Management Solution is a management software system that manages resources and eliminates poor resource planning, the under- or over-utilisation of staff and standardisation to improve revenue and reduce costs.

The key benefits include:

i. **Increased Revenue**: It assists in utilising resources daily, weekly and monthly. This ensures that the work load is balanced and resources are used to the maximum, resulting in increased revenue.
ii. **Conflict Resolution:** It resolves double bookings and easily re-schedules resources and skills efficiently.
iii. **Improves Project Delivery:** There are reduced costs and increased profit margins due to the feature of high performance. It also allocates work on specific criteria such as availability, skills and location so that the right person is allocated to the right job.
iv. **Reduced administration costs:** The software reduces administration costs by continuously updating the system and providing visibility, control and opportunity.
v. **Customer Satisfaction:** The software is continuously updating and reflects the current capacity and revenue opportunities, thereby improving customer satisfaction (Bennett, 2020).

During the International Transport Forum, Beck (2013), who compiled a report, discussed the opportunities to improve railway efficiency. The document discusses the following that can be done to improve efficiency, benchmarking the following topics and continuously improving the standards:

a. **Asset Utilisation:** use assets to their capacity and utilising under-utilised assets to improve profitability.
b. **Personnel Allocation:** reducing labour costs and simultaneously improving worker productivity results in increased revenue.
c. **Performance Standards for Infrastructure Managers:** to improve the level of service and reduce costs, managers should be given incentives for agreed performance targets.

d. **Investments in Technology and Automation:** technological advancements and automation assist in improving efficiency by reducing personnel costs and administration costs.

e. **Corporate Governance and Railway Management:** leadership and relationships between all leaders in an organisation should be accountable and responsible for the efficiency of the organisation (Beck et al., 2013).

The researcher is confident that if the framework provided by the two previous authors- Bennett (2020) and Beck (2013) is implemented, it will improve the optimisation of resources at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

The following section discusses the train cancellations and adopted systems in other organisations.

2.2 Scenario of delays and cancellations

The researcher will now discuss a scenario of delays and cancellations in Transnet. Generally, TE confirms that a locomotive maintenance has been completed and it is ready to be used, whereupon a roadworthy certificate must be issued. The driver who was booked on duty forty-five minutes before the train departure time, arrives and then proceeds to re-examine and test the locomotive/s. This examination is similar to a vehicle's forty-point check, which is done to re-affirm that the locomotive is safe and roadworthy. If the driver is satisfied and the locomotive passed all the preliminary tests, the driver then proceeds to couple a load of wagons, with the assistance of a train assistant and a shunter. The driver then tests *again* the compatibility of the locomotives and the wagon, now called a train. The terminology used, is to *power test,* to check the power of the locomotive and *brake test,* to check the brakes, including a visual examination. If the train meets all the requirements and the driver is satisfied, the driver proceeds with the journey.

However, subsequently, if there are any faults or defects noted by the driver, it is reported to his superior, who is known as a section manager and who then reports it to the National Command Centre (NCC), which is situated in Johannesburg. A fault is logged on the Transnet Occurrence Management System (TOMS) or Train Execution Management System (TEMS). A reference number is then issued to the section

manager and simultaneously also issued to a diesel electric fitter telephonically. The diesel electric fitter is now activated and is authorized to attend to the fault, known as a *callout*. If the fault is minor and can be repaired within less than an hour, the artisan proceeds to do so and then the driver continues with his journey.

The artisan then reports the feedback to the NCC and the number of delay minutes is logged. The recorded information will be discussed in the following day's clearing house and the responsible party will take responsibility for the delay. It is also used for Continuous Improvement (CI) and to eliminate such delays in future.

Alternatively, if the artisan fails to repair the locomotive or wagon and it may require a component change out requiring unscheduled repairs, the defective locomotive or wagon is removed and replaced with another roadworthy locomotive or wagon, if available. The uncoupling and re-coupling of another locomotive or wagon causes delays, and if this process is not completed within an hour from the time the defect was reported, the procedure is that Transnet Engineering (TE) and Transnet Freight Rail (TFR) managers will try to mitigate the delay and if possible re-plan the train. If unsuccessful, the train is cancelled on the ITP. At this stage, the planners and managers will try to re-schedule a slot where possible. However, if this is not possible and if it will lead to a total cancellation, this will result in a loss of revenue, agitated customers and poor customer service. This process seems ruthless, but this is the Service Level Agreement (SLA) between TE and TFR. All efforts are made to re-schedule the train according to the availability of resources. The resources are TFR staff, loco and wagon availability and a train slot. Usually, spare drivers and spare locomotives and wagons are not readily available due to reasons which will be discussed next.

A driver and train assistant are booked on duty eight hours and forty-eight minutes per shift. However, if there is a delay and they both agree, they can work up to twelve hours, resulting in three hours twelve minutes overtime. TFR drivers and train assistants can only work a maximum of twelve hours per shift per day, unless there is an emergency which will then be authorized by the General Manager (GM). This causes immense pressure for staff to be flawless in all procedures and more importantly, for targets to be met. Timeous planning and execution of duties from all employees are required to ensure that the ITP is met consistently. This is in an ideal

situation and generally does not materialize due to human factors or unforeseen circumstances. The reasons include if there is bad weather, an accident, employees book off sick and defective locomotives. These executive decisions are made by management and have to be done, keeping in mind that one needs to avoid delays and cancellations but nonetheless still run trains timeously.

From the interviews, it is evident that not all employees are aware of the policies and procedures to be followed for train delays and cancellations. Even those who are aware of the policies and procedures do not adhere to them religiously. There are certain scenarios where employees may not be able to reach management timeously and are forced to make decisions using their own initiatives. These initiatives are done to minimize train delays and cancellations. However, the researcher feels that this is not always the correct decision, or the decision management would have made.

2.3 Train cancellations and adopted systems in other organisations

Literature by European Railway Agency (ERA, 2011) suggests that Rail Network Systems are indeed important to a country's local and global productivity. Contrarily, the European Railway Agency (ERA, 2011) argues that using information technology and computer software programs like the Real-Time model in the United States of America is the solution to resolving all delays and optimizing the resources. The researcher has an opinion and opts for an increase in efficiency rather than software programs to address cancellations.

The real-time model entails capturing of data onto a computer software program. The data needs to be captured timeously and consistently. This can be a tedious, time consuming, accurate process which needs be done at every step of the train scheduling. The researcher is of the opinion that since the software program needs to be continuously updated and requires constant monitoring, Transnet Engineering and its staff are not yet ready for that. Transnet should rather concentrate on being efficient using the current software programs and processes as discussed in Figure 2.1.

The inclusion of government legislation such as Basic Conditions of Employment Act (Republic of South Africa. BCEA, 1997) and the Variation Agreement (Transnet Variation Agreement, 2015) exclusive to Transnet complicates the scheduling of

employees. To add to these complications, the organization is highly unionized and requires that all changes need to be agreed and discussed constitutionally with all stakeholders before being implemented. This does not allow for the flexibility of employees in a flexible rail network service.

Messaoud and Teheni (2014) discuss regulations of economic growth in 162 countries during the period 2007 to 2011. The findings suggest that some policies can help poor nations grow faster. The literature measures economic growth as the average annual rate of per capita real gross domestic production. The results of this study support the hypothesis that good business regulations are associated with higher economic growth. It also suggests that policy-makers should decrease business costs and risks, as well as increase competitive pressure by improving administration and fiscal policies. Each country should view the standards of the business environment independently (Messaoud & Teheni, 2014).

Archbold (2017) supported Messaoud and Teheni's hypothesis. Archbold (2017), in the United States, argues that regulations are also administrative laws which specify standards stipulating what individuals and organisations can and cannot do. Regulations are the rules for an enterprise. The article discusses government's intervention to correct prices through regulations or fiscal policies. Regulations can be used by government to intervene in a market economy.

The justification for regulation is:

- To assist in market failure when market prices are incorrectly stipulated;
- To give all competitors an equal opportunity to enter markets and increase economic growth; and
- To ensure the safety of consumers, workers and the community by having transparency of services and products (Archbold et al., 2017).

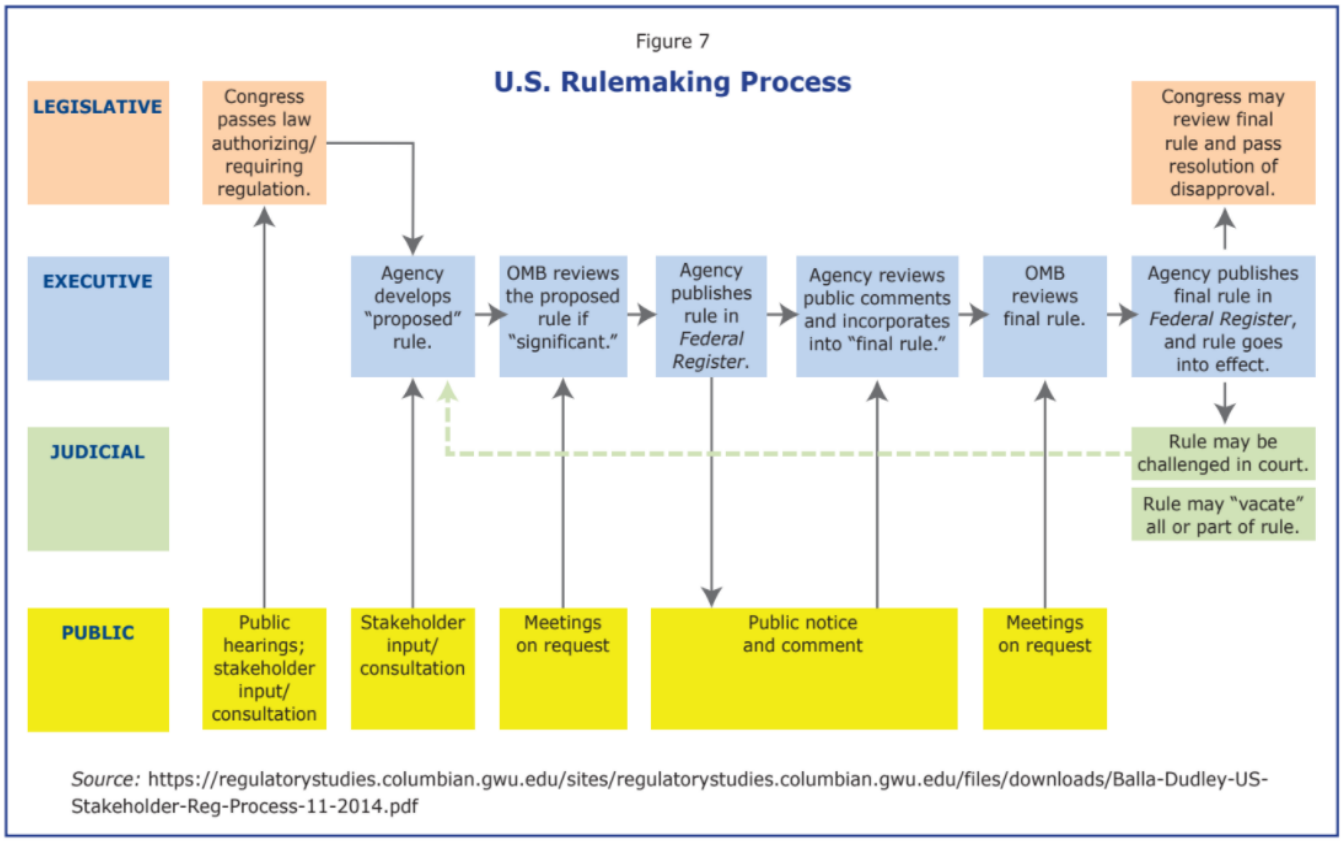

Figure 2.8: United States Rule-making Process (Archbold et al., 2017)

In Transnet Wentworth Diesel Depot, the following regulations were hindering production and service delivery. These summarise how certain regulations sometimes hinder productivity:

- **Union Meetings**: union meetings are scheduled weekly on Fridays from 10am to 1pm. Union representatives that are rostered to be working on those days need to be replaced, causing the shift roster to be adjusted. This causes other employees to work extra hours and overtime.
- **Shift Work**: certain employees are unable to work shifts for various reasons. This also causes the shift roster to be changed. Transporting of employees also causes delays, especially if the first employee is late. This causes a delay in production.
- **Gender Equality**: Female employees are afraid to drive trains through desolate areas at night. Pregnant and breastfeeding employees need to be accommodated in alternative duties (Transnet SOC Ltd. Transnet Annual Report, 2015).

These regulations need to be abided to, but hamper production.

The researcher supports Archbold, Hart and Minarik (2017) and Messaoud and Teheni's (2014) hypotheses and the U.S Rule-making process. The researcher believes that if process can be adapted to the South African legislation, it can improve productivity and ultimately the GDP.

Similarly, in an article, Thomas (2017) stated that in the United Kingdom (UK), Southern Network Rail in Tunbridge Wells UK blamed cancellations due to staffing issues and strikes over salary increases. The remuneration increases given by the company were not adequate for employees from the period of January 2016 to April 2016. Due to strike action and no staff, this resulted in 40 trains being cancelled (Thomas, 2017).

Correspondingly, Transnet Annual Reported in 2015/2016 that it reached targets and exceeded it by 9% (238407 units) (Transnet, 2016). There has been improvement in On Time Departures (OTD) and the Integrated Train Plan (ITP) (see Figure 2.8, page 37). Success is mainly due to the collaboration between corridor managers, teams and compliance with company policies and procedures. In addition, the National Command Centre (NCC) Ongoing Time Management Drive (OTMD) for OTDs is implemented. The efficiencies performance declined by 7.5%, but asset utilization was stable. As compared to 2014, Transnet Annual Reported that delays were reduced by 14% compared to the previous year (Transnet SOC Ltd. Transnet Annual Report, 2015).

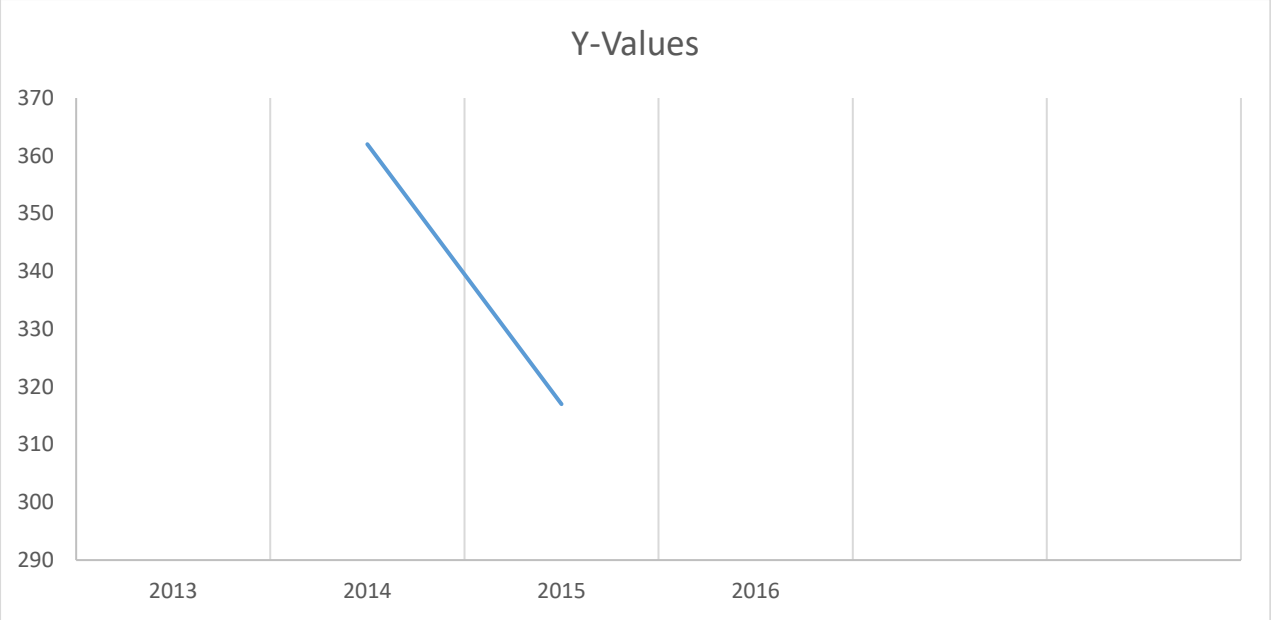

Figure 2.9: Transnet Delays for 2014 and 2015 (Transnet SOC Ltd. Transnet Annual Report, 2015)

Consequently, in separate incidents, Sherlissa Peters (2015) stated that cable theft costs Transnet more than R580 million a year. This constitutes of 1.6 million a day. It also caused a total of 3285 train delays (Peters, 2015).

Transnet is not unique to the problem of train delays and cancellations. To re-emphasize the previous author, Riana Scott, stated that train collisions accounted for the highest number of safety incidents. The Rail Safety Regulator (RSR) representative, Rirhandzu Mashava, stated that there was an increase of 1.6% in the 2017/2018 year, with train derailments up by 17% in 2017/2018. She stated that investigations revealed that the main causes were theft and vandalism of cables and infrastructure, poor maintenance of rolling stock and points which have not been set correctly (Liedtke, 2018).

An article in the Eye Witness newspaper, emphasised that the travel time of about 60 minutes for Metrorail commuters travelling along the mutual Woltemade and Maitland lines were vandalised. In an exclusive interview, Metrorail's spokesperson said that 2 coaches were lost to vandalism in Maitland and impacted mostly the Northern Line trains. "The technicians managed to clear some points so trains can continue on their routes, however there will be a 60-minute delay" (Isaacs, 2017)

A report released in Boston, United States of America (USA), stated that Delays and Cancellations were blamed on new locomotives that were failing. KELOIS Commuter Service (KCS) reported that technicians found a higher failure rate than expected. The new locomotives were blamed but is confident that the locomotives will be repaired and reliable (Dungca, 2017).

Equally important, according to the *South African Journal of Industry Engineering*, August 2016, Wilson (2016) suggests that a mathematical model and simulation can be used to resolve train cancellations (Wilson, 2016). Specifically, Mathematical models, Queuing models and First Come First Served (FCFS) and Last Come First Out (LCFO) principles. Job Shop Models use timetables to plan between trains and crossings (Gross et al., 2011). This is similar to current Timetables, Scheduling and In – Out on account of time and importance is used in Transnet. No mathematical equations are used, but similar models to the Job Shop Models are used.

A case study from the Journal in Quality Engineering in Sweden indicated that the Swedish Rail Network (SRN) found that the model can be used for certain sections of the Swedish Rail Network but needs to be adapted for other areas. It measures the railway infrastructure system, taking into account key performance indicators. These indicators formed an input into the model and involve effective decision-making, which will decide whether it will cause the model to fail or pass. This model requires critical decision-making at an executive level. However, the researcher disagrees that this will work in South Africa for reasons that follow. The *Overall Railway Infrastructure Effectiveness* (ORIE) model can be used as a key performance indicator for the railway infrastructure manager. It can provide input, support decisions and assist with further investigations. The researcher is sceptical about this working in Transnet as high-level decisions are not only made by the Infrastructure Manager alone, like in Sweden. Transnet requires the approval of Procurement, the Operations Department, Logistics and Civil Engineering Departments to be proactive. This becomes a cumbersome task as there will need to be meetings and approvals. Moreover, this requires planning, decision-making and authorisation of different levels of management (Ahren & Parida, 2009).

In other sources, a *Sliding – Window Algorithm and Mixed Integer Programming* can be used to prevent cancellations. Here, the authors Bai, Bourdeaud'huy, Castelain and Babenasolo (2014) have a sophisticated and complicated scientific and mathematical equation with variables, integers and assumptions (Bai et al., 2014). The researcher feels that training a few mathematical inclined engineers on how to develop these algorithms and thereafter converting the mathematical model developed into decision support systems, that is user-friendly for use by all Operation Managers at Transnet.

In a similar article on a study conducted in Sweden, the article states that rail transport has been decreasing in Europe. There is a switch from rail to road and there has been a decline of 3.2% between the years 2000 – 2009. However, there were also political reasons, and the largest contributing factor was the inefficiencies in rail transport. These inefficiencies included unplanned maintenance, strikes and railroad repairs. The authors present an algorithm to forecast delays based on the Markov Chain Model. It is used in Decision Support Systems (DSS) which provide support for the planning and dispatching of trains (Barta et al., 2012). The researcher acknowledges that the aforementioned study has potential to be used in train planning, but at this juncture, the researcher is of the opinion that the algorithm is too complex for Transnet.

Along the same lines, in the UK, a report found models for timetabling, in which the author Cacchini (2012) used cyclic timetabling, models and job scheduling to create a mathematical equation to plan a train timetable (it is a complex but understandable model). Scheduling is a problem faced also in the USA. Hence, the USA researched how to improve the planning of locomotives (Cacchini & Toth, 2012).

In a separate article, the author, Vaidyanthan (2008), extended the constraints to several dimensions. A real-time model is used to monitor locomotive reliability and faults and then decisions are made to group together locomotives of similar characteristics. Locomotives that are more reliable and that have a no-failure rate are grouped together for longer hauls. The more problematic locomotives are used on short hauls so that in the event of failure, it can be attended to sooner (Vaidyanthan et al., 2008).

According to the Centre of Traffic and Transport, a Technical University of Denmark study was conducted at Denmark (Banedanmark) *Copenhagen Urban Railway*

Network in collaboration with the RailSys model system. DSB-S–tog (The train company of Copenhagen's suburban rail network) indicated that the difference between train regularity and passenger delays is due to the different number of passengers in the trains during the day and the fact that the passengers (to some extent) will change routes due to delays. Furthermore, there is higher risk of delays in the rush hours due to more passengers and more trains. Using a well-calibrated RailSys model, it will be possible to compare travel time and delays for future scenarios. Even though the results in this paper are very similar to what has been observed on the Copenhagen suburban rail network, the results can be improved both by better calibration of the RailSys model and estimation of the correct threshold of delay before reconsidering the route (Landex & Nielsen, 2004).

Relatively, in a research paper, a study by Veelenturf was conducted on 1530 trains, on a timetable rescheduling for passenger trains on a macroscopic level in a rail network. An Integer Linear Program (ILP) was introduced to solve the real-time railway timetable-rescheduling problem for a railway network. The ILP is modelled in an event activity network in which each event represents an arrival or departure of a train, and in which an activity refers to passing on a resource unit from one event to another event. The resources considered are the tracks in the opened track sections; the tracks in the stations; and the rolling stock compositions. Computational tests are performed on a heavily used part of the Dutch Rail Network. Solutions are provided within computation times which are very well -suited for use in practice. Most cases can be solved within 2 minutes of computation time. The results show that a smaller number of trains needs to be cancelled and the number of cancelled minutes is significantly reduced if one allows slight delays on delayed trains or to re-route some trains (Veelenturf et al., 2014).

In Europe, according to Europe Railway Agencies (ERA) (see Figure 2.9, page 41), this agency uses a sophisticated network of software programming and information technology network programs to forecast, schedule and prevent train cancellations. The computers are simply linked to a train number and cameras placed at signals are all along the railway lines. It monitors the routes, compares with any changes and calculates the probability. Cancellations are therefore reducing using this formula (ERA, 2011).

