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In

THE FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

Methods for Improving the Turn-around Time of Iron Ore Wagon Utilisation at Transnet

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December 2015
AGREEMENT PAGE

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ABSTRACT

Transnet Freight Rail (Transnet Freight Rail) focuses on optimising supply chains in the Ore industry by providing integrated logistical solutions. These comprise TFR-owned and subcontracted activities beyond rail. The advantages to customers include the elimination of inefficiencies, the capacity for inventory management throughout the supply chain, and reduced supply-chain costs. Transnet Freight Rail’s locomotive and wagon-fleet-renewal plan has been updated to address growth requirements in terms of the increased demand for rail services. However, in the daily operation, Transnet Freight Rail is mostly challenged with meeting the turn-around time, as scheduled.

Based on quantitative and qualitative data, this research attempts to identify the main reasons why rail freight is dropping away; and what we can do to get it back on track. A detailed plan is needed in every yard to ensure that all the activities in the run-up to train departure are executed on time. The common cause for the problem might include things, such as inadequate training, poor planning, and poor management; furthermore, the problem could also be caused by the design of the service, or the product itself.
ACKNOWLEDGEMENTS

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Thanks to all the Transnet employees who participated in the questionnaires. Last, but not least, a special word of thanks to my husband and family for sharing my dreams and encouraging me to continue with my studies. And lastly, to my dear Julliet Madubanya, for pushing me to always do the job during the hard times.
DECLARATION OF ORIGINAL AUTHORSHIP

I, THEMBISILE ANNAH MABHENA on this day 20 October, 2015 declare that the work in this dissertation is my own; all sources used or referred to have been documented and recognized, and this dissertation has not previously been submitted in full or partial fulfilment of the requirements for an equivalent or higher qualification at any other recognized educational institution.

Signed………………………………………………..
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NOMENCLATURE

TFR – Transnet Freight Rail

TAT – Turnaround Time

IATMS – Integrated Assessment Train Monitoring System

AMSA – Arcelor Mittal of South Africa

CPR – Canadian Pacific Railway

LPI – Logistics Performance Indicator

ITP – Integrated Train Plan

DCI – Durban Container Terminal

TNPA – Transnet National Port Authority

DMS – Dense Medium Separation

PMG – Postmasburg

SPSS - Statistical Product and Service Solutions

SIN – Sishen

TEU – Twenty-Foot Equivalent Unit
GLOSSARY OF TERMS

C
Crew: The staff that operates the train, crew consist of a driver and assistance driver

D
Deviation Management: Comprehensive approach and activities to reduce the adverse impacts of deviations.
Driver: The person in front who (usually) controls the movements of the train itself.
Drop-offs:

E
Efficiency: Performance level that describes a process that uses the lowest amount of inputs to create the greatest amount of outputs

F
Freight: Consignment that is transported in bulk

I
Infrastructure: Physical structure needed for the operation of originality
Intermodal Containers: Rail containers

L
Locomotives: Powered railway vehicle used for pulling trains
Logistics: Cost effective management of the handling, storage and transport of Raw materials as inputs for manufacture, distribution of completed goods and other commodities from source to the final consumer.

M
Monitoring: An on-going review and control of the implementation of a project to ensure that inputs, work schedules and agreed activities proceed according to plans and budgetary requirements.
Maintenance: The state of being well-maintained
P
Performance: The accomplishment task given measured against present known standards of completeness

Q
Questionnaire: A set of printed or written questions with a choice of answers, devised for the purposes of a survey or statistical study.
Quality: The degree of excellence of something measured against other things of a similar kind

R
Resources: Assets to achieve an outcome
Refurbish: Repairing and restoring in rail operations

S
Service: Work done in terms of the whole package
Siding: The yard where the operations takes place

T
Train: One or more railway vehicles capable of being moved.
Transit time: The operation of a train service from where the trains will start and finish
Train Schedule: A train schedule consists of the arrival and departure times of the lines at certain points of the network
Tonnage: The carrying capacity that the train withholds
Turnaround Time: The total amount of time between when a request from a customer is made until it is completed.

W
Wagons: a collection of coaches with suitable motive power attached in the form of a train.
1.1 BACKGROUND
Freight-railway infrastructure and operations in South Africa are owned and run by Transnet Freight Railway. The State-owned company is serviced from an engineering point of view by Transnet Railway Engineering, which builds and maintains wagons and locomotives. The two rail companies are part of the bigger State-owned transport group of Transnet, which also owns and operates ports and pipelines. It is currently adopting a new business strategy that it believed will be able to deliver where its turn-around plan introduced six years ago has failed.

The new plan is to reduce the average wagon cycle/turn-around time by 20 per cent, and deviations from scheduled train departure and arrival times by nearly 25 per cent; while at the same time improving locomotive efficiency by more than 30 per cent (Munshi, 2013). In view of these, the "quantum-leap strategy" aim is to refocus the business, and to concentrate on improving service to the customers.

Transnet Freight Railway (TFR) operates an iron ore line, which is the only line of its kind in Southern Africa; and it is the world's second longest heavy haul line (Kumba Resources, 2002). It is important to know that Africa’s growth depends on solid transportation networks; and the Transnet Freight Rail as a freight-focused business does not only link the continent’s economy; but it also plays a vital role in strengthening Southern Africa (Transport News, 2013).

The Iron Ore business operates the heavy haul line from mines of the Sishen area to the Port of Saldanha Bay, Mpumalanga mine complexes, as well as those in KwaZulu-Natal. Sishen mine has sufficient resources to sustain a 21-year production; and mostly the mine’s Iron Ore is exported, with about 6,2Mt of its production being supplied to Arcelor Mittal of South Africa (AMSA) in 2011.

This essential transport line has benefited South Africa’s economy by literally keeping it moving; offering commercial and competitive advantage to the economy with its vast mineral resources. It has further moved South Africa’s natural resources to factories and refineries –
in order to ensure progressive growth of both large- and small-scale industries (Transport News, 2013).

In order to meet iron ore export imperatives arising from the expansion of activities at Sishen and Khumani mines, the iron ore export capacity of the abovementioned export line already needs to be increased from the current 38 million tons per annum to an expected 47 million tons per annum by the year 2009 (Kumba Iron Ore Limited, 2012). The Port is currently authorised to handle 47 million tons per annum, through the provision of an additional tippler, stacker / re-claimers and new ship loaders. Longer-term planning is now investigating the feasibility of increasing the logical capacity upgrade phases beyond 47 million tons per annum to around 93 million tons per annum.

In support of the primary Government objectives, Transnet’s mandate as a parastatal organisation is to reduce the cost of doing business in South Africa, whilst remaining profitable by reducing costs, improving efficiencies, investing in the infrastructure and upgrading the ageing rolling stock (Kumba Iron Ore Limited, 2012).

During the past few years, the demand for export iron ore has increased from 18 million tons per annum to the present 38 million tons per annum, with Environmental Authorisation already gained for 41 million tons per annum (Kumba Iron Ore Limited, 2012). To enable Transnet Freight Rail to deliver on the traffic demand, the track was laid on the previously constructed odd-numbered crossing loops 5, 7, 9, 11, 13, 15 and 17 in the period 2000 - 2004, allowing crossings at 45km intervals instead of 90km.

The axle loading on the line was also increased to 30 tonnes. Table 1.1 shows the initial capacity components of the ore line, as designed for 18 million tons per annum operations (Kumba Iron Ore Limited, 2012). It shows the length of the railway line, which is 861km; and the number of wagons needed for the transportation of Iron Ore per train is 200, with 3X9E locomotives. The weekly demand from the customer is 21 trains, which require a total number of 31 X9E locomotives, with a turn-around time of 64 hours to Sishen and 104 hours for Beeshoek.
Table 1.1: Original design and operating criteria for the Iron Ore Line (Kumba Iron Ore Limited, 2012)

<table>
<thead>
<tr>
<th>Description: Activity / Infrastructure or Rolling Stock component</th>
<th>Original design</th>
</tr>
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<tbody>
<tr>
<td>18MTPA</td>
<td></td>
</tr>
<tr>
<td>200 wagon trains</td>
<td></td>
</tr>
<tr>
<td>Period commissioned / planned</td>
<td>1974 - 1976</td>
</tr>
<tr>
<td>Design capacity</td>
<td>18 MTPA</td>
</tr>
<tr>
<td>Length of line</td>
<td>861 km single track</td>
</tr>
<tr>
<td>OHTE - Overhead track equipment</td>
<td>50 kV AC</td>
</tr>
<tr>
<td>Number of crossing facilities</td>
<td>10 loops with CTC</td>
</tr>
<tr>
<td>Wagons per train 200</td>
<td>200</td>
</tr>
<tr>
<td>Axle load, payload per wagon</td>
<td>26 tonnes per axle</td>
</tr>
<tr>
<td>Net payload per wagon</td>
<td>85 ton</td>
</tr>
<tr>
<td>Number of wagons</td>
<td>26 tonnes axle; 2252 CR, 5</td>
</tr>
<tr>
<td>Locomotives per train</td>
<td>3 x 9E – 50 kV electric</td>
</tr>
<tr>
<td>Number of locomotives</td>
<td>31 x 9E – 50 kV electric</td>
</tr>
<tr>
<td>Trains per week</td>
<td>21 iron ore trains/ week</td>
</tr>
<tr>
<td>Turnaround time</td>
<td>64 hours Sishen, 104 hours Beeshoek</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Daily between trains and 1 week total shut down</td>
</tr>
</tbody>
</table>

1.2 REDUCING THE TURN-AROUND TIME OF TRAINS BETWEEN THE MINES AND THE PORT

It is not believed that the current traction, rolling stock or infrastructure would be able to accept the major increase in line and operating speeds required to deliver a significant decrease in the journey time from mines to Port; and this option is discounted for further consideration, thereby significantly increasing the length (capacity) of trains.

Transnet Freight Rail focuses on optimising the supply chains in the Ore industry by providing integrated logistical solutions, which consist of both the TFR-owned and subcontracted activities beyond the rail. The advantages to customers include the elimination of inefficiencies, a capacity for inventory management throughout the supply chain, and reduced supply-chain costs. Transnet Freight Rail’s locomotive and wagon fleet renewal plan has been updated to address the growth requirements in terms of the increased demand for
rail services (Transport News, 2013). The company has also reduced the length of cable stolen from its railway network between May and August 2010 by 77%; and it has also decreased its monthly average of stolen cable by 52%. But still, in 2012, the TFR Media release (2010) reported that theft had reached unprecedented levels, with an average of 10 trains being cancelled per day – due to cable theft.

The Acting Chief Executive, Tau Morwe, ascribed the success in tackling cable theft to a focused strategy, in which the company has intensified its data-gathering and intelligence operations by 50%. These include land and air surveillance, and also involves close cooperation with law enforcement units, like the Hawks and SAPS Crime Intelligence (Admin, 2012).

Starting in 1997, Canadian Pacific Railway (CPR) began exploring the concept of running a scheduled railway. With this approach, trains are operated with a high degree of schedule adherence; this has the immediate benefit of improved customer service and asset utilization (Kraft, 2002). However, it was feared that if all the trains were run in accordance with a fixed timetable, an excessive number of trains would be required, and costs would increase dramatically. To avoid this problem, it was clear that the operating plan had to be tightly matched to the available traffic, and that it needed to be updated on a regular and consistent basis, to ensure that shifts in traffic patterns were accounted for within the operating plan.

Furthermore, transportation is a demand-pull industry. In a typical month, CPR’s operating plan must respond to approximately 10,000 unique origin-destination combinations between any combinations of 4,200 locations (Kraft, 2002).

There are two competing practices for operating railways in North America: Tonnage-based dispatching, and schedule-based dispatching. Schedule-based dispatching is once again gaining favour in North America, as new management science tools that are used for crafting cost-effective and customer-effective operating plans. Canadian Pacific Railway is one of the first railways to adopt a true schedule-based approach that can quickly adjust to changing traffic demands, and is the most rigorously disciplined railway in its scheduling (Kraft, 2002).

On the other hand, tonnage-based train dispatching is based on the premise that reducing the number of trains operated and creating longer trains would minimize costs. A tonnage-based
approach has wagons held in a yard until sufficient wagons have been gathered to form a train. In recent years, some railways have set that level at a minimum of 80 wagons. Their operating plan may list a train that operates every day; but if there are insufficient wagons, they cancel or delay the train.

Another option is to cancel the first few legs of a train, which then effectively has the train starting from a downstream location (Chen et al., 1999).

When viewed from a narrow-minded perspective, this approach appears to minimize the total number of trains operated by maximizing their size. This is perceived as minimizing train-based cost through reduced crew costs (who are generally paid according to the time worked or the distance travelled), a reduced need for locomotives (through reduced in-service locomotive miles), and the reduced usage of the track (Chen et al., 1999).

The tonnage-based approach, however, has serious drawbacks, which include the following:

1. It creates an unreliable service for the customer.
2. It may actually increase crew cost and locomotive-resource demand, due to increased light locomotives, which is the non-productive movement of crew and equipment resources to position them for productive work. It reduces the ability to better plan crew and locomotive use; and it increases the unproductive time.
3. It does not allow the yards to fine-tune their operations on the basis of a repetitive schedule. It also increases the “standing capacity” (the maximum number of wagons that can be held in a yard) required at the yards; and it decreases the effectiveness in processing wagons.
4. The total equipment needs for wagons is increased – due to the slower transit times and the increased turn-around time of wagons idly waiting for train assembly.

Unfortunately, Kraft (2002) mentioned many railways that tried to schedule services deviate from those schedules, and revert to tonnage-based dispatching when their financial results do not meet their expectations. This reaction is common throughout the North American railways; and it is based on the belief that a tonnage railway is less expensive to operate.
The schedule-based approach forces trains to run on-time, as scheduled, even if they travel with light loads. Until recently, scheduled-based dispatching has been shunned by the industry for several reasons:

1. It may require the operation of some trains with smaller numbers of wagons when the customer demand is below expectations.
2. It requires the ability to forecast traffic (freight levels).
3. It requires sophisticated planning tools and algorithms to recommend changes, and to analyse the current and proposed plans that have the right number of trains relative to the total traffic to be handled.
4. Entering some changes in the railway operating plan, such as route changes – due to yard closures. This causes changes to thousands of data entries. This makes it difficult to later refine the schedule in response to changes in customer-traffic patterns.

However, a well-crafted operating plan for a scheduled railway can actually lead to increased train sizes. Train size becomes a design criterion; and as long as the operating plan is refined as traffic patterns change, train sizes will continue to be large. At Transnet Freight Rail, moving to scheduled railway, using sophisticated design support software, has allowed them to increase the average carload train size by over 10% (Dlamini, 2010).

For Transnet Freight Rail, using support software has changed from tonnage-based to schedule-based dispatching for their carload and intermodal business, which accounts for a significant portion of TFR’s operations and revenues (57%). The other segment is bulk commodities moving as unit trains, which are typically scheduled separately from 3 to 14 days in advance. These trains always have sufficient tonnage to justify their operation (Dlamini, 2010). This has been a significant accomplishment.

The problem required the scheduling of 65,000 wagons over a 14,000-kilometre network. There are about 250 capacity-constrained yards consuming limited wagons, locomotive and train crew resources that further complicate the problem. Then one could reduce the enterprise-extending constraints of supply-chain management on transportation systems; and the degree of difficulty then increases again (Dlamini, 2010).
To address some challenges, Transnet Freight Rail began working with IT Systems to apply an operation-planning and simulation software called an Integrated Assessment Train Monitoring System (IATMS) suitable to manage deviation (Transport News, 2013). This decision-support system enabled Transnet Freight Rail to develop an operating plan that was tightly matched to their traffic patterns. This included optimization of the routing and classification plan for each wagon movement, and the determination of which trains to run.

The new operating plan was structured to reduce: Intermediate wagon handling; fuel consumption; wagon transit time; transit time variability; and the total number of wagon-kilometres traversed (Transport News, 2013).

1.3 THE PROBLEM STATEMENT

Transnet Freight Railway has an extensive network of strategically positioned factories and in-service depots to refurbish and maintain wagons, including heavy overhauls, conversions, upgrades, accident repairs and essential life-cycle interventions. However, there have been numerous press reports about the railway’s poor service on Iron Ore recorded in the past, some of which include the frustrations experienced by dissatisfied railway customers and the decrease in tonnages per week/year.

There is a delay of wagons between the drop-off depot (Postmasburg) and the Mine (Sishen), which is suspected to be unnecessary, causing a tension in keeping up with the schedule of the turn-around time of wagons, where wagons are being over-utilised and compromised, and sometimes do not meet the schedule for maintenance time.

1.4 THE RESEARCH QUESTIONS

The design of the trains shows/indicate how trains should run as per their schedule on the departure and arrival side, making it possible for the customer to plan on their production as they will have a broader view on when to expect their products. By running train as per the design, this will minimise the TAT of wagons.
The research questions for this study are presented as follows:

- Does the design of train schedule match with the on-time departure and arrivals of trains?
- Does the number of trains planned per day/week match with the sets of wagons given?
- Are the customers satisfied with the given service?
- Is the flow of communication amongst employees effective?
- Do the wagons meet their scheduled maintenance plan?
- Does Transnet run a scheduled railway?

1.5 HYPOTHESIS STATEMENT

1.5.1 Hypothesis one – The train scheduling methods that is currently being used by the Transnet Freight Rail for planning the turnaround time of wagons is not effective.

1.5.2 Hypothesis two – There is a lack of communication between Transnet Freight Rail and Sishen mine in keeping up with the design of service that deals with the total supply of wagons and locomotives.

1.5.3 Hypothesis three – There is a delay between Sishen and Postmasburg that causes the loads to be delivered late, resulting in poor service delivery.

1.6 THE DELIMITATION OF THE RESEARCH

The study will be conducted only for the Transnet Freight Rail; and it will not cater for other railway organizations. This will now make it difficult to get enough people to fill the survey questionnaires; and it may also be difficult to get interviews with the General Managers – due to their busy schedules. The sample framework may be seen as biased, because most of the people interviewed would be Transnet employees.

1.7 THE ASSUMPTIONS

- The delay of the turn-around time for wagons does not necessarily mean that it is the result of poor planning and the lack of locomotives.
• Problems between customers have contributed to the delay of wagons in the past. For instance, differences between ArcelorMittal of South Africa (AMSA) and Kumba Iron Ore have resulted in wagons being parked outside the Sishen iron ore mine in the Northern Cape.

• Other common causes for the problem might include issues, such as inadequate training, poor management; and they could also be caused by the design of the service or the product itself. An optimal schedule for the trains must be designed in such a way that the overall cycle time can be minimised.

1.8 THE SIGNIFICANCE OF THE STUDY

It is believed that the freight rail business would benefit from this study; hence the compiled data of records will show all the company’s deviations, the number of trains cancelled daily with reasons, and the root causes. The information obtained from this study will be submitted to the management – to help with the necessary adjustments on rail networks, such as restructuring the train schedules and improving the planning. Generally, this should help to improve the availability of wagons, quicker turn-around times, and improvements in infrastructure and customer relations.

1.9 AIM OF THE STUDY

The aim of this study is to help improve the turn-around time of wagon utilisation between Postmasburg and Sishen; while the objectives are as follows:

• To help improve production and quality customer service.
• To help improve the operational efficiencies of Transnet Freight Rail.
• To establish the causes and impact of late deliveries on the customers.
• To develop better knowledge on the loading process or techniques used.
• To proffer solutions to improve the production.
1.10 ORGANIZATION OF THE DISSERTATION

This dissertation is organized into six chapters; these are as follows:

**Chapter 1** – Introduction to the research problem; this chapter covers the background of the study, the problem statement, the research questions, the hypothesis statement, the significance of the research as well as the aim of this study.

**Chapter 2** – This presents a detailed view of the literature review, focusing on how Transnet does planning and scheduling, particularly on Iron Ore trains and how turnaround time is managed and can be improved.

**Chapter 3** – This chapter presents the research methods, the data collection, and the design of the questionnaires and interviews.

**Chapter 4** – This chapter presents the response obtained from the questionnaire and the analysis, validation of the results and reliability of the study.

