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Masters Title: ***Optimisation of Key Performance Indicators along a Value Chain***

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1 Corrections: Examiner 1

1.1 Argument:

1) Paragraph 1: Coal Stockpile- Addressed in the first paragraph of Section 5.3.

" It should be stated that the system aims to improve the efficiency of the value chain and not the capacity of any single phase of the value chain, i.e. improving the efficiency of the rail network would reduce the stockpiling of coal in line with creating a leaner pull orientated network."

2) Paragraph 2: Coal Delivered more reliably...- Addressed in section 4 and section 5.3. and recommendations made in section 8.2.

Section 4: " It should be emphasised that although the railway network is focused on significantly, the formation of an overall KPI aims to create a measure of performance for the entire value chain, i.e. the overall performance KPI takes into account the gaps in performance of each phase. Thus, the scenario where the railway delivers more coal than the port can handle will be guarded against. It should be noted that in the current state the port runs a ruling of carrying a minimum of 8 million tons of coal in its stockpile. The system is modelled as a pull system. The next chapter will discuss a detailed methodology of how these objectives will be reached."

Section 5.3: as Above in point 1.

Section 8.2 " The Richards Bay Coal Terminal should be modelled to include all processes and their interdependencies. This is to increase the efficiency and reliability of the material handling processes. Reasons for large stock piles and only 14% of coal delivered directly onto the ship should be investigated and the percentage passed onto the train directly should increase as expected from a pull system. Port operations and material handling processes should be accurately replicated on a micro scale and identify where the port can increase export capacity."

3) Paragraph 3 and 4: KPI on PG 57...- This is addressed under the definition of storage space utilisation in section 6.1.4.

Section 6.1.4: " Storage space utilisation – This KPI measures how much space is currently being occupied in the warehouse. The ideal value is 85% of capacity; however, if we are aiming to improve the physical storage space should be reduced in order to make the system leaner. This is in line with modelling the system as a pull system in the long term."

4) Paragraph 5: Three tested scenarios - Addressed in section 7.1.8.

Section 7.1.8 " From the above findings and the findings in the paper authored by Govender et al, 2015, the following scenarios are formulated:

A) The improvement of Ermelo as a hub (suggested improvements are made by Govender (2015)),
B) The use of smaller 100 wagon consists (suggested by the findings on idle times and Govender (2015)),
C) The removal of Ermelo as a hub and the upgrading of the Overvaal single track (suggested by the findings on idle times and Govender (2015))"

5) Paragraph 6: 100 wagon Consists at the mines – Addressed in section 3.2, trains leaving Ermelo for the mines are already in wagon consists.

Section 3.2: " Consists from the mines to Ermelo are constructed with four locomotives (locos) followed by 100 wagons followed by another four locomotives (100 wagon long train). Consists from Ermelo down to Richards bay are constructed with four locomotives followed by 100 wagons, four locomotives, 100 wagons and another four locomotives (train). This structure of train allows better braking as the braking forces are more evenly distributed throughout the train length. The symmetry of the train also allows for the train to be moved forwards or backwards with the same functionality (Kuys, 2011)."

6) Paragraph 7: Volume vs Proportion – Addressed in section 6.1.1.

Section 6.1.1: " Percentage export quality coal of total volume produced – This KPI measures what percentage of coal is produced for export. The target for this KPI is set at 42%. This was calculated by the using the forecasted amount of coal to be exported, 77 Mtpa (Million tons per annum) divided by the total amount of coal produced at 260 Mtpa. This KPI is important to Transnet as it allows them to gage the feasibility of the export market which may affect their decision on where to invest their time, i.e. local vs. international. The proportion instead of volume is taken as volumes mined may be inconsistent due to strikes and the instability within the mining sector. Furthermore, the local energy

generator for Southern Africa (ESKOM) may purchase larger volumes of coal in a bid to stabilise the energy supply in this region. The proportion of Export vs Local coal volumes is used because trends may be found and used to forecast demand."

7) Paragraph 8: Lead time to award contract – addressed in section 6.1.1 under the definition of the KPI Lead Time to Award Contract.

Section 6.1.1: "Lead time to award contract – This KPI measures how long it takes for Transnet to formally agree contacts with its customers. This KPI customer facing, i.e. it is the contract Transnet is trying to acquire in order to add to its customer list. The target for this KPI is six weeks (G2 Incorporated, 2017). This target is based on the signing of a new telecom contract. The relationship between the customer and the company has a largely similar nature as explained by G2 Inc., 2017. The rules and regulations in the telecom industry are as complex as the coal industry. Thus, due to the nature of the coal industry and its regulations a six week target was deemed feasible in this study. Furthermore, investigation was carried out into PFMA (public finance management act) for this KPI and no guidelines were found."

8) Paragraph 9: Benchmarking in the USA – Addressed in section 6.1.1 under the definition for cost in comparison to International Companies.

Section 6.1.1: " Cost in comparison to international companies – This KPI measures the cost of transporting coal using Transnet versus internationally. The target for this value is R0,017 per km (US Energy Information Administration, 2014). The USA is the largest freight rail network in the world (Pierce, 2013). Transnet has the size and buying power of a large privatised freight rail network, such as those operating in the USA. Similarly to Transnet, the profile of the rail network in the USA services majority freight shipments as opposed to passengers. The coal export market in the USA is the fourth largest in the world and uses this rail infrastructure to export the commodity (Workman, 2018). Thus, with these similarities using the USA to form the basis for the costing is deemed feasible."

9) Paragraph 10: In depth Monitoring of KPI's – Addressed in section 6.1.

Section 6.1: " The chosen KPI's, their definitions and the performance questions that they answer with regards to the business operation of Transnet are shown **Error! Reference**

source not found. through to **Error! Reference source not found.**. It should be noted that Transnet has Live monitoring of their KPI's as needed for their annual integrated report which is available publicly."