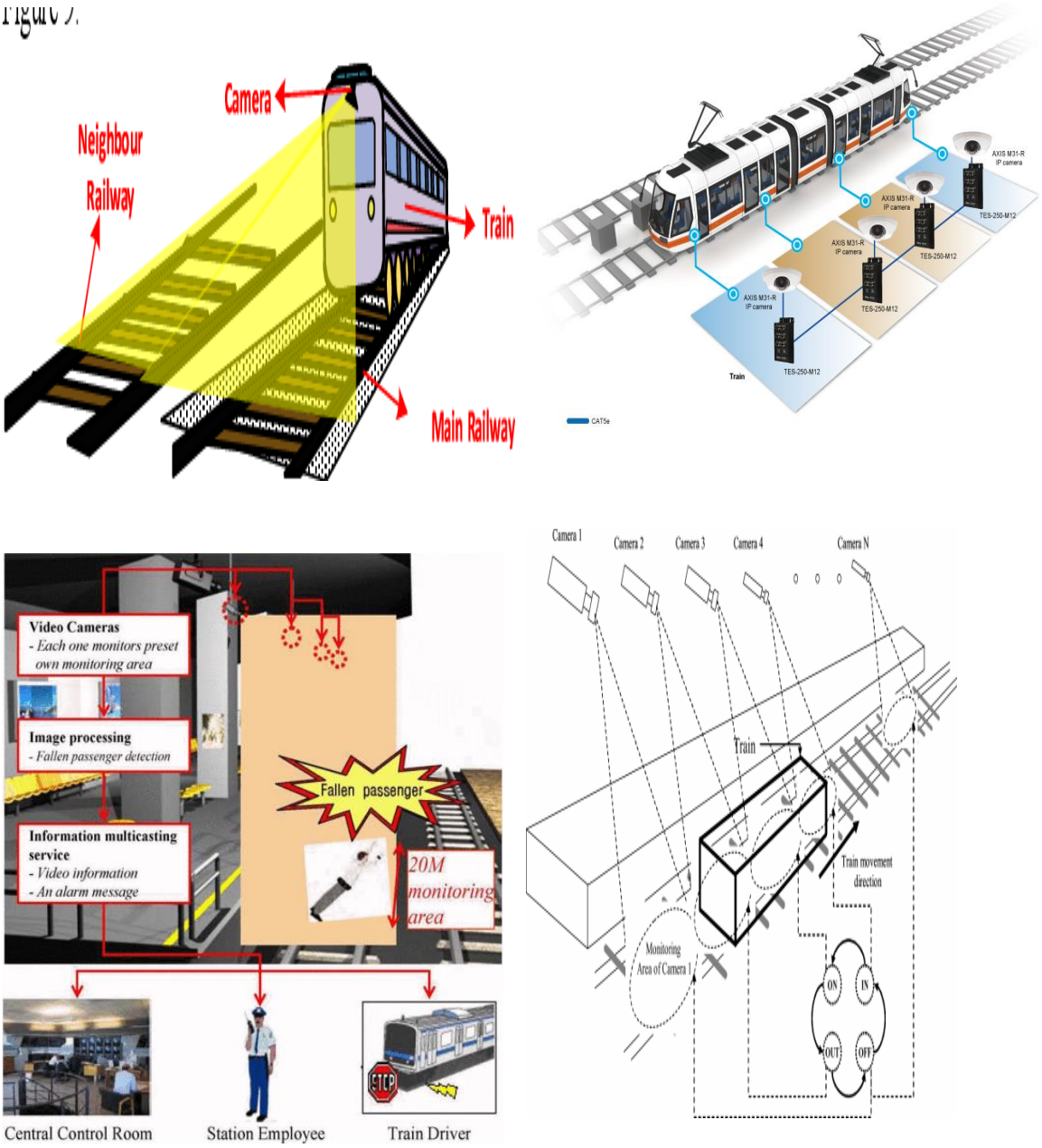

Figure 2.10: Linked cameras for software programme (European Railway Agencies, 2011)

Transnet is not yet technologically advanced with cameras at strategic points. However, they use colour light signals which illuminate the track on a controlled board, indicating a train's presence.

In an interview with the Chief Executive of Transnet, Brian Molefe by the Business Times conducted on the 28 June 2011, Mr Molefe assured SA that freight trains will

run on schedule. He stated that the company has strategic plans to resolve these issues (Khanyile, 2012).

In another article, Gibson (2005) explains how the rail systems were controlled by the British prior to 1994. He stated that maintenance and repairs on infrastructure was complicated due to the fact that maintenance was done while trying to run an undisturbed rail service without any delays and cancellations, but regrettably that was practically not possible. To add to the cancellations there were accidents. The cause of accidents were old and damaged infrastructure- a broken rail at a curve to be precise. In this accident, 4 people were killed and 70 injured due to the derailment. Gibson (2005) explains the relationship between a good maintenance schedule and the output of reduced asset failure. Transnet has its own 45-day schedule maintenance plan. It also schedules maintenance on railway tracks. Additionally, employees are sent for refresher courses (Gibson, 2005).

An article by BBC News (2019) states that state owned power utility Eskom battles to meets it demand. The result is load-shedding or blackouts, which is when the power is switched off for one or two hours depending on a scheduled time-table. The article attributes load shedding to maintenance issues in Eskom's power station. Eskom generates electricity from coal-fired power stations. Since 1994, the demand has increased, but no new power plants have been completed. The Medupi Power Station is still to be completed since 2012. Changes in the different Chief Executive Officers add to the change in policies and procedures. Moreover, increasing costs and coal prices have forced the power utility to increase costs. Load-shedding is damaging Eskom's revenue and is also damaging the economy, lowering industrial and business productivity. The company is R420 billion in debt (BBC News, 2019).

Eskom is looking for a possible bailout from the government, which also does not have the money. The government has considered splitting Eskom into three sub-private companies: one each responsible for generation, transmission and distribution to make this sector more efficient and competitive. The labour unions have resisted the move to privatisation as they fear that this will result in job losses (BBC News, 2019).

In an article by Business Tech (2019) studies resulted in the findings that the cost of load shedding has reduced South Africa's gross domestic productivity growth by approximately 0.30% in 2019. This means that R8.5 billion is the net monetary value. The article also states that South African Airways (SAA) was also going to follow a similar trend (Business Tech, 2019).

In an article, Phillips (2019) stated that Eskom had not planned for the maintenance of the power plants and this has resulted in load-shedding. Phillips also mentions that the president should step in and rescue Eskom. He states that the ordinary citizens need to stand up for better service delivery from Eskom (Phillips, 2019).

Nest (2015) discussed that the demand for electricity has exceeded the supply and Eskom has insufficient capacity to supply. Nest mentioned that the problems at Eskom were:

- Inconsistent supply of coal;
- Skills shortage;
- An increased demand;
- Lack of maintenance;
- Not meeting the deadlines of the Medupi and Kusile power stations construction; and
- Businesses having to close due to no power resulting in job losses.

Nest (2015) suggested that partial privatisation and renewable energy and other sources of energy should be considered to lessen the demand (Nest, 2015).

The researcher supports BBC News, Phillips and Nest that poor maintenance has resulted in load-shedding, which has a knock-on-effect of load-shedding which impacts the economy and which inadvertently results in job losses.

Comparatively, in another article, Casson (2004) discusses *The future of railway UK systems,* calling it "Michael Brookes Vision" (MBV). He envisions how the privatization of the rail systems is the answer to reduce delays and cancellations. The author brings a different perspective of competition amongst service providers- Privatization through franchising the business. It has brought competition, cost awareness, supply of private capital, optimizing boundaries of firms and the international transfer of skills (Casson, 2004).

The researcher finds that this could be a possible solution to the cancellations and delays at Transnet. However, Privatization will involve political and governmental interventions. In the opinion of the researcher, at this time, it is not viable to use this MBV system. Australia is an example of such a practice and it is effective.

Callaghan (2018) stated that in a survey conducted by the Academic Staff Association of Wits University (ASAWU) in 2016, it was postulated that:

- Precarisation (political term referring to living and working conditions without future guarantee) in this context results in low salaries.
- Short-term contracts with the possibility of renewals.
- Forced to perform duties outside the scope of work.
- Amendments in agreed rates and contractual agreements.
- Gender bias towards women.

The report stated that the abovementioned has a negative influence on morale and working relationships. This also results in the casualization of workers (Callaghan, 2018).

According to Bozzoli (2016), structural conditions are driving trends towards precarity in academic work. The important trend is the underfunding of the countries' tertiary sector. (Bozzoli, 2016).

According to Lindeque (2017), political demoralisation of a country's strong labour federation raises concerns that tertiary management cost-saving and increasing precarisation in a country's universities are being overlooked by political issues and aggressive populist political agenda (Lindeque, 2017).

Bozzoli (2016) and Lindeque (2017) supports Callaghan (2018) that employees who are employed on a casual basis lack long term stability and growth to contribute positively to the economy and society at large. Employees may become disgruntled when contracts cannot be renewed and possible strike action can lead to damage to property and injury to employers

Webster (2017) stated that the country's labour unions are struggling for social justice and the expectations would be a strong response from labour to the crisis of precarisation. Referring to post-apartheid, the trade unions should be effectively fluent in the political landscape. In a global context, organised labour has waned in the

growing informalisation of work and faced criticism of protecting the employer instead of the employee (Webster, 2017).

Conversely in South Africa, the Congress of South African Trade Unions (COSATU) until recently has aligned with the ruling party, the African National Congress (ANC). Furthermore, the National Union of Metalworkers of South Africa (NUMSA) has formed its membership consisting of all university staff and metal workers. In terms of precarious work and the response to the crisis, the South African Federation of Trade Unions (SAFTU) has emerged. Its objective is to separate organised workers and a growing precariat to assist in realistic methods to resolve the crisis (Webster, 2017).

In South Africa, there is a Tripartite Alliance consisting of the African National Congress (ANC), South African Communist Party (SACP) and the Congress of South African Trade Unions (COSATU). Lindeque (2017) discussed that there was a side-lining of the tripartite alliance partners (COSATU and SACP) by the ruling party (ANC), which may result in poor political commitment to workers' needs if the clash with populist politicians continues. The implications may be:

- Worker rights and precarity in academic work.
- Academics and workers may be denied recourse to political labour responses.
- A devaluation of the political weight in the labour movement.

Callaghan (2018) concludes that those exposed to casualization and precarity in South Africa may currently face a storm of budgetary pressure and diminishing power of labour unions due to increasing political populism. He further concludes that there is an urgent need to reinvigorate the tripartite alliance and realise that labour movements may have to agree to the part or full privatisation of public institutions (Callaghan, 2018).

In an article in the Business Maverick, Stoddard (2019) reported that the Congress of South African Trade Unions (COSATU) spokesperson Sizwe Pamla stated that it is not changing their policy but are embracing limited privatisation of SOEs that are ailing. COSATU stated that it would consider privatisation if the asset was not strategic and that government maintains a majority share (Stoddard, 2019). Transnet may soon have to consider privatisation if revenue and profits decrease.

Chothia (2019) from the South African News reported that more than 50 000 workers from unions and the country's State-Owned Enterprises (SOEs) will down tools against privatisation in 2020. The National Union of Metalworkers of South Africa (NUMSA) president Andrew Chirwa stated that it is beyond Eskom and they are mobilising with NUMSA and SAFTU to defend the privatisation of SOEs (Chotia, 2019).

Monde, (2019) a senior lecturer at Wits School of Business argued that the South African government owns about 41% of the economy. Her belief is that the only way to relieve the state is to sell some of their assets to improve the financial statements (Chothia, 2019).

Sithole, (2019) a chartered accountant analyst, argued that the state has a role to play in the economic sector, as no private company will be able to handle the capacity at SOEs. He argued that it is not privatisation that is needed, but profitability of the SOEs (Chothia, 2019).

The researcher acknowledges the need for trade unions and political parties like the SACP who are opposed to privatisation. However, the literature shows that there is a need for privatisation or part–privatisation to assist state owned enterprises to become profitable. The researcher is also of the opinion that if SOEs can be more effective and efficient, this will result in better profits which could reduce the need for privatisation.

To support that planning is an important element to reduce train cancellations, a report in the United Kingdom spokesperson Charles Horton, for Govia Thameslink Railway, who stated that the company will restore 100 services of the 300 services that were reduced from the timetable. Southern Railways stated the reasons were due to the high numbers of staff being sick. There were reports that the employees of Southern Railways proposed a strike over the new working conditions (Albawaba, 2016).

In a Journal, Parbo (2016) explains that understanding passengers' preferences and being able to address these preferences explicitly in the planning is the basis for a more passenger-oriented railway planning. Passenger-orientated key performance indicators (taking all relevant attributes into account) should be applied by researchers and operators. Exhaustive performance measurements ensure that enhancing a single parameter is not realised at the expense of non-measured parameters, thus leading to a *de facto* deterioration or status quo in service level. The robustness and train cancellations reduction is discussed in the next section.

To summarise from the journal, Parbo (2016) the author made three crucial findings:

I. Firstly, regarding travel time variability, studies show that passengers rate schedule adherence higher than travel time reductions. Therefore, a definition of robustness and related measurements needs to capture the system performance as well as the efficiency, that is, travel time and capacity utilisation.
II. Secondly, when the price of robustness is disregarded, enhanced robustness may be achieved by allocating disproportionally large time supplements and buffer times.
III. Thirdly, since robustness is a trade-off between several attributes. Improving railway operations should take a more holistic and generic view, thus addressing all relevant attributes rather than only a subset. The same goes for the performance measurements.

The researcher takes into cognisance the aforementioned findings and states the following:

I. Commuters plan their lives and work on a schedule. Delays are not considered in their daily planning and therefore an efficient and robust train schedule will be applauded by commuters.
II. Commuters pay a price for the service of being transported. Poor service to commuters results in dissatisfied and disgruntled commuters. The price commuters pay is for a robust, reliable, time-sensitive train schedule. Therefore, commuters will pay the price for robustness.
III. A holistic view of improving railway operations will result in a reliable, safe and robust network. This will guarantee satisfied commuters who will continue the railway system, resulting in continued sales and future sales.

Coupling generic optimisation approaches and the planning of railway operations with knowledge of passengers' travel behaviour will enhance the reliability and applicability of the results, thereby decreasing the gap between what railways planners provide and how it is perceived and experienced by the passengers. Equally important, Parbo (2016) states that providing real-time information to the passengers about their itinerary when delays occur is shown to have a stress relieving effect. There is huge potential in individualising information on the current state of the transit system (eg.travel time uncertainty, delayed and cancelled services). Providing passengers

with information about route alternatives in case of large disruptions, taking into account seat availability, has a significant impact on the average expected delay and thus also on their travel experience (Parbo et al., 2016).

Comparatively, in Sweden, the Centre for Transport Studies conducted a study at the Swedish Transport Administration (STA). The thesis discusses The Swedish Rail Network consisting of 12000 track kilometres, of which the STA owns and manages 90% of the rail network (Bergstrom and Kruger, 2013). It is also unique that the passenger and freight trains use more or less the same infrastructure and operation systems. Along the same line, in a study conducted to determine the actual train delays and cancellations, the analysis of delay distribution facilitates the selection of appropriate methods for valuation of rail reliability and thus cost benefit analysis of rail investment and other measurements. More specific STAs analysis suggests that the standard deviation is not an appropriate measure of reliability risk.

However, another conclusion was reached that stated that only a sound valuation method can answer the question of whether society would benefit from reducing the number of delays in general or from preventing extremely large delays. In order to know whether it is more important to target the many small or few large delays, authors Bergstrom and Kruger (2013) suggest that more research be conducted. Currently, there is no research about societal nor individual willingness to pay for avoiding extreme delays. Moreover, one would expect that the network structure causes many more delays so that an analysis of network topology might be a fruitful avenue of research. A better network organisation, for example decentralising steering, backup capacity, extreme focus on hubs with regard to maintenance and coupling the express bus network to the train network, might reduce the vulnerability of the rail network. A major share of all delay times is associated with the tail of the delay distribution, indicating that extreme delays cannot be neglected when prioritising between measures improving rail infrastructure (Bergstrom and Kruger, 2013).

On a different basis, in an article, NJ Transits spokesperson Lisa Torbic stated that the cancellations were due to the installation of a positive train control technology to verify train speeds and locations. The engineers were being trained and this is the reason for the cancellations. The New Jersey Assembly transportation committee expressed their disgust, saying that NJ Transit needs a complete overhaul. Hutter

(2018) added that the agency experienced the most accidents for the period 2011 to 2016 (Hutter, 2018).

In an attempt to counter electricity consumption and due to the current load-shedding timetable, research was conducted. The results of the study were that due to the high temperatures in South Africa, the solar photovoltaic solar panels would offer renewable energy, cleaner energy and cheaper energy. The study shows that it can be used on current trains systems as an alternative energy supply and not to eliminate the conventional energy supply (Lencwe et al., 2016).

After careful deliberation, the researcher found that this is a project that is cost intensive and time-consuming. It is an alternative and does not replace the conventional power supply. Therefore, this will not be suitable for Transnet during these uncertain economic times.

An article by Global Economies, reported that according to the International Monetary Fund (IMF) the decline in the economy of South Africa is directly related to Eskom. The first three months showed that an inconsistent electrical supply slowed South Africa's annual GDP to 3, 2%. Eskom's impact on the South African economy should be mindful of the following:

- Eskom is the leading provider of jobs to the embattled labour market in South Africa;
- Domestic industrial growth is highly reliant on the energy resources delivered by the power utility; and
- Large debts incurred by the power utility are proving to be a drag on South Africa's budget deficit (Forex Capital Market Limited, 2020)

In a dissertation by Goldberg (2015) stated that South Africa is in an electricity crisis. A shortage of electricity remains one of the most critical challenges for Eskom as aging infrastructure and power plants are deteriorating. The impact of load-shedding is a critical consideration for all businesses and consumers. The results highlight the major pain points experienced by retailers. The results also indicate that R13.72 billion was lost in revenue in the first 6 months in 2015. The results estimate R716 million has been invested by retailers in backup generators or other energy resources (Goldberg 2015).

The Berea Mail ran a piece on *Load shedding affects economy* by Phili (2019), which stated that the Durban Chamber of Commerce and Industry is appalled by the lack of planning demonstrated by Eskom. This is having a drastic deteriorating effect on all electricity consumers, including the manufacturing sector. There is an urgent need for government and Eskom to drastically improve Eskom's supply of electricity and reduce load-shedding (Phili, 2019).

Rall and Mkhize (2019) wrote in *Business Chamber* that the power utility needs to take load shedding seriously and rectify the problems it has. The power utility requires urgent government assistance as this is not only affecting the business and private sector, but also social services like hospitals, police stations and fire brigades (Rall & Mkhize, 2019).

In agreement with the previous author, Mogotsi (2018) reports that the dysfunctional train service affects commuters' lives negatively. The report states that workers sometimes lose pay for late arrival. Some workers have even lost their jobs due to late-coming. Scholars have also suffered as a result of missing tests or examinations and students were also reprimanded for late-coming. The article quotes numerous workers and scholars stating that they have lost faith in the reliability of the train system and more importantly, are left with a financial burden of having to pay double fees for other modes of transport when trains are cancelled or delayed (Mogotsi, 2018).

Figure 2.11: Disgruntled train users (Mogotsi, 2018)

The researcher acknowledges the report and is confident that the suggestions and recommendations in Chapter Five will reduce the train delays and cancellations thereby resolving the aforementioned issues.

Equally important, at the 16th Meeting of the EURO Working Group on Transportation, research was conducted focusing on the secondary reasons for delays. The paper discusses the Swedish Rail's usage of the prioritisation rule, whereby the main measure of train performance is punctuality. The calculations were conducted by quantifying the delays into monetary terms and the value of time (VOT) is used. A delayed trip has negative effects on the passengers, which are also associated with costs. A parameter frequently used for estimating the value of the uncertainty in travel time is the *value of reliability* (VOR). VOR is a parameter that describes how much money a person would pay to reduce the travel time uncertainty. The current prioritisation rule is easily communicated and implemented that an on-time train should always be prioritised before a delayed train.

Anderson (2014) stated that for a frequently occurring conflict situation, the prioritisation rule leads to poor economic efficiencies that bring large costs that could

have been avoided with another strategy. Anderson also shows that it is possible to reduce costs by delaying the on-time train and by such means prevent the already delayed train to get even more delayed. Often, the train dispatchers make good decisions that result in overall reduced delays, but there is a need for decision support that encourages them. The main contribution of this paper is to show that cost reductions can be made with another prioritising strategy. For an acceptance amongst operators, however, the strategy should be combined with some type of economic compensation controlling equity between the operators and TRAFIKVERKET (Anderson, 2014). In such a way, the service provider would achieve a higher reliability, which would also lead to increased railway travel. The following section discusses the three different recovery strategies of robustness and the effect on the Robustness Simulation Model (Anderson, 2014).

2.4 The three different recovery strategies of robustness and effect on the Robustness Simulation Model

Robustness and recovery in train scheduling – a simulation study from DSB-S-tog a/s by Hofman (2006), submitted a simulation model to study the robustness of timetables of DSB-S-tog a/s (S-tog), the city rail of Copenhagen. Dealing with rush-hour scenarios only, the simulation model investigates the effects of disturbances on the S-tog network. DSB-S-tog is the sole supplier of rail traffic on the infrastructure of the city rail network of Copenhagen. S-tog has the responsibility of buying and maintaining trains, ensuring the availability of qualified crew and setting up plans for departures and arrivals, rolling stock, crew etc. The simulation model is for testing the timetable robustness and the effect on robustness of the three different recovery strategies.

The three strategies are:

i. Firstly, *early turnaround time*: the basic idea of this recovery method is that if a train is delayed more than a certain threshold, it changes direction at an intermediate station before it reaches the planned next terminal.
ii. Secondly, the strategy is called *take out*: this recovery method cancels specific lines in the network in case of disruption. The cancellation of lines is initiated by regularity falling below a certain threshold. The candidates to be cancelled are

pre-defined. For example, if delays are on line A, line A+ is cancelled. Trains can only be taken out at depot stations.

iii. Thirdly, *replace*: this recovery method inserts an on-time train from Copenhagen Central (KH) to replace a train delayed along its route, which is then taken out. It is activated when a train is later than a certain threshold and the previous train that was allowed to continue along its entire route. The model of the method is divided into 2- one handling the take out of trains at Copenhagen Central (KH) and one handling the observation of delays at the other stations and the scheduled insertion of Copenhagen Central (KH). In the latter of these, a duplicate of the train entity is created to ensure that the train is taken out when it reaches Copenhagen Central (KH). It is at all times assumed that rolling stock is available at KH for inserting trains (Hofman et al., 2006).

The main result from the KH tests are that there is an upper limit on the amount of buffer time, leading to a positive effect on the regularity and that small delays, though insignificant on their own, have a significant additional effect when occurring together with large delays. Finally, there is a clear tendency that the recovery methods rendering the largest increase in headways result in the best robustness and thereby the best increase in regularity (Hofman et al., 2006).

More importantly, at the 16thSwiss Transport Research Conference, a study was conducted, where Toletti (2016) shows that a resource conflict graph is very flexible with respect to the objective function, but also that different functions may lead to very different results. In particular, results obtained by minimizing only train delays tend to have an extremely high impact on passengers. Thus, passengers should be considered explicitly by any approach to railway conflict resolution. It was shown that the results obtained with average data do not differ from those obtained from actual data. This means that these procedures may be implemented by practitioners using historic data without a loss of solution quality. An important open point is the weight to be associated with freight services. *How many passenger delay minutes have to be accounted for each freight train delay minute?* The numerical experiment showed that the solution depends on these weights. A solution to this issue may be to include a factor for converting a freight train delay to passenger delays into slot allocation contracts in order to allow more transparent decisions in the case of disturbed railway

operations. The succeeding section discusses train cancellations and interventions in other organisations (Toletti & Weidmann, 2016).

2.5 Technological Advancements

In an international article in Chinese High Speed Railways (HSR*)*, Xu, Corman and Peng (2016) illustrated that the developments of HSR performance are still confronted with disruptions. The Zero-Truncated-Negative-Binomial distribution (ZTNB) model demonstrates the relationship between sources of disruption and delayed traffic by predicting probability and the number of delay events. This model uses a regression model based on ZTNB. It estimates the probability and the impact of the delay, combining the sources of disruption. The disruptions are categorized by low frequencies, which are one or no disruptions for a week. On the other hand, there are also other disruptions that result in larger impacts which occur seldom. The researcher takes cognisance of this literature and the core of this article will be considered in the recommendations. However, it must be noted that South Africa does not use HSR (Xu et al., 2016).