**Chapter 5** – This chapter presents the discussion of the results for the dissertation.

**Chapter 6** - This chapter is presents the conclusion and recommendations for the dissertation.
CHAPTER 2: 
THE LITERATURE REVIEW

2.0 INTRODUCTION

Turn-around has been defined as ‘performance decline followed by performance improvement’ (Schendel et al., 1976). Brandes and Brege (1993) also define it as: ‘a process that takes a company from a situation of poor performance to a situation of good sustained performance’. While the literature on the factors that lead to organisational turn-around in the private sector is well developed, that on public sector turn-around is of recent origin. In addition, Bruton et al. (2006) state that: ‘Turn-around Management Strategies have been researched widely in the private sector as part of the organizational study area. However, only recently have these strategies been researched in the public sector’.

Research in the private sector context ascribes successful turn-around to the appropriate application of the necessary managerial strategies.

Transnet Freight Railway has intensified its efforts to improve the turn-around time of wagons and locomotives in recent years – a process that began prior to the onset of the recession. New systems for tracking and tracing wagons and locomotives and for train scheduling have been introduced, with the support of the South African Transport and Allied Workers Union (SATAWU).

Following the recession, approximately 400 locomotives and thousands of wagons were out use. The management brought to the table proposals for the temporary redeployment of the operating staff to depots where volumes remained high, namely, those depots dealing with the export and domestic coal, export of iron ore and containers (Railway Union Report, 2009).

2.1 ANALYSIS OF FREIGHT RAILWAY IN CHINA

For Transnet to improve on turnaround time of wagons, we need to look at how other countries manages their turnaround time of wagons, one of them being China. In recent years, the statistics on China’s railway transportation showed that the turn-around time of wagons is becoming longer and longer (Xiamiao, 1999). The turn-around time in 1998 was 45.4% higher than that of 1987; and the forward speed of freight transport is very slow in China
(Ciguang, 1999). According to their investigations and analyses (Ciguang, 1999), they concluded that the time that influenced the speed of freight transport is mainly consumed at the freight stations and transfer stations. Furthermore, when more goods are held up in the transport process, the more circulation money is required for transport (Xiamiao, 1999).

Bennetto (2013) stated that when trains deviate from a perfect plan; they may not depart as scheduled because of drivers not being available, equipment not being accessible, or even resource failure. When a train is unable to depart as planned, the current schedule becomes invalid.

2.2 RAILWAY TURN-AROUND TIME MEASURE

In Australia, trains typically arrive within a short span of time after an overnight journey to be unloaded during the morning hours; and then, during the afternoon and early evening, they are loaded and dispatched. However, overall transit times, and more importantly, transit time reliability, are often cited as key mode choice decisions by customers (Fowkes et al., 1991). Therefore, customer turn-around times and train departure times are critical indicators of terminal performance.

In the context of customer service, it is important that customers should be able to monitor the progress of their consignment; enter consignment details; pre-book space on trains; and obtain management reports at regular intervals. Other terminal performance indicators relate to plant and human-resource productivity, and operating costs per unit of output handled. A set of appropriate terminal performance measures was put forward by Ferreira and Sigut (1995).

In 2006, the Washington Times carried a lead story on the turn-around of the Indian Railway (Kundu, 1995). It stated that few doubted that the Minister for Railway (Mr Yadav) had presided over an impressive business turn-around. He had taken 1.5 million employees and boosted revenues by 15.5 per cent without raising fares; yet, the freight volume growth of the Indian Railway deteriorated during 1990s.

The annual growth rate of freight cargo transportation fell from an average 5.33 per cent between 1984 to 1991 to 1.86 per cent during the period 1992 to 1999 (Kundu, 1995). This deterioration continued until 2001 – and then again from 2004 to 2006. It then improved; but
in 2006 it deteriorated again. Table 2.2 shows the annual growth rate of the freight cargo transportation from 2004 to 2008, along with the fluctuations experienced, which in 2005-06 were 8.7, in 2006-07 were 10.0, and in 2007-08 were 9.3.

**TABLE 2.1: The annual growth rate of freight cargo transportation (Kundu, 1995)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Domestic Product Growth (India)</th>
<th>Potential Growth of railway</th>
<th>Actual growth of railway</th>
<th>Percentage shortfall as per expected elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-05</td>
<td>7.05</td>
<td>9.3</td>
<td>7.3</td>
<td>21.9</td>
</tr>
<tr>
<td>2005-06</td>
<td>9.5</td>
<td>11.9</td>
<td>8.7</td>
<td>26.4</td>
</tr>
<tr>
<td>2006-07</td>
<td>9.8</td>
<td>12.2</td>
<td>10.0</td>
<td>18.0</td>
</tr>
<tr>
<td>2007-2008</td>
<td>9.0</td>
<td>11.3</td>
<td>9.3</td>
<td>17.5</td>
</tr>
</tbody>
</table>

The Indian Railway had three major strategies for regaining their revenue. These were: retrenchment, repositioning and re-organisation. Retrenchment included sub-strategies, like quitting difficult markets, selling assets, outsourcing and downsizing (Boyne & Meier, 2006). And several empirical studies supported this strategy. Firstly, the retrenchment strategy was on cost reduction and identifying and correcting inefficiencies within the organisation; the focus of the repositioning strategy was on revenue rising.

Another turn-around strategy found referred to re-organisation, which changed the planning systems. This includes the replacement of leadership and other senior managerial staff (Chowdhury, 2002).

All these strategies resulted in a significant improvement for Indian Railway, which increased the operation ratio of total working expenses to gross revenue receipts which amounted to a 98.8 per cent increase for the year ending March 2001. This dropped down to 83.2 per cent in 2006; and further to 78.7 per cent by 2007 (Boyne & Meier, 2006). The focus of policy change effected by the Indian Railway was also on meeting the requirements of its customers.
To reduce the wagon turn-around times, cash incentives were offered to freight customers to free up the wagon faster. The handling capacity of freight terminals was increased; strict control was maintained over idle wagon capacity through the use of a Freight Operations Information System. The users were encouraged to adopt round-the-clock loading and unloading depots. Through these measures, the Indian Railway was successful in reducing the wagon turn-around time from seven to five days. Simultaneously, the connectivity to ports was increased – to facilitate quick clearance of arriving goods, and to facilitate the speedy export of goods (Robbins & Pearce, 2010).

2.3 RAILWAY COAL SERVICE

In a study conducted by Mkhatshwa (2010) on the Improvement of Coal Tonnages at Transnet Freight Railway Coal Export Line, he discovered that the vehicle-routing problem is one of the popular methods used to solve transportation and distribution problems. However, this is a complex integrative optimization, where a number of clients need to be served by a fleet of vehicles (in this case by train) with known demands and capacities. To solve the problem, one must design an optimal route that would result in the reduction of cycle time – thereby maximizing the coal tonnage shipped from the mines to Ermelo – and eventually to Richards’s bay for exports.

Thirteen mines operate as drop-offs, where locomotives are detached from the wagons for loading. But, this model was built on the basis of three operating drop-off mines at the coal fields located in Witbank. When a locomotive arrives in the Ermelo Departure Yard, it can immediately be attached to a wagon set; but it may only move to the halfway place in the next increment of time. This is done, in order to simulate the preparation of a train in the yard.

The same principle applies at the end of the process at a drop-off mine. The load, as well as the locomotive, must be attached; and only on the next two-hour cycle may it be shipped at the next stage of movement, representing the loaded train. When a train arrives at the Ermelo Arrival Yard, the load is shipped directly to Richards Bay; and the wagon set is moved by diesel locomotives to the departure yard.

Only on the next cycle, may the locomotive move to the first position in the Locomotive Depot. As a train reaches the second block of a drop-off mine, the locomotive may be
detached to either wait for the wagon set that has just been detached from, or it can wait at another mine for a different wagon set. In addition, it can also be sent back light to the Locomotive Depot at Ermelo (Mkhatshwa, 2010).

2.4 RAILWAY IRON ORE SERVICE
It is important to note that some of the challenges at the railway are caused by the unavailability of drivers. When booking the drivers, there should be a standby driver for deviations, in case the booked driver does not make it to work. Furthermore, there is no communication between the client at the Mine and Transnet, causing the wagons to be delayed, and the train not departing on time from the terminal. Consequently, criticism is still being levied against Transnet by some mining executives.

They maintain that this is the reason for South Africa losing out on much of the global commodities boom over the past few years, including the capacity constraints, which also added to South Africa’s inability to profit as much as it should have from Iron Ore (Admin, 2012).

To save time, specialised wagons are used for ease of loading and offloading of this commodity. In addition, the company offers an optional insurance service to ensure peace-of-mind value to the customers, particularly those who are transporting time-sensitive goods. The core benefit of Transnet Freight Rail’s service is the predictability provided by running dedicated trains; and this translates into cost-efficient transportation. However, besides late arrival and departure times, the availability of wagons has been a problem. Transnet Freight Rail strives to improve the service delivery to clients; therefore, the operation managers at the depots deal with all the planning of train movements; and they use the usual method of scheduling, which is considered to be ineffective; as it has resulted in higher cycle times, insufficient capacity, and an inadequate service to clients (Mkhatshwa, 2010).

2.5 OPERATIONAL PLANNING
According to Franklin (2012), planning and scheduling are the main aspects of every organisation; and for their proper execution, it is expected that the company must be able to conduct a time-based planning schedule, which would put things in order for a better service, and for the satisfaction of the clients. Transnet Freight Rail uses a classical method of
scheduling for setting up the time slots for each train with a minimum waste of time. The purpose is getting as many trains as possible in a track safely.

The schedule specifies the departure time of trains from the origin, arrival times at the destination, which are the most relevant parameters for this research. Things that are considered in scheduling are the length of the section, in which a train may be at a time, the time it has to wait, where it has to wait, and the cycle time. The planning is done on a daily basis, which is categorised, according to a strategic plan (planning over a long term), tactical planning (medium-term planning), and operation planning (short-term planning). These issues will be considered in this research.

The operational planning in Transnet Freight Rail is performed by a local management team, which is responsible for control. Again, the operational decisions entail the implementation of schedule plans, adjustments where possible, maintenance activities, and crew allocation (Ndlovu, 2007).

Planning railway operations requires a detailed forecast of train volumes, tonnages and length for each origin/destination pair, as shown in Table 2.2. These data must be by day-of-week, type of traffic, load/empty status, and other railways that interchange traffic with TRF. Some of the sample templates that Transnet Freight Rail uses for loading purposes include the following:

- The loading date,
- The train number with which the empty wagons will be placed with at the Mine,
- The time it supposed to be placed,
- The train number that the train will be cleared with after it has finished loading,
- The time it is supposed to be cleared from the siding,
- The number of wagons loaded along with the consignment number.
Furthermore, locomotive planning can be classified into two parts (Ndlovu, 2007):

1. Calculating the minimal locomotive needs for each train, which is a function of the train weight, the desired speed, and the track grade/curvature,

2. Positioning locomotives, so that there are sufficient locomotives at the yards at the right time. Repositioning is necessary; since locomotive inventories tend to

### TABLE 2.2: Loading Plan (Ndlovu, 2007)

| VIR WEEK VAN | 21-Oct tot | VOORSIENINGS-LEEG RUIMINGS BELAAI | DAT | TREIN | TROUKE | JDG | TAG | DAT | TREIN | TROUKE | JDG | NA | GRAD | TREIN | TROUKE | JDG | NA | GRAD |
|--------------|------------|----------------------------------|-----|-------|--------|-----|-----|-----|-------|--------|-----|-----|------|-------|--------|-----|-----|------|-------|--------|-----|-----|------|-------|--------|-----|-----|------|-------|--------|-----|-----|------|-------|--------|
| 20-Oct       | 8423       | 00:06                            | Mon | 21-Oct| 7402   | 00:50| BIJ | 21-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086617072 | 105 | C | 8411  | 11:15 | 6832    | 105 | F | 8417  | 19:38 | 7404    | 20:10| BIJ | 8086617113 | 105 | F |
| 21-Oct       | 8423       | 00:06                            | Tue | 22-Oct| 7402   | 00:50| BIJ | 22-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086619842 | 105 | F | 8411  | 11:15 | 7940    | 12:46| BIJ | 8417  | 19:38 | 7404    | 20:10| BIJ |
| 23-Oct       | 8423       | 00:06                            | Thu | 24-Oct| 7402   | 00:50| BIJ | 24-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086619912 | 105 | C | 8411  | 11:15 | 7940    | 12:56| BIJ | 8417  | 19:38 | 7404    | 20:10| BIJ | 8086620002 | 105 | C |
| 24-Oct       | 8423       | 00:06                            | Fri | 25-Oct| 7402   | 00:50| BIJ | 25-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086619932 | 105 | F | 8411  | 11:15 | 7940    | 12:56| BIJ | 8417  | 19:38 | 7404    | 20:10| BIJ | 8086620031 | 105 | C |
| 25-Oct       | 8423       | 00:06                            | Sat | 26-Oct| 7402   | 00:50| BIJ | 26-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086619959 | 105 | F | 8411  | 11:15 | 7940    | 12:56| BIJ | 8417  | 19:38 | 7404    | 20:10| BIJ | 8086617131 | 105 | F |
| 26-Oct       | 8423       | 00:06                            | Sun | 27-Oct| 7402   | 00:50| BIJ | 27-Oct| 8401  | 03:58  | 6454  | 08:50| NCY | 8086617142 | 105 | C | 8411  | 11:15 | 7940    | 12:56| BIJ | 8417  | 19:38 | 7404    | 20:10| BIJ | 8086617151 | 105 | F |
accumulate at locations where heavily loaded trains terminate, such as port locations, and relatively light out-bound empty trains originate.

TRF uses two techniques to position locomotives:

- The first one is for the loaded train to supply the empty train with the same locomotive, i.e. an empty train will depart from Postmasburg with a certain number of locomotives to Sishen mine. It will use the same locomotives to run the loaded train that was at Sishen back to Postmasburg, after placing the empties for loading.

- In the second one, there is a separate yard or a place where the locomotives are kept, and they will be checked before departing from the yard to where the load (wagons) will be, and coupled to make a train. These locomotives would leave their yard without any load (wagons) attached to them.

![Locomotive Productivity](image)

Figure 2.1: Gross Tonnage per Locomotive (Ndlovu, 2007)

2.6 OPERATING STRATEGIES

Reducing train tonnage ratios and matching train weights to pull the capacity of locomotives results in locomotives using their most efficient throttle position and maximum pulling capacity, and thereby they optimise locomotive utilization. Locomotive trip plans cycle individual locomotives between scheduled trains; and these are adjusted to reduce locomotive
idle time. Bang-Yan et al. (2011) maintain that the cross point of light locomotives occurs when the trains are in balance over the week, and in particular with the day-of-week operations leaving crews remaining for too long at the away terminals.

In such situations, the crew dispatcher would send the crew at the away base back via a light locomotive, in order to limit penalty payments, but implicitly to create a need for another light locomotive in the opposite direction one or two days later. It is significantly more costly to run special trains due to the additional crew costs. A light locomotive means that the locomotive is not carrying any wagons.

Railway crews typically operate between two areas: their home base and their away base. Each base could be composed of several railway yards.

Crews sometimes need to cut-off between these two bases for one of two reasons:
1. There is an imbalance, by direction, of trains,
2. The crew has to wait too long at the away base to run a train back to their home base.

Figure 2.2 below shows the tonnages lost as a result of crew challenges in the area between Sishen mine and Postmasburg yard impacting on the placement of empties at a mine for the loading and clearance of loaded wagons at the mine.

![Labour Productivity Graph](image)

**Figure 2.2: Gross tonnage per employee (Transnet Newsflash, June 2014)**
Crew challenges that are faced on a daily basis include: reporting late on duty, booking off sick prior to train departure, train assistant absent (not reported on duty), and absent without leave. The train would be staged in the section because of the mentioned challenges resulting in the train being cancelled, or the late delivery of the product impacting on the turnaround time (TAT) of wagons. A tonnage-based railway inherently has an excess of crew light locomotives. This is due to the cancelling of trains; and it effectively creates imbalances, and the inability to plan schedules to achieve minimal light locomotives (Bang-Yan et al., 2011).

The Transnet Executives on the customer care, particularly those in the planning department have the weekly alignments with the Arcelo-Mittal of South Africa (AMSA), discussing the current week’s reasons for cancellations. The aim is to minimize the train cancellation, and to find ways to manage the deviations. Figures 2.3 and 2.4 show the number of cancellations as percentages caused by both Transnet and the customer, which would include operational inefficiencies.

![Figure 2.3: Cancellations by Transnet (Transnet Newsflash, June 2014)](image-url)
The performance is calculated from the budget and commitment versus the actual tonnages handled – with the reasons for deviations being divided between Transnet and the customer (Arcelo-Mittal). Below is the performance report for June 2013 from Transnet Newsflash (June 2014).

- Budget of 283 594 tons weekly,
- Commitment of 341 447 tons weekly,
- Releases of 272 104 tons weekly,
- Actual Real Time Monitoring of 266 255 tons weekly,

It was noted that the total tonnage lost due to Transnet Freight Rail was 34 350 tons (57 per cent) with the following information:

- Locomotive Failure = 13 230 tons, showing 46% on Figure 2.3
- TPT Conveyor belt breakdown = 10 400 tons, showing 31% on Figure 2.3
- Locomotives shortages = 4 200 tons, showing 12% on Figure 2.3
- Hauler challenges = 2 040 tons, showing 5% on Figure 2.3
- Yard Blockage at Postmasburg = 2 280 tons, showing 6% on Figure 2.3.
Total tonnage lost due to Customer is 13,230 tons (43 per cent):

- Product Shortage at Sishen mine = 4,200 tons, showing 18% on figure 2.4
- Slow offloading = 5,760 tons, showing 24% on Figure 2.4
- Product out of spec at Kumba = 4,080 tons, showing 17% on Figure 2.4
- Conveyor belt breakdown = 9,600 tons, showing 41% on Figure 2.4

Table 2.3 shows the summary of the plan given versus the actual figures, with the total deviations in tonnage per flow on the Steel Sector or on the commodity line.

### Table 2.3: Summary of critical loads: Actual verses the actual and deviation

(Transnet Newsflash, June 2014)
2.7 OPERATING SYSTEMS

One of the systems being used Integrated Asset Train Monitoring System (IATMS) by Transnet Freight Rail produces reports that demonstrate the above results. These reports can then be used to identify potential crews in light locomotive situations and optimally resolve the problem. In some cases, rescheduling trains might solve the potential problem. Every railway is responsible for the maintenance of the track infrastructure. In a tonnage-based train dispatching approach with minimal train predictability, the maintenance crews often either waits by the track for the train to pass, or closes the track (to work), thereby generating train delays and inconsistent customer service levels (Gramlich, 1994).

Transnet Freight Rail has integrated the scheduling of engineering work programmes into their Integrated Assessment Train-Monitoring System (IATMS). Scheduling work programmes into a scheduled train operation results in a significant improvement in the productivity of both the train operation and the engineering maintenance crews. Another system used by Transnet Freight Rail is the Integrated Train Plan, which accommodates variations in traffic levels and resource availability that occurs from time to time.

Forecasting the sources of errors can be generally categorized into the following categories:

- Customer behaviour – including missing shipment information, shipment diversions, variability in demand, poor demand forecasts, overloaded wagons, customer facility backlogs resulting in unloaded queues, wagons weighing requests, and plant maintenance downtime.
- Non-controllable externals, including weather, road-crossing incidents, trespasser incidents, customs-shipment inspections.
- Network effects, including varying network load, interconnection variability with transportation partners.
- Resource availability, including yard space, train crews, passing sidings, locomotives, and mainline track slots.
- Flexibility constraints, including work rules, train make-up rules, and a complex product mix.

Plant reliability, including locomotive mechanical failures, train derailments, locomotives detaching from wagons, mechanical problems on the wagons, loss of the air train brakes,
right-of-way problem-detection devices falsely identifying a mechanical problem as the train passes.

In view of these, Kgare et al. (2011) conducted a study to identify what has been done at the Port of Durban during the last decade, in an effort to reduce the cargo turn-around time. This also demonstrated the impact of a reduced cargo turn-around time on port operational capacity. The study especially described the public sector, such as customs, the port authority and the port operator. There is increasing evidence that transport time decreases trade and increases logistics costs, notably because of increased inventories. Hummels (2001) demonstrated empirically that increased transport time dramatically reduces trade. With the rise in maritime traffic volumes, at their peak, South African ports handled up to 185 million tonnes in 2008, before experiencing a slight drop in 2009/2010 because of the fall-out from the global financial crisis.

Furthermore, the demand at South African ports surpasses all countries in Eastern and Southern Africa. With a network of eight ports, the country has a critical role to play in the international trade landscape for the region. Widely acknowledged for relatively good performance compared to others in the region, South Africa and its network of ports is ranked 28th in the Logistical Performance Indicator (LPI) for 2010, followed by Senegal at 58th (Kgale et al., 2011).

