

# Methods of Improving Turnaround Time of Iron Ore Wagon Utilisation

Thembisile Mabhena, Stephen A. Akinlabi, *Member, IAENG* and Charles Mbohwa, *Member, IAENG*

**Abstract**— Transnet Freight Rail (TFR), an arm of Transnet Limited is a multinational company established to optimize supply chains system of the iron Ore industry through the integrated logistics initiatives. The growth demand on rail services has been adequately considered by ensuring that the existing TFR's infrastructures, locomotives and wagon fleets are functional and serviceable. However, in the daily operation TFR is mostly challenged with meeting the turnaround time as scheduled. 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 planning is needed in every yard to ensure that all activities in the run up to train departure are executed and executed on time.

**Keywords**— Turnaround time, Utilization, and tonnages

## I. INTRODUCTION

RIGHT railway systems and activities in South Africa are managed and owned by Transnet Freight Railway. As a result of the expertise of Transnet in Engineering, they service the entire government establishment in all engineering related services. It is currently adopting a new business strategy that it believed will be able to deliver where its turnaround plan introduced six years ago has failed. The new plan is to reduce the average wagon cycle/turnaround time by 20 percent and deviations from scheduled train departure and arrival times by nearly 25 percent, while at the same time improving locomotive efficiency by more than 30 per cent [1].

Transnet Freight Railway (TFR) operates an iron ore line which is the only line of its kind in Southern Africa and the world's second longest heavy haul line [2], [3]. It is important to know that Africa's growth depends on solid transportation networks and the TFR as a freight-focused business does not only link the continent's economy but also plays a vital role in strengthening Southern Africa [3], [4]. The Iron Ore exploitation and exploration operates the heavy haul line from mines of the Sishen area to the Port of Saldanha Bay, Mpumalanga mine complexes as well as in KwaZulu-Natal. Sishen mine has sufficient resources to sustain a 21-year production and mostly the Mine's Iron Ore exported, with about 6.2Mt of its production being supplied to Arcelor Mittal

Thembisile Mabhena is with the department of Quality and Operations  
Stephen A. Akinlabi is with the Department of Mechanical Engineering  
Science, University of Johannesburg, South Africa.  
([stephenakinlabi@gmail.com](mailto:stephenakinlabi@gmail.com)).

Charles Mbohwa is a Professor with the Department of Quality and  
Operations Management, University of Johannesburg, South Africa  
([cmbohwa@uj.ac.za](mailto:cmbohwa@uj.ac.za))

of South Africa (AMSA) in 2011 [4]. This essential transport line has benefited South Africa's economy by literally keeping it moving and its heavy haul operations have positioned South Africa as one of the pioneer of a cutting-edge technology, offering commercial and competitive advantage to the economy with vast mineral resources. It has further moved South Africa's natural resources to factories and refineries to ensure progressive growth of both large and small scale industries, [3], [4].

In order to address some of the identified problems, TFR employ the strategy of collaborating IT Systems to apply operations planning and simulation software called Integrated Asset Train Monitoring System (IATMS) suitable to manage deviation [4], [5]. The approach adopted was highly welcome because the system give TFR a good business environment for developmen of their operating plan.

This included optimization of the routing and classification plan for each wagon movement, and 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 total wagon-miles traversed [4], [5].

## II. MOTIVATION

There have been numerous press reports about the railway's poor service on Iron Ore recorded in the past, some of which includes 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 with keeping up with the schedule of turnaround time of wagons, in a sense that wagons are being over utilised and compromised, and sometimes do not meet the scheduled time for maintenance time.

The outcome is to improve the turnaround time of wagon utilisation between Postmasburg and Sishen., whilst improving operational effecience, production and quality customer service. The following questions are asked:

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

### III. LITERATURE REVIEW

In comparison with the early stage Transnet activity in the usness of wagons and locomotives, TRF has improved in the turnaround time for their wagons and locomotives. Some of the improvements include the installation of tracking and tracing system on the wagos, and locomotive. In addition, trains scheduling was also introduced. All theses have been achieved through the support of the South African Transport and Allied Workers Union (SATAWU). After the global economic recession, over four hundred locomotives and thousands of wagons were out use. In view of this, a proposal to relocate and redeploy operating staffs depots such as export and domestic coal depots, export iron ore and container depots where volume of activity are high [6], [7].