Similarly, in a study conducted internationally in China analysis on High Speed Railway Trains, Yang (2019) stated that a distribution model passed the *Kolmogorov-Smirnov* (K-S) test except for the communication systems, transponders, faults of signals (CSSF), which consist of faults of signals, transponders and communication equipment. The model accurately describes the disturbance affecting the train delay time. The delay causes are:

I. **HE:** unexpected maintenance (Related departments require a temporary operation interruption, which is not scheduled; departure before the maintenance operation is completed; and a stop at a neutral Sect; physical discomfort of the driver, to maintain or examine the tracks, vehicles or other facilities).
II. **FBI**: hitting animals, pedestrians, stepping on tracks or catenary (overhead cable) faults.
III. **PI**: passenger aid, temporary stops owing to passage of key trains, large passenger volumes and transferring of passengers.

IV. **VF**: fault in any component of a vehicle.
V. **TPSF**: braking system, pantograph, faults of catenary, hauling system and so on.
VI. **DCSF**: centralized traffic control (CTC) system, monitoring system, risk prevention system, faults in automatic train control (ATC) system, Chinese train control system (CTCS) and so on.
VII. **CSSF**: communication systems, transponders, faults of signals.
VIII. **ND**: fires, earthquakes, floods, landslides.
IX. **LF**: train shaking, track settlement, switches, faults in tracks, tunnel drainage facilities.
X. **OP**: faults in the air-conditioning equipment and so on.
XI. **BW**: heavy snow, rain or wind (Yang et al., 2019).

The researcher acknowledges and agrees with the aforementioned causes. It is also used by Transnet in their operations.

Supporting technologic trends, an article in Australia, Pender (2013) explains that a survey conducted with 86 rail agencies resulted in 86% who used Twitter, 33% used Facebook and 12% who did not use social media. The paper highlights that communicating disruptions with commuters in real-time is highly acknowledged by passengers as an attempt by the railway company to keep them informed. Social media platforms provide the following advantages:

I. It is cost-efficient;
II. Keeps everyone updated about time-sensitive information;
III. Allows passengers to bypass any bureaucracy;
IV. It makes the agency appear to be in touch with younger users; and
V. Reaches people wherever they are (Pender et al., 2013).

The research also states that the conventional methods still need to be adhered to and that social media will not replace the conventional methods (Pender et al., 2013).

In a research study published in the Netherlands, Toletti (2015), models for scheduling and re-scheduling were evaluated with respect to features that are particularly critical for freight trains: energy consumption and train length. Then a model that satisfied these requirements was proposed and tested using simulated data.

i. Firstly, the literature analysis highlighted that all models proposed considered the length of trains, but only 3 approaches included energy considerations in scheduling or re-scheduling in mixed traffic. Energy consumption optimisation in separate levels includes energy efficiency in a scheduling procedure.
ii. Secondly, scheduling models with low traffic density were extended to re-scheduling by adding terms linked with real-time operations, such as delays and penalties for train run cancellations to the objective function. The resulting model minimises energy consumptions, delays and cancellation in a unique step.
iii. Finally, tests on a numerical example were performed. In these tests, trajectories to be used as control variables were generated using a simulation based approach. In these tests, increasing the length of these trains up to 100% increased the overall energy consumption and delays, but had no influence on feasibility and computation time. Larger increases yielded to train cancellations, huge computation efforts or losses of precision due to rougher time steps for departure (Toletti et al., 2015).

Correspondingly, in another research study, Myeni (2018) discusses that the current chronic overcrowding is in the entire major train metropolis, with huge number of passengers boarding during peak hours. Overcrowding of trains is due to the unavailability and unreliability of rolling stock and infrastructure. The author, also in the same article, claims that the unavailability of trains puts more strain on the lives of ordinary people in the country who are relying on rail transportation. The paper suggests excellence methods and techniques that one can introduce to better the situation or resolve the issues completely. Best practices and efficiency improvement models can be articulated with a view to delivering efficient and reliable commuter train transportation in South Africa. The aspects investigated are to deliver the ultimate goal of an efficient and reliable transport system.

The author further discusses the interventions that will assist to get to the root cause of the problem and came up with recommendations, as the industry is currently not coping and losing large amounts of money due to train sets that have been burnt and vandalised by frustrated commuters longing for availability. The recommendation is that the railway industry should always strive for a robust transport system that is able to cope with both expected and unexpected events, and the infrastructure of the rail must be designed in such a way that it minimises the stoppages and the distractions resulting from in-service failures and incidents (Myeni et al., 2018).

Overcrowding on railways is the manifestation on many underlying problems: a lack of track capacity; a sub-standard and unreliable network and signalling; the lack of coaches to build up healthy sets; and a lack of communication during service to commuters. It is unfortunate that this problem is not being treated with anything like sufficient urgency. However, overcrowding cannot be tackled unless there is enough rolling stock regularly available to replace defective coaches promptly. According to an article found on a website, (Citizens Advice, 2020) the rail ombudsman in England states that:

a) If a ticket is purchased and that train is cancelled, then the commuter can claim a refund and also get a partial refund if the trip is delayed;
b) Twenty-five percent off the ticket price if the delay is fifteen to twenty-nine minutes late; and
c) Fifty percent off the ticket price if the delay is thirty to fifty-nine minutes late and anything more than an hour is a full refund (Citizens Advice, 2020).

In a thesis, the author Bulicek (2018) focuses on the interface between passenger transport demand after utilisation of individual trains influenced by current operational situations; delays and overtaking of trains; and on aspects of capacity utilisation of railway lines. The researcher is inspired by an idea to operate rush lines on higher levels of capacity utilisation due to the possibility of cancelling delayed trains and making the time schedule more stable in this way. The findings indicated that if a train is delayed between 37 and 49 minutes, train cancellations can be considered as a possibility on how to save the capacity of railway infrastructure.

This decision is strictly related to specific, given operating conditions (time schedule), which will be different for each specific situation. The results show that the application of simulation models in the field of interface between railway infrastructure capacity and transport demand is possible. Train cancellation is not a simple tool. Its application and effectiveness is related to complex operational conditions and time schedules, not only to the capacity of the occupation (Bulicek, 2018).

In a similar article, Nagy and Csiszar (2015) conducted an investigation over a period of one year in the region of Gyor in the Hungarian Railways. The results of this study indicated that in summary, the majority of delays and cancellations were due to loss of time in attending to faults of traffic control and technical incidences. Another reason was the delay in the management of the delays that were caused by interchanges with different railway companies. Most of the delays were registered during January and March due to the excessive bad weather conditions, including heavy rain and snow, as well as extremely hot and extremely cold weather conditions (Nagy and Csiszar, 2015).

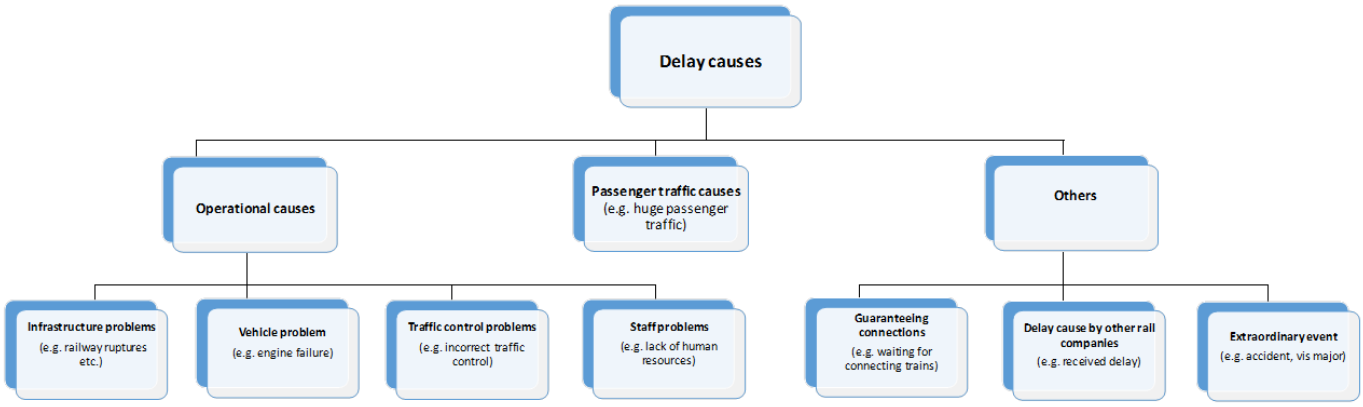

Figure 2.12: Delay Causes in Hungarian Railways (Nagy and Csiszar, 2015)

In a case study of Nordland Line, the author Zakeri (2018) discussed the relationship between whether variables and the punctuality of the passenger trains on the Nordland railway line were investigated. The results clearly indicate that the extent to which the weather factors have influenced the punctuality of passenger trains varies in different years. Weather factors effect punctuality to a greater extent in years with harsh winters compared to years with milder winters. Very cold weather during winters is crucial to drivers of delays and low punctuality of trains. It was found that the main weather

variable that best explains the variation in punctuality is snow depth and the other variables have less effect. This study partially supports the assumption that weather is an important influencing factor contributing to delays and low punctuality (Zakeri et al., 2018).

The author Wang (2018) discusses the impact that abnormal weather events has on the safety and operational performance of the railways in Great Britain. The rapid advances in weather forecasting and emerging information technology mean that the weather forecasting data can be utilised to improve the performance of train control models in dealing with weather events. The proposed control methods were recommended since trains travelling through adversely impacted zones follow reduced speed limits and in severely impacted zones where the tracks are blocked, trains need to be re-routed or wait until the blockage disappears.

The case studies indicated that compared with existing control methods, the re-scheduling methods were shown to make significant reductions in total train delays (an average of a 21% reduction. Secondly, within the time scale considered, the further ahead the weather forecast information is considered, the less the overall delay tends to be and lastly, under severe weather disruptions (track blockage), the proposed re-routing model is shown to be able to effectively and efficiently find a cost effective route and timetable (Wang, 2018).

Additionally, in New Delhi, Shri Manoj Sinha, Minister of State for Railways, stated in his parliamentary presentation that trains were being cancelled due to foggy weather. The minister admitted that there were delays caused by foggy weather during the winter seasons. In an attempt to reduce the train cancellations by 50%, the minister stated that the following interventions would be implemented: the government has started with a trail of fog cameras to assist trains drivers with fog density, which will regrettably bring a high cost factor and it will take time to do the entire fleet (Sinha, 2016).

In the Slovakian Republic, a thesis about Six Sigma Methodology Using Defined Measure Analyse Improve and Control (DMAIC) was based on a study conducted to achieve process improvement in Railway Transport. The author Nedeliakova (2019) suggests that one of the ways to constantly improve the company's performance while fulfilling customer expectations is to implement the Six Sigma philosophy in the day-

to-day business process of individual process management. It focused on changing corporate culture and gradually re-designing the process from strategic planning to operational processes. The structured cycle of DMAIC represents the basic means of improving processes within the Six Sigma methodology, and it can be used for the gradual improvement of railway transport process. This process requires continual monitoring (Nedeliakova et al., 2019).

The effectiveness of Rolling Stock Maintenance on Quality Assurance at the largest South African Rail Company supports the author, Nedeliakova (2019). The evidence stated that the engineering division does not possess a criterion to monitor the effectiveness of Transnet's maintenance plan. It also stated that the artisans and technicians who use the system are not well-versed with the maintenance system. The Quality Assurer (QA) is present. However, there are gaps that need to be closed regarding the poor quality service and disappointing customers. The study also states that the aging fleet of rolling stock contributes to the poor quality service. Additionally, the study found that the competency of the artisans are not of the required calibre. The recommendations were that management play a crucial role in the implementation of maintenance standards and training in order to constantly emphasize the need for empowered artisans to perform their duties according to the maintenance system (Mukwakungu et al., 2019).

To support the author, Mukwakungu, studied in service failure, the cost of the failure, the maintenance plans and disrupting commuter service. The facility maintenance management system was used highlighting the critical failure modes. The results of this study were:

i. Reliability cannot be ignored. The relationship between maintenance, cancellations and delays are highlighted.
ii. The most evident trend is that cancellations and delays are increasing over the years when in service.
iii. A trend that the aging of trains compounds the reasons for failure.

There was inadequate information to do a root cause analysis (Conradie & Treunicht, 2012).

The researcher deduces that it is evident that reliability and the ageing of trains is a contributory factor for delays and cancellations, which will be further discussed in Chapters Four and Five.

In an article in the Cape Argus June 2019 edition, it was reported that Transport Minister Fikile Mbalula gave an undertaking to improve Metrorail's service and accelerate the implementation of PRASA's modernisation programme. He met with PRASA's board of directors and asked for the daily and weekly grievances of workers and plans to get PRASA back on track (Mlamla, 2019).

In a separate article in the Cape Argus August 2019 edition, it was suggested to Passenger Rail Agency of South Africa (PRASA) that if a passenger train is delayed or cancelled, PRASA should reimburse the commuters either proportionally or their full fares. This required approval from PRASA's board. To date there has been no change (Mlamla, 2019).

Identification of Delay Factors that affect High Dwell Times of Freight Trains discusses that the factors that contribute to poor on-time performance of trains were:

i. Power failures
ii. Defective Infrastructure
iii. Train Conflict
iv. Crew Shortages
v. Signal Communication Failures
vi. Locomotive Shortages
vii. Adverse weather conditions (Magadagela et al., 2017).

Their recommendations were:

I. Robust and feasible train timetables.
II. Timetables should allow slack for delays.
III. Trains should be enforced to operate timeously to prevent train conflict.
IV. The demand capacity must match the infrastructure capacity; and
V. Infrastructure projects must be aligned to the projected demand so that results are reached (Magadagela et al., 2017).

Trains are causing longer dwell times being stationary, rather than moving freight (Magadagela et al., 2017).

The researcher takes cognisance of the abovementioned recommendations and these are further discussed in Chapters Four and Five.

In a separate analysis from the National Command Centre, the total cancellations for the financial year 2016/2017 are depicted in Figure 2.6.1. The following were the top 5 cancellation reasons for delays and cancellations:

i. Highest at 5, 03% (powder blue) was no product available from the customer.
ii. Secondly, followed by 4,87% (cream) which was cancelled by customer.
iii. Thirdly, followed by 4,51% (purple) which was locomotive failure (in-service) and (dove grey) wagon failure (in-service).
iv. Fourthly, followed by 4,21% (rust) which was for delays/short shipment; and
v. Lastly 4, 21% (light orange) which was late release by the customer.
vi. This is a total of the top five reasons for delays and cancellations: totalling 22 or 83%. This is greater than one-fifth of the total tonnages lost. In a report from the yearly performance of Transnet, the target was 268 million tons (Gama, 2016). Wagon and Locomotive failure contributed as the third highest, and the aim of this study is to compare it with the results achieved from this study. The aim of the study is to find gaps and more creative solutions to minimize delays and cancellations at Wentworth Locomotive Diesel Depot, Durban, South Africa

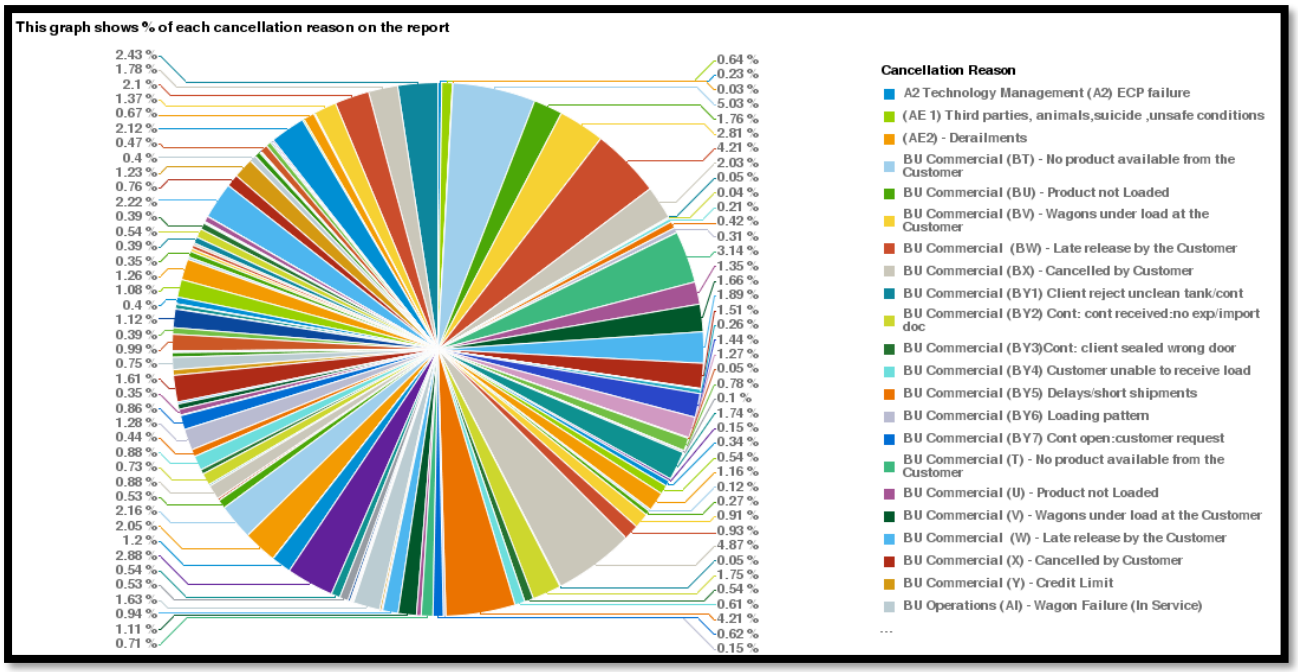

Figure 2.13: Total cancellations for the financial year 2016/2017 (Transnet, 2017)

2.6 Critique of Transnet's policy and procedures of train cancellations and delays

During the intense studies conducted by the researcher on the procedures and policies of Transnet in South Africa, it was evident that there were international standards implemented. In order to be the major rail company in South Africa and neighbouring countries, it requires constant compliance to these rules and regulations. Transnet is monitored by the Railway Safety Regulator (RSR) of South Africa. The RSR is a body independent of Transnet and is appointed by the government. Random audits are carried out by RSR during the year at various departments in Transnet. An intense report is then produced, and Transnet is given time to comply or face legal action. The RSR has the authority to remove the permit given to Transnet to operate as a railway organisation if the audits prove that the regulations and standards are not being adhered to.

On the 18th June 2013, the Chief Operating Officer (COO) to staff of the different divisions of Transnet circulated a memo titled *Adherence to Clearing House Requirements.* In this memo, the COO highlights that some Business Units (BU) are not adhering to the rules as some BUs are not conducting Clearing House meetings.

The COO instructs that all BUs will conduct Clearing House meetings within 72 hours. Thus, allowing BUs 72 hours to gather information and investigate the root cause by conducting a Root Cause Analysis (RCA) and use the 5 Ws and H principles (Who, When, Why, What, Where and How) for the cancellation or delay to Continuously Improve (CI) the current situation and learn from them. The COO has included General Managers' (GM) cell phone numbers and where BUs cannot come to an amicable solution or recommendation, the GMs should be consulted (TFR-IMS-NCC-WOI-10.0).

The previous paragraph illustrates the commitment from the GM of Transnet to ensure that CI and RCA are been implemented, which additionally illustrates that the GM is adhering to International Organization for Standardization (ISO) quality standards and principles, ensuring continuous Customer Satisfaction (CS) by repeatedly trying to improve the train service and by continually repeating these processes. The GM was simply adhering to methods of CI which would lead to CS. The Define, Measure, Analyse, Improve and Control (DMAIC) principle was implemented, even for those employees who were not aware of it.

The researcher also acknowledges that at a period in time, the processes were also adhered to by the subordinates from different BUs. However, during this period, there have been changes in management numerous times since 2013. This has led to certain non-conformance or procedures not being correctly followed. The researcher will discuss this and possible recommendations in Chapter 5. The researcher also noted that there is little or no information on the internal policies and procedures of international railway companies to compare to. The possible reason is company confidentiality and privacy clauses. The researcher's objective is to analyse the interviewees' responses in order to either support or disregard the above theory of non-conformance.

In 2017, there was an amended and updated version of the document titled, *Occurrence Management guideline: Clearing House*. The document was updated to reflect the new TEMS procedures. The changes were decentralising clearing houses that will be held in different BUs across Transnet. Clearing house attendance from all cross-functional stakeholders is mandatory. The last change was that cancellations booked against locomotives and wagon failure are to be done in consultation with a

Transnet Engineering Senior Manager, and that a direct cause-and-effect link exists (TRF-IMS-JHB-GUI-014.1).

This aforementioned amendment demonstrates that senior management in Transnet was partially aware of the impact that cancellations and delays of trains had on the overall network of train movement. The researcher supports the inclusion of a Transnet Engineering Senior Manager in the decision-making process.

The researcher supports the inclusion of Senior Managers in the decision-making process so that the decisions taken will come from a person of authority. The decisions taken will be informed decisions taken by the subject matter expert. The decision will be timeous and communication on the Transnet intranet will be almost simultaneous. Post implementation of the amendment, positive results were noted. These results were unfortunately short-lived due to the change in the COO and Transnet Senior Management. It is the researcher's opinion, stemming from the above fact, that when a person or leader leaves Transnet, their beliefs leave with them. The researcher believes that the abovementioned have contributed to an increase in the number of train delays and cancellations.

The literature review from various international and local authors suggests that the rail network systems are indeed important to any rail infrastructure, in their countries and globally. However, the following authors have different opinions about which systems are the best. Authors: Beck (2013), Patel (2019), Hutter (2018) and the European Railway Agency (2011) argued that using information technology and computer software programmes are the solution to resolving all delays by optimising resources; Whilst other authors like Dieude (2016), Mescht (2006), Stafie (2010), Liedtke (2018), Ahren and Parida (2009), Gibson (2005), Myeni (2018), Magadagela (2017), Nagy and Csiszar (2015), Zakeri and Olsson (2018) and Wang (2018) argue that infrastructure, weather and unforeseen circumstances will always result in train delays and cancellations.

The researcher is of the opinion that the human aspect is being ignored and putting together a timetable and commanding employees to follow procedures is not the answer. The researcher also believes that the inclusion of the Basic Conditions of Employment Act (BCEA) and the Variations Agreement (VA), exclusive to Transnet in South Africa, complicates staffing issues. The organisation is also highly unionised

and is governed by a democratic government. This means that all amendments need to be discussed and agreed upon prior to implementation. Rules, regulations, policies and procedures need to be abided by both subordinates and management, leading to disharmony in the workplace. Adding to this there is little or no flexibility of resources at specific given times, which can magnify the disharmony in the workplace.

2.7 Chapter Summary

Chapter Two discusses the literature from various authors locally and internationally. The various reasons for train delays and cancellation from different railway networks all across the globe were researched and similar themes were identified. The reason for the literature exploration is to find recommendations to assist Transnet Engineering Locomotive Diesel Depot in Wentworth Durban to reduce cancellations and delays. The researcher discusses how inefficiencies, poor infrastructure and ageing assets contribute to a railway network's delays and cancellations. Additionally, human resources legislation, government legislation and contractual obligations hinder certain procedures and also result in train cancellations and delays. Adverse weather conditions, natural disasters, vandalism, theft and load shedding compound the aforementioned difficulties that Transnet faces. The next chapter outlines the research methodology that the researcher used in conducting this study.

CHAPTER 3:

RESEARCH METHODOLOGY

3. 1 Introduction

Chapter Three provides insight into the qualitative research methodology used for this study. This study follows the interpretivist philosophy as it uses the qualitative approach which centres on discovering and interpreting this study and benefits the respondents as well. The interviewees were predominantly employees of Transnet Engineering Locomotive Maintenance Diesel Depot, Wentworth and Transnet Freight Rail Operations Diesel Depot, Wentworth. When choosing the interviewees, the researcher used non-probability sampling known as judgmental or purposive sampling in which the participants chosen are either familiar with or experts in the field of study. The approach was semi-structured in-depth face-to-face interviews and open-ended questions, which allowed the interviewees to communicate openly and without prejudice. Data obtained from the framework analysis was via a qualitative method and the steps of data analysis were used.