The global trend of the rising popularity of containers means that African ports also experienced growth in the containerized cargo market. South Africa handled the highest container volumes, reaching a peak of 3.9 million Twenty-Foot Equivalent Unit (TEU) in 2008, with the Port of Durban accounting for over 60% of the traffic. (Kgale et al., 2011).

Consequently, a review study of the Durban Inland Intermodal Terminal and Logistics Hub conducted in 2008 revealed that the turn-around time in the port area was too long; and this had major implications on the efficiency of the system (Arup, 2008). Although, from interviews, it appears that the port performance usually emerges as the main culprit for long delays along transit corridors, disentangling port inefficiency is rarely carried out, especially in Sub-Saharan Africa. However, in a country with a relatively higher trade value, such as South Africa, this is very important (Arup, 2008).
Table 2.4 shows the data for the period from 2005 – 2009 for container ports in the region, highlighting Durban’s dominance in the container market.

**Table 2.4: Port Container Traffic - Eastern and Southern Africa (Arup, 2008)**

<table>
<thead>
<tr>
<th>PORT</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durban</td>
<td>1 899.0</td>
<td>2 334.9</td>
<td>2 479.2</td>
<td>2 642.1</td>
<td>2 395.0</td>
</tr>
<tr>
<td>Cape Town</td>
<td>690.8</td>
<td>764.7</td>
<td>764.0</td>
<td>767.5</td>
<td>694.5</td>
</tr>
<tr>
<td>Mombasa</td>
<td>436.7</td>
<td>479.4</td>
<td>585.4</td>
<td>615.7</td>
<td>618.8</td>
</tr>
<tr>
<td>Port Elizabeth</td>
<td>369.7</td>
<td>497.2</td>
<td>422.8</td>
<td>423.8</td>
<td>441.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4109</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East London</td>
<td>49.3</td>
<td>41.8</td>
<td>41.9</td>
<td>57.4</td>
<td>52.5</td>
</tr>
<tr>
<td>Walvis Bay</td>
<td>71.4</td>
<td>83.2</td>
<td>144.9</td>
<td>170.5</td>
<td>Data</td>
</tr>
<tr>
<td>Maputo</td>
<td>54.0</td>
<td>62.5</td>
<td>80.3</td>
<td>92.2</td>
<td>107.0</td>
</tr>
</tbody>
</table>

However, normal cargo turn-around times differ between ports; and even more importantly between port users and stakeholders. In the case of Durban, 28 days is the time limit for Customs to consider a case to be “abandoned cargo”; and this then represents the end of normal cargo turn-around time.Clients, who represent the automotive industry, consider three days already as being an excessive turn-around time (Kgale et al., 2011). However, some small clients would tend to consider a “normal” cargo turn-around time to be around 4-5 days.

In the absence of any irrefutable and uncontested benchmark of what is considered to be an abnormal cargo turn-around time, the Transnet National Port Authority (TNPA) decided to target a turn-around time of three days for the Port of Durban. In reality, it seems as if this target has been achieved; but the data obtained for the Durban Container Terminal (DCT) are confirmed by haulers and the availability of lines; and this indicates a 3-4 days turn-around time for that terminal since 2006 (TNPA, 2009).

Figure 2.5 below shows that the average turn-around time at the port is below 4 days for both imports and exports – with a slight peak of 5 – 7 days around May 2010, which correlates with the 2010 Transnet labour strike period.
Figure 2.5: Average Turnaround Time (TNPA, 2009)

Transnet Annual Report (2009) shows that the turn-around time for trans-shipments is around 5 to 10 days, with a few irregular peaks at around the 15-day mark, notably between July and September. This is also related to the fact that the “free time” for trans-shipments is set at 7 days (with lower charges below 15 days).

The level of service has significantly improved in the last decade. However, in order for Durban to become a worldwide major port, the Transnet National Port Authority (TNPA) still has to overcome a few challenges, which are crucial for port competitiveness from a cost perspective i.e. high port costs to labour productivity, and relatively inefficient inland transport networks. Some of the issues of concern are already highlighted by the Regulator’s report on the economic review of South African ports 29.

These issues are not just important for turn-around time. While the port of Durban has seen meaningful improvements over the last few years, the challenge to address the above-mentioned issues still remains.
The South African logistical capacity is as good as that of any developed country in the world; however, logistical costs still remain high. Cargo dues (berth costs, wharfage) and terminal-handling charges, account for more than 50% of total port costs in South Africa (illustrated in Figure 2.6). The issue of port dues is a major concern in the country, an aspect that is also raised in the regulator’s report.

According to the TNPA, cargo dues on all commodities, articles, things or containers (full or empty) are levied at all ports belonging to or controlled and managed by Transnet. Cargo dues are charged to recover the cargo contribution towards port infrastructure (TNPA, 2009).
In 1997, the Canadian Pacific Railway (CPR) recognised the need to replace the tonnage business model, in order to improve customer service, operating efficiency and effectiveness. CPR was plagued with a relatively high cost of operation and low level of profitability. With customers focusing on the total supply-chain logistical costs – railways can only be cost effective if the shipment transit time is reliable and competitive.

CPR’s experience suggested that adding operational capacity does not always improve effectiveness. A number of capital renewal projects were launched to replace the ageing
It was recognized that CPR needed to integrate these investments into its operating plan. Furthermore, the old approach to designing the operating plan needed to be changed. This was a massive paradigm shift for operation designers. CPR had a train tonnage-based operating plan in an ever-increasingly customer-shipment oriented world, (Ireland, 2003).

2.8 TRIP PLAN IN TRANSNET

A railway operating plan describes how wagons should be moved (the routing and train plan); and it often includes the use of major assets (such as train crews, locomotives, yards and tracks) needed to move the wagons. At Transnet Freight Rail, this is called the Integrated Train Plan (ITP); and it involves a total replacement of the existing operating plan except for Integrated Assessment Train-Monitoring System (IATMS), it was designed to dramatically improve service and significantly reduce the number of trains, which are often competing goals (Transnet Annual Report, 2009).

In the same vein, the ITP must also integrate the requirements of the customer needs. The major components of an integrated operating plan are:

- **Rail Network Definition** – The initial component of the plan is the rail network, which is usually defined on a hard-copy map or in a “node and link” format in a geographical information system. The nodes represent customer locations, railway yards and other physical points on the network. The links represent the track sections between the various nodes.

- **Customer Traffic** – Customer traffic is represented by traffic records. A traffic record is the aggregate movement of wagons from a single loading point to a single unloading point, or to and from a location, where the wagons enter or exit the railway (interchanging with other railways). Attributes of the traffic include the customer, the commodity, loaded/empty status, and origin/destination(s). Empty wagon movements that reposition wagons to their loading or interchange points are also included in the traffic. Typically, 25 000 traffic records represent the compression and consolidation of some 500 000 raw traffic movement records.
• **Block** – A group of wagons that are moved together by one or more trains from a common origin or assembly point to a common destination or disassembly point.

• **Blocking Plan** – A blocking plan is the set of rules governing which blocks will be made, and which wagons will be put into each block. In some railroads, this is known as the “routing plan.” The blocking plan is considered to be the most critical component of the operating plan.

• **Train Plan** – Complementary to the blocking plan is the train-operating plan or timetable. A train plan is composed of the train routes, the arrival and departure times for the trains at the yards, and the specifications for those blocks to be picked up or delivered at the yards. The train plan also specifies crew-change points, fuelling and inspection locations, and the order of the blocks on the trains.

A fundamental concept needed to understand the routing of wagons is the notion of a block. The concept of blocking is essential in understanding the impact of computerized planning tools for an Integrated Operating Plan. We will illustrate this through the following simplified example:

![Figure 2.7: Simple example rail network (Ndlovu, 2007)](image)

In Figure 2.7, vertices A through F represent the railway yards and the edges represent the tracks. Within these yards, wagons are gathered into blocks – groups that have common characteristics. In a simple blocking plan, each yard builds a block of wagons to its nearest neighbour (Yard A builds a block for C; Yard B builds a block for C; Yard C builds blocks for A, B, D, etc.).
A more sophisticated plan would build longer distance blocks, bypassing any intermediate handling. For example, adding an A to D block and bypassing C. Bypassing reduces the workload at the bypassed yards; and it reduces the transit time. On the other hand, excessive bypassing would create too many small blocks, eliminating the economies of scale to provide adequate service. Furthermore, a given yard has physical limitations on the number of blocks that it can create. Too many blocks increase the number of wagons held in a yard, and the time they are held, due to the frequency of the train service that picks up those blocks (Ndlovu, 2007).

For any given traffic record, the wagon is moved through a series or sequence of blocks. In the above example, a traffic record from A to E may move first on the A-D block, and then the DE block. At yard D, the wagon is classified, that is, the wagons on the A-D block are divided up into new, outbound, blocks. In practice, a short block is used to move the wagon from the loading point to the nearest rail yard, where the carload shipment is processed (switched onto another block).

The wagon may be switched into multiple blocks until it reaches its destination. The path of the wagon, given by the ordered set of blocks, is called the block sequence. The process of switching wagon from block to block is called classification. The blocking plan must be able to define valid block sequences for any possible wagon shipment (Ndlovu, 2007).

While the above example illustrates the blocking concept, practical problems are much larger. Transnet Freight Rail has in excess of more than 10 000 wagons online; and in any given month, there are over 1,000 different paths for each unique train Origin – Destination combination; and many of these paths have a wide variety of traffic types. The efficient routing of wagons would significantly impact the railway profitability and the operational fluidity.

The blocking plan enables a strategic opportunity to fundamentally change the simplistic tonnage-based approach and, in its place, implement strategies to:

1. Reduce the transit time of the trains by reducing the wagon processing. The handling and waiting of wagons in the yards often represents at least 50% of the total transit
time. Optimizing the blocking plan can reduce the number of handlings, which then dramatically reduces the total transit time (Ireland, 2003).

2. Use the time saved from fewer handlings to reduce the speed of trains to greatly reduce fuel consumption, while maintaining customer commitments in terms of shipment transit times. CPR’s fuel consumption at 1.25 U.S. gallons per 1000 gross ton miles, reduced 16%, is now among best in the industry, despite having to move much of its traffic over some of the highest grades in North America (Ireland, 2003).

3. Balance workloads among yards. Seasonal adjustments to the blocking plan can create system capacity by moving processing demand from yards near their wagons processing capacity limit, to yards with available capacity.

4. Reduce the turn-around time (time period a car is not moving) of wagons in yards by redirecting car routings to build sufficient departing volumes to enable more than one departure per day between processing yards. The result is a significant reduction in the turn-around time for connecting wagons. CPR’s wagon velocity at 160 miles per day is among the highest in the industry, having improved 41.6% since 1998, (Ireland, 2003).

An intelligent design of the blocking plan is the foundation for generating an efficient Integrated Train Plan. Most railways use a table-based approach for describing blocking plans. These are large computer tables (usually from 100,000 to 1,000,000 entries) that decide which blocks a wagon should take, given its current location and the characteristics of the wagons, and the load it is carrying. Table-based blocking plans are very difficult to analyse and optimize. Some wagons routing changes could involve tens of thousands of changes in the traditional blocking plan tables, making it difficult, if not impossible, to perform a what-if analysis, or any type of optimization.

In addition, the table-based approach is strongly influenced by the skill level and the care taken by the analyst (Transnet News, 2013).
2.9 THE BLOCKING PLAN

The blocking plan has a large influence on the efficiency and capacity utilization of railway yards. There are several types of yards. For the carload business, there are intermediate switching yards whose function is to switch wagons from block-to-block. These generally fall into two categories (Yu et al., 2008). One is a hump yard that pushes trains over a hump and then lets gravity roll the wagons into one of 30 to 60 tracks. A computer usually controls the switches that govern which track will be used. The second type is a flat yard with a series of tracks and switches, where the classification process is performed on a more manual basis. There are also specialized yards, such as those for finished automobiles, intermodal containers, and trailers – that require different handling techniques (Transnet News, 2013).

The yards’ primary role is the classifying of trains. While not as visible as movement of wagons on trains, optimization of the yards is perhaps the most important consideration in railway planning, and most of the optimization occurs within the blocking plan. Studies have shown that yards are the source of the greatest delay and variability in operations; and they have the greatest impact on the overall asset velocity (Transnet News, 2013).

An operating plan needs to restrict the number of blocks that a yard is required to make. The number of tracks a yard has, and in the case of hump yards, the number of classification tracks, is related to the number of blocks it can make. The actual constraint comes from experience in managing each individual yard, and the traffic routed to the yard for processing. Yards also have capacity restrictions on the number of wagons that they can store at any given time (standing capacity). The standing capacity is also calculated through experience in managing the yard.

Complementary to the blocking plan is the train-operating plan or timetable. A train plan is composed of the train routes, the arrival and departure times for the trains at the yards, and the specifications of which type of traffic is picked up or delivered at the yards. Trains have other characteristics, including the days-of-week they operate, whether they start or end on another railway, the location of crew-change points, fuelling locations, and work locations for setting off (dropping off), or picking up shipments.

All railways have a strong focus on the development of a train plan. Tonnage-based railways specify more trains than they would actually run. For these types of railways, the train plan
symbolizes the superset of allowable trains, and the actual trains run are picked from the train plan. For scheduled-based railways, the train plan must be developed very carefully; since all trains in the timetable are expected to be operated as specified. Design parameters and constraints that are used in developing a train plan include:

- **Train Size** – Longer trains are more economical, because of the efficiencies in crews, track capacity, and locomotives. For example, the crew size for the train does not depend on the train length. However, train sizes cannot be too long due to the train mechanical forces (stress on the couplings between the wagons), and siding length (the physical length of the sections of railway where trains “pull over” to let other trains pass on the main track). Transnet Freight Rail (TFR) by carefully crafting the train plan, is able to run trains that are longer than the sidings by running the longer trains in one direction only. In the opposite direction, the trains are short enough to fit into the sidings.

This allows the smaller train to take the siding; while the opposing longer train passes it on the mainline. There are many congested areas of the railway, often consisting of a single track with passing sidings. The most important factor relating to congestion is the number of trains to be operated due to the constraints of how closely one train can follow another train. Fewer, longer trains lead to less congestion than more, shorter trains. Congestion is also related to the physical characteristics of the railway, such as the signalling system, the number and length of sidings, and the number of mainline tracks, and to external factors, such as the use of passenger trains on the same track. While longer trains are desirable, there is a downside.

2.10 COSTS IN RELATION TO TURN-AROUND TIME

The costs associated with long trains include the need for longer passing sidings and increased turn-around times for wagons, in order to accumulate sufficient wagons to operate the train. A hidden cost component is whether the wagons on the train are traveling out-of-route, in order to build up sufficient volume to justify the train. This is called circuity; and it is measured by the ratio of the distance the wagons travels in trains from its origin to its destination, and the shortest-path distance.
Directional Balance of Trains – Train crews typically specialize in a single lane, between their home and their away bases. If there are more trains travelling from, say, the home base to the away base, compared to the opposite direction, then an excess number of crew light locomotive movements will occur. To correct this imbalance of directional crew starts, longer and, therefore, fewer trains are run in one direction than in the other.

Train Weight, Speed and Locomotive Requirements – A common model that is used for planning the number and size of locomotives is to assign to a train an operating horsepower per ton requirement. Higher speeds (but higher fuel costs) may be achieved if a fourth locomotive is used and the maximum track speed is sufficiently high.

Train Scheduling – The timing of trains into and out of yards also significantly affects the transit times and, surprisingly, the road locomotive count. Train timings affect how long wagons stay in the yard, the crews’ needs, track congestion, and peak wagon inventory in the yard. Train timing must also meet any curfews imposed on the routes they share with passenger train services.

Locomotive Distribution – Train weight is often unbalanced (when loaded trains/wagons leaves the cargo, there are no empty wagons placed ready for loading; and this results in loading delays; i.e. they have to wait for the empties to arrive empty); and hence, extra locomotives are added to the trains to reposition them for later moves; and sometimes locomotives are ferried between locations for balancing power (called a light-engine-move). The constraints usually associated with locomotives are the fleet size (number of locomotives of each type) and the minimum number of locomotives needed to power a train. The objective is to limit the total number of locomotives used, while keeping in check the number of pure repositioning light-engine moves.

Traffic Considerations – Traffic is the collection of wagons that move over the railway. On a day-to-day basis, this traffic is variable; and it is hard to predict at a detailed level; but it is predictable to approximately 20% accuracy (mean absolute
deviation) on a yard-by-yard basis. The variability in traffic has led the railways for the past several decades into a tonnage-based dispatching discipline. Creating an operating plan that is robust enough to handle this variability in traffic is a paramount consideration in perfecting the scheduled railway.

There are several types of constraints and objectives that deal with wagons. Some wagons, such as those that move finished automobiles or double-stacked intermodal containers, are higher than other wagons and cannot fit through some tunnels or under some overpasses. Some sections of track may also have a wagon-weight restriction for wagons weighing more than 138 tons (or, in some cases, 143 tons).

There is a time-based asset payment by the railway to the owner of the wagon, while the wagon is on-line. Typically, it is important for a railway to take excess empty wagons that are not owned by the railway, and to return them to the railway that owns them – as quickly as possible. The reduction of asset payments is often bundled with the reduction of total wagon cycle time (or increased wagon velocity). The cycle time is the period from when an empty wagon is identified as being needed by a customer until the time when the customer releases the car as an empty again; and it is subsequently identified as being needed by another customer.

Reducing cycle time reduces the asset payments, the track needed to store empty wagons, and the number of wagons that the railway needs to own or lease. This is often measured at a macro-level through a statistic known as total wagons on-line, which the railways seek to minimize.

- **Block-to-Train Assignments** – Part of the train plan is specifying which type of traffic is picked up or delivered by the train at yards along the way. This is the process whereby the blocking plan is applied to the train plan. There could be two trains with identical paths that are significantly different in the type of traffic they carry, and the intermediate locations where the trains stop and pick up or deliver cars.

Assignments of the blocks to trains determine the number of wagons and the weight that the train carries. They also determine the transit times (each intermediate stop takes time). The operating plan designer can modify the train size through manipulation of the blocks it carries. Another way to modify the train size is to
change the day-of-week service, which means either running the train less than 7 days per week, or having the assignment of blocks to train change by the day-of-the-week. Changing day-of-the-week parameters could result in wagons spending more or less turn-around time in the yards.

When planning day-of-the-week variations, the operating plan designer uses a seven-day simulation to estimate the train and block volumes, and then tunes the day-of-the-week frequency and block planning to resolve issues on the train length (either being too long or too short), yard operations, and transit times.

The most important railway objective is to establish a reliable customer service with low variability, so that the wagons arrive at the customer site when the customer expects them. There are varying requirements for service. For example, automobile manufacturers generally expect auto parts to be delivered to their location within a few hours of the expected time due to their just-in-time manufacturing processes; while power plants that store large amounts of coal can accept two or three days of deviation in their delivery times.

According to Ferreira and Sigut (1995), some contracts for automobile manufacturers have financial penalties for late or early arrivals of their parts; and if necessary, these penalties can be mathematically modelled. Many other contracts do not have specific financial penalties, but systematic unreliability would cause a breach of contract, or a diversion to competing railways or trucks. Even without a contract, unreliability has severe penalties. Customer satisfaction surveys taken at many railways uniformly report that reliability of service is a critical criterion in their selection of transportation supplier. Interestingly, reducing the average transit time is not nearly as important a customer objective as a reliable transit time.

In Sishen (SIN), all mining activities are done by open-cast methods, with the ore being transported to the beneficiation plant, where it is crushed, screened and beneficiated. Kumba is the only haematite ore producer in the world to fully beneficiate its product; and this is achieved through the Dense Medium Separation (DMS) process and jig technology. The local structures in the mine area are, however, very complicated; and the interplay between the various tectonic events and the resulting geological structures were critical to the ore’s formation and preservation. In general, the high-grade laminated and massive ore is preserved in synclinal structures, which are the result of multiple deformation events (Barrow, 2012).
CHAPTER 3:
THE METHODOLOGY

3.0 INTRODUCTION

Franklin (2012) defines Research Methodology as the process used to collect information and data for the purpose of making business decisions. Hence, the research design ensures that the study becomes relevant to the problem, and that it uses an economically sound procedure. This study aims to perform in-depth research on the processes and the train-schedule plans, in order to have a better knowledge of the day-to-day operations for train schedules, and to have a better understanding of the problems that the Transnet Freight Rail is facing on a daily basis, so as to be able to proffer a solution for the identified problem.