10) Paragraph 11: Averaging data sets – This is addressed in section 5.2.

Section 5.2: " In this phase of the methodology the current performance of the supply chain was measured using the adapted framework described in section **Error! Reference source not found.**. Target values are determined against a combination of best practices, values found in the Transnets integrated report 2014 and ideal values. Ideal values are relevant to KPI's such as accidents for the year. It should be mentioned here that binary and continuous data sets are averaged together; however, a suggestion for future work is ensure that all data collected is continuous in nature to increase the accuracy of the framework."

11) Paragraph 12: Severity of KPI – Addressed in section 8.1.

Section 8.1: "The framework should include a severity coefficient, which would remove the assumption that all KPI's impact the system equally. This means that the framework will become more accurate."

12) Paragraph 13: Difference in percentage – Addressed in Table 6.7:

Table 6.7:

% of product sourced for export market	%	42	38	-10%

13) Paragraph 14: Margin vs cost – Addressed in section 6.1.3 and section 7.1.3.

Section 6.1.3: " Transportation costs versus product value – This identifies the cost of the route versus the cost of the actual product. This tells Transnet is it is cost effective enough for the end customer to use, i.e. does the product cost more that the transportation of the product. The target for this KPI according to the international market is 20% (US Energy Information Administration, 2014). It must be noted that this is note the margin of profit that Transnet is applying."

Section 7.1.4: "Figure 7.6 illustrates the average difference for the financial KPI's is 26%. It must be noted that these KPI's measure the cost to Transnet of transporting coal to the

RBCT. These financial KPI's are the running costs experienced by Transnet, i.e. the 'Cost Price"."

14) Paragraph 15 and 16: simulation results calculated in framework –Sections 6.4 and 7.2.7 have been added in to address this correction.

1.2 Structure of the Report:

1) Paragraph 1: KPI Model – The Final KPI model has been added in section 2.3.3.
2) Paragraph 2: Editing – Corrections made under section 5.4 to remove the 2oo and replace with 200. Editing has been done throughout the report and spelling and grammar corrected through the report.
3) Paragraph 3: Adding in Target values – Target values have been added into tables 6.1 onwards.

2 Corrections: Examiner 2

2.1 Research Questions and Objectives:

1) Sections 6.4 and 7.2.7 have been added in to address this correction.

2.2 Methodology:

1) Paragraph 1: Repeated sections have been removed. Assumptions have been reworded to become more clear in section 5.4.1 under number 1 and 4.

Section 5.4.1 number 1: " The trains move at a constant average speed as opposed to using different speed and acceleration values because it is assumed all trains are the same model and will have similar travel times. The average travel time is used for each train. Furthermore, information regarding the nature of the trains top speed, acceleration and deceleration capabilities were not readily available at the time this report was published. There are recommendations given in Section **Error! Reference source not found.** which address the use of average values across the simulation as well as constant route profiles. The model is designed using a triangular distribution to model some real life variability."

Section 5.4.1 number 4: "200 wagon trains are simulated as single wagons seizing twice the capacity of coal as the simulated rail network has a maximum length. This means that if there is a bottleneck of trains that the network will be at full capacity and no more trains can be produced at the source. Thus, adjusting the capacity and utilising a single wagon avoids this potential complication, whilst not changing the real output.

Recommendations to counter this assumption are given in Section **Error! Reference source not found.**."

2) Paragraph 2: High Level Process Flow – Figure 5.1 is added in to adress this correction. Futhermore, flowcharts can be found in appendix A1 for each stage of the Value Chain.
3) Paragraph 3: Train speed etc. – This is addressed in section 5.4.1 under number 1 and 4 (Shown in point 1) and Section 8.2.

- Section 8.2: " The model should use the geographical locations of the pickup points, Ermelo, Overvaal and RBCT. The model should also utilise the actual train speeds and distances as opposed to modelling travel time as a delay. This would make the travelling of the trains more lifelike and introduce other characteristics like gradient, breaking and accelerating behaviour. The geographical locations of the rail network could also be used to identify points in the network most susceptible to breakdowns or accidents. Utilising the actual length on the geographic position of the coal network would allow for both 100 wagon and 200 wagon consists to be modelled accordingly. The following information would assist the refining of the model:
    - Determining the exact location of the rail networks utilised for the coal export industry. Then using the GIS (Geographical Information System) in Anylogic,
    - Attaining train by train information for the measured KPI's will prove invaluable in eliminating the risk of using average KPI values."

4) Paragraph 4: Compare Base Model Results – Sections 6.4 and 7.2.7 have been added in to address this correction.

2.3 Observations:

1) Paragraph 1: Target Values – Added in as above in Tables 6.1 and onwards.
2) Paragraph 2: Time Period of Information – This is addressed in Section 5.2.

Section 5.2: " All achieved values were found in open source documentation on Transnet for the year 2014. The majority of the achieved values were attained from Transnet's integrated report for the year 2014. All information is taken over a one year period."

3) Paragraph 3: Standardising KPI's – This is addressed in Section 8.1.

Section 8.1: "In future it is recommended that the performance values are standardise, i.e. all negative for underperformance and positive for over performance. Normalising a dataset collected over a year will assist in strengthening the accuracy and clarity of the data inputted into the framework."

2.4 Results and Discussion

1) Paragraph 1: Restructure Section 7 – This section has been restructured as suggested.
2) Paragraph 2: Clarification of WIP – This has been done on all graphs in this section.

2.5 Recommendations

1) Paragraph 1: Comparing Framework results of Simulations – This has been done in section 6.4 and 7.2.7.

Spelling and grammar checks have been redone and corrections made.