The importance of data used in this study is that it has the highest degree of trustworthiness and data analysis is done thematically. It was for this reason that the researcher consulted with a Subject Matter Expert (SME), being the Industrial Engineer, who approved the interview schedule. It is key that the ethical considerations be adhered to at all times. Therefore, the researcher has highlighted the ethical documentation completed by the interviewees.

Consequently, the structure of this chapter includes the following:

- The purpose of this study.
- The research question.
- The Methodology, research design, population target, sampling, measuring instrument, participant selection, ethical consideration, data collection, data analysis.
- Pretesting.
- Trustworthiness and credibility.
- Anonymity and Confidentiality.

- Ethical consideration

3.1.1 Purpose of this study

The purpose of this qualitative study was to explore and understand Transnet's employees' understandings of the reasons for cancellations, with a view to help reduce the cancellations at Wentworth Diesel Depot.

3.1.2 Research Questions

The research questions from the interview schedule consisted of ten questions (See annexure D on page 159 attached).

3.2 Methodology

In this dissertation, the researcher defines methodology as the philosophy and design applied in data collection, data analysis and the ethical considerations of the interviewees. Rajasekar, Philominathan and Chinnathambi (2013) agree that it was noteworthy to understand different styles in order to be able to get the preferred and best method for the relevant study. Furthermore, Creswell (2014) postulated that in order to achieve a well-structured research, it should include questions and procedures, data collected from interviewees, data analysis and interpretation of the data collected.

3.2.1 Research design

A qualitative research approach was adopted in order to get an understanding on who, when, why, what, where and how decisions are made on cancelling trains. Explanatory research was conducted to explain the procedures followed.

The research design for this study was descriptive: it used qualitative research and thematic analysis to find possible reasons. Explanatory research was also used to clarify the exact nature of the problem. A cross-sectional study was conducted to

collect data from the sample population. The qualitative study was the most suitable method since quantitative methods cannot represent personal experiences and emotions. The objective of this study was to collect descriptive, clear, precise knowledge into the reasons for the delays and cancellations at the Transnet Engineering Locomotive Diesel Depot in Wentworth, Durban. The descriptions of the employees' personal experiences were researched and analysed. The research design included collecting demographic data regarding participants' grade, job title, number of years of service, previous job descriptions, current duties, educational courses completed and highest educational level. Mertens (2014) explained that typically, people doing this type of research gather demographic data that may or may not be relevant to this study (Mertens, 2014).

In qualitative research, information-gathering consists of methodologies such as interviews, perceptions and composed archives (Petty et al., 2012). In addition, Cohen (2006) suggested that the finest strategy to collect information in a subjective report is to utilise a semi-structured interviewing technique. Semi-organised meetings permitted open-endedness and strength in the information accumulation improvement (Cohen, 2006).

Therefore, semi-structured face-to-face interviews served as an essential method to accumulate data for this study. The interviews began at a time and location convenient to the researcher and the interviewee. To preserve their privacy, interviewees were given numbers one to twenty. All interviews were audio recorded, transcribed and checked against the audio recording for any deviations. When the researcher completed the transcriptions, the interviewees reviewed the transcribed documents to ensure trustworthiness and originality. According to Creswell (2017), one method to reinforce credibility of the study is too triangulate information sources by using several sources (Creswell, 2017).

Three copies of the interviews were produced. One set being the originals were stored in a locked safe at the researcher's residence. The second set was the work in progress used for this dissertation, which was always password locked when not in use. The final copy was electronically stored in a password protected file on the researcher's private laptop. All original documents, duplicates and transcriptions were always kept safely.

The data collection methods in this study were supported by Percy (2015), stating that generic qualitative approach involves investigating people's findings of their subjective opinions, attitudes, beliefs and experiences. The process initiates semi- structured or structured interviews, questionnaires, surveys and content or activity specific participant observations. According to Percy (2015), most generic qualitative studies depend on the following data: semi-structured which is open-ended or structured which is close-ended interviews. Interviews can be either oral or written, oral being the most common. In qualitative interviews, the questions are pre-planned, although there may be opportunities for open-ended questions (Percy et al., 2015).

Secondly, in a written or oral survey, the items in the survey were constructed based on the prior knowledge of the topic. According to Paton (2002), no trustworthy study methodology is affected or distorted by group supporters, nor should the information be presented to help the scholars. Qualitative documents are reliable, dependable, accurate and impartial. The interviewer requested interviewees to check and verify that the correct information was recorded. Yin (2011) suggests that to ensure reliability requires an active study to be repeatable. Supported by Englander (2012), he stated that validity depends on the development of an accurate instrument to guarantee that the instrument recorded what it was intended to record.

3.2.2 Population/target population

The population target were employees at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. The total population at Wentworth Diesel Depot was fifty-three employees (this is the total unit of analysis). The target population for this study was twenty five out of the fifty-three, which was close to half of the total population. Off the twenty-five, one was a pilot questionnaire, two questionnaires were participants who felt they would incriminate themselves, so they were removed. One participant's questionnaire was discarded due to it being vandalised. The sample population used consisted of a variety of different levels of people in the organisation. The representation of the sample population was thirty-eight percent of the total population.

3.2.3 Sample and sampling procedure

The sampling technique used was non-probability, convenience sampling. The researcher used a sample of all the role-players involved in the decision-making process in sampling employees. In non-probability sampling, the researcher does not give all the individuals in the population an equal chance of being selected but rather specialists and knowledgeable participants were chosen. The following table illustrates the participants that were chosen and the rationale for the purposive sampling. The table below explains the rationale for choosing the participants. All participants are involved in or partly responsible for the delays and cancellations of trains, and the decision-making process in Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

In general, the samples for qualitative research do not need to include a large number of participants (Creswell, 2007).

Table 3.1 - Sampling Table

Participants/Job Title	Number interviewed	Rationale for Selections
Shed Man - TFR	1	The shed man fuels the locomotive, shunts the locomotives, builds a train and prepares the train for the driver.
Production Planner - TE	2	The production planner plans for the materials and for locomotives maintenance. The planer is responsible for planning all the events before and after maintenance.
Senior Technical Supervisor -TE	1	The senior technical supervisor supervises and manages employees in the maintenance of

		locomotives and wagons. The supervisor ensures that correct maintenance is executed on locomotives and wagons.
Master Diesel Electrical Fitters -TE	4	The master diesel electrical fitters maintain and repair diesel locomotives. They also perform dailies on locomotives and attend to callouts, breakdowns and derailments.
Chief Shed men - TFR	2	The chief man arranges and organises train sets. The chief shed man works with the shed man.
Engineering Technician - TE	3	The engineering technician maintains engineering principles however to go on. They monitor availability and reliability. Ensure that the assets are maintained according to Service Level Agreement Do quality spot checks on work done by diesel electric fitters.
Resource Manager - TFR	1	The resource manager ensures that there is enough resources in all departments. Ensures sufficient staff,

		locomotives, customers and plan accordingly.
Customer Services Manager - TFR	1	The customer service manager ensures liaison between TE and TFR with reference to the number of locomotives that are available to meet the ITP. The customer service manager also is a link between the client and Transnet management.
Section Manager – TFR	2	The section manager manages and supervises train drivers and assistants, ensure that the trains run as per the ITP.
Acting Quality Assurer – TE	1	The quality assurer does quality checks on locomotives after maintenance. Also creates non-conformance reports (NCR), and also creates findings for first, second and third party audits.
Contractor – Transnet	1	This contractor was employed especially for the 45 class diesel locomotives. The contract worker is the original engineering manufacturer. The contractor monitors

		and repairs the 45 class diesel locomotives as they are under warranty.
Technical Training Co-ordinator (TTC) – TE	1	The technical training co-ordinator co-ordinates training with the School of Engineering (SOE) and TE operations. He evaluates the competencies of the skilled and unskilled employees of Transnet Engineering
TOTAL	**20**	

3.2.4 Measuring instrument

A semi-structured interview schedule was used to interview all participants. The interview schedule was tested and presented to an Industrial Engineer-Transnet Engineering, an operations manager – Transnet Engineering, a technical supervisor – Transnet Engineering, an operations manager – Transnet Freight Rail and a section manager – Transnet Freight Rail in order to ensure its relevance. The interview schedule was piloted by these five Subject Matter Experts who approved the interview schedule. Data collection methods, interviewing procedures and schedules were analysed and presented. The necessary tests were conducted.

3.2.4.1 Participant Selection

An invitation was sent to participants via email to participate in the interview. Twenty-five invitations were sent out. Twenty-three participants responded and participated in the interview. Upon receipt of the signed consent form, the researcher diarised a date for a formal interview. An interview roster was shared with all the participants and changes were made to accommodate all the participants.

3.2.4.2 Participant Ethical Considerations

Prior to the interviews, the participants were allowed to ask any questions and to clear up any doubt that they may have had. They then granted formal consent to contribute to the study by signing and returning the consent document. The participants were informed that their data and identities would be protected and stored in a secure location. Each participant received a numerical code, for example P1, P2 up to P20 to conceal their identity during this interview. The purpose of the research was again explained to the participants. The risks to these participants in this study were minimal and there was no anticipation that the participants will be harmed. The participants were reminded that the participation in the study was strictly voluntarily and that they could stop participating at any time. The participants were also informed that there was no monetary reward.

3.2.5 Data collection

The data was collected through the interview schedule. The semi-structured interview was conducted in a private office at Wentworth Diesel Depot. The interviews were conducted in private hours and not during working hours. All interviews were audio recorded for transcription and hand-written notes were taken. A reminder was sent to participants prior to the interview to remind them of the appointment. The researcher clearly informed all participants of the purpose of this dissertation, which was to investigate the delays and cancellations at Wentworth Locomotive Diesel Depot. During the data collection phase, the researcher met the participants at the car park and escorted them to the private room. Two Dictaphones were set up in the room and copies of the interview schedules and pens were available. The Dictaphones were tested and the pens as well. The researcher made the participants comfortable and directed them to the ablution facilities and explained the emergency evacuation route. The researcher recorded the interviews timeously and started the interviews with an icebreaker to ease their tension. The researcher then again explained the purpose of the interview and repeated during the data collection that the participants will be referred to by pseudonyms for their confidentiality. The participants were informed

that they could stop and ask questions when they did not understand any questions in the interview. The researcher informed participants that their responses will be transcribed, and they will be afforded an opportunity to review the transcript for accuracy. To start the interview, verbal permission was given, and the researcher started to record the interview. The start of the interview was marked by stating the date and the purpose of the interview, with a pseudonym. The researcher reminded the participants about the consent and anonymity form. The rest of the interview was conducted in a professional and friendly manner. At the end of the interview, the researcher thanked the participants for the time they volunteered and ensured that the participant was satisfied with the interview. The researcher escorted the participant to the carpark and proceeded to the interview room and prepared for the next interview. Attached in the appendices is a copy of the interview schedule (Annexure B).

3.2.6 Data analysis

The researcher used the thematic framework analysis approach. Interviews with subject matter experts and the open-ended interview schedule resulted in the data collected.

In agreement with Percy (2015), outlining concepts within the theoretical framework and identifying repeated patterns are helpful in data analysis. Analysing of collected data in this generic qualitative study included the application of the thematic analysis framework.

The researcher has used the five-phase guide which is a very useful framework for conducting qualitative analysis. The following steps were followed:

Step one: become familiar with the data, data is absorbed and collected and key ideas and frequent themes are identified.

Step two: thematic framework, here the researcher used key notes gathered during the first step and allows the data to bring out themes and issues.

Step three: indexing, the researcher looked for parts or sections of data and correlated to a theme.

Step four: charting- was when parts of the data indexed from the previous step were set out in charts or themes.

Step five: mapping and interpreting stage, was when the focus is on charts and characteristics. Additionally, a schematic diagram of this study surfaced and directed the researcher on the interpretation of data.

The following will be a discussion of the actual events that transpired during the analysis. Data was collected as per the aforementioned process. The first step in data analysis was to carefully read the data collected. This process created an understanding for the researcher to reveal what information was relevant. Re-checking the participants was another step in preparing the data to ensure that trustworthiness and data analysis was done thematically to reach the goal.

An inductive analysis was conducted because inductive analysis is data driven and does not attempt to fit the data into any pre-existing categories. The researcher set aside all previous biasness and previous experiences; the data collected from each participant was analysed individually and without prejudice. Once the data from all participants were analysed, the repeating patterns and themes from all participants were deduced into a composite synthesis, which attempts to interpret the meanings or implications regarding the interview schedule (Percy et al., 2015). The researcher analysed the data without imposing pre-existing knowledge but rather was guided by the emerging data relative to the conceptual and theoretical framework in this dissertation.

3.2.6.1 Interviewees' Relative Frequency

The interviewees' relative frequency illustrated the skill level that contributed to each theme and class. There were ten skilled interviewees: 50 % of relative frequency, six were management interviewees; 30% and four were specialist interviewees; and 20% that contributed in each theme and categories. Figure 3.1(page 94) represent the previously stated interviewees' relative frequency. The Y-axis demonstrates the themes and sub-categories, whilst the X-axis demonstrates the relative frequency in percentage, resulting in the categories and sub- categories (relative frequency), which was discussed and exhibited by Figure 3.2 (page 82).

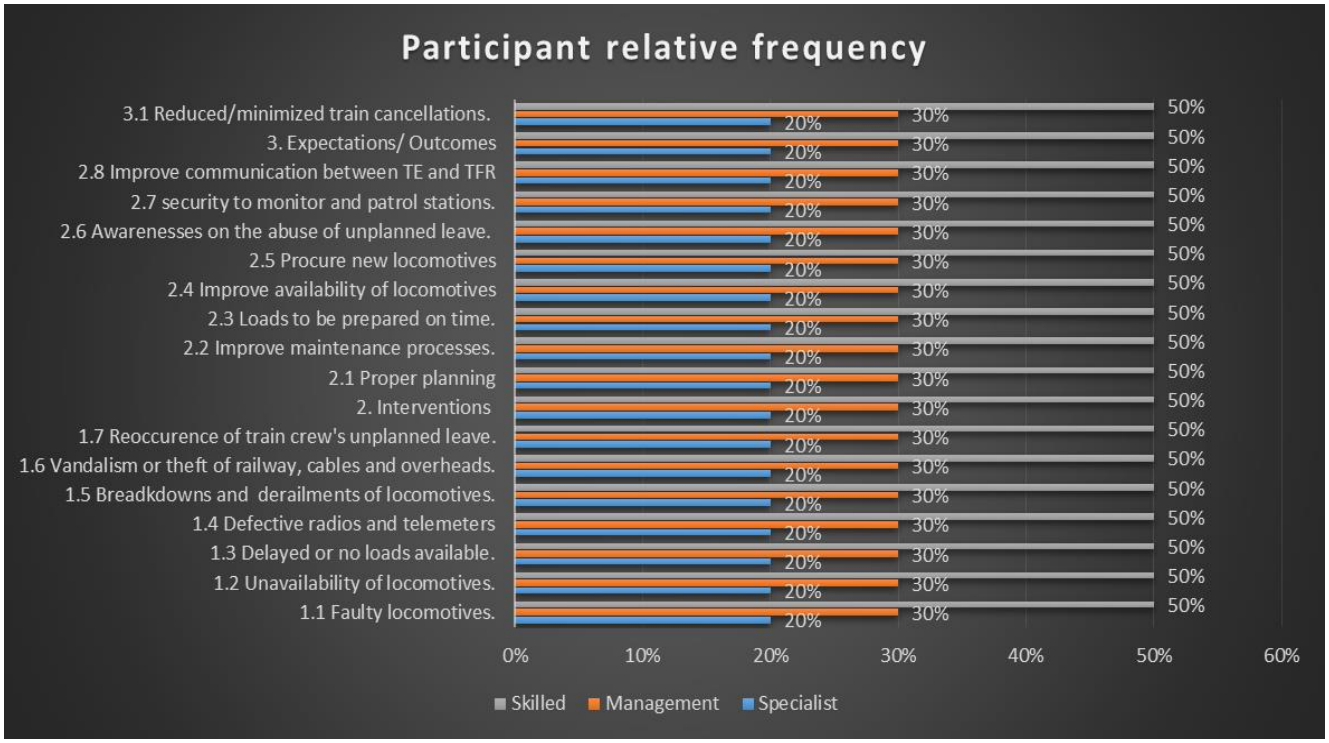

Figure 3.1: Participant Relative Frequency

3.2.6.2 Categories and sub-categories (relative frequency)

Themes are considered as categories and sub-categories that are categorised or clustered under each theme. The themes or categories are created from the data gathered and are words or phrases that were frequently used by the interviewees and that are most pertinent responses to the research questions of this study. Therefore, the researcher found it imperative to confer the categories' and sub-categories' relative frequency as a prerequisite to calculate the importance of each of the themes, and its significance or insignificance in directing the research question. Figure 3.2 (page 82) displays the categories and sub-categories' relative frequency. The Y-axis presents the categories and sub-categories, and the X-axis represents the relative frequency in ratios.

It was perceived that the expectations (with 46% relative frequency) contributes the maximum relative frequency; followed by the current occurrences which is 31% followed by interventions which was 23%. This highlights the most important concerns to have interventions, with the least relative frequency as the sub-categories that incorporate proper planning, improve maintenance processes, loads to be prepared on time, improve availability of locomotive, procure new locomotives, awareness on the abuse of unplanned leave, security to monitor and patrol stations and improve communication between Transnet Engineering and Transnet Freight Rail.

Following this, a detailed explanation of the results and findings of this study are expounded upon during the interpretation of the data. Equally imperative, the relative frequency of the categories and sub-categories steered the researcher to expectations or outcomes of reduced or minimised train cancellations and delays.

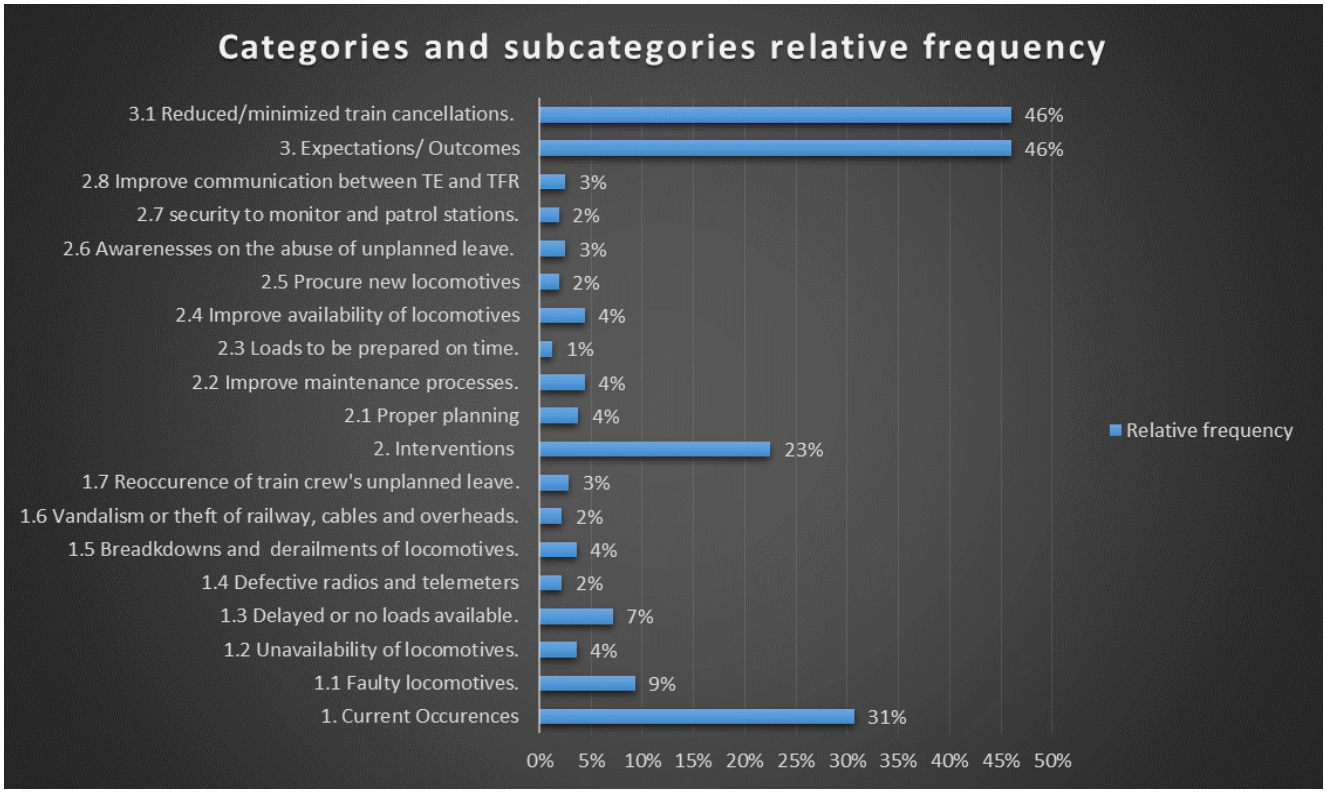

Figure 3.2: Categories and Sub-Categories - Relative Frequencies

3.3 Pre-testing

During the pilot test, changes to the format of the questions were re-arranged. Two questions were removed from the interview schedule and one question was added. Proofreading was conducted by the aforementioned employees and the interview schedule went through three draft processes. The industrial engineer – Transnet Engineering, an operations manager – Transnet Engineering, a technical supervisor – Transnet Engineering, an operations manager – Transnet Freight Rail and a section manager – Transnet Freight Rail. They all approved and authorised the interview schedule and saw relevance with this topic. The interview schedule, being qualitative, used an interview schedule type design.

3.4 Trustworthiness and Credibility

According to Lincoln and Guba (2015), in qualitative research, trustworthiness, credibility, validity and reliability will depend on the interviewees. Trustworthiness and credibility were tested with the manager and industrial engineer of the department at Transnet. Validity is the importance of correct information. Reliability is the conciseness of the results (Lincoln and Guba, 2015). A pilot study and corrections were made, ensuring that the study contains trustworthiness. The researcher in this qualitative research study used an inquiry audit to ensure dependability, which was reviewed and examined by the industrial engineer. The industrial engineer also evaluated the research process and the data analysis to make certain that the findings are consistent and if needed, could be repeated (Lincoln & Guba, 2015).

According to Burns and Grove (2011), reliability and validity with reference to research findings are of great importance. In qualitative research, reliability and validity is often viewed with scepticism. However, the criterion used to judge qualitative studies is **rigour**. As qualitative research is different from quantitative research, Rigour in qualitative research refers to openness, relevance, methodical congruence, thoroughness in data collection and the data analysis processes, and the researcher's understanding. Burns and Grove (2011) emphasize that the researcher's knowledge is an interactive process of the researcher's personal history, values, gender, social

class, race and ethnicity of the participants. The researcher should not have any preconceived ideas and judgments of the phenomenon and participants. The researcher should participate with oneness in the research (Burns and Grove, 2011).

Reliability is concerned with the consistency, stability and reliability of the interviewees and the ability to collect and record information correctly (Creswell, 2009).

Validity is concerned with the accuracy and truthfulness of scientific findings (Burns & Grove, 2011).

According to Pilot and Beck (2014), *trustworthiness* refers to the level of confidence in the data, interpretation and methods used to ensure the quality of a study.

In this qualitative study, emphasis is placed on data trustworthiness. Data trustworthiness consists of the following four elements, also known as the four dimensional criteria:

3.4.1 Credibility

Credibility refers to the confidence in the truth of the data and the interpretation of the data. This must be done in such a way that the findings show credibility, meaning that the reader will believe them (Lincoln and Guba, 1985).

According to Lincoln and Guba (1985), credibility is used to highlight confidence that the results from the participants are true, credible and believable (Lincoln and Guba, 1985).