3.1 RESEARCH METHOD

Both qualitative and quantitative approaches were employed. This helps to validate one set of improperly defined techniques employed in the data collection. The advantage of using the qualitative approach is that the respondents are responsible for the completion of the questionnaire. The questionnaires focus on the principle of standardized methodological procedures; and the data will be analysed by using statistical software.

Creswell (2009) addresses qualitative research as a method that creates conclusions about a population by analysing a representative sample of the population; while Leedy and Ormrod (2010) see quantitative research as a method that seeks to differentiate between the attributes of a phenomenon, and to study the relationship between two or more phenomena.

3.2 DATA COLLECTION

The data were collected comprehensively and systematically on the relevant section, between the drop-off depot (Postmasburg) and the Mine (Sishen). In order to address the research questions, a combination of methods was employed in this research study for collecting the primary data and the secondary data. For the primary data, the method included a semi-structured group interview that was tape-recorded; and in addition, the questionnaires were
administered to allow the participants to explore the topic, and to give their opinions and ideas in their own words.

### 3.2.1 The semi-structured group interview

At the outset of the group interaction, the researcher assured the interviewee that confidentiality would be guaranteed, in order to encourage the interviewee to speak freely. The discussions were aimed at getting an individual overview of the possible causes of the delays in the turn-around times of wagons in general, and the effect on the company and on the customer. The interview was very short and brief, to allow the population time to voice their thoughts on the questionnaire as well. Three questions were presented and discussed.

### 3.2.2 The Questionnaire design

The questionnaires were designed and structured, according to the quantitative approach. The questionnaire contained eight (8) sections, on which the employees and the managers would be asked to comment. They were sent out to the participants electronically – for them to complete and return to the sender; and the reminder was sent to them by email, to ensure that it was completed in time.

The sections were grouped into the following elements:

- **Demographic Information** – Understanding the respondents and their level of maturity.
- **Company Profile** – Getting to know the level of experience and knowledge within the company.
- **Performance Management** – Exploring Transnet performance in general, and how the performance management was implemented.
- **Improving Turn-around Time** – Analysing the situation and the root causes thereof, and finding ways to improve.
- **Just-In-Time Deliveries** – Assessing the impact of late deliveries, and how they affect the day-to-day production.
- **Management of Challenges** – Assessing how the challenges are managed.
- **Some typical challenges encountered by the freight rail** – Breakdown of the challenges that recur most frequently.
- **Communication** – Assessing the flow of communication internally and externally.
In this study, the Likert Scale was a useful device to build a degree of sensitivity and differentiation of responses, while generating numbers; and the respondent would indicate agreement or disagreement with the statement. For the secondary data, the internet was also used to retrieve information and the reports of previous years, which would be helpful.

3.3 THE POPULATION

The population for this research were Transnet employees, as well as internal customers. This study was focused on how to improve the Turn-around Time of Iron Ore Wagon Utilisation at Transnet.

3.3.1 The Sample Frame

The focus of the research was on the area where the empty wagons arrive at Postmasburg (PMG) to the time they are finished and cleared. This monitored directly the schedule of the trains, and the step-by-step procedure that is followed when executing the activities, as well as the cycle time of the wagons. This research study targeted the Transnet Freight Railway employees from Customer Care, Train and Network Planning location based in Parktown Johannesburg. A list of all the employees was obtained for the appointments, and the numbers of the managers were also obtained from the internal phone book; and appointments were made with their personal assistants.

3.3.2 The Sample Size

100 questionnaires were distributed, 30 in the customer-care department, 30 in the Train and Network Planning department, and 40 between Sishen and the Postmasburg depot. The questionnaires were placed at the reception tables; and each person who entered was requested to take one to fill in; and then there was a box also placed at the reception, into which the employees were requested to put the completed questionnaires for collection.

3.4 ANALYSIS OF THE DATA

The data from the interviews and the questionnaires were transcribed and analysed. The Statistical Product and Service Solutions (SPSS) software package was used by the Statkon to generate the descriptive statistics and analyse data. The Microsoft Excel Ranking function was used to compute the rank of mean scores of responses. The questionnaires were
subsequently analysed using the 5-point Likert system; the researcher ensured that there were no incomplete questionnaires, by personally checking them one by one. The data were scored using the Likert Scale; and the values for the five scoring categories were presented as follows:

| Strongly agree | 2 |
| Agree         | 1 |
| Neither agree nor disagree | 0 |
| Disagree      | -1 |
| Strongly disagree | -2 |

The mean score and frequency for each item were then calculated.

According to Bowling (1997), a Likert Scale is a psychometric scale for measuring the attitudes of people, by asking them to respond to a series of statements about a topic, in terms of the extent to which they agree or disagree with them, and so tapping into the cognitive and affective components of their attitudes.

The survey asked the respondents to indicate their opinion on how strongly the agree or disagree with the statement and questions, ranging from strongly agree to strongly disagree and poor to excellent, also to no extent to a large extent. Cross-tabulation was used for the statistics, and to reveal formerly hidden relationships that helped to explain the data more clearly. These tables were presented at the end of the research project, after the data had been collected and analysed.

The semi-structured interview was administered with the distribution of the questionnaire which assisted to establish the context of the survey. The interviewer was guided by a set of questions to attempt to establish rapport with the respondent to produce richer data. The advantage of a semi-structured interview is the flexibility in obtaining information based on themes such as infrastructure development and performance outputs at the rail interface. It also provided the opportunity to probe answers.
3.5 RESEARCH RELIABILITY AND VALIDITY

Reliability – Van der Colff (2001); states that reliability can be related to the capacity of the observer to carry out the process of measurement consistently. If the subject of study does not change it can be assumed that the results would be the same from one measurement to the next.

Reliability is concerned with estimates of the degree to which a measurement is free of random or unstable error. The forms of reliability are stability, equivalence and internal consistency which we got on this study. A measure is said to be stable if you can secure consistent results with repeated measurements of the same person with the same instrument. The semi-structured interviews was used to enhance the reliability of the responses to the questionnaire, this was achieved by discussing the themes around which the questions were based. The response rate was not high as compared to the study, but it is acceptable for the level of the study.

Validity – refers to the question whether the instrument measures what it is supposed to measure i.e. has the researcher gained full access to knowledge and meaning from respondents. The results of the study are legitimate because the data gathering and the analysis performed were consisted with standard procedure adopted in research methodology. Semi-structured interviews were administered in this study to allow meanings to be probed.
CHAPTER 4:
RESULTS AND ANALYSIS

4.0 INTRODUCTION

This chapter presents the results of the data collected in this study by means of the questionnaires and interviews. The analysis of the results was conducted with the help of Statkon and the discussion of the results is also presented in this chapter. It then concludes with a section presenting the main findings of the analysis of the data collected data for this study.

4.1 RESPONSE TO QUESTIONNAIRES

Response to the questionnaires were done in a form of frequencies and descriptive statistics.

SECTION A – Demographic Information
Every question in Section A starts with an A, in Section B with a B, in Section C with a C, in Section D with a D, in Section E with an E, and so on.

A1. What is the name of your company?
The questionnaire was given to Transnet employees only; therefore. Everyone who answered was from Transnet. Table 4.1 below shows that all the respondents named it differently; and some used different spellings.

| Table 4.1: Company responses to the questionnaire |
|---------------------------------|-------|--------|--------|
|                                | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                          | 7       | 10.0    | 10.0    | 10.0            |
| Transnet Freight Rail          | 1       | 1.4     | 1.4     | 11.4            |
| Transnet                       | 4       | 5.7     | 5.7     | 17.1            |
| Transnet Freight Rail          | 1       | 1.4     | 1.4     | 18.6            |
| Transnet freight rail          | 1       | 1.4     | 1.4     | 20.0            |
| Transnet freight rail          | 5       | 7.1     | 7.1     | 27.1            |
| Transnet Freight Rail          | 46      | 65.7    | 65.7    | 92.9            |
| Transnet Freight Rail          | 4       | 5.7     | 5.7     | 98.6            |
| Trasnet                        | 1       | 1.4     | 1.4     | 100.0           |
| Total                          | 70      | 100.0   | 100.0   | 100.0           |
A2. How many people does your company employ?
The results showed that 91.4% of the respondents said that the company employs more than 200; while 8.6% said the company employs less than 200 people. The results are presented in Figure 4.1 below.

![Figure 4.1: Responses to the number of people the company employs](image)

A3. What is your Ethnic group?
The results show that most of the respondents were Blacks; and this amounted to a percentage of 87.1%. The Whites comprised 8.6%; and the Coloureds were 4.3%. Figure 4.2 indicates the distribution of the ethnic groups in the questionnaire.

![Figure 4.2: Distribution of ethnic groups](image)
A4 What is your gender?
The results indicate that 61.4% of the respondents were females, and 38.6% were males. Figure 4.3 indicates the distribution of gender responses to the questionnaire.

A5 What is your age?
The result shows that the majority of the responders were between the ages 31-40, followed by the ages between 41-50. Figure 4.4 indicates the distribution of ages in the questionnaire.
A6 What is your employment status?
The results show that 95.7% of the responders were permanent staff members; and only 4.3% were temporary staff. The permanent staff members had more of an interest in answering the questionnaire, which made the information, obtained more believable looking at the 95.7% of the respondents. The results are presented in Figure 4.5.

![Figure 4.5: Employment status of the respondents to the questionnaire](image)

A7 What is your job level?
Most of the questionnaires were answered by the junior employees amounting to 81.4%; while 12.9% were the management. Only one person answered differently. The results are presented in Figure 4.6 with the distribution of the job level.
Figure 4.6: Job level of the responses to the questionnaire

A8 Work environment
The results indicated that 92.9% of the respondents are office-based; while 7% were from the fields. Figure 4.7 shows the distribution of the work environment of the respondents to the questionnaire.
A9 What is your highest educational qualification?

The results for this question show that 60% of the respondents had a postmatric Diploma and/or Certificate; while 22.9% had only a grade 12; and 17.1% had degrees. The results are shown on the graph below.
SECTION B: COMPANY PROFILE

B10 Does Transnet run a scheduled railway between Postmasburg and Sishen?
The results revealed that Transnet does not run a scheduled railway, with 76% of the respondents who said that Transnet Freight Rail does not run a scheduled railway; and only 24% said yes it does run a scheduled railway. Figure 4.9 indicates the level to which the respondents referred.

![Employee status chart](image)

**Figure 4.9: Responses to the Scheduled railway**

B11 If you answered yes to question 10, how effective is the scheduling method currently being used between Postmasburg and Sishen?
The majority seemed to think that Transnet Freight Rail does not run a scheduled railway; and 24.3% rated the scheduling method to be somewhere between neutral and effective. Figure 4.10 shows how effectively the respondents rated the scheduling method at Transnet.
Figure 4.10: Responses to the effectiveness of the scheduling method asked in the questionnaire

B12 How would you rate the Turn-around Time of the wagons between Postmasburg and Sishen?

The results show that 77.1% rated the turn-around time of the wagons to be between poor and fair; and only 23% said the time was good. Figure 4.11 indicates the rating of the turn-around time of the wagons.

Figure 4.11: Rating of Turn-around time of the wagons
B13 If you answered poor to fair in question 12, tick the factors contributing to the poor turn-around time.

Figure 4.12 shows the results in which the majority of the respondents suggested that in order to improve the turn-around time of wagons the company needs to have a proper plan with regard to the wagons and locomotives; and that the resources must be well maintained. As many as 36.1% said that the defective wagons were contributing to the poor turn-around time of the wagons; whilst 44.3% said it was the challenges presented by the locomotives.

Figure 4.12: Factors contributing to the poor turn-around time of the wagons

SECTION C: PERFORMANCE MANAGEMENT

Likert-Scale Questions
### Table 4.2: This shows the Statistics on Performance Management

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Valid</th>
<th>Missing</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Employees in this organization have clear performance criteria against which they are rated.</td>
<td>69</td>
<td>1</td>
<td>3.54</td>
<td>4.00</td>
<td>4</td>
<td>1.02</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>C2</td>
<td>There is sufficient communication on the importance of performance improvements in the organization.</td>
<td>69</td>
<td>1</td>
<td>3.80</td>
<td>4.00</td>
<td>4</td>
<td>0.99</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>C3</td>
<td>Employees in this organization have the necessary skill/s or training to succeed in their key performance area.</td>
<td>69</td>
<td>1</td>
<td>3.65</td>
<td>4.00</td>
<td>4</td>
<td>0.82</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>C4</td>
<td>Employees in this organization are given the requisite training to achieve their performance goals.</td>
<td>69</td>
<td>1</td>
<td>3.16</td>
<td>3.00</td>
<td>4</td>
<td>1.08</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>C5</td>
<td>Performance Management is clearly defined in the organization.</td>
<td>69</td>
<td>1</td>
<td>3.70</td>
<td>4.00</td>
<td>4</td>
<td>0.99</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>C6</td>
<td>Employees are empowered to continuously improve their work outputs.</td>
<td>69</td>
<td>1</td>
<td>3.19</td>
<td>4.00</td>
<td>4</td>
<td>1.12</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>C7</td>
<td>Rating of employee performance by management is fair.</td>
<td>69</td>
<td>1</td>
<td>2.54</td>
<td>2.00</td>
<td>2</td>
<td>0.98</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The average on performance management is between neutral and agree, except on C7 which is between disagree and neutral, with the lowest mean of 2.54, meaning that employees are not satisfied with the performance ratings.

### SECTION D: IMPROVING THE TURN-AROUND TIME

### Table 4.3: Shows the Statistics on improving the turn-around time

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Valid</th>
<th>Missing</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Reducing cycle time reduces the number of wagons that the railway needs to own.</td>
<td>69</td>
<td>1</td>
<td>4.10</td>
<td>4.00</td>
<td>4</td>
<td>0.83</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>D2</td>
<td>Reducing cycle time reduces the asset payments needed to store empty wagons.</td>
<td>69</td>
<td>1</td>
<td>4.06</td>
<td>4.00</td>
<td>4</td>
<td>0.94</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>D3</td>
<td>Longer trains are more economical due to efficiencies in crews.</td>
<td>69</td>
<td>1</td>
<td>3.99</td>
<td>4.00</td>
<td>4</td>
<td>0.93</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>D4</td>
<td>Longer trains are more economical due to efficiencies in locomotives.</td>
<td>69</td>
<td>1</td>
<td>3.94</td>
<td>4.00</td>
<td>4</td>
<td>0.98</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>D5</td>
<td>Longer trains are more economical due to efficiencies in in track capacity.</td>
<td>68</td>
<td>2</td>
<td>3.88</td>
<td>4.00</td>
<td>4</td>
<td>1.00</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>D6</td>
<td>Wagons will meet their scheduled maintenance plan if the turnaround time is decreased.</td>
<td>69</td>
<td>1</td>
<td>3.97</td>
<td>4.00</td>
<td>4</td>
<td>0.79</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
The average on improving turn-around time is between neutral and agree, except on D1 and D2, which is agree and strongly agree with the highest mean of 4.10 and 4.06, respectively.

SECTION E: JUST-IN-TIME DELIVERIES

Table 4.4: This shows the statistics on just-in-time deliveries

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1 Inspection is done prior to the departure of the product to avoid delays in transit.</td>
<td>69</td>
<td>4.25</td>
<td>4.00</td>
<td>0.53</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>E2 Customers receive their good on time.</td>
<td>69</td>
<td>1.88</td>
<td>2.00</td>
<td>0.98</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>E3 Employees have the ability to deliver as per customer requirements.</td>
<td>69</td>
<td>3.93</td>
<td>4.00</td>
<td>0.55</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>E4 The method of execution with regards to deliveries is being utilized correctly.</td>
<td>69</td>
<td>3.51</td>
<td>4.00</td>
<td>0.88</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>E5 Work processes with regards to the deliveries are continually being optimized.</td>
<td>69</td>
<td>3.72</td>
<td>4.00</td>
<td>0.68</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The average on just-in-time deliveries is between neutral and agree; while E1 is between agree and strongly agree; and E2 is between strongly disagree and disagree, with the highest mean of 4.25.

SECTION F: MANAGEMENT OF CHALLENGES

Table 4.5: This shows the statistics on the management of challenges

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 Employees are provided with opportunities to contribute to their own aims.</td>
<td>69</td>
<td>2.64</td>
<td>2.00</td>
<td>1.04</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>F2 We have enough resources to move the required amount of commodities.</td>
<td>69</td>
<td>3.90</td>
<td>4.00</td>
<td>0.77</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>F3 We have reliable resources to move the required amount of commodities.</td>
<td>69</td>
<td>2.67</td>
<td>2.00</td>
<td>1.01</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>F4 The system used for tracking trains is effective.</td>
<td>69</td>
<td>4.25</td>
<td>4.00</td>
<td>0.58</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>F5 Employees are involved in improvement programs to enhance efficiency.</td>
<td>69</td>
<td>2.99</td>
<td>3.00</td>
<td>1.05</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
The average on management of challenges is between agree and strongly agree, except on F1 and F3, which are between disagree and neutral.

SECTION G: SOME TYPICAL CHALLENGES ENCOUNTERED BY THE FREIGHT RAIL

Table 4.6: This shows the statistics on typical challenges encountered by the Freight Rail

<table>
<thead>
<tr>
<th>Statistics</th>
<th>N</th>
<th>Valid</th>
<th>Missing</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 Cable theft</td>
<td>69</td>
<td>1</td>
<td></td>
<td>4.16</td>
<td>4.00</td>
<td>4</td>
<td>0.63</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>G2 Maintenance of infrastructure</td>
<td>69</td>
<td>1</td>
<td></td>
<td>1.90</td>
<td>2.00</td>
<td>2</td>
<td>0.86</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>G3 Locomotive failure</td>
<td>69</td>
<td>1</td>
<td></td>
<td>4.32</td>
<td>5.00</td>
<td>5</td>
<td>0.90</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>G4 Wagons out of service</td>
<td>69</td>
<td>1</td>
<td></td>
<td>4.30</td>
<td>4.00</td>
<td>5</td>
<td>0.81</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>G5 Poor employee commitment</td>
<td>69</td>
<td>1</td>
<td></td>
<td>3.38</td>
<td>4.00</td>
<td>4</td>
<td>0.84</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>G6 Lack of management support</td>
<td>69</td>
<td>1</td>
<td></td>
<td>2.65</td>
<td>3.00</td>
<td>2</td>
<td>1.11</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

The average on typical challenges encountered by the Freight Rail is between agree and strongly agree, except on G2 where they disagreed to say the maintenance of infrastructure does not have much impact on the freight deviations, with the mean of 1.90.

SECTION H: COMMUNICATION

Table 4.7: This shows the statistics on communication

<table>
<thead>
<tr>
<th>Statistics</th>
<th>N</th>
<th>Valid</th>
<th>Missing</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1 There is good communication amongst the employees.</td>
<td>69</td>
<td>1</td>
<td></td>
<td>3.68</td>
<td>4.00</td>
<td>4</td>
<td>0.61</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>H2 Railway's wide communication network fully satisfies the data transmission of railways.</td>
<td>69</td>
<td>1</td>
<td></td>
<td>3.81</td>
<td>4.00</td>
<td>4</td>
<td>0.62</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>H3 Customers are always kept in the loop for every deviation occurring.</td>
<td>69</td>
<td>1</td>
<td></td>
<td>4.03</td>
<td>4.00</td>
<td>4</td>
<td>0.79</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>H4 The design of train schedule matches with the on-time departure and arrivals of trains.</td>
<td>69</td>
<td>1</td>
<td></td>
<td>2.04</td>
<td>2.00</td>
<td>2</td>
<td>0.88</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>H5 The number of trains planned per day/week matches with the sets of wagons given.</td>
<td>69</td>
<td>1</td>
<td></td>
<td>2.20</td>
<td>2.00</td>
<td>2</td>
<td>1.07</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
The average on communication is between agree and strongly agree, except on H4 and H5 where they disagreed on the design of the train schedule, saying that it does not match with the on-time departure and arrivals of trains; and they maintain that the number of trains planned per day/week matches with the number of wagons given.

4.2 FACTOR ANALYSIS

Factor Analysis takes a large set of variables and looks for a way the data may be reduced or summarised by using a smaller set of factors or components. Various statistics were used to measure the relevance of the research which is necessary in showing the reliability and accuracy of the study.