The researcher is confident that the findings of the interviews are true, accurate and credible. The researcher supports this statement because during and after the interview, the researcher requested the interviewees to double-check their responses and clear any ambiguity. The researcher also played back the recorded interviews to the interviewees to re-affirm confirmation of the data provided. The researcher also listened twice to the tape recordings on separate occasions to analyse the responses from the interview schedule.

3.4.2 Transferability

Transferability refers to the ability to apply the findings in other context or to other participants. In qualitative research, Pilot and Beck (2014) emphasizes that the researcher is not primarily interested in generalising the findings, but rather in defining what is observed within the specific context in which it happens. Qualitative research showing the transferability of findings lies with those who wish to apply it to another context. To enhance transferability, thick descriptions, purposeful sampling and data saturation are used. Thick descriptions are the collection and provision of sufficiently detailed descriptions of the data and reporting on them (Pilot and Beck, 2014).

Purposive sampling maximises the range of information obtained from a particular context by purposefully selecting the participants who have knowledge of the phenomenon and their location. Data saturation occurs where the additional participants provide no new information and no new themes emerge, and themes became repetitive. When this happens, the sample is said to be adequate, and the data is rich and thick (Pilot and Beck, 2014).

According to Lincoln and Guba (1985), transferability extends the degree to which the results can be generalised or transferred to other contexts.

The researcher is convinced that in other contexts or situations, this dissertation will be transferable. This dissertation is applicable to others contexts, provided that they are similar in the population and the topic. Using similar or the same interview schedule should result in similar, if not the same, responses simply because there have been no changes implemented in any of the variables. It is also noted that the exact same results may not be achieved or replicated because the interviewees' identities will remain anonymous and confidential. Thus, the researcher proposes that it is unrealistic for two different interviewees in future to replicate these responses.

3.4.3 Dependability

Dependability is a criterion listed by Lincoln and Guba (1985) to show the trustworthiness of a study. This entails an audit. The auditor, who is generally a subject

matter expert, follows the processes and procedures used by the researcher and confirms whether they are acceptable, meaning dependable.

According to Lincoln and Guba (1985), dependability is to ensure that the findings of a qualitative study are repeatable if conducted with the same participants and in the same context.

The researcher is satisfied that the dissertation is dependable because if it is repeated or an inquiry audit should be performed by an outside person, the results will be the same, if not similar. The researcher is adamant because the industrial engineer, who is an outside person, reviewed the documents beforehand. Additionally, the documents were re-evaluated by the supervisor assigned to the researcher from the tertiary educational institution.

3.4.4 Confirmability

Confirmability guarantees that the findings, conclusions and recommendations are supported by the data and that there is fluidity between the researcher's interpretation and the actual evidence. This is accomplished by the audit procedure.

According to Lincoln and Guba (1985), confirmability is to extend the confidence that the results will be confirmed or corroborated by any other person.

The researcher is optimistic that the dissertation is off a neutral standing and that it is also impersonal and non-biased. The researcher supports the statement due to the fact that the researcher is honest, has integrity and values. Subsequent to this, the researcher has signed a non-disclosure document. The interviewees have also signed a non-disclosure document. This also verifies that there is no personal or monetary gain by any parties (Lincoln and Guba, 1985).

3.5 Anonymity and Confidentiality

The identities of respondents were not revealed. A non-disclosure agreement and confidentiality agreement were entered into between the researcher and the

interviewees. A letter of consent was also signed. Adherence to the DUT confidentiality clause was followed.

3.6 Ethical Considerations

Attached is the ethics documentation (see Annexure A, page 156) which was completed before each interview. The researcher conducted the interview in accordance with the DUT's ethical code of conduct. The interviewees were not discriminated against or exploited to obtain information. The researcher respected the interviewee's right to stop the interview at any point. The researcher informed interviewees that the interview was totally voluntarily, and no money will be exchanged. There was no coercion for the interviewees to participate. Privacy, anonymity and confidentiality was practised by the researcher during the entire research.

3.7 Chapter Summary

The purpose of this study was to answer the research question pertaining to the reasons for cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. A qualitative research methodology was adopted using an interview schedule to obtain data. This research methodology has been designed to follow a qualitative analysis. The qualitative methodology was used to get an in-depth understanding of why Wentworth Diesel Depot had a high number of cancellations and delays. The interview schedule was given to Transnet Engineering and Transnet Freight Rail employees that are directly involved with train planning, scheduling, maintenance and decision-making for the trains. The study focused on diesel locomotives in Wentworth only and not electrical locomotives country wide. Strenuous efforts by the researcher have been made to ensure that the interview schedule has relevance to the topic. Two questions in the interview schedule that focused on the main enquiry were questions five and six. Twenty-five Transnet employees participated in the semi-structured interviews. The pilot study was approved by five professional employees being the industrial engineer– Transnet Engineering, an

operations manager – Transnet Engineering, a technical supervisor – Transnet Engineering, an operations manager – Transnet Freight Rail, and a section manager – Transnet Freight Rail. Two of the interviews had to be voided due to one of the participants feeling that they may incriminate themselves with the company Transnet. Also, one of the interviewees questionnaires was discarded due to vandalism. Twenty interviews then led to the thematic framework analysis and led to the patterns and relevant themes being extracted. Chapter Four will present these findings.

CHAPTER 4:

PRESENTATION OF DATA AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter shows the data that was gathered and the way in which the data was studied, i.e., the process, research questions and conceptual framework. It shows how data was organized and gathered and arranged in a logical manner.

The purpose of this study is to investigate the train cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. The objective is to find the reasons for train cancellations and delays. The interview schedule was used to obtain information about the train cancellations and delays. A thematic framework to analyze the data and themes was obtained.

This information was used to verify the data gathered, which was then correlated with the literature review findings to assist in resolving the problem of the study and answer the research questions. Consequently, the procedure or the design is described to create a common-sense flow of the necessary features of this chapter in order to have satisfactory findings and results.

It is for this reason that the researcher starts with the outline of the design in this chapter. The researcher compiled the findings based on the actual raw data gathered, a breakdown of results and a discussion of conclusions. Evidently, in the process of data collection, it has been emphasized from the previous chapter that the in-depth face-to-face interviews were piloted with the applicable Subject Matter Expert (SME), Industrial Engineer – Transnet Engineering, an operations manager – Transnet Engineering, a technical supervisor – Transnet Engineering, an operations manager – Transnet Freight Rail, and a section manager – Transnet Freight Rail. Moreover, the actual data was structured in an organized method for data analysis, through which the data analysis- during all the stages implemented for framework analysis- ensured the familiarization of data, identification of a thematic framework, indexing, charting and interpretation of data was studied and analyzed.

Lastly, the results unveiled during data analysis through the application of the framework analysis and the application of the desirable or suggested stages are

discussed for further explanation and transparency. Therefore, in the following segment, there is a demonstration of data that is a prerequisite for this study and also an explanation on how the data was gathered. It is pertinent and imperative to have the arrangement of data required and also to explain the method by which the data was gathered in order to guarantee the validity and reliability of the outcomes and findings. The presentation of data will be explained in the following section.

Hence the structure of Chapter Four is as follows:

- Presentation of data.
- Analysis of data: familiarization, thematic framework, indexing and charting of data.
- Ishikawa Fishbone diagram of train delays and cancellations at Wentworth Diesel Depot.
- Pareto Analysis of train delays and cancellations at Wentworth Diesel Depot.
- The Interpretation of the findings and
- The Findings

4.2 Presentation of data

This segment culminates in the significant data gathered from the interviewees of the study. As stated in the previous chapter on Methodology, it is emphasized that this is a qualitative study which requires qualitative data. Consequently, in-depth face-to-face interviews were conducted to acquire the essential data. The data was acquired via the implementation of judgmental sampling. The target population was employees of Transnet Engineering Locomotive Diesel Depot, Wentworth Durban and Transnet Freight Rail Operations Diesel Depot, Wentworth. Sampling was centered on the professional employees in relation to the studied occurrence, which is the reasons for delays and cancellations in Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. To be more detailed, the data was gathered amongst the direct and indirect employees at TE, Wentworth Locomotive Maintenance in Durban, KwaZulu-Natal, South Africa.

The personnel that participated in data collection included the Engineering Technicians (ET), the Resource Manager (RM), Customer Services Manager (CSM),

Section Manager(SM) Master Diesel Electrical Fitters (MDEF), Technical Training Coordinator (TTC), Senior Technical Supervisor, Chief Shed men, Shed men, Production and Material Planner, Contractor-China Railway Rolling stock Corporation (CRRC) and Acting Quality Assurers (QA).

Essentially, the responsibilities of the different jobs and job descriptions are as follows: the main function of engineering technicians is to design, modify, data analysis, failure analysis, trends reporting and updating the specifications of products or services. The role of the senior technical supervisor is to plan, organize, lead and control the subordinates, ensuring scheduled and unscheduled maintenance on locomotives. The role of section managers is to plan, organize, lead and control train drivers and train assistants. The role of the chief shed men and shed men is to shunt locomotives and wagons to build trains. The production and material planners' role is to ensure the dispatch of materials and consumable items. The role of the resource manager is to manage the section managers, chief shed men, shed men and ensure On-Time Arrivals (OTA) and On-Time Departures (OTD). The role of the customer service manager is to liaise with the client and resource manager to ensure that the Integrated Train Plan is executed timeously. The role of the Technical Training Coordinator (TTC) is to co-ordinate and facilitate the training needs of all the employees. The role of the contractor is to assist with the repairs of the new locomotives whilst under warranty. Master Diesel electrical fitters, according to the researcher, are responsible for sustaining the locomotives and fault findings. Quality assurers are accountable for warranting that the quality management practices are efficiently employed, with continuous compliance with audit pre-requisites.

Henceforth, the data gathered is the primary data, which is viewed to be valid and reliable as the interviewees are endorsed to be professionals who comprehend the studied phenomenon the best. From this time, the sample targeted was estimated at thirty-seven percent of the total population (twenty out of fifty-three employees). Afterwards, the data gathered had to be evaluated and the analysis process is emphasized in the following section.

4.3 Analysis of results (framework analysis)

This section emphasizes the analysis of data via the use of the framework analysis to complete this qualitative study**.** Supported by Lacey (2009), it was emphasized that framework analysis was developed for applied research in ascertaining information and providing results at a probable shortest timeframe. Furthermore, readers are able to comprehend the results that are generated from the data collected due to the fact that the steps followed through the entire process were evidently shown. Lacey (2009) further implies that when framework analysis is correctly used in a qualitative study, it is much simpler for readers to comprehend the content of the study with the author not being present (Lacey and Luff, 2009).

Insistently, Smith and Firth (2011) hypothesized the analytical method is used when creating themes from the gathered data and which is a common trait of the qualitative method. It is the belief of the researcher that the qualitative data gathered through the approved method is used to produce the themes that were used during the analysis of the data. Likewise, Smith and Firth (2011) added that it is always difficult for learners in research to create a capable system that transfers from data management to data analysis, which will sufficiently answer the research questions. This means that for the conversion of data gathered to be examined, it is always difficult for learners in research. Consequently, framework analysis is much simpler to be accepted and used as an analysis method. In keeping with this assertion, Smith and Firth (2011) additionally stated that the framework approach has regular stages that are evidently defined and similarly directs the systematic analysis from mature transcripts to an illustrative interpretation (Smith and Firth, 2011).

In support, Lacey and Luff (2009) stated that there are logical steps executed during the data analysis, which include the following; familiarisation, identifying a thematic framework, indexing, charting and mapping and interpretation. In the same way, O'Connor and Gibson (2014) draw attention to the following parts of the framework analysis: organizing data, discovering and conceptualizing ideas, developing themes from data, ensuring the reliability and validity of data analysis and findings, and concluding probable and realistic explanation of the findings. Furthermore, the

researcher additionally brings attention to the design process for framework analysis as depicted in Figure 4.1 which it includes all the stages of analysis (O'Connor and Gibson, 2014).

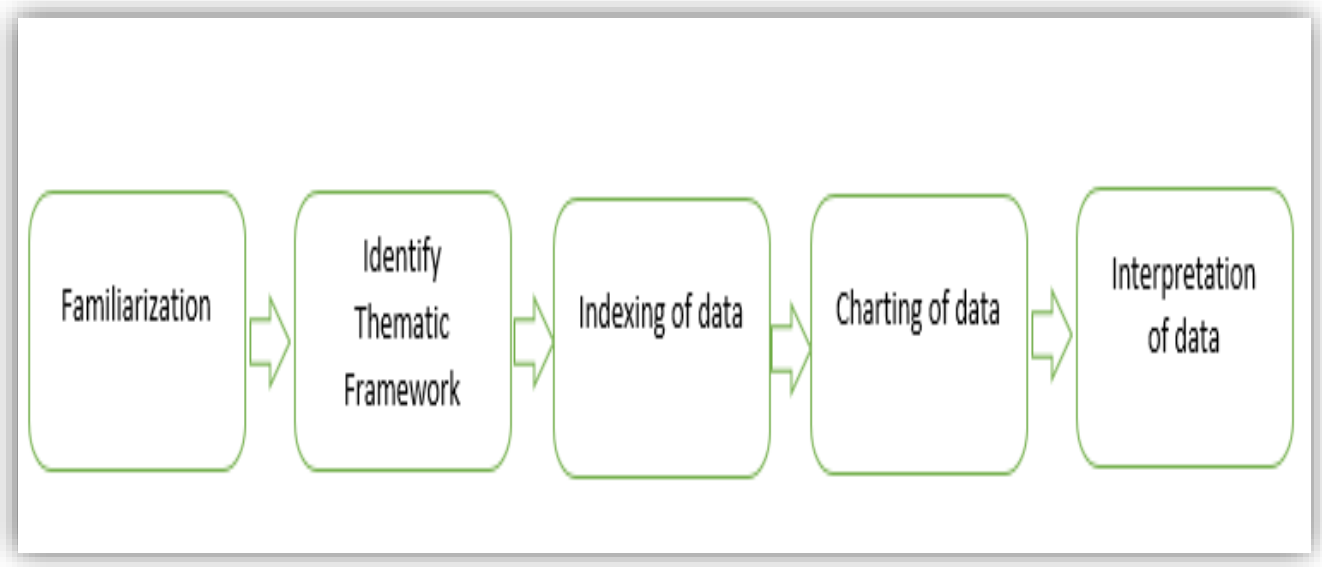

Figure 4.1: Data analysis design process (O'Connor and Gibson 2014)

Accordingly, in the following segment, the familiarization process is elaborated on. The initial step of framework analysis is familiarization, continuing the design process of the framework analysis. Familiarization is followed by identifying a thematic framework, followed by the indexing of data, charting of data and lastly interpretation. There is uniformity in each of the stages discussed in order to articulate a rational understanding of the process the researcher used to move from gathering data and data management to concluding findings via the interpretation of data.

4.3.1 Familiarization of data

Srivastava and Thomson (2009) claim that familiarization is a procedure whereby the researcher is immersed in the gathered data through listening to the audiotapes meticulously, reviewing the transcripts. Moreover, this procedure allowed the researcher to ascertain the fundamental ideas and repeated themes that were recorded. From the researcher's standpoint, familiarization is the initial stage of framework analysis that the researcher is required to ardently comprehend in order to

create ideas and themes that are repeated from all the interviewees during the gathering of data (see table 4.1, page 92).

Moreover, Srivastava and Thomson (2009) postulate that qualitative research creates a large volume of gathered data and the outcome may lead to facing difficulties during data analysis owing to a botch in reviewing the entire data material. Henceforth, it is suggested that one chooses comparative data that will be defined for data analysis through the best method and preference should be done according to the preferred process conditional to the aspects of data (Srivastava and Thomson, 2009).

By the same token, O'Connor and Gibson (2014) supported that the data gathered through the meeting, which was a qualitative method, can give solutions to various questions and that it is yet essential to liaise with the study questions to avoid wasting extended resources trying to examine the data (O'Connor and Gibson, 2014).

Supporting this claim, O'Connor and Gibson (2014) propose that the acclaimed way to data consolidation is to try recognizing and distinguishing questions that are necessary to be answered and that were stated in the interview guide. Essentially, once the first questions were replied to, it was vital to also evaluate the ideas and themes that appeared from the data gathered and to take cognisance of the first cause as to why the interview was led at the first instance. To summarise, the data that is gathered ought to be able to speak to the research questions and the themes developing from the data should be affiliated to the answers provided during data gathering (O'Connor and Gibson, 2014).

Prominently, NSUN (2016) of the National Survivor User Network enhances that familiarisation with the gathered data in order to critique the relevant themes and concepts comprises the following: recognising the recurring themes, thoughts, visions and inspirations; sketching the index structure around the interview questions; producing relations between themes; and grouping into categories and sub-categories, numbering the code of index. The next step of the familiarisation process will be discussed in the following section. Data gathered was formulated in the following table to accentuate the replies from each interviewee as per the question.

Where the columns signify the interviewees that participated during data collection, the rows accentuate the questions and reply from each interviewee (NSUN, 2016).

Table 4.1: Familiarization process

Interview questions	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Participant 8	Participant 9	Participant 10
1. Grade /Job Tittle	Shed man	Production and material planner.	Production Planner	Senior technical supervisor	Master Diesel Electric fitter	chief shed man	Engineering technician	Master artisan-DE fitter	Chief shed man	Resource manager
2. How many years of service do you have with the company? What were your previous job description ?	7 years, Shed assistant.	20 years.	29 years. No previous job	27 years, 9 months- No previous job.	9 years, student	18	11 years, Technician in training	8 years	15 years	8 years
3. Briefly explain your duties?	Refuelling locomotives and placing on service road. Preparing trains.	Production and material planning.	Loco maintenance and material planning.	Supervise and manage employees in the maintenance of diesel locomotives and its components.	Maintain diesel locomotives	To arrange and organise train sets.	Fleet owner and maintenance scheduler.	Daily examination of locomotives, fault finding on faulty locomotives and attending call outs reported by NCC	To plan and build train plans.	Ensure that there is enough resources e.g. staff, locomotives, goods and plan accordingly.

4. What qualifications do you have? What courses did you complete?	National Diploma: Administrative management (UNISA)	Qualified Electrical Fitter .BPIM. PPIM	Grade 12. SAP R3. Sprint. Monarch's	Diesel electrical trade test certificate. Management. Business management. Supervisory Development programme.	N6 Electrical Engineering Certificate. Diesel electric trade test certificate. Currently studying 2nd year in business administration.	Certificate in logistics	Electrical Engineering- B Tech	All relevant brake courses, high voltage courses, SDP course and 45 on job training.	Certificate in train planning.	Train working rules. Currently studying for diploma in operations.
5. From your understandings, what are you 5 main reasons for cancellations?	Late release from back shops of locomotives. Faulty locomotives. Delay in preparation of trains. Unavailability of locomotives.	Faulty locos		Incorrect maintenance – poor maintenance. Tri-age process not followed. Preparation concept of train consist not followed.	Faults (Unrepairable Quickly). Time delays. No Job for that particular loco. Imbalance of locomotives. Number of locomotives. Loads not ready in the yard.	Old locomotives fails. Short supply of locomotives. No loads available.	Unavailability of locomotives. Unavailability of loads. Locomotives failure. Unavailability of crew. Derailment.	LWPTs, Locos not pairing; same not pairing (bright star and normal), Locos train overloading. Oil and water leaks. Radio not working. Telemeter not synchronizing.	Breakdown derailments, drivers book off sick, failures in locomotives, Loads not available.	Shortage of spares for locomotives-some spares comes from overseas. Vandalism and theft and locomotives and the line. Some drivers are not qualified to drive

										different class of locomotives. Accidents and derailments.
6. In your opinion what are your solutions to the above?	Ensuring trains are made available on time. Signing off for the cleared trains' time.		Better Planning	Maintenance schedule and process to be followed. Staff to be trained and the correct personnel for the task. The tri-age incoming inspection to be carried out. The preparation team to be formed and process followed.	Loco must be prepared in time, in order to see early if it has a fault so that fault cannot be fixed, they can organise/prepare another one. We need to have enough locomotives and also preparation of loads of time.	Get new locomotives. Plan ITP for loads. Locomotive infrastructure to be improved.	Quick release of locomotives that are scheduled for maintenance and locomotives that failed in section.	Communication between TE and TFR during building of consist. Vandalism to be stopped on radios. More training and better preparation.	We need rail upgrades to prevent derailments, we need drivers to replace other drivers-standby. Proper maintenance of locomotives. Ensure availability of loads on time.	Order spares on time. Security need to be stepped up. Ensure that all drivers have qualifications to drive. Ensure continuous awareness of rules-TWR.

7. What similarities did you notice in train cancellations?	There are hardly similarities because each locomotive has a different set of problems.		Depending on loco availability		Time delay and faults and prepare loads in time.	Time delay and faults and prepare loads in time.	No load and locomotive failures.	None	Loads, time delays and faults.	Failures. No planning.
8. What is the process of cancelling a train?	I am not sure of this.		TFR planners		Communicate with stakeholders, tell them loco won't be able to run and ask for reference number and fill the relevant documents.	Train is scheduled/ train depart. Driver calls NCC and NCC activates the fitter. Fitter attends the call and if he fails to fix the locomotive, NCC will informs the section manager and train gets cancelled.	Train scheduled, train depart and fails in section. Driver calls NCC and NCC activates the TE fitter and fitter attends the call and if fails to fix the locomotive in section then the train is	Examination of locos. Identification. Fill and communicate stop form with TFR. Complete handover book and post on WhatsApp.	NCC activates the fitter and he checks the train. Stop it if it cannot be repaired and NCC informs the Section manager and the planner that the train had been cancelled.	Inform NCC of faults, they activate the fitter. And the fitter checks the loco and if it cannot be repaired, it is stopped and the NCC informs the planner and the section manager that the

							cancelled .			train is cancelled .
9. What is the average number of train cancellations per month and the actual number of trains planned?	I don't know.					6 cancellations and 500 Planned for a month.	5 cancellations and 320 planned for a month.	None	4 Trains, 180 trains	More or less than 8 trains and 6 trains a day.
10. Is there anything else you would like to comment on about train cancellation in Wentworth Diesel Depot?	The scraps that are all every the yard need to be taken away, since they delay the shunting.		None		TFR must prepare the locomotives in time and check everything is fine also fitters must make sure that they do their work 100% correctly before releasing the locomotive.	No comment	No comment	None	None	None

	Participant 11	**Participant 12**	**Participant 13**	**Participant 14**	**Participant 15**	**Participant 16**	**Participant 17**	**Participant 18**	**Participant 19**	**Participant 20**
1. Grade /Job Tittle	Customer service manager-TFR.	section manager	Section manager	Engineering Technician	Engineering Technician	Acting QA	Contractor CRRC.	TTC	Master Diesel electric fitter	Master diesel electrical fitter
2. How many years of service do you have with the company? What were your previous job description?	18	13 years	15 Years	5 years	11 years technician in training	10 years	One and half years. Engineer.	18 years	16 years assemble GE and GM turbocharger.	43 years, 1 month.
3. Briefly explain your duties?	Ensure liaison between TE and TFR with reference to locomotives available against	Ensure that trains runs as per ITP. Manage the drivers and assistants.	Manager of train drivers and assistants. Ensure that trains runs as per ITP.	Monitor availability and reliability. Ensure assets are maintained according to	Maintenance engineering principles.	Do quality checks for locomotives. Opening and closing of NCRs. Opening and	Monitor and repair D45 class.	Coordinate	Doing dailies of locomotives, fault finding, minor mechanical repairs. Attend call outs and	Daily inspection of GE locomotives. Fault finding and call out on locomotives on route.

	locos needed.			SLA. Do quality spot check and component change out verification.		closing of findings.			breakdowns.	
4. What qualifications do you have? What courses did you complete?	National diploma-customer services	Completed diploma in transport management	National diploma: Transport management.	B Tech: Electrical Engineering	B Tech Mechanical Engineering. B Tech: project management.	Diesel electric fitter. S4 Electrical engineering.	Accountant and English Diploma.	Diploma logistics and supply chain management.	Electrical engineering Heavy current (Diploma). NQF level 4 and supervisory development program, ISO 9001.	All relevant brake courses. High voltage. White belt. On job diesel training 45Ds.
5. From your understandings, what are you 5 main	Locos not supplied when needed. Locos fail in	Customer cancels loads. Vandalism or theft of signals, lines or overheads.	Locomotives fail when on a train. Train drivers or assistant books off sick	Locomotives not enough in terms of availabili	Locomotive availability. Locomoti	Loco failures. Train crew not available. Load not	Locos defective and drivers don't take	Driver off sick. Locomotive failures. Cancelation of trains	Doing dailies of locomotives, fault finding, minor	LWPT because of locos not pairing. Loco train

reasons for cancellations?	section. Possibility locomotives old and they fail. No load. Book off-sick or leave.	Derailments and accidents. Train drivers and assistants booked off sick. Locomotives fails when on trains.	and leave at last minute. Customer cancels loads. Vandalism or theft of signal, lines and overheads. Derailments and accidents.	ty. Component failures. Load not available.	ve failure. Load availability. Driver availability. Telemeter availability.	available. Cable theft. Driver sick.	locos. Lack of spares. Derailments unplanned repairs.	from origin due to no load. Occupations between trains. Good communication.	mechanical repairs. Attend call outs and breakdowns.	overloading. Water and oil because of parts that fail. Radio and telemeter that fails.
6. In your opinion what are your solutions to the above?	Locomotive infrastructure to be improved. Get new locomotives. Planning for unforeseen circumstances e.g. have spare drivers and assistant available on all shifts. Plan ITP for loads.	Penalty for late cancellations by customer. Security to patrol and monitor lines. Proper maintenance or new locomotives. Standby staff should be available.	Proper or better maintenance or new locomotives. Have spare staff available. Penalty for late cancellations by customer. Security to monitor or patrol lines.	Having available locomotives for planned trains. Locomotives maintained on schedule.	Plus or minus 10 trains cancelled per month and plus or minus 300 trains planned per month.	New locomotives. Employee management / HR involvement. Increase security personnel. Replacement/ standby. Ensuring availability of load in time.	Loco defective do proper maintenance. TFR makes sure that drivers takes locos orders spares on time. Drivers must be focus.	Driver awareness of abuse of sick. Proper maintenance of locomotives. Proper planning of ITP. Good communication.	Driver book sick leave. Failures of locomotives. Breakdowns and derailments. Yard log out. Cancel from origin and no load.	Better communication between TE and TFR during preparation. More training. Radio program are implemented.