Factor analysis was used to determine whether any relationships can be further determined between the variables. The SPSS package was utilized to extract the data and a number of factors were determined from all the questionnaires’ sections. The Kaiser-Meyer-Olkin measure of sampling adequacy was used to ensure that the values were above the recommended value of 0.6 for all the factors; and that the test is significant at 0.000 sig. value.

4.2.1 Performance Management

Table 4.8: This shows the total variance explained for performance management

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
<th>Total Variance Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
<td>Total</td>
</tr>
<tr>
<td>2</td>
<td>1.070</td>
<td>15.290</td>
<td>61.276</td>
<td>0.644</td>
</tr>
<tr>
<td>3</td>
<td>0.932</td>
<td>13.313</td>
<td>74.590</td>
<td>0.615</td>
</tr>
<tr>
<td>4</td>
<td>0.512</td>
<td>7.315</td>
<td>90.686</td>
<td>0.351</td>
</tr>
<tr>
<td>5</td>
<td>0.301</td>
<td>4.299</td>
<td>100.000</td>
<td></td>
</tr>
</tbody>
</table>

For performance management the inspection of the correlation matrix reveals the coefficients of 0.3 and above. The Kaiser-Meyer-Oklin value was 0.768, exceeding the recommended value of 0.6; and the Bartlett’s test of sphericity was statistically significant at 0.00. The anti-
image matrices for the MSA were all bigger than 0.6; so no questions needed to be excluded. Commonalities are between 0.3 and 0.8, except on C1, which is 0.152. The Principal Components Analysis revealed the presence of two components with eigenvalues exceeding 1, explaining 46% and 15.3% of the variance, respectively, C1 being 61% before rotation and 48% after rotation. (The results are shown in Appendix II).

Table 4.9: This shows the factor matrix rotated for performance management

<table>
<thead>
<tr>
<th>Rotated Factor Matrix*</th>
<th>Factor</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4</td>
<td></td>
<td>0.856</td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td></td>
<td>0.627</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td></td>
<td>0.525</td>
<td>0.519</td>
</tr>
<tr>
<td>C1</td>
<td></td>
<td>0.302</td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td></td>
<td></td>
<td>0.766</td>
</tr>
<tr>
<td>C2</td>
<td></td>
<td>0.315</td>
<td>0.694</td>
</tr>
<tr>
<td>C3</td>
<td></td>
<td>0.370</td>
<td>0.449</td>
</tr>
</tbody>
</table>

Table 4.9 shows that the Rotated Factor Matrix C4 has the highest loading of 0.856, which is closer to 1. C4, C7, C6 and C1 are in group 1; and C5, C2 and C3 are in group 2. (2nd Order Factor Analysis.) The Correlation Matrix is quite high above 0.3

4.2.2 Improving Turn-around Time

Table 4.10: This shows the total variance for improving Turn-around Time

<table>
<thead>
<tr>
<th>Total Variance Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>
For improving Turn-around Time the correlation matrix revealed coefficients of 0.3 and above. The Kaiser-Meyer-Oklin value was 0.849, exceeding the recommended value of 0.6; and the Bartlett’s test of Sphericity was statistically significant at 0.000. The anti-image matrices for the MSU were all bigger than 0.6; so no questions need to be excluded. The commonalities are all bigger than 0.3. The Principal Components Analysis revealed the presence of one component with eigenvalues exceeding 1, explaining the 76% of the variance. Shown in Table 4.10 above.

Table 4.11 shows that for the factor matrix everything is in one group, D3 having the highest loading of 0.923.

4.2.3 Just-in-time deliveries

Table 4.12: This shows the total variance for just-in-time deliveries
For the correlation matrix values, some of the correlations are below 0.3; and very few have a high correlation, shown in Table 4.12. The respondents agreed with some of the questions and disagreed with others; so the questions proved that they were not testing the same thing. The Kaiser-Meyer-Olkin value was 0.530 below the recommended value of 0.6. The anti-image matrices for the MSA were all below the recommended 0.6; so no questions needed to be excluded. Commonalities are all smaller than 0.3. The Principal Component Analysis revealed the presence of two components with eigenvalues exceeding 1, explaining 33.9% and 27.7% of the variance, respectively, E1 being 61.6% before rotation and 22.5% after rotation.

Table 4.13: This shows the component matrix for just-in-time deliveries

<table>
<thead>
<tr>
<th>Component Matrix(^a)</th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.255</td>
<td>0.705</td>
</tr>
<tr>
<td>E2</td>
<td>0.401</td>
<td>-0.512</td>
</tr>
<tr>
<td>E3</td>
<td>-0.003</td>
<td>0.766</td>
</tr>
<tr>
<td>E4</td>
<td>0.844</td>
<td>0.083</td>
</tr>
<tr>
<td>E5</td>
<td>0.898</td>
<td>-0.046</td>
</tr>
</tbody>
</table>

Table 4.13 shows that E3 has the lowest score on Component Matrix; and this needed a reverse scoring.

Table 4.14: This shows the commonalities for just-in-time deliveries

<table>
<thead>
<tr>
<th>Commonalities(^a)</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.106</td>
<td>0.222</td>
</tr>
<tr>
<td>E2</td>
<td>0.099</td>
<td>0.130</td>
</tr>
<tr>
<td>rE3</td>
<td>0.099</td>
<td>0.371</td>
</tr>
<tr>
<td>E4</td>
<td>0.398</td>
<td>0.401</td>
</tr>
<tr>
<td>E5</td>
<td>0.445</td>
<td>0.999</td>
</tr>
</tbody>
</table>

Table 4.14 shows that there is a commonality of a variable that exceeds 1.0 and has used the likelihood as the Extraction Method to see which variable Commonality exceeded 1. E5 has the highest commonality of 0.999 in the extraction table, which is closer to 1.
Table 4.15: This shows the factor matrix rotated for just-in-time deliveries

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>rE3</td>
<td>0.532</td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>-0.512</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>0.375</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>0.359</td>
<td></td>
</tr>
</tbody>
</table>

E3 and E1 are grouped together and E4 and E2 are also grouped together. Shown in table 4.15.

4.2.4 The management of challenges

Table 4.16: This shows the component matrix for the management of challenges

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>0.704</td>
<td>0.181</td>
</tr>
<tr>
<td>F2</td>
<td>0.167</td>
<td>0.685</td>
</tr>
<tr>
<td>F3</td>
<td>-0.032</td>
<td>0.836</td>
</tr>
<tr>
<td>F4</td>
<td>0.633</td>
<td>-0.236</td>
</tr>
<tr>
<td>F5</td>
<td>0.871</td>
<td>-0.076</td>
</tr>
</tbody>
</table>

Table 4.16 shows that F3 has a negative component, which needed to be reversed, and in iteration 25 the commonality of a variable exceeded 1.0. When the maximum likelihood as the extraction method was used to see which variable’s commonality exceeded 1, F3 and F5 are 0.999, which is closer to 1.

When omitting F3 and F5, very few correlations are below 0.3; and most of the correlations are above 0.2. The Kaiser-Meyer-Olkin value was 0.502 below the recommended value of 0.6, and Bartlett’s test of Sphericity was statistically significant at 0.000. The anti-image matrices for the MSA were below the recommended 0.6, except on F2 which was 0.658. The commonalities are all bigger than 0.3, except on F2, which was 0.014. The Principal
Components Analysis revealed the presence of two components with eigenvalues exceeding 1, explaining 42% and 25% of the variance, respectively, F2 being 67% before rotation and 40% after rotation. The results are shown in Table 4.17 below.

Table 4.17: Shows the total variance for the management of challenges

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>1</td>
<td>1.684</td>
<td>42.101</td>
<td>42.101</td>
</tr>
<tr>
<td>2</td>
<td>1.011</td>
<td>25.267</td>
<td>67.368</td>
</tr>
<tr>
<td>3</td>
<td>0.877</td>
<td>21.936</td>
<td>89.304</td>
</tr>
<tr>
<td>4</td>
<td>0.428</td>
<td>10.666</td>
<td>100.000</td>
</tr>
</tbody>
</table>

Table 4.18: This table shows the factor matrix for the management of challenges

| Rotated Factor Matrix  
<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5</td>
<td>0.701</td>
<td>0.450</td>
</tr>
<tr>
<td>F1</td>
<td>0.670</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>0.132</td>
<td>0.663</td>
</tr>
<tr>
<td>F2</td>
<td></td>
<td>0.119</td>
</tr>
</tbody>
</table>

After rotation, two factors were extracted. F5 with the highest loading of 0.701, F1 with 0.670 and F4 with 0.132 are in factor 1, and F2 is in factor 2.
4.2.5 Communication

Table 4.19: Shows the total variance for communication

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>1.849</td>
<td>61.636</td>
</tr>
<tr>
<td>2</td>
<td>0.616</td>
<td>20.537</td>
</tr>
<tr>
<td>3</td>
<td>0.535</td>
<td>17.827</td>
</tr>
</tbody>
</table>

H4 and H5 needed to be excluded from the MSAs of 0.533 and 0.357, respectively. The correlation matrix revealed the coefficients of 0.3 and above. The Kaiser-Meyer-Olkin value was 0.665, exceeding the recommended value of 0.6, and Bartlett’s test of Sphericity was statistically significant at 0.000. The anti-image matrices for the MSA were all bigger than 0.6; so after excluding H4 and H5, the commonalities are all bigger than 0.3. The Principal Components Analysis revealed the presence of one component with eigenvalues exceeding 1, explaining the 61.6% of the variance.

Table 4.20: Shows the factor matrix for communication

<table>
<thead>
<tr>
<th>Factor Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>H2</td>
</tr>
<tr>
<td>H3</td>
</tr>
<tr>
<td>H1</td>
</tr>
</tbody>
</table>

Only one factor was extracted after omitting H4 and H5, H2 having the highest loading of 0.704, shown in table 4.20.
4.3 RELIABILITY OF SCALE

This refers to the degree to which the items that make up the scale are all measuring the same underlying construct. The Cronbach Alpha coefficient is used as an indicator of internal consistency; and the scale should be above 0.7. The Cronbach Alpha values are, however, dependent on the number of items in the scale; but with the small number (less than 10), it is sometimes difficult to get a decent Cronbach Alpha value, possibly as low as 0.4.

4.3.1 Performance Management

Table 4.21: This shows the reliability of the performance management for Factor 1

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.713</td>
</tr>
</tbody>
</table>

Performance management Factor 1 has good internal consistency with a Cronbach Alpha coefficient of 0.713, shown in table 4.21 above.

Table 4.22: This shows the reliability statistics of the performance management for Factor 2

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.705</td>
</tr>
</tbody>
</table>

Performance management Factor 2 has good internal consistency with a Cronbach Alpha coefficient of 0.705, shown in table 4.22 above.

4.3.2 Improving Turn-around Time

Table 4.23: This shows the reliability statistics for Improving Turn-around Time

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.935</td>
</tr>
</tbody>
</table>
The turn-around time has an excellent internal consistency with a Cronbach Alpha coefficient of 0.935, shown in table 4.23 above.

### 4.3.3 Just-in-Time Deliveries

Table 4.24: This shows the reliability statistics of Just-in-time deliveries

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.419</td>
</tr>
</tbody>
</table>

The Cronbach Alpha values on Just-in-Time Deliveries are quite sensitive to the number of items in the scale. The Cronbach Alpha coefficient is 0.419, shown in table 4.24 above.

### 4.3.4 Management of Challenges

Table 4.25: This shows the reliability statistics for the management of challenges

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.647</td>
</tr>
</tbody>
</table>

The management of challenges has a good internal consistency with a Cronbach Alpha coefficient of 0.647, shown in table 4.25 above.

### 4.3.5 Communication

Table 4.26: This shows the reliability statistics of Communication

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's Alpha</td>
</tr>
<tr>
<td>0.681</td>
</tr>
</tbody>
</table>
Communication has a good internal consistency with a Cronbach Alpha coefficient of 0.681, shown in table 4.26 above.

**Conclusion on Reliability**

All the values are acceptable; showing very good internal consistency reliability, the Just-in-Time Deliveries with the Cronbach Alpha coefficient of 0.419 is also acceptable looking at the number of items in the scale.

### 4.4 CROSS-TABULATION

This is used to find out what percentage of the employees think whether Transnet Freight Rail runs a scheduled railway (question B10 on the questionnaire) when comparing it with the job level (question A7 on the questionnaire). In this case, 10.5% of the junior employees said yes; and 89.5% said no – that it does not run a scheduled railway with the total number of 57 respondents. When comparing these results with the results of the junior employees with the Supervisory/Management, 91.7% said yes; and 8.3% said no with a total number of 12 respondents. The results are shown in Table 4.27 below.

<table>
<thead>
<tr>
<th></th>
<th>Junior Employee</th>
<th>Supervisory / Management</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>rA7</strong></td>
<td>Count</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>% within rA7</td>
<td>10.5%</td>
<td>91.7%</td>
</tr>
<tr>
<td><strong>B10</strong></td>
<td>Yes</td>
<td>51</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>57</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>% within rA7</td>
<td>89.5%</td>
<td>8.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>Count</td>
<td>57</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>% within rA7</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Table 4.27: Cross tabulation on comparison between B10 and A7**

#### 4.4.1 Chi-Square Test

This test is used to explore the relationship between two variables, to compare the observed frequencies of cases that occur in each of the categories, with the values that would be expected if there were no association between the two variables being measured. The Alpha value must be less than 0.05. The results are shown in Table 4.28 below.
Using the Fisher’s Exact Test it shows there is difference between the junior employees and the supervisor/management given the p value of 0.000, for which the Alpha value must be less than 0.05.

### 4.4.2 Symmetrical Measures

Using the Fisher’s Exact Test it shows there is difference between the junior employees and the supervisor/management given the p value of 0.000, for which the Alpha value must be less than 0.05.

4.4.2 Symmetrical Measures

Using the Fisher’s Exact Test it shows there is difference between the junior employees and the supervisor/management given the p value of 0.000, for which the Alpha value must be less than 0.05.

#### Table 4.28: Chi-Square Test on comparison between B10 and A7

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>35.150(^{a})</td>
<td>1</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction(^{b})</td>
<td>30.916</td>
<td>1</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>31.804</td>
<td>1</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher's Exact Test</td>
<td></td>
<td></td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Linear-by-Linear</td>
<td>34.641</td>
<td>1</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Using the Fisher’s Exact Test it shows there is difference between the junior employees and the supervisor/management given the p value of 0.000, for which the Alpha value must be less than 0.05.**

**4.4.2 Symmetrical Measures**

**Table 4.29: Is used to measure the association between the two variables**

<table>
<thead>
<tr>
<th>Symmetric Measures</th>
<th>Value</th>
<th>Approx. Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal by Nominal</td>
<td>Phi</td>
<td>-0.714 0.000</td>
</tr>
<tr>
<td></td>
<td>Cramer’s V</td>
<td>0.714 0.000</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

**Using the Fisher’s Exact Test it shows there is difference between the junior employees and the supervisor/management given the p value of 0.000, for which the Alpha value must be less than 0.05.**

**4.4.2 Symmetrical Measures**

**Table 4.29: Is used to measure the association between the two variables**

<table>
<thead>
<tr>
<th>Symmetric Measures</th>
<th>Value</th>
<th>Approx. Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal by Nominal</td>
<td>Phi</td>
<td>-0.714 0.000</td>
</tr>
<tr>
<td></td>
<td>Cramer’s V</td>
<td>0.714 0.000</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

In this case, there is a negative relationship between the groups looking at the Phi value of 0.714, which is bigger than the Alpha value of 0.05, shown in table 4.29 above.

Figure 4.13 shows the relationship between the junior employees and the supervisor/management when enquiring whether Transnet runs a scheduled railway.
Figure 4.13: Relationship between junior employees and Supervisory/Management

Figure 4.13 indicates that basically the junior employees are saying that Transnet does not run a scheduled railway; while the management are saying, yes it runs a scheduled railway. There is a large difference between the groups.

4.5 DESCRIPTIVE STATISTICS

Descriptive statistics provide some information on the distribution of the scores on continuous variables, that is the skewness and the kurtosis. The skewness value provides an indication of the symmetry of the distribution; while the Kurtosis, on the other hand, provides information on the degree of ‘peak’ of the distribution curve.

4.5.1 TEST OF NORMALITY

Normality is used to describe a symmetrical, bell-shapes curve, which has the greatest frequency of scores in the middle, with smaller frequencies towards the extremes.
In the output presented from the Descriptive statistics, we have information from 69 respondents. In the table of descriptive statistics, we are provided with descriptive statistics and other information concerning the variables, the information is the mean, the median, the standard deviation, etc.
The other statistics we are looking at is the 5% Trimmed Mean. This is compared with the original mean, in order to see whether our extreme scores are having an influence on the mean.

4.5.2 BOX PLOT
A box and protruding lines represent each distribution of scores. The length of the box is the variables’ interquartile range; and it contains 50% of the cases. The line across the inside of the box represents the median value.

4.5.2.1 Turn-around Time
When rating the Turn-around Time of the wagons between Postmasburg and Sishen, for the Junior Employees, the box plot is used when you have two groups or datasets and wish to compare the mean score on some continuous variable. From Figure 4.14, it is seen that the junior employees rated the Turn-around Time of the wagons to be very poor – with the mean of 1.65, compared to the management with their mean of 2.75 with outliers just above 7%.

![Box plot of job level](image)

**Figure 4.14: Box plot of job level**
4.5.2.2 Performance Management
When rating the Performance Management between the job levels, it is seen that the junior employees had a mean of 2.94, and a median of above 2% when compared to the management with the mean of 3.9 and above 3%, and management having an outlier of 1%, as shown in Figure 4.15.

![Figure 4.15: Box plot of performance management](image)

4.5.2.3 Cable Theft
When comparing cable theft between Junior Employees and management, it is seen that the junior employees rated the impact of cable theft to be very high with the mean of 4.07, as did the management also, with their mean of 4.58. The two groups rated cable theft as having the a major impact. The results are shown in Figure 4.16.
4.5.2.4 Locomotive failure

When comparing locomotive failure between the Junior Employees and the management, it is seen that the junior employees rated the impact of locomotive failure to be very high with the mean of 4.43, as also did the management with their mean of 3.75, the junior employee having an outlier of just 2%, as shown in Figure 4.17.
4.5.2.5 Wagons out of Service

When comparing wagons out of service between Junior Employees and management, it is seen that the junior employees rated the impact of wagons out of service to be very high with the mean of 4.38, as also did the management with their mean of 4.0. There is an outlier on the junior employee of just 2%. Both groups rated the wagons out of service as having an impact on the turn-around time of wagons, as shown Figure 4.18.
4.5.2.6 Lack of Management Support

When comparing the lack of management support between Junior Employees and management, it is seen that the junior employees rated that there is no support from the management, with the mean of 2.8 compared to the management with their mean of 1.92, management having an outlier of 5%, as shown Figure 4.19.
4.5.3 COMPARISON BETWEEN JOB LEVELS

The comparison is done between the job levels of the Junior Employees and Supervisory/Management. If the variable is normally distributed, we use the parametric test; and when they are not normally distributed, we use the non-parametric test.

In this case, a non-parametric technique is used to detect any differences between the groups that actually exist, and the test is the Mann-Whitney test, because all of the variables were not normally distributed, which is being influenced by the small number of Supervisory/Managers.