7. What similarities did you notice in train cancellations?	Locomotives failures cause most cancellations. No load from customer also contribute.	Happens near payday.	Usually near paid public events. Happens near payday or month end.	If train is delayed for more than 30 minutes it's considered a cancellation.	All mentioned in question 5.	I do not see any similarities.	Most of the train fail because of the shortage of spares.	Proper planning of ITP.	Driver are involved in all cancellation. Planner as well. Involves rail upgrade to prevent breakdown.	Many cancellations happens when there are shortage of locos. Most could have been avoided.
8. What is the process of cancelling a train?	Inform NCC of fault, activate fitter, checks the loco, if loco cannot be repaired it is stopped. NCC inform planner, section manager, and cancels the train.	The driver calls the planner/TCO/ section manager who reports to NCC then activates the fitter, if the fitter can't fix the loco. Then the fitter informs in reverse order, then cancel trains.	The driver calls the planner/TCO/ section manager who reports to NCC then activates the fitter, if the fitter can't fix the loco. Then the fitter informs in reverse order, then cancel trains.	If train is delayed is delayed for more than 30 minutes it's considered a cancellation, where NCC is notified.	Driver-CTC-TCO	Resource manager cancels trains.	Driver report to manager -NCC - artisan- fault finding- fix or stop- section manager - cancelling the train. Check everything properly.	Driver report to TTC, TFR informs NOC. NOC informs artisans/TE.	Induction / educate drivers about the importance of their jobs. Planner should always step on his job.	Investigate the fault. Find the fault. Fill the stop form and communicate it to the chief shed man.

9. What is the average number of train cancellations per month and the actual number of trains planned?		4 trains a month against 200 trains.	4 trains a month against 200 trains.	3 and planned is 18 trains a day.	Plus or minus 10 trains cancelled per month and plus or minus 300 trains planned per month.	12 month	2 per month, 2 per day.	4 cancellations.	One per day allowed, to cancel 30% not more than that. Difficult to say because ITP of everyday not the same.	None.
10. Is there anything else you would like to comment on about train cancellation in WDD	No comment.	No comment.	Communication and constant awareness can improve.	None.	None	Availability of material /spares to fix locos.	Spares orders need to be done in time.	No	None.	None.

4.3.2 Thematic framework

NSUN (2016) supports that the thematic framework is the next stage of framework analysis and in this stage, data was structured methodically to permit the directive of identifying significant themes, concepts and categories or sub-categories. Moreover, it is suggested by NSUN (2016) for each theme to be recorded independently within its own matrix, while interviewees are highlighted in rows and columns that are indicating the thematic sub-topics. This means that this is a stage in which the diverse themes, concepts and categories acknowledged from the familiarisation process are used to cultivate a thematic framework. Additionally, the thematic framework represented each theme separately, including the rows as the interviewees and also the columns as the sub-topics.

Moreover, it was recommended for the researcher to be unbiased and impartial during this stage, as there might be a priori issues which do not need data to be forced in fitting these issues. This means that data should guide the researcher on defining and identifying the themes and a priori issues during the familiarization process and thematic framework, as the results may be void. Even so, the a priori issues are probable to influence the thematic framework since the research was intended around these a priori issues (Srivastava and Thomson, 2009). Supporting this, the research questions and the goals of the study support the a priori issues, which are also engaged to develop the thematic framework.

The preparation and organisation of the thematic framework is not an automated or motorised operation, but practicality and intuitions are required. Likewise, making decisions on the definitions applicable and consequences of issues to be remembered and the underlying interdependence between ideas is important (Srivastava and Thomson, 2009). Furthermore, O'Connor and Gibson (2014) stated that the researcher should choose using words and statements that were used frequently by the participants, which may be different from how others communicate. Correspondingly, the researcher took into cognisance the concepts or particular words that were recognised with the different interviewees for every specific question. For that reason, the thematic framework for this study is emphasized in the next segment, with several themes and groups that were obtained from the data gathered.

Table 4.2: The Thematic framework

1. Current Occurrences	2. Interventions	3. Expectations/ Outcomes
1.1 Faulty locomotives.	2.1 Proper planning	3.1 Reduced/minimized train cancellations.
1.2 Unavailability of locomotives.	2.2 Improve maintenance processes.	
1.3 Delayed or no loads available.	2.3 Loads to be prepared on time.	
1.4 Defective radios and telemeters	2.4 Improve availability of locomotives	
1.5 Breakdowns and derailments of locomotives.	2.5 Procure new locomotives	
1.6 Vandalism or theft of railway, cables and overheads.	2.6 Awareness on the abuse of unplanned leave.	
1.7 Recurrence of train crew's unplanned leave.	2.7 Security to monitor and patrol stations.	
	2.8 Improve communication between TE and TFR	

As indicated in the above thematic framework, it was emphasized that from the familiarization process, there are three main themes that have emerged and which contain sub-categories. The **main three themes** comprise current occurrences (findings), interventions (recommendations) and expectations or outcomes. In the *first theme, current occurrences* include seven sub-categories, namely faulty locomotives, unavailability of locomotives, delayed or no loads available, defective radios and telemeters, breakdowns and derailments of locomotives, vandalism or theft of railway, cables and overheads and recurrence of train crew's unplanned leave. *Secondly, interventions* include proper planning, improve maintenance processes, loads to be prepared on time, improve availability of locomotives, procure new locomotives, awareness on the abuse of unplanned leave, security to monitor and patrol stations and improve communication between Transnet Engineering and Transnet Freight Rail. *Lastly, expectations and outcomes* are minimized train delays and cancellations. For that reason, the previous stage of the thematic framework was the indexing, which is defined in the following segment.

4.3.3 Indexing of data

In line with the researcher, the indexing of data includes grouping the recognized related themes with the consistent groups whilst also emphasizing the association amongst these fundamentals (see Table 4.3, page 105). The themes unveiled in Table 4.3 is supported by participants one to twenty.

In aid of this claim, NSUN (2016) highlights that in the indexing process, initially the theme or idea stated in each section of the data must be recognised, followed by editing and proofreading the text, which is suggested to assist the researcher in recognising which part of indexing to relate and finally, other categories may be necessary for filtering after this initial index (NSUN, 2016).

Nevertheless, O'Connor and Gibson (2014) hypothesize that it is suggested for the researcher to pay heed to the manuscripts from the data obtained by the interviews to avoid misconception of the vital or related expressions and ideas.

Hence, the indexing process is emphasized independently with each theme, group and substantial examples. Every table includes the columns and rows, comprising of the columns of the themes, description and important example statements. The themes are extracted from the direct gathered data with the repetitive expression and ideas, while the report emphasizes the significant relationship between the key theme and the groups, whilst the noteworthy example statements offer numerous essential statements from numerous interviewees.

Table 4.3: Indexing of data

Theme	**Description**	
1. Current Occurrences	**What are the reasons of train cancellations?**	
Subcategories	**Description**	**Significant examples statement**
1.1 Faulty locomotives.	How are faulty locomotives a reason for train cancellations?	a) Faulty locomotives, participant 1, participant 11 and participant 14.
1.2 Unavailability of locomotives.	How are the unavailability of locomotives a reason for train cancellations?	a) Unavailability of locomotives participant 1, participant 5, participant 6, participant 7 and participant 14.
1.3 Delayed or no loads available.	How are the delayed or no loads available being a reason for train cancellations?	a) No loads available. Participant 1, participant 5, participant 6, participant 7 and participant 14.
1.4 Defective radios and telemeters	How defective radios and telemeters does influences train cancellations?	a) Radio and telemeter that fails. Participant 8, Participant 15 and Participant 20.
1.5 Breakdowns and derailments of locomotives.	How the breakdowns and derailments of locomotives does influences train cancellations?	a) Breakdown and derailments. Participant 9, Participant 10, Participant 11, participant 12, Participant 17 and Participant 17.
1.6 Vandalism or theft of railway, cables and overheads.	How can vandalism or theft of railway, cables and overheads be reasons of train cancellations?	a) Vandalism or theft of signal, lines and overheads. Participant 10, Participant 11 and Participant 12.
1.7 Reoccurrence of train crew's unplanned leave.	How are the reoccurrence of train crew's unplanned leave influences train cancellations?	a) Unavailability of crew. Participant 7, Participant 9, Participant 11, Participant 12, Participant 13 and Participant 16.
Theme	**Description**	
2. Interventions	**What will be the impact of interventions on the train cancellations?**	
Subcategories	**Description**	**Significant examples statement**
2.1 Proper planning	How will proper planning impact the train cancellations?	a) Better planning. Participant 3, Participant 6, Participant 11 and Participant 18.
2.2 Improve maintenance processes.	How will an improved maintenance processes have an impact in train cancellations?	a) Maintenance schedule and process to be followed. Participant 4, participant 9, participant 13, participant 14, participant 17 and participant 18
2.3 Loads to be prepared on time.	What will be the impact of loads being prepared on time have on train cancellations?	a) Ensure availability of loads on time. Participant 5, participant 9, participant 11, participant 16 and participant 19.
2.4 Improve availability of locomotives	How will an improved availability of locomotives impact train cancellations?	a) Ensuring trains are made available on time. Participant 1, Participant 5 and Participant 14.
2.5 Procure new locomotives	How will procuring new locomotives impact the train cancellations?	a) Get new locomotives. Participant 6, participant 11, participant 12, participant 13 and participant 16.
2.6 Awareness's on the abuse of unplanned leave.	How will the awareness on the abuse of unplanned leave impact the train cancellations?	a) Ensure continuous awareness of rules-TWR. Participant 10, participant 16 and participant 18.
2.7 security to monitor and patrol stations.	How will an increased security to monitor and patrol stations impact train cancellations?	a) Security need to be stepped up. Participant 10, participant 12, participant 13 and participant 16.
2.8 Improve communication between TE and TFR	What does an improved communication between customers have an impact on train cancellations?	a) Better communication between TE and TFR. Participant 8, participant 18 and participant 20.
Theme	**Description**	
3. Expectations and outcomes	**What will be the expectations and outcomes?**	
Subcategories	**Description**	**Significant examples statement**
3.1 Reduced or minimized train cancellations.	How will the trains' cancellations be reduced or minimized?	a) Participant 4, participant 5, participant 6, participant 7, participant 8, participant 9, participant 10, participant 11, participant 12, participant 13, participant 14, participant 15, participant 16, participant 17, participant 18 , participant 19 and participant 20.

4.3.4. Charting of data

This segment highlights the charting of data converted from the data gathered. The indexing of data from the preceding section covered different themes and categories. Coherently, the charts comprise of the interviewees' relative frequency categories and sub-categories relative frequency, and hierarchy relationship model. Agreeing to Dean and Illowsky (2010), an article titled *Sampling and Data: Frequency, Relative frequency, Cumulative Frequency* stated that relative frequency was the result from the percentage of times a response appears. Significantly, to define the frequencies, it is acclaimed that each occurrence is shared by the sum of the interviewees in the sample as long as the relative frequency can be in decimals, percentages or fractions (Dean and Illowsky, 2010).

In line with this, there is a chain of command relationship which illustrates the findings of this study. Supported by Chattopadhyay and Malhotra (1999) in an article titled *Paradox leading to human wastage*, claims are made that the term chain of command also known as hierarchy, is used in interconnection with various types of business institutes. In future, the researcher describes the chain of command as the grouping of different organisations as per the classification level and interconnections amidst individual organisations. Hence, Table 4.2 in this section illustrates the interconnection amongst themes, which are arranged in order of importance and the effect it has on each theme. That is to say, in an interconnection also known as hierarchy, there must be a rational classification for readers to simply understand the entire model. In the subsequent section, the interviewees' relative frequency is deliberated, with the goal of illustrating the quantity of the various skills levels that contributed to each theme and sub-categories.

4.4. Ishikawa Fishbone Diagram for Train Delays and Cancellations

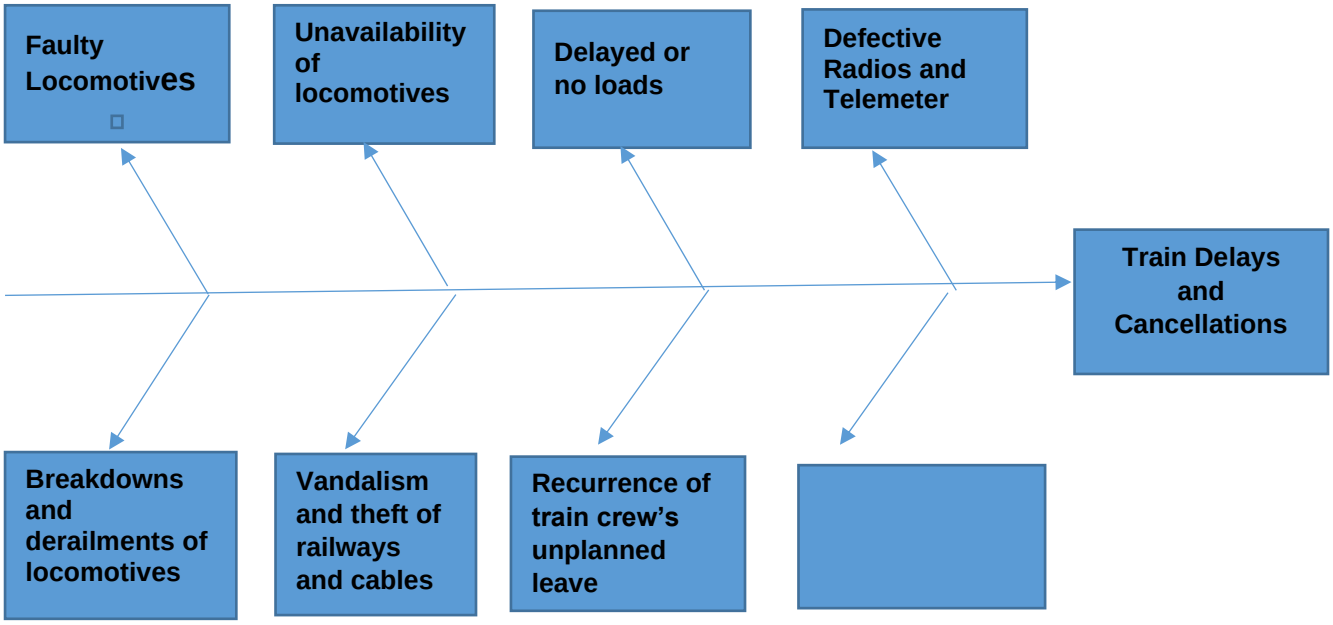

Figure 4.2: Ishikawa Fishbone Diagram for Train Delays and Cancellations

The Fishbone Diagram reveals that the cause for train delays and cancellations are:

- Faulty Locomotives
- Unavailability of locomotives
- Delayed or no loads
- Defective Radios and Telemeters
- Breakdowns and Derailments of Locomotives
- Vandalism and Theft of Railways and Cables
- Recurrence of Train Crew's Unplanned Leave

4.5 Pareto Analysis for Train Delays and Cancellations

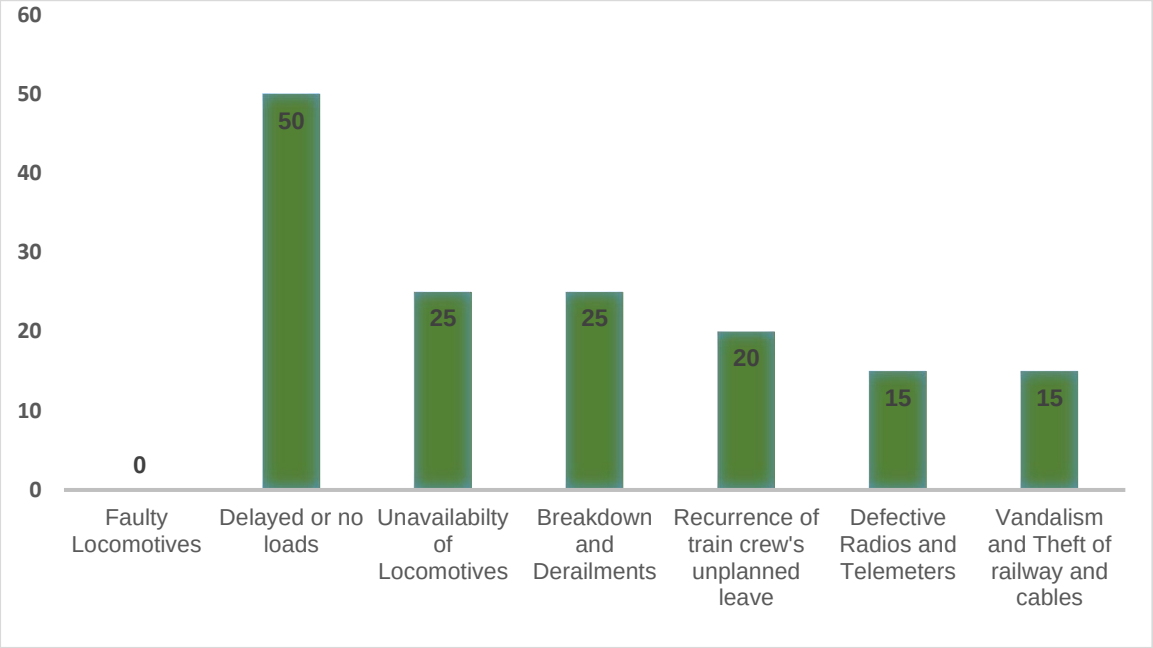

Figure 4.3: Pareto Analysis for Train Delays and Cancellations

The researcher systematically presented the themes developed from the interviewees. The Pareto analysis. The Pareto analysis unveils that the highest theme, faulty locomotives is the main reason for train delays and cancellations. This translates that if faulty locomotives can be reduced, it can result in up to 80% lesser cancellations and delays. Both above classify the root causes of train cancellations and delays as well as ascertain the core root causes.

4.6 Interpretation of findings

In accordance with the researcher, the interpretation of data is the method of assigning meaning to the data gathered. In this segment, the researcher interpreted the findings of this study, beginning with the relative frequency of the interviewees, categories and sub-categories (relative frequency). The researcher indicated that interpretation or explanation assigns meaning to data. Similarly, this means that data or findings on its own may be understood in a different way and perceptions can be skewed or incorrect. Therefore, it is important to understand the findings of the study in order to have related

meanings and to avoid any misapprehension of the findings from different viewpoints. As a result of referring to Figure 3.1, interviewees' relative frequency fundamentally is the graph that shows the number of interviewees who took part in each category and subcategory.

As emphasized earlier, through the deployment of the qualitative data analysis method, the interviewees such as the Engineering Technicians (ET), Quality Assurers (QA), Technical Supervisors (TS), Master Diesel Electrical Fitters (MDEF), Section Managers (SM), Customer Service Manager (CSM), Contract Worker (CT), Technical Training Co-ordinator(TTC). Chief Shed man and Shed men, Resource Manager and Production Planners were categorised into three groups in accordance with their participation, which comprised of specialists, skilled and management. Hence, there were four specialist interviewees: 20% of relative frequency, ten were skilled interviewees: 50% and six were management interviewees: 30% that participated in each theme and category. The aforementioned interviewees showed no difficulty in answering the interview questions. This therefore implies that the questions were direct and to the point. This also meant that they were easier to answer. These straightforward questions assisted in ascertaining comprehensive information that is focused on answering the research questions and which is creditable.

Additionally, the relative frequency of the categories and sub-categories emphasize the themes that were analyzed from the data. Subsequently, the themes that were repetitively used by the interviewees are calculated and used to create the relative frequency. Formerly, the researcher stated that the expectation theme has the maximum frequency, trailed by current occurrences, this becomes very interesting. Therefore, the highlighted challenges to thoroughly discuss the correlations between the discovered challenges as sub-categories will be determined.

According to the researcher, in view of Figure 4.4, there are numerous outcomes that can be attributed. Hence, it is important to emphasize the core outcomes that add value to this study and which also address the research questions. The researcher began with the expectations and outcomes which attribute the maximum relative frequency and most importantly, the expectations and outcomes are one parameter. Denoting the conceptual framework of this study, this parameter was applied and denotes the outcomes and outputs. The expectations and outcomes had the maximum

relative frequency. Nonetheless, the relative frequency of an association with the interventions to be actioned provided that the current occurrences were taken into consideration. It is the opinion of the researcher that this therefore implies a successive relationship between the current occurrences, interventions, expectations and outcomes. In addition to highlighting the relative frequencies between the sequences of: faulty locomotives, unavailability of locomotives, delayed or no loads available, defective radios and telemeters, breakdowns and derailments of locomotives, vandalism of theft of railway cables and overheads and recurrence of train crew unplanned leave. The relative frequencies of these sub-categories are unlike and alone. Henceforth, each of the sub-categories is explained starting with faulty locomotives as it has the highest relative frequency.

4.6.1 Relative Frequency

The researcher reiterates that the relationship model in this study is from the conceptual framework that was discussed. To further explain the relationship between the current occurrences, the interventions and the expected outcomes, Figure 4.4 emphatically confers that in relative frequency, 31% of participants highlighted the current occurrences as: -

i. Faulty locomotives
ii. Unavailability of locomotives
iii. Delayed or no loads available
iv. Defective radios and telemeters
v. Breakdowns and derailments of locomotives
vi. Vandalism or theft of railway cables and overheads
vii. Recurrence of train crew's unplanned leave.

These themes, categories and sub-categories were deduced from the interview questionnaires after the analysis.

The interpretation is that these current occurrences as stated above are what the interviewees emphasized as their understanding of the challenges that result in the train delays and cancellations at Wentworth Locomotive Diesel Depot, KwaZulu-Natal, South Africa. These challenges can be resolved by implementing the interventions

derived from the researcher's analysis. The relative frequency result shows that 23% of the participants highlighted the following interventions to be implemented:

i. Proper planning
ii. Improve maintenance processes
iii. Loads to be prepared on time
iv. Improved availability of locomotives
v. Procure new locomotives
vi. Awareness of abuse of unplanned leave
vii. Security to monitor and patrol stations
viii. Improve communication between Transnet Engineering and Transnet Freight Rail.

The conceptual framework model indicates that following the above steps will result in the following expectations or outcomes: -

- **Reduced or Minimized train cancellations**

This emphasizes the conceptual framework model for this study. To elaborate on the findings in relative frequency, 31% of the interviewees agreed.

This results in 46% of the participants highlighting that if steps 2.1 to 2.8 are used to resolve steps 1, 1 to 1.7 from Figure 3.2, (page 82) the train delays and cancellations will be minimized or reduced. This can therefore be a solution to the case study of minimizing delays and cancellations in Wentworth Locomotive Diesel Depot, KwaZulu-Natal, South Africa.

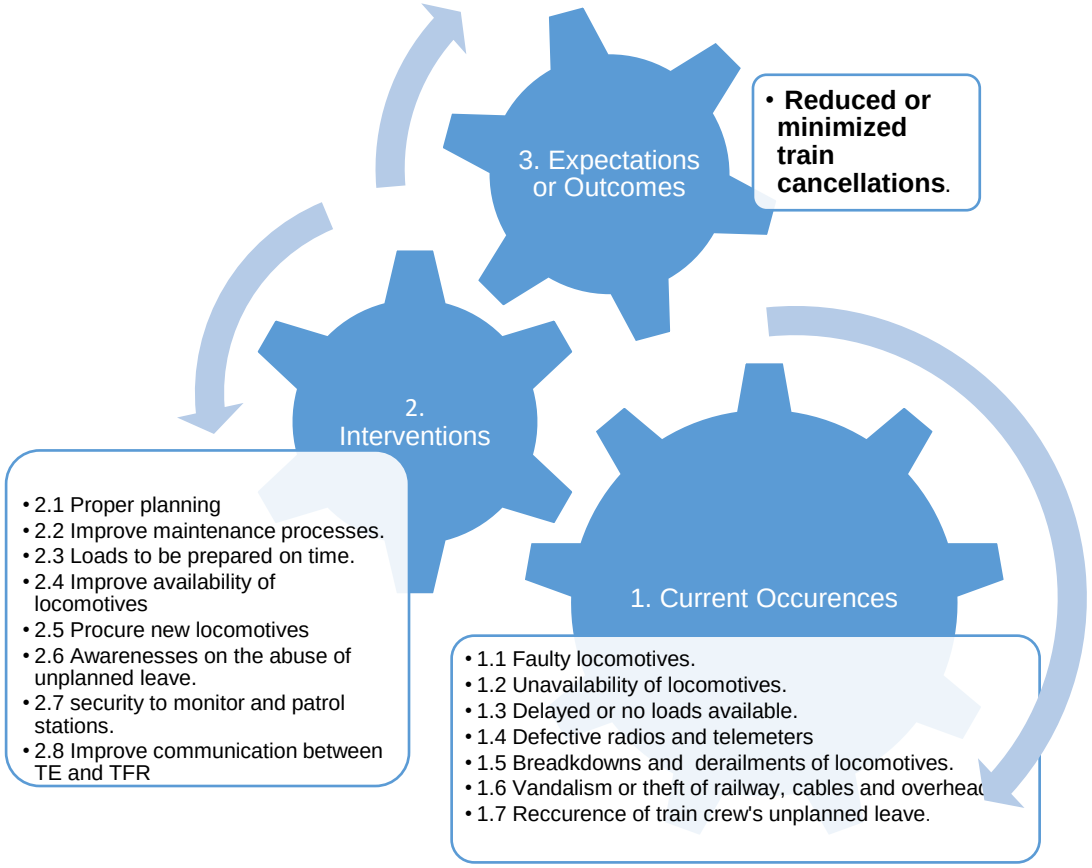

Figure 4.4: Relationship model

4.7 Findings

The researcher has identified the following findings from Table 4.1. The current occurrences are the actual findings. The researcher also made reference to the interview schedule of the participants to support the findings.

4.7.1 Finding 1: **Faulty locomotives**

The first finding the researcher deduced was that sixty-five percent of the interviewees stated that *faulty locomotives* are one of the reasons that trains are delayed and causes cancellations. Sixty-five percent is the largest contributing percentage for the occurrences of train failures and delays. The researcher believes that according to the Pareto analysis, eighty percent of the delays are caused by twenty percent of the problems. With the aforementioned statement being analyzed, the researcher concludes that if the recommendations are followed, train delays and cancellations will reduce by more than eighty percent.

The participants 1,2,4,7,9,11 and 14 contributed to this theme by stating:

> *Faulty locomotives are the cause for delays and cancellations*.

The deduction is that faulty locomotives do result in delays and cancellations. This deduction is supported by participants, 1,2,4,7,9,11 and 14. To support this, in the literature review in Chapter 2, Dungca (2017) stated that in the United States of America, technicians found a higher failure rate than expected in new locomotives. The technicians were not well versed with the new operating systems of the locomotives.

Another article by Gibson (2005) explained that good maintenance reduces asset failure. However, locomotives that were recently maintained did cause accidents in the United Kingdom.

Additionally, Nest (2015) discussed the lack of maintenance resulting in load shedding. This article concurs with the researcher's finding that proper maintenance will yield proper performance of locomotives.

Similarly, Phillips (2019) stated that Eskom had not scheduled maintenance of power plants and this has resulted in load-shedding.

Additionally, Yang (2019) reported that breakdowns and faults resulted in emergency repairs. This caused an interruption before the departure of trains, resulting in train cancellations and delays.

Myeni (2018) iterates that overcrowding of trains is due to the unavailability and unreliability of rolling stock (locomotives and infrastructure). The author also discusses that a more robust transport system will be able to cope with in-service failures and incidences.

The authors Vaidyanthan, Ahuja, Lui and Shughant (2008) extended the constraints to several dimensions.

Furthermore, Conradie and Treunicht (2012) studied in-service failures. The authors highlighted that reliability cannot be ignored because there is a relationship between maintenance, cancellations and delays. One of the findings was a trend that aging trains compound the reason for failure.

Mukwakungu (2019) stated that the aging fleet of rolling stock in Transnet also contributes to the poor quality service.

4.7.2 Finding 2: Unavailability of locomotives

The second finding the researcher deduced was that twenty-five percent of the interviewees stated that the *unavailability of locomotives* is one of the reasons that trains are delayed and causes cancellations. Locomotives are unavailable due to them being withdrawn for maintenance and repairs. However, locomotives are staged in the section due to failure or the crew's shift being over. An alternative cause is that locomotives are used to bring back locomotives that have been staged or failed in the section. Additionally, locomotives and wagons could be staged at a customer's yard due to a cancelled load.

Participants 1 and 7 contributed to this theme stating:

> *Unavailability of locomotives* caused delays and cancellations.

Participant 5 contributed to this theme stating:

> *The number of locomotives available, not sufficient* caused delays and cancellations.

Participant 6 contributed to this theme stating:

> *Short supply of locomotives* caused delays and cancellations.

Participant 14 contributed to this theme stating:

> *Locomotives not enough in terms of availability* caused delays and cancellations.

The conclusion the researcher reached is that twenty-five percent of the interviewees' response is the third highest occurrence which leads to delays and cancellations. This deduction is supported by participants 1, 5, 6, 7 and 14. To support this conclusion, the researcher defined the unavailability of locomotives to mean locomotives not being available for a train due to various reasons. These reasons are faulty locomotives, delayed loads, derailments, vandalism, theft of railways, train crew's unplanned leave, not having a robust rail network and poor efficiencies in procedures, unreliable locomotives, a lack of flexibility in the network infrastructure and demand exceeds the supply. Old, outdated locomotives result in defects and unscheduled maintenance causing the unavailability of locomotives. Customer dissatisfaction is a by-product of the unavailability of locomotives.

Faulty locomotives has been discussed above in Finding 1. Delayed loads will be discussed in Finding 3, derailments will be discussed in Finding 5, vandalism will be discussed in Finding 6 and train crew's unplanned leave will be discussed in finding 7.

To support the abovementioned findings, Dieude (2016) suggested that an organization should keep investing in skills, infrastructure, technology and machinery.

To further support the finding, an article by Patel (2019) stated:

- **Delighted customer**: customer satisfaction is the main goal. It is a simple and cheap option to satisfy customers.
- **Invest in deeper customer relationships**: be personal, create relationships with customers as this will create a competitive edge.

- **Create a killer culture**: customers should buy into the company's culture, which means that if the company treats the workers well, customers will be satisfied knowing that the company has happy workers. A happy worker is a productive worker (Patel, 2019).

In Transnet Wentworth Diesel Depot, regulations were hindering production and service delivery. Union meetings, transporting shift workers and gender equality regulations need to be adhered to, but the lost time hampers production (Transnet SOC Ltd. Transnet, 2018).

Similarly in the United Kingdom (UK), Thomas (2017) blamed cancellations due to staffing issues and strikes over salary increases. Due to strike action and no staff, this resulted in 40 trains being cancelled.

Nagy (2015) stated that most of the delays were registered due to the excessive bad weather conditions, including heavy rain and snow, as well as extremely hot and extremely cold weather conditions.

Barta (2012) stated that the inefficiencies in Sweden were due to unplanned maintenance, strikes and railroad repairs.

Parbo (2016) stated that scheduled adherence is a measure of the robustness of a train system. The performance as well as the efficiency will improve railway systems.

Anderson (2014) focussed on secondary reasons for delays. Anderson quantifies the delays into monetary terms, the *value of time* (VOT).

In agreement, Mogotsi (2018) reported that workers lost salaries due to late arrivals at work due to delays of the train services. Some workers have lost their jobs. Scholars have also missed tests and examinations and were reprimanded for late-coming.

In support, Myeni (2018) stated that the overcrowding of trains is due to the unavailability and unreliability of rolling stock (locomotives and infrastructure). The author also asserts that a more robust transport system will be able to cope with in-service failures and incidences.

4.7.3 Finding 3: Delayed or no loads available

The third finding the researcher deduced was that fifty percent of the interviewees stated that *delayed or no loads available* is one of the reasons that trains are delayed and causes cancellations. This indicates that half of the interviewees stated that delayed or no loads available caused train delays and cancellations.

Participant 1 contributed to this theme stating:

> *Delays in preparation of trains* caused delays and cancellations.

Participant 4 contributed to this theme stating:

> *Preparation concept of train consists testing not being followed* caused in delays and cancellations.

Participant 5 contributed to this theme stating:

> *Loads not ready in the yard caused delays and cancellations.*

Participants 6 and 9 contributed to this theme stating:

> *No load available* caused delays and cancellations.

Participant 7 contributed to this theme stating:

> *Unavailability of loads* caused delays and cancellations.

Participants 9,14 and 16 contributed to this theme stating:

> *Loads not available* caused delays and cancellations.

Participants 12 and 13 contributed to this theme stating:

> Customer *canceling loads* caused delays and cancellations.

Participant 15 contributed to this theme stating:

> *Load availability* caused delays and cancellations.

Participants 18 and 19 contributed to this theme stating:

Cancellation of trains from origin due to no load caused delays and cancellations.

This finding is supported by participants 1, 4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 16, 18 and 19. The researcher explains that delayed or no loads available implies that the loads could be on the customer's side or delayed due to the findings. Faulty locomotives, derailments, vandalism, theft or railways, train crews unplanned leave are all contributing factors on the rail network.

According to Transnet (2015), an Ongoing Time Management Drive (OTMD) for On Time Departures (OTD) was implemented. The efficiencies performance declined by 7.5%, but asset utilization was stable.

4.7.4 Finding 4: Defective radios and telemeters

The fourth finding the researcher deduced was that fifteen percent of the interviewees stated that *defective radios and telemeters* is one of the reasons that trains are delayed and causes cancellations. TFR drivers use a radio on a locomotive to communicate with the controllers. The drivers also couple a telemeter to the end of the load that remotely sends a signal to the radio, informing the driver that the load is coupled and has not parted. This telemeter needs to be charged regularly and needs to be secured to the load by a shunter and train assistant.

Participant 8 contributed to this theme stating:

> *Radio not working and telemeter not synchronizing* causes delays and cancellations.

Participant 15 contributed to this theme stating:

> *Telemeter availability* causes delays and cancellations.

Participant 20 contributed to this theme stating:

> *Radio and telemeters that fails and radio programs not implemented* causes delays and cancellations.

The researcher presents that if a radio or telemeter is defective, it will cause train delays and cancellations. The reason is that it is a piece of operating equipment required for the driver to communicate and monitor the train. This finding is supported by participants 8, 15 and 20. Defective radios and telemeters are a communication

tool used for Transnet train drivers. A radio is used to communicate between the driver and the train control officer to confirm the route that is being travelled. The radio is also used to communicate any changes or emergencies that may arise. The telemeter is a device that communicates to the Centralized Traffic Control (CTC) that the end of the train is coupled to the train. A telemeter is placed at the end of the last vehicle of a train. The researcher notes that this is a unique problem in Transnet.

4.7.5 Finding 5: Breakdowns and derailments of locomotives

The fifth finding the researcher deduced was that twenty-five percent of the interviewees stated that *breakdowns and derailments of locomotives* are one of the reasons that trains are delayed and causes cancellations.

Breakdowns consist of a collision of a locomotive with any other foreign object. A collision that occurs and does not derail a locomotive from the rail tracks requires the breakdown team. The breakdown team examines and does an assessment of the locomotive and effects temporary repairs so that the locomotive can travel to the nearest depot safely. A derailment occurs when a locomotive derail off the tracks due to a collision, rail defect or defective controlling points or incorrect points. A derailment can also occur when two locomotives have a collision, and they are forced off the rails.

Participant 7 contributed to this theme stating:

> *Derailments* causes delays and cancellations.

Participant 9 contributed to this theme stating:

> *Breakdown and derailments* cause delays and cancellations.

Participant 10 contributed to this theme stating:

> A*ccidents and derailment* cause delays and cancellations.

Participant 11 contributed to this theme stating:

> *Possibly locomotives are old, and they fail* causes delays and cancellations.

Participants 12 and 13 contributed to this theme stating:

Derailments and accidents cause delays and cancellations.

Participant 17 contributed to this theme stating:

Derailments and unplanned repairs cause delays and cancellations.

Participant 19 contributed to this theme stating:

Attending callouts and breakdowns causes delays and cancellations.

The researcher presents that breakdowns and derailments of locomotives will result in delays and cancellations of trains. This finding is supported by participants 9, 10, 11, 12, 13, 17 and 19.

The researcher makes reference below to other authors to support this finding. Stafie (2010) stated that the old infrastructure resulted in speed restrictions to reduce derailments. The Romanian railways also needed to have efficient administration and management (Stafie, 2010).

Rirhandzu Mashava (RSR representative) stated that there was an increase in train derailments. Investigations revealed that theft and vandalism of cables and infrastructure, poor maintenance of rolling stock and points were the causes (Liedtke, 2018).

Lisa Torbic, NJ Transit spokesperson stated that the cancellations were due to the installation of a positive train control technology. The engineers were being trained and this is the reason for the cancellations (Hutter, 2018).

Magadagela (2017) highlighted that trains are causing longer dwell times being stationary rather than moving freight.

4.7.6 Finding 6: Vandalism or theft of railway tracks, cables and overheads

The sixth finding the researcher deduced was that fifteen percent of the interviewees stated that *vandalism or theft of railway tracks, cables and overheads* are reasons that trains are delayed and causes cancellations.

Railway tracks, cables and overheads act as a network for trains. The overhead wires act as a positive feed to the locomotive, which collects power via a pantograph, which then passes through the locomotive's traction motors, through the wheels to the railway tracks which act as a negative feed. The cables also provide power and signals to the Centralized Traffic Control (CTC) room.

Participant 10 contributed to this theme stating:

> *Vandalism and theft of locomotives and railway lines causes delays and cancellations.*

Participants 12 and 13 contributed to this theme stating:

> *Vandalism or theft of signal lines or overheads causes delays and cancellations.*

The researcher presents that vandalism or theft of railway tracks, cables and overheads resulted in delays and cancellations of trains due to the fact that the *network* is interrupted. This finding is supported by participants10, 12 and 13. The researcher supports this finding with literature in the discussion below.

Rirhandzu Mashava, stated that there was an increase in train derailments. Investigations revealed that the main causes where theft and vandalism of cables and infrastructure, poor maintenance of rolling stock and points (Hutter, 2018).

Isaacs (2017) emphasised that the travel times for Metrorail commuters were delayed due to vandalism and 2 coaches were lost to vandalism.

4.7.7 Finding 7: Recurrence of train crew's unplanned leave

The seventh finding the researcher deduced was that twenty percent of the interviewees stated that *recurrence of train crew's unplanned leave* is one of the reasons that trains are delayed and causes cancellations.

Leave is planned in an annual leave roster, completed with staff and their supervisors. All efforts should be made for this roster to be adhered too. However, unforeseen circumstances may arise and supervisors should plan accordingly. Unfortunately, no spare staff are available or can be called out if the train crew books off sick or requires

urgent leave a few hours before the shift starts. Supervisors still need to be accommodating and work around this problem.

Participant 7 contributed to this theme stating:

> *Unavailability of crew* causes delays and cancellations.

Participant 9 contributed to this theme stating:

> *Driver's booking off sick* cause's delays and cancellations.

Participant 11 contributed to this theme stating:

> *Crew booking off sick or leave causes delays and cancellations.*

Participant 12 contributed to this theme stating:

> *Drivers and assistants booked off sick* cause's delays and cancellations.

Participant 13 contributed to this theme stating:

> *Train drivers or assistant's book off sick and leave* last minute causes delays and cancellations.

Participant 15 contributed to this theme stating:

> *Driver availability due to sick or leave* causes delays and cancellations.

Participant 16 contributed to this theme stating:

> *Train crew not available* causes delays and cancellations.

Participant 18 contributed to this theme stating:

> *Train driver off sick* cause's delays and cancellations.

The researcher presents that the recurrence of train crew's unplanned leave resulted in delays and cancellations of trains due to no crew being able to drive the locomotive to its destination. Therefore, the train cannot move. Only train crew who are qualified are allowed to drive a locomotive from one point of departure to another point of destination. This finding is supported by participants 7, 9, 11, 12 13, 15 16 and 18.

Unplanned leave affects any organization because staff are the main resource in a business. Transnet has about 56 000 staff. This is a massive number to manage and

sometimes monitoring becomes difficult. The researcher emphasizes that strikes are also considered as unplanned leave.

Bennett (2020) recommends the implementation of *a management software* system that manages resources and eliminates poor resource planning to improve revenue and reduce costs.

Similarly, Thomas (2017) stated that the UK blamed cancellations due to staffing issues and strikes over salary increases.

Albawaba (2016) stated that the reasons for cancellations were due to the high numbers of staff being sick.

Barta (2012) stated that the inefficiencies in Sweden were due to unplanned maintenance, strikes and railroad repairs.

4.8 Chapter Summary

The researcher collected the raw data and the analysis of the data was conducted. The design process, presentation of data and analysis of data included the following steps:

- Familiarization of data, including a table of the familiarization process.
- The thematic framework, including a table of the thematic framework.
- Indexing of data, including a table of indexing.
- Charting of the data, including the interviewees' relative frequency.
- Participative relative frequency.
- Categories and sub-categories.
- Interpretation of the findings.
- Relative frequency.
- Relationship model.

The findings were also discussed, and 7 findings were identified:

- Finding 1: Faulty Locomotives
- Finding 2: Unavailability of locomotives
- Finding 3: Delayed or no loads

- Finding 4: Defective radios and telemeters
- Finding 5: Breakdown and derailment of locomotives
- Finding 6: Vandalism or theft of railway track, cables and overhead
- Finding 7: Recurrence of train crew’s unplanned leave

The researcher has collected the data, analyzed the data, found themes from the data and has presented the data using the thematic framework. The results and findings were verified and captured with the approval of the industrial engineer and the supervisor. The next chapter, Chapter 5, will include a summary, conclusions and recommendations of this study.

CHAPTER 5:
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study conducted by the researcher concludes in this chapter. The purpose of the dissertation was to explore the reasons for cancellations and delays with a view to assisting in reducing the cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban. The purpose is also to provide a framework of standard operating practices. The research questions asked were: What are the reasons for cancellations and delays at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban? and what can be done to assist in reducing the number of cancellations and delays? This study was conducted using a qualitative research methodology.

The structure of Chapter Five is as follows:

- Summary
- The Conclusions.
- The Recommendations.
- Implications for the Future.

5.2 Summary

The process of cancelling a train requires consultation with managers, supervisors, planners, artisans and drivers. This is the process that should be followed in a perfect scenario. However, the researcher has shown through the data obtained from the interviews that, this is not always true. After investigating delays and cancellations, the researcher found that departments within Transnet play the blame game. There also seems to be employee-related issues such as being short-staffed, grievances, vacancies not being filled and discrepancies in the recruitment process. The researcher also noticed that due to the hierarchy of Transnet, this causes delays in communication, both bottom to top and vice versa.

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The researcher also deduced that employees do not follow the proper communication channels. This job and responsibilities are time and information-sensitive, meaning that there is little or no room for error. Information is not always transferred or passed to all staff due to employees working dayshift, nightshift, rest days, leave and being sick. The TE and TRF operation staff work shifts and as aforementioned, are not aware of activities that transpired previously, resulting in miscommunication or a lack thereof. However, there is a handover book where information is recorded and all teams need to familiarize themselves with previous shifts' events. The researcher noticed that it is not always possible due to two reasons:

i. If it is not recorded properly due to time constraints or if information is not completed in detail, due to staff completing jobs late and not having sufficient time to give details; and
ii. Employees who have been off duty due to rest days, sick or leave then miss the events of up to a week. On return, staff do not have the time to read the two weeks' handover that they missed because they had to do their assigned tasks for the day.

Forty-six percent of the interviewees had the expectations that implementing the aforementioned findings and recommendations will result in reduced train delays and cancellations in Wentworth Diesel Depot. The findings, results, conclusions and recommendations for Wentworth Diesel Depot can be summarized as detailed below. It is the opinion of the researcher that the recommendations will also assist in reducing train delays and cancellations:

The researcher also deduced that policies and procedures in Transnet TE and TFR were not always implemented, which resulted in the policies and procedures not always being followed. It creates the impression that the policies and procedures are a mere paper exercise, whereby certain rules and regulations are not strictly adhered to. The researcher recommends that the Human Resources Department regularly issue printed hard copies of policies and procedures and formally discuss any changes. An attendance register should be signed to acknowledge receipt thereof.

Communication in Transnet Engineering and Transnet Freight Rail is partially dysfunctional. The flow of information from managers to staff and vice versa is not

meticulously shared across all platforms. Certain individuals who have access to laptops will receive communication timeously. However, individuals not having a laptop will rely on their superiors to share the communication. This can sometimes lead to breakdowns in communication of vital details that may be required to be put into action immediately. The researcher recommends that Transnet create a cellphone app on the portal, giving access to all employees. This can be done by entering one's employee number and being able to view all current news in Transnet.

Multi-skilling and multi-tasking of employees in TE and TFR was not evident in employees. The researcher also concluded that employees were not willing to share their expertise and knowledge with other employees without remuneration. The researcher recommends that Transnet formalize skills transfer and where possible offer remuneration to employees willing to participate in the program.