4.5.4 Mann-Whitney U Test

This is used to test for differences between two independent groups on a continuous measure. The Mann-Whitney U test actually compares medians, converts the scores on the continuous variable to ranks across the two groups, results are shown in table 4.31 and table 4.32.
Table 4.31: Show the ranks for comparison between job levels

<table>
<thead>
<tr>
<th>Rank</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12</td>
<td>57</td>
<td>30.62</td>
<td>1745.50</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>55.79</td>
<td>669.50</td>
</tr>
<tr>
<td></td>
<td>69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean_SecC_F1</td>
<td>56</td>
<td>30.08</td>
<td>1684.50</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>55.13</td>
<td>661.50</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean_SecC_F2</td>
<td>56</td>
<td>32.61</td>
<td>1826.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>43.33</td>
<td>520.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean_SecD_F1</td>
<td>56</td>
<td>34.16</td>
<td>1913.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>36.08</td>
<td>433.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>56</td>
<td>31.86</td>
<td>1784.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>46.83</td>
<td>562.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>56</td>
<td>34.89</td>
<td>1954.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>32.67</td>
<td>392.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>56</td>
<td>36.79</td>
<td>2060.50</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>23.79</td>
<td>285.50</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>56</td>
<td>35.88</td>
<td>2009.50</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>28.04</td>
<td>336.50</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G5</td>
<td>56</td>
<td>32.68</td>
<td>1830.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>43.00</td>
<td>516.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>56</td>
<td>37.34</td>
<td>2091.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>21.25</td>
<td>255.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean_SecH_F1</td>
<td>56</td>
<td>33.98</td>
<td>1903.00</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>36.92</td>
<td>443.00</td>
</tr>
<tr>
<td></td>
<td>68</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.32: This shows the test statistics of comparison between job levels

<table>
<thead>
<tr>
<th>Test Statisticsa</th>
<th>Mann-Whitney U</th>
<th>Wilcoxon W</th>
<th>Z</th>
<th>Asymp. Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B12</td>
<td>92.500</td>
<td>1745.500</td>
<td>-4.224</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean_SecC_F1</td>
<td>88.500</td>
<td>1684.500</td>
<td>-4.011</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean_SecC_F2</td>
<td>230.000</td>
<td>1826.000</td>
<td>-1.730</td>
<td>0.084</td>
</tr>
<tr>
<td>Mean_SecD_F1</td>
<td>317.000</td>
<td>1913.000</td>
<td>-0.310</td>
<td>0.756</td>
</tr>
<tr>
<td>G1</td>
<td>188.000</td>
<td>1784.000</td>
<td>-2.764</td>
<td>0.006</td>
</tr>
<tr>
<td>G2</td>
<td>314.000</td>
<td>392.000</td>
<td>-0.395</td>
<td>0.693</td>
</tr>
<tr>
<td>G3</td>
<td>207.500</td>
<td>285.500</td>
<td>-2.317</td>
<td>0.020</td>
</tr>
<tr>
<td>G4</td>
<td>258.500</td>
<td>336.500</td>
<td>-1.365</td>
<td>0.172</td>
</tr>
<tr>
<td>G5</td>
<td>234.000</td>
<td>1830.000</td>
<td>-1.771</td>
<td>0.077</td>
</tr>
<tr>
<td>G6</td>
<td>177.000</td>
<td>255.000</td>
<td>-2.646</td>
<td>0.008</td>
</tr>
<tr>
<td>Mean_SecH_F1</td>
<td>307.000</td>
<td>1903.000</td>
<td>-0.493</td>
<td>0.622</td>
</tr>
</tbody>
</table>

The values that we look at in our output are the Z value and the significance level, which is given as Asymp. Sig (2-tailed). In this case, the Z value is -4.224 with a significance level of p=0.000, and B12 with the Mean_SecC_F1 the Z value is -4.011 with a significance level of 0.000, both of these variables have a probability value that is less than 0.05; so the results are significant as per table 4.32. There is a statistically significant difference in the rating of the turn-around time of the wagons; and there is a statistically significant difference in Performance Management.

The rest of the variables show a probability value of more than 0.05; so there is no statistically significant difference between the groups.

### 4.6 REGRESSION ANALYSIS

Regression Analysis is a family of techniques that can be used to explore the relationships between one continuous dependent variable and a number of independent variables. It will provide us with information about the model as a whole; and it will also allow us to to test whether adding a variable contributes to the predictive ability of the model.
Table 4.33: This shows the correlations for the dependent variables

<table>
<thead>
<tr>
<th></th>
<th>B12</th>
<th>Mean_SecC_F</th>
<th>Mean_SecD_F</th>
<th>G3</th>
<th>G4</th>
<th>Mean_SecH_F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Correlation</td>
<td></td>
<td>0.635</td>
<td>0.571</td>
<td>-0.182</td>
<td>-0.367</td>
<td>-0.295</td>
</tr>
<tr>
<td></td>
<td>Mean_SecC_F1</td>
<td>1</td>
<td>0.571</td>
<td>0.106</td>
<td>-0.236</td>
<td>-0.074</td>
</tr>
<tr>
<td></td>
<td>Mean_SecD_F</td>
<td>0.174</td>
<td>1.000</td>
<td>1.000</td>
<td>0.266</td>
<td>0.387</td>
</tr>
<tr>
<td>G3</td>
<td>-0.367</td>
<td>-0.320</td>
<td>-0.236</td>
<td>1.000</td>
<td>0.471</td>
<td>-0.056</td>
</tr>
<tr>
<td>G4</td>
<td>-0.295</td>
<td>-0.135</td>
<td>-0.074</td>
<td>0.387</td>
<td>1.000</td>
<td>0.035</td>
</tr>
<tr>
<td>Mean_SecH_F1</td>
<td>0.116</td>
<td>0.243</td>
<td>0.448</td>
<td>0.236</td>
<td>-0.056</td>
<td>0.035</td>
</tr>
</tbody>
</table>

Table 4.33. This shows only two of the variables (Section C Factor 1 and G4), and they have a relationship with our dependent variable with values of more than 0.3; whilst the rest show no relationship, with the values of less than 0.3. Performance Management and Locomotive failure correlate substantially.

4.6.1 MODEL SUMMARY

The model summary tell us how much of the variability of the independent variable (Rating the turn-around time of wagons between Postmasburg and Sishen) is not explained by other independent variables in the model under the heading R Squared.

Table 4.34: This shows the model summary for the dependent variable, B12

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.723a</td>
<td>0.522</td>
<td>0.476</td>
<td>0.564</td>
</tr>
</tbody>
</table>
In this case, the R squared value is 0.522; and this means that our model explains 52.2% (0.522 X 100) of the variance in rating the turn-around time of the wagons between Postmasburg and Sishen.

**4.6.2 ANOVA**

This tests the null hypothesis that multiple regression in the population equals 0; and it serves to assess the statistical significance of the results. In Table 4.35, the model reaches statistical significance with the sig. value = 0.000.

Table 4.35: This shows the ANOVA for a dependent variable, B12

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>21.543</td>
<td>6</td>
<td>3.591</td>
<td>11.299</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>19.703</td>
<td>62</td>
<td>0.318</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41.246</td>
<td>68</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**4.2.3 COEFFICIENTS**

This is used to show which variables included in the model have contributed to the prediction of the dependent variable (Rating the turn-around time of wagons between Postmasburg and Sishen) by looking in the column labelled Beta under Standardised Coefficients.

Table 4.36: This show the coeffecients for the dependent variable, B12
In this case, the largest beta coefficient is 0.739, which is the Performance Management Factor 1, meaning that this variable makes the strongest unique contribution to explaining the dependent variable when the variance explained by all the other variables in the models is controlled. The Beta for the rest of the variables is lower, indicating that they made less of a contribution.

The next step is when we look at the column marked Sig, to see whether this variable is making a statistically significant unique contribution to the equation. In this case, Mean SecC F1 with the Sig. value of 0.000 made a unique and statistically significant contribution to the prediction of the dependent variable (B12). However, all the other Sig. values are greater than 0.05, meaning that the variables are not making a significant unique contribution to the prediction of our dependent variable. Figure 4.20 shows the residual for the dependent variable; and it is normally distributed.

Figure 4.20: Residual for dependent variable
4.7 RESULTS FROM THE INTERVIEWS

4.7.1 Semi-Structured group interviews

The discussion aimed to get an individual overview of the causes for the delays in the turn-around times of wagons in general, and the effect this has on the company and on the customer. The questions were very brief; and the respondents had three questions to be answered.

**Question 1: Does Transnet Freight Rail run a scheduled railway between Postmasburg and Sishen?**

The majority of the respondents said, there was no scheduled railway trains departing that would indicate when they are ready to depart, which affects the turn-around time of the wagons. And this messes up the schedule of the customer.
The empties wagons somehow arrive at Postmasburg almost on time; but there are delays when they are supposed to be in place at Sishen, the loading station. This results in wagons standing without loading because the mine has scheduled times for loading and strict rosters for the personnel.

**Question 2: How would you rate the Turn-around Time of the wagons between Postmasburg and Sishen?**

The majority of the respondents rated the turn-around time to be very poor; and they said that the wagons are placed late at the mine; and again, there are delays in-between the sections before they could actually reach the destination. And when coming back to Postmasburg, there are every day challenges.

**Question 3: For those who rated fair to poor, what are the factors contributing to the poor Turn-around time, and what could be done to improve the turn-around time of the wagons?**

The respondents were of the opinion that the problems were caused by locomotive issues, such as breakdowns, and the need to be taken for repairs, such as offloaded wagons which
along the way have an impact on the locomotives. Others mentioned the short supplies of wagons caused by thousands of wagons standing at the repair sidings.

They mentioned that the wagons are not properly monitored: they go to load and to offload without proper handling, and without any maintenance plan. Wagons only go to be serviced after they break down. All these issues were mentioned by the employees in general.

According to most of the respondents, top management should be responsible for delivering as per the commitment to the customer. The lack of a clear command and control chain was a contentious issue with most respondents, especially from middle management down to operational level. The reason was that so many people are appointed as managers with only train experience; and most do not have the credentials – thereby resulting in priority issues being handled inefficiently.
CHAPTER 5: DISCUSSION

5.1 INTRODUCTION

This chapter analyses the results from the interviews and questionnaire, which consist of eight sections, in which the results are analysed accordingly. The questions were designed to probe the respondent’s opinions and evaluation of the current state of problems experienced and discusses how people see the turn-around time of wagons; and how they are affected by it. The discussion is given on Demographic and organization Information, Performance Management, Improving Turn-around Time and the challenges encountered by the freight rail.

5.2 DEMOGRAPHIC AND ORGANIZATION INFORMATION

The responses covered a wide range of positions from graduates in training, junior employees, supervisors and management. The majority of the respondents (60%) at least have a postmatric diploma, 92% being males; while only 8% were females. This is followed by 87.1% of Blacks, and 8.5% Whites, and 4.3% Coloureds. Most of the respondents (76%) indicated that the company does not run a scheduled railway; while 24% maintained that it runs a scheduled railway; furthermore, of the 24% that said the company runs a scheduled railway, 24.3% rated the scheduling method to be between neutral and effective.

There were differences between junior employees and management when asked whether Transnet run a schedule railway or not. 89.5% of junior employees said no whilst 91.7% of management said yes it run a scheduled railway.

5.3 PERFORMANCE MANAGEMENT

The company still needs to improve on how they rate the performance of the employees, or rather on how the approach is done thus far; as 47.8% of the respondents responded negatively and disagreed with the fact that the performance rating is fair. It has the lowest mean of 2.54. A number of issues can be addressed to improve the performance management.
5.4 IMPROVING TURN-AROUND TIME

There are a lot of concerns that the company needs to consider. The respondents strongly agreed with the improvement that still needs to happen. From the results shown, the Turn-around Time of the wagons exceeds the expected time; and this sets a bad record for customers’ satisfaction. Their feelings of frustration, not only concerning the Turn-around Time of wagons, but also about the real operational problems, limitations and restrictions to function effectively in this environment came through very strongly. They mostly gave an insight into the internal critical factors regarding organisational issues that they struggled with on a day-to-day basis. Among those internal factors, the major one was operational inefficiency.

5.5 CHALLENGES ENCOUNTERED BY THE FREIGHT RAIL.

The major challenges outlined by the respondents are:
1. **Locomotive issues**: some of the locomotives are being over-worked or being over-used to pull oversized loads than the required quantity. Some of the locomotives are not being serviced as required; because of the demands of the customers.
2. **Wagons that fail on rail**: the company is experiencing some of the wagons being out of the service, and not being maintained as they ought to.
3. **Cable theft** causes the trains to remain at the sections.
4. The flow of **communication** between Transnet and the mine is not effective enough and its impact on the Turn-around time of the wagons causes a delay; because sometimes wagons are placed for loading; but the client would leave it to load other prioritized trains.
5. **Scheduling of trains**: this does not match with the booking of resources and personnel, resulting in trains standing at the sections waiting for locomotives or personnel.
6. **Lack of Management support**: most of the junior employees pointed out that some of the management do not take the moving of tonnages too seriously.

5.6 SEMI-STRUCTURED INTERVIEW FINDINGS

The questions were investigative in nature in order to obtain direct answers on issues contained in the Research Objective. The semi-structured interviews were flexible, assisted to probe issues, elicited responsive interactions, identified key themes and relationships and
provided the researcher with a fuller access to knowledge and meanings from the respondents.

Respondents had a good understanding of the relationship between economic growth and logistics management and the pressing need for Transnet and South Africa to succeed as an exporting country. Many of the respondents who were senior managers of the shared similar ideas on the type of interventions required for a turnaround strategy for TFR. The prolonging of the turn-around time of wagons reduces the efficiency of rail transportation.
CHAPTER 6:
CONCLUSION AND RECOMMENDATIONS

6.0 SUMMARY OF THE RESEARCH

Both the qualitative and quantitative approach were used in this study, which helped in investigating and stipulating the research procedures – with the objectives that described the impact that the turn-around time has on customer satisfaction.

6.1 CONCLUSION

The main objective of the research was to find ways to improve the train turn-around time of the wagons. Transnet has always been striving to solve the problem in train scheduling and resource scheduling; and it became a huge challenge for years. Much capital has been spent on trying to improve scheduling; but the turn-around time of the wagons has remained an issue. Scheduling incorporates a number of resources and the systems becomes very complex. Various method of solving the problem were identified in the literature study; however, the applicability of some still have to be determined.

This project depicts and recommends possible methods that could be used to reduce the turn-around time of the wagons.

The following were major issues that are affecting the operations of PMG:

- Poor infrastructure due to lack of maintenance.
- Productivity in the yard is poor due to the loss of skilled personnel who had opted to go on early retirement.
- Poorly maintained locomotives and rail wagons affect the timeous departure of trains due to the high incidence of breakdowns.

It was evident that there is a delay between Sishen and Postmasburg that causes the loads to be delivered late – resulting in poor service delivery. The customers are not happy; and even resort to transporting some of their loads by road. Again, the lack of communication between Transnet Freight Rail and Sishen mine results in not keeping up with the design of service that deals with the total supply of wagons and locomotives.
Firstly, the wagons were reinforced and allocated for each business unit, based on the commodity of goods. Then again, each business unit had specific locomotives allocated based on the routes and tonnages that had to be pulled. The next step was to execute the demand at possible minimum cycle time with a train schedule. However, many respondents felt that the programming used for assigning resources was not properly done – as to where and when the locomotives and wagons must be sent to the mine – with the train slots booked accordingly. They also felt that the service or maintenance book for all the resources should be done prior to the time they need to go and be serviced; thus, the locomotives failures and wagons being withdrawn from service at the most critical time – when it was loaded with the customer’s product.

6.2 RECOMMENDATIONS

The purpose of the recommendations is to articulate to Transnet top management solutions that will not only address the operational inefficiencies, constraints and infrastructural problems that have been identified by the research study but can also be implemented in order to enhance the competitiveness of the port/rail interface and to substantially improve the service delivery.

Firstly, a model structure designating the routes of locomotives and trains must be drawn up. This structure would enhance the user to understand the basic functions of all the flows responsible. Secondly, there must be training of all the systems used to enable the employees to know what needs to be done and when, as well the understanding of the importance of calculating of the Turn-around Time of the wagons; and to minimise this, where possible. Thirdly, there should be a system that would trace the wagons and locomotives due for service.

The operations management team must understand what it is trying to achieve, meaning, how the operation should contribute to the organization achieving its long-term goals and to translate these goals into performance objectives. Such performance objectives may include quality services to the customer, the speed with which the consignment is delivered to customers, the dependability with which the operation keeps its delivery promises and the flexibility of the operation to change what it does.
The performance management system must be introduced to establish business objectives, plan and set targets, focus on continuous improvements and to monitor progress. Every employee in the organization should be given a chance to attend training and go for re-fresher training because doing one thing over and over again tends to be less challenging to the employees; and they end up being bored and frustrated.
REFERENCES


Leedy, P. D. and Ormrod, J. E. (2010). *Practical research planning and design*, Qualitative research methodologies. 8, 133-160.


APPENDIX I: RESEARCH QUESTIONNAIRE

Dear Sir/Madam,

I am a postgraduate student at the University of Johannesburg. This questionnaire forms part of the research for my Master’s Degree, with the aim of improving the turn-around time of wagon utilisation at Transnet Freight Rail. Please be assured that all answers will be treated confidentially; and they are for research purposes only. This questionnaire is anonymous; so please feel free to give your honest opinions.

The questionnaire should take no longer than 07 minutes to complete. When done please fold and put it inside the box at the reception.

The questionnaire consists of the following eight sections. Please ensure that all sections are completed:

1. Section A: Demographic Information.
2. Section B: Company Profile
3. Section C: Performance Management
4. Section D: Improving Turn-around Time
5. Section E: Just-In-Time Deliveries
6. Section F: Management of Challenges
7. Section G: Some typical challenges encountered by the freight rail
8. Section H: Communication

For any queries or comments regarding this survey, please contact me.

Thank you,
Thembisile Mabhena
Department of Quality and Operations management
AKB Campus
University of Johannesburg
Student number: 820410248
Email: tamabhena@yahoo.com
Tel: 011 570 7028
**Section A: DEMOGRAPHIC INFORMATION**

1. What is the name of your company?

2. How many people does your company employ?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 50</td>
<td></td>
</tr>
<tr>
<td>Between 50 and 200</td>
<td></td>
</tr>
<tr>
<td>More than 200</td>
<td></td>
</tr>
</tbody>
</table>

3. What is your Ethnic group?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td></td>
</tr>
<tr>
<td>Coloured</td>
<td></td>
</tr>
<tr>
<td>Asian/Indian</td>
<td></td>
</tr>
</tbody>
</table>

4. What is your Gender?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
</tr>
</tbody>
</table>

5. What is your age?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger than 18</td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td></td>
</tr>
<tr>
<td>31-40</td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td></td>
</tr>
<tr>
<td>Older than 50</td>
<td></td>
</tr>
</tbody>
</table>

6. What is your employment status?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent</td>
<td></td>
</tr>
<tr>
<td>Temporary/Part-time</td>
<td></td>
</tr>
</tbody>
</table>

7. What is your job level?

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Employee</td>
<td></td>
</tr>
<tr>
<td>Supervisory</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

If you answered other, please specify: __________________________________________

8. Work environment:

<table>
<thead>
<tr>
<th>Option</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Office based</td>
<td></td>
</tr>
<tr>
<td>Field based</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

If other, please specify: __________________________________________
9. What is your highest educational qualification?

<table>
<thead>
<tr>
<th>Grade 11 or lower (std 9 or lower)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12 (Matric, Std 10)</td>
<td></td>
</tr>
<tr>
<td>Postmatric Diploma or Certificate</td>
<td></td>
</tr>
<tr>
<td>Baccalaureate Degree(s)</td>
<td></td>
</tr>
<tr>
<td>Postgraduate Degree(s)</td>
<td></td>
</tr>
</tbody>
</table>

Section B: COMPANY PROFILE

Please answer the following questions with regards to the railway between Postmasburg and Sishen.

10. Does Transnet Freight Rail run a scheduled railway between Postmasburg and Sishen?

| Yes |  |
| No  |  |

11. If you answered yes to question 10, how effective is the scheduling method currently used between Postmasburg and Sishen?

| Not effective at all |  |
| Slightly effective  |  |
| Neutral              |  |
| Effective            |  |
| Very effective       |  |

12. How would you rate the Turn-around Time of the wagons between Postmasburg and Sishen?

| Poor |  |
| Fair |  |
| Good |  |
| Very good |  |
| Excellent |  |

13. If you answered poor to fair in question 12, tick the factors contributing to poor Turn-around time:

| Defective wagons |  |
| Absenteeism of drivers |  |
| Delays in train inspection |  |
| Machine breakdowns in the Mines |  |
| Unplanned or emergency occupations |  |
| Other |  |

If other, please specify.  _______________________________________________________

14. If you answered poor to fair in question 12, what could be done to improve the turn-around time of the wagons?  ___________________________________________
### Section C: Performance Management

<table>
<thead>
<tr>
<th>To what extent do you agree with the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees in this organization have clear performance criteria against which they are rated.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is sufficient communication on the importance of performance improvements in the organization.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees in this organization have the necessary skill/s or training to succeed in their key performance area.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees in this organization are given the requisite training to achieve their performance goals.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance Management is clearly defined in the organization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees are empowered to continuously improve the work outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rating of employee performance by management is fair.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Section D: Improving Turn-around Time

<table>
<thead>
<tr>
<th>To what extent do you agree with the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing cycle time reduces the number of wagons that the railway needs to own.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducing cycle time reduces the asset payments needed to store empty wagons.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longer trains are more economical due to efficiencies in crews.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longer trains are more economical due to efficiencies in locomotives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longer trains are more economical due to efficiencies in track capacity.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wagons would be able to meet their scheduled maintenance plan if the turn-around time is decreased</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section E: Just-In-Time Deliveries

<table>
<thead>
<tr>
<th>To what extent do you agree with the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection is done prior to the departure of the product to avoid delays in transit.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers receive their goods on time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees have the ability to deliver as per customer requirements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The method of execution with regards to deliveries is being utilized correctly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work processes with regards to the deliveries are continually being optimized.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section F: Management of challenges

<table>
<thead>
<tr>
<th>To what extent do you agree with the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees are provided with opportunities to contribute to their own aims.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have enough resources to move the required amount of commodities.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We have reliable resources to move the required amount of commodities.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The system used for tracking trains is effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees are involved in improvement programs to enhance efficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section G: Some typical challenges encountered by the freight rail

<table>
<thead>
<tr>
<th>To what extent is your company affected by the following challenges:</th>
<th>To no extent</th>
<th>To a small extent</th>
<th>To a moderate extent</th>
<th>To a large extent</th>
<th>To a very large extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable theft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locomotive failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wagons out of service</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor employee commitment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of management support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Section H: Communication

<table>
<thead>
<tr>
<th>To what extent do you agree with the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is good communication amongst the employees.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Railway’s wide communication network fully satisfies the data transmission of railways.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers are always kept in the loop for every deviation occurring.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The design of train schedule matches with the on-time departure and arrivals of trains.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The number of trains planned per day/week matches with the sets of wagons given.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX II: RESULTS FROM THE QUESTIONNAIRE

Frequencies and Descriptives for T Mabhena

Section A: Demographic Information

### A1 What is the name of your company?

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>7</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Tansnet Freight Rail</td>
<td>1</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Transnet</td>
<td>4</td>
<td>5.7</td>
<td>5.7</td>
</tr>
<tr>
<td>Transnet Freight Rail</td>
<td>1</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Transnet freight rail</td>
<td>1</td>
<td>1.4</td>
<td>20.0</td>
</tr>
<tr>
<td>Transnet freight rail</td>
<td>5</td>
<td>7.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Transnet Freight Rail</td>
<td>46</td>
<td>65.7</td>
<td>92.9</td>
</tr>
<tr>
<td>Transnet Freight Rail</td>
<td>1</td>
<td>1.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### A2 How many people does your company employ?

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>6</td>
<td>8.6</td>
<td>8.6</td>
</tr>
<tr>
<td>More than 200</td>
<td>64</td>
<td>91.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### A3 What is your Ethnic group?

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>61</td>
<td>87.1</td>
<td>87.1</td>
</tr>
<tr>
<td>White</td>
<td>6</td>
<td>8.6</td>
<td>95.7</td>
</tr>
<tr>
<td>Coloured</td>
<td>3</td>
<td>4.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### A4 What is your gender?

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>27</td>
<td>38.6</td>
<td>38.6</td>
</tr>
<tr>
<td>Female</td>
<td>43</td>
<td>61.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
### A5 What is your age?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>18-30</td>
<td>13</td>
<td>18.6</td>
<td>18.6</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>36</td>
<td>51.4</td>
<td>70.0</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>21</td>
<td>30.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

### A6 What is your employment status?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Permanent</td>
<td>67</td>
<td>95.7</td>
<td>95.7</td>
</tr>
<tr>
<td></td>
<td>Temporary/Part-time</td>
<td>3</td>
<td>4.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

### A7 What is your job level?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Junior Employee</td>
<td>57</td>
<td>81.4</td>
<td>81.4</td>
</tr>
<tr>
<td></td>
<td>Supervisory</td>
<td>3</td>
<td>4.3</td>
<td>85.7</td>
</tr>
<tr>
<td></td>
<td>Management</td>
<td>9</td>
<td>12.9</td>
<td>98.6</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1</td>
<td>1.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

### A7 Other Specify other

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td>70</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

### A8 Work environment

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Office based</td>
<td>65</td>
<td>92.9</td>
<td>92.9</td>
</tr>
<tr>
<td></td>
<td>Field based</td>
<td>5</td>
<td>7.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

### A8 Other Specify other

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missing System</td>
<td>70</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A9 What is your highest educational qualification?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Grade 12</td>
<td>16</td>
<td>22.9</td>
<td>22.9</td>
<td>22.9</td>
</tr>
<tr>
<td>Post-Matric Diploma or Certificate</td>
<td>42</td>
<td>60.0</td>
<td>60.0</td>
<td>82.9</td>
</tr>
<tr>
<td>Baccalaureate Degree(s)</td>
<td>12</td>
<td>17.1</td>
<td>17.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Section B: Company Profile

Please answer the following questions with regards to the railway between Postmasburg and Sishen

B10 Does Transnet Freight Rail run a scheduled railway between Postmasburg and Sishen?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Yes</td>
<td>17</td>
<td>24.3</td>
<td>24.3</td>
<td>24.3</td>
</tr>
<tr>
<td>No</td>
<td>53</td>
<td>75.7</td>
<td>75.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Statistics

B11 If you answered yes to question 10, how effective is the scheduling method currently used between Postmasburg and Sishen?

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>17</td>
<td>3.35</td>
<td>4.00</td>
<td>.862</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Slightly effective</td>
<td>4</td>
<td>23.5</td>
<td>23.5</td>
<td>23.5</td>
</tr>
<tr>
<td>Neutral</td>
<td>3</td>
<td>17.6</td>
<td>17.6</td>
<td>41.2</td>
</tr>
<tr>
<td>Effective</td>
<td>10</td>
<td>58.8</td>
<td>58.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
B12 How will you rate the Turnaround Time of the wagons between Postmasburg and Sishen?

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>27</td>
<td>38.6</td>
<td>38.6</td>
</tr>
<tr>
<td>Fair</td>
<td>27</td>
<td>38.6</td>
<td>77.1</td>
</tr>
<tr>
<td>Good</td>
<td>16</td>
<td>22.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
<td>100.0</td>
<td>100.0</td>
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</tbody>
</table>

Multiple Response

Case Summary

<table>
<thead>
<tr>
<th>N</th>
<th>Percent</th>
<th>N</th>
<th>Percent</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>100.0%</td>
<td>0</td>
<td>0.0%</td>
<td>54</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

a. Dichotomy group tabulated at value 1.

$\$B13$ Frequencies

<table>
<thead>
<tr>
<th>Responses</th>
<th>N</th>
<th>Percent</th>
<th>Percent of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>B13.1</td>
<td>22</td>
<td>38.1%</td>
<td>40.7%</td>
</tr>
<tr>
<td>B13.2</td>
<td>6</td>
<td>9.8%</td>
<td>11.1%</td>
</tr>
<tr>
<td>B13.3</td>
<td>2</td>
<td>3.3%</td>
<td>3.7%</td>
</tr>
<tr>
<td>B13.4</td>
<td>2</td>
<td>3.3%</td>
<td>3.7%</td>
</tr>
<tr>
<td>B13.5</td>
<td>2</td>
<td>3.3%</td>
<td>3.7%</td>
</tr>
<tr>
<td>B13.6</td>
<td>27</td>
<td>44.3%</td>
<td>50.0%</td>
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</table>

Total

61 100.0% 113.0%

a. Dichotomy group tabulated at value 1.
<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>31</td>
<td>57.4</td>
<td>57.4</td>
<td>57.4</td>
</tr>
<tr>
<td>Broken locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>59.3</td>
</tr>
<tr>
<td>Challenges in locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>61.1</td>
</tr>
<tr>
<td>Changes in locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>63.0</td>
</tr>
<tr>
<td>Constant traction failures</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>64.8</td>
</tr>
<tr>
<td>Defective locomotives</td>
<td>2</td>
<td>3.7</td>
<td>3.7</td>
<td>68.5</td>
</tr>
<tr>
<td>Insufficient Locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>70.4</td>
</tr>
<tr>
<td>Issues of locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>72.2</td>
</tr>
<tr>
<td>Lack of communication</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>74.1</td>
</tr>
<tr>
<td>Lack of locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>75.9</td>
</tr>
<tr>
<td>Lack of Locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>77.8</td>
</tr>
<tr>
<td>Locomotive</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>79.6</td>
</tr>
<tr>
<td>Locomotive breakdown</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>81.5</td>
</tr>
<tr>
<td>Locomotive challenges</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>83.3</td>
</tr>
<tr>
<td>Locomotive failure</td>
<td>3</td>
<td>5.6</td>
<td>5.6</td>
<td>88.9</td>
</tr>
<tr>
<td>Locomotive imbalance</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>90.7</td>
</tr>
<tr>
<td>Locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>92.6</td>
</tr>
<tr>
<td>Locomotives challenges</td>
<td>3</td>
<td>5.6</td>
<td>5.6</td>
<td>98.1</td>
</tr>
<tr>
<td>Subserviced locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>
If you answered poor to fair in question 12, what could be done to improve the turnaround time of the wagons?

<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocate enough locomotives for each sector</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>9.3</td>
</tr>
<tr>
<td>Avoid staging of trains for various reasons incidents and inefficiency</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>11.1</td>
</tr>
<tr>
<td>Be able to manage the available locomotives</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>13.0</td>
</tr>
<tr>
<td>Buy more locomotives</td>
<td>2</td>
<td>3.7</td>
<td>3.7</td>
<td>16.7</td>
</tr>
<tr>
<td>Check the wagons regularly</td>
<td>1</td>
<td>1.9</td>
<td>1.9</td>
<td>18.5</td>
</tr>
<tr>
<td>Defective locomotives</td>
<td>1</td>
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<td>Transnet must have more staff and reliable resources</td>
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<td>Wagons to be inspected before and the drivers must be disciplined</td>
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### Likert-Scale Questions

#### Section C: Performance Management

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<td>C1 Employees in this organization have clear performance criteria against which they are rated.</td>
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<td>C2 There is sufficient communication on the importance of performance improvements in the organization.</td>
<td>Count 4.3%</td>
<td>18.8%</td>
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<td>C3 Employees in this organization have the necessary skills or training to succeed in their key performance area.</td>
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<td>C4 Employees in this organization are given the requisite training to achieve their performance goals.</td>
<td>Count 0.0%</td>
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<td>C5 Performance Management is clearly defined in the organization.</td>
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<td>C6 Employees are empowered to continuously improve their work outputs.</td>
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<td>C7 Rating of employee performance by management is fair.</td>
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#### Section D: Improving Turnaround Time

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<td>D3 Longer trains are more economical due to efficiencies in crews.</td>
<td>Count 4.3%</td>
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<td>D4 Longer trains are more economical due to efficiencies in locomotives.</td>
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<td>D5 Longer trains are more economical due to efficiencies in in truck capacity.</td>
<td>Count 5.8%</td>
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<td>D6 Wagons will meet their scheduled maintenance plan if the turnaround time is decreased.</td>
<td>Count 5.8%</td>
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### Section E: Just In Time Deliveries

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<td>E2 Customers receive their good on time.</td>
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<td>E3 Employees have the ability to deliver as per customer requirements.</td>
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### Section F: Management of Challenges

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<td>F1 Employees are provided with opportunities to contribute to their own aims.</td>
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<td>F3 We have reliable resources to move the required amount of commodities.</td>
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<td>F5 Employees are involved in improvement programs to enhance efficiency.</td>
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### Section G: Some Typical Challenges Encountered by the Freight Rail

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### Section H: Communication

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<td>Count</td>
<td>69</td>
<td>0</td>
<td>3</td>
<td>12</td>
<td>49</td>
<td>5</td>
</tr>
<tr>
<td>Row N %</td>
<td>69%</td>
<td>0.0%</td>
<td>4.3%</td>
<td>17.4%</td>
<td>71.0%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H3 Customers are always kept in the loop for every deviation occurring.</th>
<th><strong>Total</strong></th>
<th><strong>Strongly Disagree</strong></th>
<th><strong>Disagree</strong></th>
<th><strong>Neutral</strong></th>
<th><strong>Agree</strong></th>
<th><strong>Strongly Agree</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>69</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>Row N %</td>
<td>69%</td>
<td>1.4%</td>
<td>4.3%</td>
<td>7.2%</td>
<td>63.6%</td>
<td>23.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H4 The design of train schedule matches with the on-time departure and arrivals of trains.</th>
<th><strong>Total</strong></th>
<th><strong>Strongly Disagree</strong></th>
<th><strong>Disagree</strong></th>
<th><strong>Neutral</strong></th>
<th><strong>Agree</strong></th>
<th><strong>Strongly Agree</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>69</td>
<td>19</td>
<td>34</td>
<td>10</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Row N %</td>
<td>69%</td>
<td>27.5%</td>
<td>49.3%</td>
<td>14.5%</td>
<td>8.7%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>H5 The number of trains planned per day/week matches with the sets of wagons given.</th>
<th><strong>Total</strong></th>
<th><strong>Strongly Disagree</strong></th>
<th><strong>Disagree</strong></th>
<th><strong>Neutral</strong></th>
<th><strong>Agree</strong></th>
<th><strong>Strongly Agree</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>69</td>
<td>15</td>
<td>40</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Row N %</td>
<td>69%</td>
<td>21.7%</td>
<td>56.0%</td>
<td>2.9%</td>
<td>13.0%</td>
<td>4.3%</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Valid</td>
<td>Missing</td>
<td>Mean</td>
<td>Median</td>
<td>Mode</td>
</tr>
<tr>
<td>-----</td>
<td>---</td>
<td>-------</td>
<td>---------</td>
<td>------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>H1</td>
<td>69</td>
<td>69</td>
<td>1</td>
<td>3.68</td>
<td>4.00</td>
<td>4</td>
</tr>
<tr>
<td>H2</td>
<td>69</td>
<td>69</td>
<td>1</td>
<td>3.81</td>
<td>4.00</td>
<td>4</td>
</tr>
<tr>
<td>H3</td>
<td>69</td>
<td>69</td>
<td>1</td>
<td>4.03</td>
<td>4.00</td>
<td>4</td>
</tr>
<tr>
<td>H4</td>
<td>69</td>
<td>69</td>
<td>1</td>
<td>2.04</td>
<td>2.00</td>
<td>2</td>
</tr>
<tr>
<td>H5</td>
<td>69</td>
<td>69</td>
<td>1</td>
<td>2.20</td>
<td>2.00</td>
<td>2</td>
</tr>
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</table>
Exploratory Factor Analysis for T Mabhena

Section C: Performance Management

Component Matrix (Check for Reverse Scoring)

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>.487</td>
<td>.234</td>
</tr>
<tr>
<td>C2</td>
<td>.758</td>
<td>-.306</td>
</tr>
<tr>
<td>C3</td>
<td>.672</td>
<td>-.143</td>
</tr>
<tr>
<td>C4</td>
<td>.766</td>
<td>.382</td>
</tr>
<tr>
<td>C5</td>
<td>.619</td>
<td>-.622</td>
</tr>
<tr>
<td>C6</td>
<td>.790</td>
<td>-.071</td>
</tr>
<tr>
<td>C7</td>
<td>.602</td>
<td>.603</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
a. 2 components extracted.

Factor Analysis

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>C1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>.427</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>.191</td>
<td>.400</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>.308</td>
<td>.428</td>
<td>.413</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>.164</td>
<td>.534</td>
<td>.393</td>
<td>.225</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>.155</td>
<td>.513</td>
<td>.443</td>
<td>.610</td>
<td>.466</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>.281</td>
<td>.234</td>
<td>.309</td>
<td>.544</td>
<td>.141</td>
<td>.391</td>
<td>1.000</td>
</tr>
</tbody>
</table>

KMO and Bartlett's Test

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</td>
<td>.768</td>
</tr>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td>145.043</td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>21</td>
</tr>
<tr>
<td>df</td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>
### Anti-image Matrices

**Anti-image Correlation**

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>.670⁰</td>
<td>-.370</td>
<td>-.003</td>
<td>-.131</td>
<td>.029</td>
<td>.165</td>
<td>-.171</td>
</tr>
<tr>
<td>C2</td>
<td>-.370</td>
<td>.762⁰</td>
<td>-.098</td>
<td>-.129</td>
<td>-.362</td>
<td>-.219</td>
<td>.097</td>
</tr>
<tr>
<td>C3</td>
<td>-.003</td>
<td>-.098</td>
<td>.897⁰</td>
<td>-.144</td>
<td>-.201</td>
<td>-.112</td>
<td>-.100</td>
</tr>
<tr>
<td>C4</td>
<td>-.131</td>
<td>-.129</td>
<td>-.144</td>
<td>.748⁰</td>
<td>.168</td>
<td>-.427</td>
<td>-.360</td>
</tr>
<tr>
<td>C5</td>
<td>.029</td>
<td>-.362</td>
<td>-.201</td>
<td>.168</td>
<td>.735⁰</td>
<td>-.267</td>
<td>.020</td>
</tr>
<tr>
<td>C6</td>
<td>.185</td>
<td>-.219</td>
<td>-.112</td>
<td>-.427</td>
<td>-.267</td>
<td>.773⁰</td>
<td>-.108</td>
</tr>
<tr>
<td>C7</td>
<td>-.171</td>
<td>.097</td>
<td>-.100</td>
<td>-.360</td>
<td>.020</td>
<td>-.108</td>
<td>.786⁰</td>
</tr>
</tbody>
</table>

a. Measures of Sampling Adequacy (MSA)

### Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>.253</td>
<td>.152</td>
</tr>
<tr>
<td>C2</td>
<td>.492</td>
<td>.581</td>
</tr>
<tr>
<td>C3</td>
<td>.295</td>
<td>.338</td>
</tr>
<tr>
<td>C4</td>
<td>.527</td>
<td>.788</td>
</tr>
<tr>
<td>C5</td>
<td>.380</td>
<td>.592</td>
</tr>
<tr>
<td>C6</td>
<td>.529</td>
<td>.545</td>
</tr>
<tr>
<td>C7</td>
<td>.330</td>
<td>.406</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

### Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>2</td>
<td>1.070</td>
<td>15.293</td>
<td>61.276</td>
</tr>
<tr>
<td>3</td>
<td>.932</td>
<td>13.313</td>
<td>74.590</td>
</tr>
<tr>
<td>4</td>
<td>.615</td>
<td>8.781</td>
<td>93.371</td>
</tr>
<tr>
<td>5</td>
<td>.512</td>
<td>7.315</td>
<td>90.686</td>
</tr>
<tr>
<td>6</td>
<td>.351</td>
<td>5.015</td>
<td>95.701</td>
</tr>
<tr>
<td>7</td>
<td>.301</td>
<td>4.299</td>
<td>100.000</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

123
Rotated Factor Matrix$^a$

<table>
<thead>
<tr>
<th></th>
<th>Factor</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4</td>
<td>.856</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>.627</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>.525</td>
<td>.519</td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>.302</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td></td>
<td>.766</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>.315</td>
<td>.694</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>.370</td>
<td>.449</td>
<td></td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.$^a$

a. Rotation converged in 3 iterations.

2nd Order Factor Analysis

Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>Mean_SecC_F1</th>
<th>Mean_SecC_F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean_SecC_F1</td>
<td>1.000</td>
<td>.571</td>
</tr>
<tr>
<td>Mean_SecC_F2</td>
<td>.571</td>
<td>1.000</td>
</tr>
</tbody>
</table>

KMO and Bartlett's Test

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .500 |
| Bartlett's Test of Sphericity                  |     |
| Approx. Chi-Square                            | 26.242 |
| df                                             | 1   |
| Sig.                                           | .000 |

Anti-image Matrices

Anti-image Correlation

<table>
<thead>
<tr>
<th></th>
<th>Mean_SecC_F1</th>
<th>Mean_SecC_F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean_SecC_F1</td>
<td>.500$^a$</td>
<td>-.571</td>
</tr>
<tr>
<td>Mean_SecC_F2</td>
<td>-.571</td>
<td>.500$^a$</td>
</tr>
</tbody>
</table>

a. Measures of Sampling Adequacy (MSA)
Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean_SecC_F1</td>
<td>.326</td>
<td>.570</td>
</tr>
<tr>
<td>Mean_SecC_F2</td>
<td>.326</td>
<td>.570</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>1.571</td>
<td>78.551</td>
</tr>
<tr>
<td>2</td>
<td>429</td>
<td>21.449</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

Factor Matrix

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

| Mean_SecC_F1 | .755 |
| Mean_SecC_F2 | .755 |

Extraction Method: Principal Axis Factoring.

a. 1 factors extracted. 8 iterations required.