The human factor also contributed to employees using common practices over their years working on the job. This could also contribute to complacency, whereby employees are not rewarded or recognized by receiving bonuses or remuneration for what employees will consider *going the extra mile*. To illustrate, employees who do not take leave for the year are not rewarded for full attendance. There is no motivation to improve the morale of the employees. The researcher recommends that Transnet investigates possibly rewarding employees in an awards ceremony, especially those who go above and beyond the call of duty.

In summary of the interviewees' responses, thirty-one percent of the interviewees substantiated that a twenty-three percent application of the interventions will result in reaching the expected outcome of reduced train delays and cancellations by forty-six percent. The researcher firmly believes that if the aforementioned themes and recommendations are put into practice, it will result in a reduction of train delays and cancellations in Transnet Engineering Locomotive Diesel Depot, Wentworth Durban KwaZulu-Natal, South Africa.

The researcher reverts to Chapter Two Figure 2.6 (refer to page 32), which graphically states that the top five reasons for delays and cancellations according to Transnet's database.

In agreement with the data from the Transnet database, the researchers' findings have similarities in the reasons for delays and cancellations.

To support the researcher's findings, conclusions and recommendations are drawn.

The key benefits include:

- Increased Revenue;
- Conflict Resolution;
- Improves Project Delivery;
- Reduced administration costs; and
- Customer Satisfaction.

The opportunities to improve railway efficiency

i. Asset Utilisation;
ii. Personnel Allocation;
iii. Performance Standards for Infrastructure Managers;
iv. Investments in Technology and Automation; and
v. Corporate Governance and Railway Management.

The researcher is confident that if the framework provided by the two previous authors Bennett (2020) and Beck (2013) is implemented, it will improve the optimisation of resources at Transnet Engineering Locomotive Diesel Depot, Wentworth Durban.

5.3 Conclusions

The researcher focuses on drawing conclusions on the findings from the interviews, presented in the section below. From the previous chapter, the conclusions will be discussed, results will be analyzed and possible recommendations from the researcher will be suggested.

5.3.1 Conclusion 1 for Finding 1: Faulty Locomotives

The researcher concluded from Figure 3.2 (refer to page 82) that 65% of the participants stated that *faulty locomotives* caused train delays and cancellations. The conclusion from the researcher is that the quality standard of the maintenance and repairs done by TE should meet the ISO 9001:2015 standard as per the service level

agreement between TE and TFR. Training and development of skilled and unskilled workers doing repairs and maintenance should be re-evaluated. Refresher courses should also be done with TE employees and the organization should arrange scheduled refreshers throughout the year. A skills development program should be initiated for skills improvement and skills transfer, thus improving the overall knowledge of all employees.

5.3.2 Conclusion 2 for Finding 2: Unavailability of Locomotives

The researcher concluded from Figure 3.2 (refer to page 82) that 25% of the participants' responses was that the *unavailability of locomotives* causes train delays and cancellations. The conclusion from the researcher is that the turnaround time for locomotives stopped for maintenance and repairs should be reduced. Staged locomotives should be brought back to the depot as soon as possible. Locomotives at customers' yards that are staged should be scheduled by relief or spare crew to be rostered on the ITP daily. The monitoring of train positioning should be improved and an intense exercise should be done to ensure that trains are available at places of origin timeously.

5.3.3 Conclusion 3 for Finding 3: Delayed or no loads available

The researcher concluded from Figure 3.2 (refer to page 82) that 50% of the participants' responses was that *delayed or no loads available* causes train delays and cancellations. Another conclusion is that late arrivals of staff can have a knock on delay on delayed or no load being available timeously. Additionally, locomotives being released late from TE maintenance, can also result in delays and cancellations.

If customers delay a load or loading a train and do not communicate with the planner, timeously the planner will not be able to remove it from the ITP, thereby resulting in it not being removed from its slot. Other causes include staff that may arrive late at work due to any circumstance, resulting in a knock on delay. Delays can also be caused by equipment not being available timeously due to late arrivals or late release from repairs. The late delay could also be due to the failure of locomotives in the section.

5.3.4 Conclusion 4 for Finding 4: Defective radios and telemeters

The researcher concluded from Figure 3.2 (page 82) that if *a radio or telemeter is defective,* it will cause train delays and cancellations. The reason is that it is an operating equipment required for the driver to communicate and monitor the train.
The conclusion from the researcher was that all radios and telemeters be continuously tested and charged twenty-four/seven, three hundred and sixty-five days per annum. A technician should be available similarly twenty-four/seven, three hundred and sixty five days to attend to any defects or failures.

5.3.5 Conclusion 5 for Finding 5: Breakdowns and derailments of locomotives

The researcher concluded from Figure 3.2 (page 82) that *breakdowns and derailments of locomotives* cause train delays and cancellations.
The researcher concludes that regular awareness and checks be carried out with all staff in TE and TFR, as well as that practical assessments be done physically on the rail tracks and locomotives. The awareness topics should include the financial and asset damage costs. Train drivers should be alert and aware of their surroundings. Train drivers should not exceed the speed limit so that in the event that they need to, they should be able to stop or slow down and mitigate any damages.

5.3.6 Conclusion 6 for Finding 6: Vandalism or Theft of railway, cables and overheads

The researcher concluded that *vandalism or theft of railway tracks, cables and overheads* causes train delays and cancellations. The reason is that the *network* is interrupted.
The researcher concluded that security patrols along the tracks create a more visible awareness. The South African Police Services (SAPS) should also be included in this awareness to minimize vandalism and theft. The turnaround time in repairing or

replacing vandalized or stolen railway tracks, cables and overheads should be prioritized and be done timeously.

5.3.7 Conclusion 7 for Finding 7: Recurrence of Train crew's unplanned leave

The researcher concluded that the *recurrence of train crew's unplanned leave* caused train delays and cancellations. The reason is that if there is no train crew the train cannot move, resulting in a cancellation. Additionally, only qualified train crew are allowed to drive a locomotive from the point of departure to the point of destination.
The researcher concluded that TFR management create awareness on the effects of casual leave on the ITP, which results in a loss of movement of tonnages. Regular leave audit counselling sessions should be held individually to analyze and discuss the casual leave trends that an employee has exhibited. Where necessary, disciplinary and corrective action should be taken in consultation with unions.

5.4 Recommendations

Based on the conclusions drawn, the researcher proposes the following pertinent recommendations:

5.4.1 Recommendation 1: The Need for Proper Planning

The first recommendation is that thirty percent of the interviewees stated that proper planning, if implemented, will reduce train cancellations and delays. Proper planning refers to the pre-planning of the Integrated Train Plan (ITP) seven days prior to the actual date of the ITP, and the execution of the plans till the train reaches its destination. The document titled *Occurrence Management Guideline: Clearing House* stipulates guidelines for proper planning in Transnet (Transnet SOC Ltd. Transnet, 2017).
Proper planning of resources and assets is integral to the execution of the ITP diligently. The researcher recommends that as far as practically possible, all plans should be put into action as religiously as possible. Planning, if not executed

continuously, will result in undesirable results. The recommendation is that all plans be effectively communicated to the relevant parties concerned, constantly.

The researcher recommends that if the ITP, resources, assets and support services are properly planned and executed, it will not result in unplanned train delays and cancellations. Planning is integral to the success of any organization, and Transnet is not immune to this, hence the execution of the plan is of the utmost importance.

5.4.2 Recommendation 2: Improving maintenance processes

The second recommendation was that thirty-five percent of the interviewees stated that improving maintenance processes, if implemented, will reduce train delays and cancellations. Maintenance processes are actioned by Transnet Engineering - maintenance, accredited to the International Organization of Standardization (ISO) 14001:2017. The maintenance agreement between Transnet Freight Rail (TFR) and Transnet Engineering (TE) is that locomotives are scheduled for regular maintenance, similar to that of a motor vehicle. The maintenance schedule is forty-five days as per the Service Level Agreement (SLA) between TFR and TE, but this schedule is not followed timeously due to circumstances that may be out of the control of the employees. Examples of these are if a locomotive is in a different area when the schedule maintenance is due, the locomotive will need to return to the allocated depot and exceed the scheduled date. This mostly results in the failure of components, causing train delays and cancellations. Another example is if there was a delay at a crossing point of the train and the locomotive is delayed at its destination, which may be the allocated service depot. To explain further, if a locomotive arrives a few hours later than the morning, that locomotive will now need to be done on the next day. This interferes with the planned scheduled maintenance as this will have a knock on effect on the next locomotive.

The above event happens on a regular basis. This does not align with the Service Level Agreement (SLA), causing train delays and cancellations. The maintenance processes are of high standards and possible non-adherence to these procedures in TE usually result in train delays and cancellations. To explain further, if there is a test that needs to be performed using a digital instrument and that instrument is gone for calibration, there is no spare instrument. Transnet Engineering then makes an

executive decision using subject matter experts as to whether that component is passed or not.

The researcher recommends that strict adherence to maintenance, procedures and policies according to the SLA and constant monitoring be done. Transnet Engineering is to procure spare instruments and tools that may be needed to perform maintenance, although this may come at a hefty price. The researcher believes that these costs can be absorbed by running trains timeously and avoiding train delays and cancellations due to maintenance procedures not being followed (Transnet SOC Ltd. Transnet, 2017).

5.4.3 Recommendation 3: Loads prepared on time

The third recommendation was that ten percent of the interviewees stated that loads prepared on time, if implemented, will reduce train delays and cancellations. In Transnet, loads need to be prepared twenty-four hours before the scheduled departure time, which is not always possible. Loads require different wagons from different lines to be shunted together in a specific order, which is a tedious task. This activity is performed by TFR staff when in a Transnet property. However, this activity becomes the responsibility of the customer when it is in a customer's yard.
The researcher recommends that Transnet communicates with and is forthcoming with the customers, cautioning customers about the implications of delaying the preparation of loads in their yards. The same should be done with TFR staff, informing them of the implications of delaying the preparation of loads. The researcher also recommends that the customer be charged a penalty should they exceed the loading and coupling times.

The researcher recommends that loads in Transnet yards and customer yards are prepared timeously and coupled to a locomotive so that the train will not be delayed or cancelled. The ITP has a strict scheduling procedure which does not allow for time wasting, especially during the coupling of loads to a locomotive to build a train. This places immense pressure on TFR staff to be meticulous in the preparation of loads.

The recommendation from the researcher is that TFR should make customers, TFR staff and TE staff aware of resultant delays when the customers, TFR staff and TE

staff delay a load. Another reason for delays could be inclement weather which does not allow trains to run. This unfortunately cannot be controlled. It is the recommendation of the researcher that the ITP be followed as meticulously as possible.

5.4.4 Recommendation 4: Improving the availability of locomotives

The fourth recommendation was that thirty-five percent of the interviewees stated that improving the availability of locomotives, if implemented, will reduce train delays and cancellations. The availability of locomotives refers to a locomotive being idle and roadworthy for use by Transnet Freight Rail. Transnet Engineering has a dashboard on their server illustrating this information. This is a live system and TFR uses it to prepare the ITP and plan for special trains, as well as to view where the spare locomotives are standing at and their status of roadworthiness. TE and TFR have a SLA stating that TE will provide a 91% availability at all times, including scheduled and unscheduled maintenance (Transnet, 2017). The researcher observed that this is a sore point as TE and TFR play the blame game with each other. As previously stated the unavailability of locomotives from TFR from the section into designated TE workshops cause TE to be delayed with their maintenance schedules, resulting in poor availability and reaching the 91% availability. TFR will however state that it is out of their hands. This grey-area is a cause for concern.

The researcher recommends that TE and TFR management revise the SLA as the availability of locomotives affects the ITP, which in turn affects the on time departures of trains, thus affecting the overall performance of Transnet as a whole. The researcher recommends that the blame game stops and responsible employees be held accountable. TFR and TE need to improve locomotive movement to the scheduled depots timeously, assisting each department and accommodating each other where possible. The researcher also recommends that senior management revise the SLA and amend the availability clause in order to incorporate the delays and cancellations into relevant employee bonuses.

The researcher has recommended that an improvement in the availability of locos will allow TFR the flexibility to change locomotives should there be fault, or possibly add a spare locomotive on heavier or strategic train loads. The researcher concludes that

an improvement in the availability of locomotives will result in a decrease in train delays and cancellations.

5.4.5 Recommendation 5: Procuring new locomotives

The fifth recommendation was that fifteen percent of the interviewees stated that procuring new locomotives, if implemented, will reduce train delays and cancellations. Procuring new locomotives means purchasing new assets called Rolling Stock, which is a very expensive and, some may say, lavish or extreme luxury in this current economic status of South Africa. The purchasing of the latest Class 45 diesel locomotives cost fifty billion rand per locomotive. This has unfortunately been put on hold after 22 locomotives have been received in South Africa. The reasons and discussions for the halt is at a high government level and will not be elaborated further. The aforementioned also explains why no new locomotives will be procured any time in the near future. The researcher also found that the results of the aforementioned purchase has left the balance sheet of Transnet unable to do any procuring, but rather to use the current assets, which may be older, to achieve a return on investment and acquire more funds to purchase new locomotives at a later stage. The researcher also took cognizance of the older fleet of locomotives that are pre-1994 and require replacement. However, there are a few fleets that have been replaced, but not adequately enough.

The researcher notes that ideally, a new locomotive will perform better than an older locomotive and should be considered by Transnet in the future.

The researcher recommends that Transnet should strategize a future plan to budget to purchase new locomotives. In the interim, the researcher recommends that Transnet considers projects to upgrade their current locomotives to international technological standards, thereby possibly reducing the need to purchase new locomotives. The researcher also recommends that when purchasing new locomotives, a proper cost versus value analysis be conducted.

5.4.6 Recommendation 6: Awareness on the abuse of unplanned leave

The sixth recommendation was that twenty percent of the interviewees stated that awareness on the abuse of unplanned leave, if implemented, will reduce train delays and cancellations. Abuse of unplanned leave in Transnet as a whole, including TE and TFR employees, has been a long and tedious problem involving senior management and unions, with no amicable solution. It is unfortunate that this is human behavior, and no official resolution was found to yield positive results within Transnet. To define the abuse of unplanned leave is a very sensitive and emotional topic as it is subjective to each individual. To illustrate, an employee decides to take leave due to the delivery of a new television that was purchased, whereas another employee will make alternative arrangements with friends or family to avail themselves when such a delivery is being made. Transnet's policy states that if proven, the abuse of unplanned leave may result in the dismissal of an employee.

The researcher recommends that an awareness campaign or roadshow should be conducted highlighting the results of the abuse of unplanned leave to employees. This should include the loss in revenue and loss in tonnages due to employees that have specialized skills in performing their duties at Transnet. To illustrate, only a train driver can drive a locomotive and not a planner. TE and TFR should consider extra remuneration for such skills. The researcher also recommends re-emphasizing that leave audits should be conducted regularly and where employees are found in violation of the policy, disciplinary action should be taken. This should also be highlighted in an awareness drive including the unions. The researcher is confident that the abovementioned recommendation will reduce train delays and cancellations.

5.4.7 Recommendation 7: Security to monitor and patrol stations

The seventh recommendation the researcher deduced was that fifteen percent of the interviewees stated that security to monitor and patrol stations, if implemented, will reduce train delays and cancellations. In South Africa, safety and security has become a major concern. Transnet is also affected by continuous sabotage, vandalism and theft to its infrastructure and assets. Transnet employs its own internal security

company to secure, patrol and monitor train stations, Transnet's infrastructure and assets.

The researcher recommends the presence of the security company be visible to reduce sabotage, vandalism and theft. However the size of Transnet infrastructure makes it impractical for the security company to utilize their resources efficiently. To explain further, it is impossible to have security guards at all the positions in Transnet's infrastructure, meaning that certain areas will be exposed to thieves when a security guard is patrolling an area.

The researcher recommends that security companies and the SAPS be more visible and vigilant, especially in areas that are being targeted. The researcher also recommends that Transnet involves the community and creates a hotline or tip-off line if any suspicious activities are noted.

5.4.8 Recommendation 8: Improving communication between Transnet Engineering and Transnet Freight Rail

The eight recommendation the researcher deduced was that twenty percent of the interviewees stated that improving communication between TE and TFR, if implemented, will reduce train delays and cancellations. Communication between TE and TFR is done in an official capacity and is a Transnet requirement. Inter departments need to communicate with each other for the smooth operations of trains according to the ITP. Communication is subjective to each individual and involves the human factor. Certain cultural and lifestyle beliefs sometimes hinder effective communication. Distortion is also another contributing factor to ineffective communication.

The researcher has recommended proper communication between TE and TFR employees. However, the researcher has noted that the communication is ineffective and that the messages are usually distorted. The researcher also concluded that the agreed upon methods of communication were not always adhered to. To illustrate, whenever there is a train delay or cancellation of more than sixty minutes, the GM needs to be notified immediately telephonically. However, this does not always happen and an email is sent instead. Consequently, if it is 01h00 and the GM only checks their

emails at 08h00, then that is the time they receive the information, which is seven hours later.

The researcher recommends that strict guidelines on communication between TE and TFR be officially implemented and re-emphasized regularly by senior management. It is the recommendation of the researcher that strategic employees be sent for effective communication courses. The researcher also recommends that a standard be set by management on the correct protocols to be followed.

5.5 Implications for future research

The researcher recommends that future research can be conducted on a larger sample population size, as the one used in this dissertation is limited. This study could possibly be conducted in other Transnet Engineering and Transnet Freight Rail depots throughout the whole of South Africa. Researchers may find more data, expanding the study throughout South Africa. Researchers may also find that using a quantitative approach as compared to a qualitative approach, or a mixed approach, may yield different results. Each current occurrence from this study can be researched to either agree or disagree with the researcher's findings. The interventions can also be researched to either agree or disagree with the researcher's findings. Future researchers can also discuss any possible literature that may not have been available at the time the researcher conducted this study.

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ANNEXURE A

MANAGEMENT SCIENCES: FACULTY RESEARCH ETHICS COMMITTEE (FREC)

29 November 2017
Student No: 19752289
FREC REF: 161/17

Dear Mr V Mohunlal

MASTERS OF PHILOSOPHY: QUALITY

TITLE: INVESTIGATION INTO THE TRAIN CANCELLATIONS AT WENTWORTH DIESEL DEPOT

Please be advised that the FREC Committee has reviewed your proposal and the following decision was made: **Ethical Level 2**

Date of FRC Approval: 29 November 2017

Approval has been granted for a period of two years from the above mentioned date, after which you are required to apply for safety monitoring and annual recertification. Please use the form located at the Faculty. This form must be submitted to the FREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the FREC according to the FREC SOP's.
Please note that ANY amendments in the approved proposal require the approval of the FREC as outlined in the FREC SOP's.

Yours Sincerely

Prof JP Govender
Deputy Chairperson: FREC

ANNEXURE B

To: Mr R. S.Ngubane
Loliwe House
151 Rossburgh
4000

01 November 2017

RE: GATEKEEPER:
REQUEST PERMISSION TO CONDUCT RESEARCH STUDY AT TRANSNET ENGINEERING W.D.D.

I, Vishal Mohunlal, Student number: 19752289, request permission to conduct a research study at Transnet Engineering, Wentworth Diesel Depot, Durban Kwa Zulu-Natal, South Africa.
The intended dissertation, will be an Investigation into Train cancellations and Delays at Wentworth Diesel Depot

Thank You in Advance
Kind Regards

Vishal Mohunlal
071 365 2113
v.mohunlal@gmail.com

ANNEXURE C

TRANSNET

29 November 2017
Mr. R. S. Ngubane
Loliwe House
151 Rossburgh
4000

To whom it may concern

I Robert Ngubane, manager at SOC hereby given permission to use the Cancellation report for his research project at Durban University of Technology

Regards

Robert Ngubane
SOC Manager
Durban
Transnet Engineering
031 361 4285 0780990666
robert.ngubane@transnet.net

ANNEXURE D

INTERVIEW SCHEDULE

1. Grade / Job Title:
   ……

2. How many years of services do you have with the Company? What were your previous job description?
   ……

3. Briefly explain your duties?
   ……
   ……

4. What qualifications do you have? What courses did you complete?
   ……
   ……

5. From your understandings, what are your 5 main reasons for Cancellations?
   ……
   ……
6. In your opinion what are your solutions to the above reasons?
   ……
   ……
   ……
7. What similarities did you notice in train cancellations?
   ……
   ……
8. What is the process of cancelling a train?
   ……
   ……

9. What is the average number of train cancellations per month?
   ……
   ……

10. Is there anything else you would like to comment on about train cancellation in Wentworth Diesel Depot?
    ……
    ……

DATE: …… **INTERVIEWEE NUMBER**: …….

ANNEXURE E

An investigation into train cancellations and delays at Transnet Engineering Locomotive Depot,Wentworth Diesel Depot
by Vishal Mohunlal

CHAPTER 1

1.1 Introduction

Global competition to be the best in the world, in any and all services or products a business offers, has led to the optimization of resources and higher efficiency rates across the globe. In South Africa, Transnet has been caught in the whirlwind of the ever-changing sales, marketing, customer service and international standards to reach world class status. In an attempt to meet these standards, Transnet has implemented the Market Demand Strategy (MDS) and recently the 2021 Strategy. The MDS and 2021 Strategy involve the maintenance of the rail infrastructure and new locomotives, the 1064 Project and up skilling of employees. Transnet needs to keep up with world class standards to provide, reliable and trustworthy transport services in South Africa and neighbouring countries (MDS, 2015)

16

In an effort to find solutions to why the campaign has failed, an investigation needed to be conducted into cancellations and delays. A train cancellation impacts financially on Transnet, employees' jobs, customer satisfaction, a decline in the overall efficiency of Transnet and the Gross Domestic Production of South Africa as a country. The researcher has deemed it necessary to investigate the cancellations and delays so as to improve the efficiency of Transnet and provide customer delight so that tonnages can be brought back to RAIL from ROAD.

16

1.1.1 The History of Transnet

Transnet's history began, way back in 1868 when diamonds where discovered in Kimberley. The Cape and Natal where chosen to be the harbours, and the railway system was started to connect there areas. The

South African state railway system in the Cape was converted to government property in 1872, and Natal in 1877. The basic harbours in Durban and Cape Town were completed. Nine years into the future, both harbours were extensively linked towards Kimberley, as there was gold and diamonds were discovered.

16

In 1910, Union was accomplished with the country's authorities, that the harbours and railways should be amalgamated. This develop in the South African Railways and Harbours organisation (SAR&H) becoming part of the government. Twenty years later,

s 2021:03: 09

An investigation into train cancellations and delays at Transnet Engineering Locomotive Depot,Wentworth Diesel Depot

ORIGINALITY REPORT

%13	%11	%6	%4
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4	www.kau.se Internet Source	%1
5	orbit.dtu.dk Internet Source	%1
6	hdl.handle.net Internet Source	<%1
7	"Advances in Human Aspects of Transportation", Springer Science and Business Media LLC, 2019 Publication	<%1
8	www.strc.ch Internet Source	<%1

84	Internet Source	<%1
85	healthpolicystudies.org.au Internet Source	<%1
86	allafrica.com Internet Source	<%1
87	trid.trb.org Internet Source	<%1
88	Chao Wen, Ping Huang, Zhongcan Li, Javad Lessan, Liping Fu, Chaozhe Jiang, Xinyue Xu. "Train Dispatching Management With Data-Driven Approaches: A Comprehensive Review and Appraisal", IEEE Access, 2019 Publication	<%1
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ANNEXURE F

EDITING LETTER

696 Clare Road

Clare Estate

Durban

4091

15 December 2020

To: Whom it may concern

Editing of Master's Thesis: V Mohunlal (19752289)

An investigation into train cancellations and delays at the Transnet Engineering Locomotive Diesel Depot in Wentworth, Durban

This letter serves as confirmation that the aforementioned thesis has been language edited.

Any queries may be directed to the author of this letter.

Regards

MP MATHEWS

Lecturer and Language Editor

Mercillenem@dut.ac.za