Rotated Factor Matrix

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor</th>
</tr>
</thead>
</table>

|                    |        |

a. Only one factor was extracted. The solution cannot be rotated.

Section D: Improving Turnaround Time

Component Matrix (Check for Reverse Scoring)
### Component Matrix

<table>
<thead>
<tr>
<th>Component</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.903</td>
<td>.847</td>
<td>.926</td>
<td>.899</td>
<td>.902</td>
<td>.738</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

### Factor Analysis

#### Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>D1</td>
<td>1.000</td>
<td>.867</td>
<td>.796</td>
<td>.714</td>
<td>.733</td>
</tr>
<tr>
<td></td>
<td>D2</td>
<td>.867</td>
<td>1.000</td>
<td>.699</td>
<td>.626</td>
<td>.639</td>
</tr>
<tr>
<td></td>
<td>D3</td>
<td>.796</td>
<td>.699</td>
<td>1.000</td>
<td>.873</td>
<td>.830</td>
</tr>
<tr>
<td></td>
<td>D4</td>
<td>.714</td>
<td>.626</td>
<td>.873</td>
<td>1.000</td>
<td>.896</td>
</tr>
<tr>
<td></td>
<td>D5</td>
<td>.733</td>
<td>.639</td>
<td>.830</td>
<td>.896</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>D6</td>
<td>.595</td>
<td>.602</td>
<td>.607</td>
<td>.550</td>
<td>.580</td>
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</tbody>
</table>

#### KMO and Bartlett's Test

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</td>
<td>.849</td>
</tr>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>394.458</td>
</tr>
<tr>
<td>df</td>
<td>15</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
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</tbody>
</table>
### Anti-image Matrices

#### Anti-image Correlation

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>0.820^a</td>
<td>-0.694</td>
<td>-0.313</td>
<td>0.065</td>
<td>-0.161</td>
<td>0.012</td>
</tr>
<tr>
<td>D2</td>
<td>-0.694</td>
<td>0.819^a</td>
<td>0.012</td>
<td>-0.014</td>
<td>0.037</td>
<td>-0.218</td>
</tr>
<tr>
<td>D3</td>
<td>-0.313</td>
<td>0.012</td>
<td>0.886^a</td>
<td>-0.501</td>
<td>-0.063</td>
<td>-0.159</td>
</tr>
<tr>
<td>D4</td>
<td>0.065</td>
<td>-0.014</td>
<td>-0.501</td>
<td>0.807^a</td>
<td>-0.634</td>
<td>0.060</td>
</tr>
<tr>
<td>D5</td>
<td>-0.161</td>
<td>0.037</td>
<td>-0.063</td>
<td>-0.634</td>
<td>0.860^a</td>
<td>-0.140</td>
</tr>
<tr>
<td>D6</td>
<td>0.012</td>
<td>-0.218</td>
<td>-0.159</td>
<td>0.060</td>
<td>-0.140</td>
<td>0.947^a</td>
</tr>
</tbody>
</table>

a. Measures of Sampling Adequacy (MSA)

### Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>0.827</td>
<td>0.785</td>
</tr>
<tr>
<td>D2</td>
<td>0.763</td>
<td>0.647</td>
</tr>
<tr>
<td>D3</td>
<td>0.828</td>
<td>0.852</td>
</tr>
<tr>
<td>D4</td>
<td>0.858</td>
<td>0.780</td>
</tr>
<tr>
<td>D5</td>
<td>0.826</td>
<td>0.785</td>
</tr>
<tr>
<td>D6</td>
<td>0.442</td>
<td>0.448</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

### Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>4.557</td>
<td>75.948</td>
</tr>
<tr>
<td>2</td>
<td>.597</td>
<td>9.946</td>
</tr>
<tr>
<td>3</td>
<td>.478</td>
<td>7.969</td>
</tr>
<tr>
<td>4</td>
<td>.165</td>
<td>2.750</td>
</tr>
<tr>
<td>5</td>
<td>.120</td>
<td>2.007</td>
</tr>
<tr>
<td>6</td>
<td>.083</td>
<td>1.380</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
### Factor Matrix

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3</td>
<td>.923</td>
</tr>
<tr>
<td>D1</td>
<td>.886</td>
</tr>
<tr>
<td>D5</td>
<td>.886</td>
</tr>
<tr>
<td>D4</td>
<td>.883</td>
</tr>
<tr>
<td>D2</td>
<td>.804</td>
</tr>
<tr>
<td>D6</td>
<td>.668</td>
</tr>
</tbody>
</table>

**Extraction Method:** Principal Axis Factoring.

- 1 factors extracted. 5 iterations required.

### Rotated Factor Matrix

- Only one factor was extracted. The solution cannot be rotated.

### Section E: Just In Time Deliveries

**Component Matrix (Check for Reverse Scoring)**

**Omitted E5 (Communality Exceeded 1)**

### Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>E1</th>
<th>E2</th>
<th>rE3</th>
<th>E4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>E1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>1.000</td>
<td>-0.087</td>
<td>-0.266</td>
<td>0.107</td>
</tr>
<tr>
<td>E2</td>
<td>-0.087</td>
<td>1.000</td>
<td>0.152</td>
<td>0.103</td>
</tr>
<tr>
<td>rE3</td>
<td>-0.266</td>
<td>0.152</td>
<td>1.000</td>
<td>-0.046</td>
</tr>
<tr>
<td>E4</td>
<td>0.107</td>
<td>0.103</td>
<td>-0.046</td>
<td>1.000</td>
</tr>
</tbody>
</table>
KMO and Bartlett's Test

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | 0.530 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 8.194 |
| df | 6 |
| Sig. | 0.224 |

Anti-image Matrices

<table>
<thead>
<tr>
<th>Anti-image Correlation</th>
<th>E1</th>
<th>E2</th>
<th>rE3</th>
<th>E4</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.536&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.060</td>
<td>0.251</td>
<td>-0.104</td>
</tr>
<tr>
<td>E2</td>
<td>0.060</td>
<td>0.533&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.138</td>
<td>-0.117</td>
</tr>
<tr>
<td>rE3</td>
<td>0.251</td>
<td>-0.138</td>
<td>0.535&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.035</td>
</tr>
<tr>
<td>E4</td>
<td>-0.104</td>
<td>-0.117</td>
<td>0.035</td>
<td>0.484&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Measures of Sampling Adequacy (MSA)

Component Matrix<sup>a</sup>

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>0.255</td>
<td>-0.705</td>
</tr>
<tr>
<td>E2</td>
<td>0.401</td>
<td>0.512</td>
</tr>
<tr>
<td>rE3</td>
<td>0.003</td>
<td>0.766</td>
</tr>
<tr>
<td>E4</td>
<td>0.844</td>
<td>-0.083</td>
</tr>
<tr>
<td>E5</td>
<td>0.898</td>
<td>0.046</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

<sup>a</sup> 2 components extracted.
### Communalities\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>.106</td>
<td>.222</td>
</tr>
<tr>
<td>E2</td>
<td>.099</td>
<td>.130</td>
</tr>
<tr>
<td>rE3</td>
<td>.099</td>
<td>.371</td>
</tr>
<tr>
<td>E4</td>
<td>.388</td>
<td>.401</td>
</tr>
<tr>
<td>E5</td>
<td>.445</td>
<td>.999</td>
</tr>
</tbody>
</table>

Extraction Method: Maximum Likelihood.

### Rotated Factor Matrix\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>rE3</td>
<td>.532</td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>-.512</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td></td>
<td>.375</td>
</tr>
<tr>
<td>E2</td>
<td></td>
<td>.359</td>
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</tbody>
</table>

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization\(^a\).
Anti-image Matrices

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>.820</td>
<td>-.694</td>
<td>-.313</td>
<td>.065</td>
<td>-.161</td>
<td>.012</td>
</tr>
<tr>
<td>D2</td>
<td>-.694</td>
<td>.819</td>
<td>.012</td>
<td>-.014</td>
<td>.037</td>
<td>-.218</td>
</tr>
<tr>
<td>D3</td>
<td>-.313</td>
<td>.012</td>
<td>.866</td>
<td>-.501</td>
<td>-.063</td>
<td>-.159</td>
</tr>
<tr>
<td>D4</td>
<td>.065</td>
<td>-.014</td>
<td>-.501</td>
<td>.807</td>
<td>-.634</td>
<td>.060</td>
</tr>
<tr>
<td>D5</td>
<td>-.161</td>
<td>.037</td>
<td>-.063</td>
<td>-.634</td>
<td>.860</td>
<td>-.140</td>
</tr>
<tr>
<td>D6</td>
<td>.012</td>
<td>-.218</td>
<td>-.159</td>
<td>.060</td>
<td>-.140</td>
<td>.947</td>
</tr>
</tbody>
</table>

a. Measures of Sampling Adequacy (MSA)

Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>.827</td>
<td>.785</td>
</tr>
<tr>
<td>D2</td>
<td>.763</td>
<td>.647</td>
</tr>
<tr>
<td>D3</td>
<td>.828</td>
<td>.862</td>
</tr>
<tr>
<td>D4</td>
<td>.858</td>
<td>.780</td>
</tr>
<tr>
<td>D5</td>
<td>.826</td>
<td>.785</td>
</tr>
<tr>
<td>D6</td>
<td>.442</td>
<td>.446</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>4.557</td>
<td>75.948</td>
</tr>
<tr>
<td>2</td>
<td>.597</td>
<td>9.946</td>
</tr>
<tr>
<td>3</td>
<td>.478</td>
<td>7.969</td>
</tr>
<tr>
<td>4</td>
<td>.165</td>
<td>2.750</td>
</tr>
<tr>
<td>5</td>
<td>.120</td>
<td>2.007</td>
</tr>
<tr>
<td>6</td>
<td>.083</td>
<td>1.380</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

Section F: Management of Challenges

Component Matrix (Check for Reverse Scoring)
## Component Matrix

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>.704</td>
<td>.181</td>
</tr>
<tr>
<td>F2</td>
<td>.167</td>
<td>.685</td>
</tr>
<tr>
<td>F3</td>
<td>-.032</td>
<td>.836</td>
</tr>
<tr>
<td>F4</td>
<td>.633</td>
<td>-.236</td>
</tr>
<tr>
<td>F5</td>
<td>.871</td>
<td>-.076</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

Omitted rF3 (Communality Exceeded 1 and this Item has the Lowest MSA between rF3 and F5)

## Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation</td>
<td>F1</td>
<td>1.000</td>
<td>.027</td>
<td>.101</td>
</tr>
<tr>
<td></td>
<td>F2</td>
<td>.027</td>
<td>1.000</td>
<td>.090</td>
</tr>
<tr>
<td></td>
<td>F4</td>
<td>.101</td>
<td>.090</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>F5</td>
<td>.479</td>
<td>.053</td>
<td>.393</td>
</tr>
</tbody>
</table>

## KMO and Bartlett's Test

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</td>
<td>.502</td>
</tr>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td>Approx. Chi-Square</td>
</tr>
<tr>
<td></td>
<td>df</td>
</tr>
<tr>
<td></td>
<td>29.488</td>
</tr>
<tr>
<td></td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>.000</td>
</tr>
</tbody>
</table>
Anti-image Matrices

Anti-image Correlation

<table>
<thead>
<tr>
<th></th>
<th>F1</th>
<th>F2</th>
<th>F4</th>
<th>F5</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>.498a</td>
<td>-.010</td>
<td>.108</td>
<td>-.479</td>
</tr>
<tr>
<td>F2</td>
<td>-.010</td>
<td>.658a</td>
<td>-.076</td>
<td>-.012</td>
</tr>
<tr>
<td>F4</td>
<td>.108</td>
<td>-.076</td>
<td>.502a</td>
<td>-.392</td>
</tr>
<tr>
<td>F5</td>
<td>-.479</td>
<td>-.012</td>
<td>-.392</td>
<td>.502a</td>
</tr>
</tbody>
</table>

a. Measures of Sampling Adequacy (MSA)

Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>.238</td>
<td>.449</td>
</tr>
<tr>
<td>F2</td>
<td>.009</td>
<td>.014</td>
</tr>
<tr>
<td>F4</td>
<td>.169</td>
<td>.457</td>
</tr>
<tr>
<td>F5</td>
<td>.349</td>
<td>.694</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>1</td>
<td>1.684</td>
<td>42.101</td>
<td>42.101</td>
</tr>
<tr>
<td>3</td>
<td>.877</td>
<td>21.936</td>
<td>89.304</td>
</tr>
<tr>
<td>4</td>
<td>.428</td>
<td>10.686</td>
<td>100.000</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
### Rotated Factor Matrix\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>F5</td>
<td>.701</td>
<td>.450</td>
</tr>
<tr>
<td>F1</td>
<td>.670</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>.132</td>
<td>.663</td>
</tr>
<tr>
<td>F2</td>
<td></td>
<td>.119</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.\(^a\)

### Section H: Communication

#### Component Matrix (Check for Reverse Scoring)

### Component Matrix\(^a\)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>.617</td>
<td>-.512</td>
</tr>
<tr>
<td>H2</td>
<td>.828</td>
<td>-.097</td>
</tr>
<tr>
<td>H3</td>
<td>.712</td>
<td>-.337</td>
</tr>
<tr>
<td>H4</td>
<td>.424</td>
<td>.759</td>
</tr>
<tr>
<td>H5</td>
<td>.413</td>
<td>.760</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

\(^a\) 2 components extracted.
Factor Analysis

Omitted H4 (MSA = 0.533)

Omitted H5 (MSA = 0.357)

Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation H1</td>
<td>1.000</td>
<td>.421</td>
<td>.390</td>
</tr>
<tr>
<td>H2</td>
<td>.421</td>
<td>1.000</td>
<td>.461</td>
</tr>
<tr>
<td>H3</td>
<td>.390</td>
<td>.461</td>
<td>1.000</td>
</tr>
</tbody>
</table>

KMO and Bartlett's Test

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</td>
<td>.665</td>
</tr>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>32.785</td>
</tr>
<tr>
<td>df</td>
<td>3</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Anti-image Matrices

Anti-image Correlation

<table>
<thead>
<tr>
<th></th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>.692(^a)</td>
<td>-.296</td>
<td>-.244</td>
</tr>
<tr>
<td>H2</td>
<td>-.296</td>
<td>.646(^a)</td>
<td>-.355</td>
</tr>
<tr>
<td>H3</td>
<td>-.244</td>
<td>-.355</td>
<td>.663(^a)</td>
</tr>
</tbody>
</table>

\(\text{a. Measures of Sampling Adequacy (MSA)}\)
### Communalities

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>.226</td>
<td>.358</td>
</tr>
<tr>
<td>H2</td>
<td>.281</td>
<td>.495</td>
</tr>
<tr>
<td>H3</td>
<td>.259</td>
<td>.428</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

### Total Variance Explained

<table>
<thead>
<tr>
<th>Factor</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
</tr>
<tr>
<td>1</td>
<td>1.849</td>
<td>61.636</td>
</tr>
<tr>
<td>2</td>
<td>.616</td>
<td>20.537</td>
</tr>
<tr>
<td>3</td>
<td>.535</td>
<td>17.827</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.

### Factor Matrix

<table>
<thead>
<tr>
<th>factor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>.598</td>
</tr>
<tr>
<td>H2</td>
<td>.704</td>
</tr>
<tr>
<td>H3</td>
<td>.654</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Axis Factoring.
### Crosstabs for T Mabhena

#### rA7 * B10 Crosstabulation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>B10</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Total</td>
</tr>
<tr>
<td>rA7</td>
<td>Junior Employee</td>
<td>Count</td>
<td>6</td>
<td>51</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% within rA7</td>
<td>10.5%</td>
<td>89.5%</td>
</tr>
<tr>
<td></td>
<td>Supervisory / Management</td>
<td>Count</td>
<td>11</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% within rA7</td>
<td>91.7%</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Count</td>
<td>17</td>
<td>52</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% within rA7</td>
<td>24.6%</td>
<td>75.4%</td>
</tr>
</tbody>
</table>

#### Chi-Square Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>df</th>
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a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 2.96.
b. Computed only for a 2x2 table

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# Explore - Tests for Normality for T Mabhena

## rA7

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| Supervisory / Management |          |            |
| **Mean** | 3.750     | .279       |
| 95% Confidence Interval for Mean |          |            |
| Lower Bound | 3.137     |            |
| Upper Bound | 4.363     |            |
| **5% Trimmed Mean** | 3.778 |            |
| **Median** | 4.000     |            |
| **Variance** | .932 |            |
| **Std. Deviation** | .965 |            |
| **Minimum** | 2.000     |            |
| **Maximum** | 5.000     |            |
| **Range**  | 3.000     |            |
| **Interquartile Range** | .750 |            |
| **Skewness** | -.864    | .637       |
| **Kurtosis** | .319     | 1.232      |

| G6 Junior Employee |          |            |
| **Mean** | 2.804     | .133       |
| 95% Confidence Interval for Mean |          |            |
| Lower Bound | 2.536     |            |
| Upper Bound | 3.071     |            |
| **5% Trimmed Mean** | 2.798 |            |
| **Median** | 3.000     |            |
| **Variance** | .997 |            |
| **Std. Deviation** | .999 |            |
| **Minimum** | 1.000     |            |
| **Maximum** | 5.000     |            |
| **Range**  | 4.000     |            |
| **Interquartile Range** | 2.000 |            |
| **Skewness** | .184     | .319       |
| **Kurtosis** | -.644    | .628       |

<p>| Supervisory / Management |          |            |
| <strong>Mean</strong> | 1.917     | .398       |
| 95% Confidence Interval for Mean |          |            |
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| <strong>5% Trimmed Mean</strong> | 1.796 |            |</p>
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* a. Lilliefors Significance Correction

### B12

### Histograms
Histogram
for rA7= Junior Employee

Mean = 1.65
Std. Dev. = .668
N = 57

How will you rate the Turnaround Time of the wagons between Postmasburg and Sishen?

Histogram
for rA7= Supervisory / Management

Mean = 2.75
Std. Dev. = .622
N = 12

How will you rate the Turnaround Time of the wagons between Postmasburg and Sishen?
Regression Analysis for T Mabhena

Graphs

How will you rate the Turnaround Time of the wagons between Postmasburg and Sishen?

How will you rate the Turnaround Time of the wagons between Postmasburg and Sishen?
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|                  |       |              |              |              |       |       |              |
| Sig. (1-tailed)  |       |              |              |              |       |       |              |
| B12              |       |              |              |              |       |       |              |
| Mean_SecC_F1     | .000  | .000         | .076         | .067         | .001  | .007  | .171         |
| Mean_SecC_F2     | .076  | .000         | .402         | .004         | .135  | .022  | .026         |
| Mean_SecD_F1     | .067  | .482         | .192         | .014         | .011  | .274  | .322         |
| G3               | .004  | .025         | .192         | .014         | .000  | .000  | .388         |
| G4               | .007  | .135         | .274         | .001         | .000  | .322  | .388         |
| Mean_SecH_F1     | .171  | .022         | .000         | .026         | .322  | .388  |              |

| N                |       |              |              |              |       |       |              |
| B12              | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| Mean_SecC_F1     | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| Mean_SecC_F2     | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| Mean_SecD_F1     | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| G3               | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| G4               | 69    | 69           | 69           | 69           | 69    | 69    | 69           |
| Mean_SecH_F1     | 69    | 69           | 69           | 69           | 69    | 69    | 69           |

### Variables Entered/Removed

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<th>Model</th>
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<th>Variables Removed</th>
<th>Method</th>
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a. Dependent Variable: B12

b. All requested variables entered.

### Model Summary

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a. Predictors: (Constant), Mean_SecH_F1, G4, Mean_SecC_F1, Mean_SecD_F1, G3, Mean_SecC_F2

b. Dependent Variable: B12
ANOVA

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a. Dependent Variable: B12
b. Predictors: (Constant), Mean_SecH_F1, G4, Mean_SecC_F1, Mean_SecD_F1, G3, Mean_SecC_F2

Coefficients

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a. Dependent Variable: B12

Collinearity Diagnostics

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## Collinearity Diagnostics

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a. Dependent Variable: B12