In 2006, the Washington Times carried a lead story on the turnaround of the Indian Railway [8]. It stated that few doubted that the Minister for Railway (Mr Yadav) has presided over an impressive business turnaround. He has taken a 1.5 million employees and boosted revenues by 15.5 percent 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 percent between 1984 to 1991 to 1.86 percent during 1992 to 1999 [8]. This deterioration continued until 2001.

In the course of business, it became necessary for the turnaround time of the wagon and locomotives in order to enhance its operations. Hence, different incentives were introduced and offered to freight clients, such as cash incentives, increasing the handling capacity of the terminals, strict control and scheduling of idle wagon using the freight terminal operational information services. All clients were encouraged to patronise the use of wagon round the clock. Robin and Peace show that through this approach, the Indian Railway was able to successfully reduce their turnarounds time from seven to five days [9].

In the study conducted by Mkhathswa [10] on 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. Though it's 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 will result in the reduction of cycle time thus maximizing coal tonnage shipped from the mines to Ermelo and eventually to Richards's bay for exports [11].

It is important that some of the challenges at the railway are caused by unavailability of drivers, that is, when booking the drivers, there should be a standby driver for deviations in case the booked driver could not make it to work. Furthermore there is no communication between the client at the Mine and Transnet causing the wagons to delay and the train not departing on time from the origin. That is why criticism still levied against Transnet by some mining executives is that it is responsible 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 [12].

In order to improve the efficiency of the operation of the wagons and locomotive and save time, a good system of loading and off loading was put in place. In addition, there is provision of insurance cover for all clients in order to protect all their transported goods. With this in place most customers are encouraged and confident to patronise the wagon and locomotives. However, besides late arrival and departure times, wagon availability has been a problem. TFR strives to improve the service delivery to clients, therefore the operation managers at the depots is responsible for planning and scheduling of train movements, which is considered being ineffective as it has resulted into higher cycle times, insufficient capacity and insufficient service to clients [11], [13].

One of the activities in a rail operations include ability to forecast train volumes, tonnage and distance covered from origin to destination accurately. All these must be effectively harmonised to avoid catastrophy. The details of this will involve capturing data for everyday of the week, the type of traffic, the capacity of the wagon/locomotives and other railways traffic interchange with TRF. Planning is done on a daily basis which is categorised according to strategic planning (planning over long-term), Tactical planning (medium-term planning), and operation planning (short-term planning) which will also be mostly considered in this research. The operational planning in TFR is performed by local management team, team responsible for control.

Bang-Yan et al. [13] stated that the cross point of light locomotives happen when the trains are in balance over the week, and in particular with the day-of-week operations leaving crews dwelling for too long at the away terminals [5]. In these situations, the crew dispatcher will send the crew at the away base back via a light locomotive to limit penalty payments, but implicitly create a need for another light locomotive in the opposite direction one or two days later [5]. It is significantly more costly to run special trains due to added crew costs. Light locomotive means that the locomotive is not carrying any wagons, it is the locomotives.

Crew challenges that are faced on a daily basis include, the late reporting on duty, booking off-sick prior to train departure, train assistant absent (not reported on duty) and absent without leave, the train will be staged in the section because of the mentioned challenged resulting in train being cancelled or late delivering of the product impacting on the turnaround time of wagons.

In view of this, Kgale et al. [14] conducted a study to identify what has been done at the Port of Durban in the last decade in Durban in the effort to reduce cargo turnaround time within the last decade. It also demonstrated the impact of reduced cargo turnaround time on port operational capacity. The paper 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.

A railway operating plan describes how wagons should be moved (the routing and train plan), and often includes the use

of the major assets (such as train crews, locomotives, yards and tracks) needed to move the wagons. At TFR, this is called the Integrated Train Plan (ITP), a total replacement of the existing operating plan except for IATMS, it was designed to dramatically improve service and significantly reduce the number of trains, which are often competing goals [5], [15].

Costs associated with long trains include the need for longer passing sidings and increased turnaround time 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 circuitry, and is measured by the ratio of the distance the wagons travels in trains from its origin to its destination and the shortest-path distance [5].

#### IV. METHODOLOGY

This study aimed to perform in depth research about the processes and train schedule plans in order to have a better knowledge on day to day operations for train execution, and have a better understanding on the deviations that the TFR is facing on a daily basis so as to be able to profer a solution for the identified problem. Both qualitative and quantitative approach was employed, this help to validate one set of improper defined techniques employed in the data collection.

#### V. 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 were employed in this research study. The methods include a semi-structured group interview that was taped recorded, and in addition questionnaires were administered because it allows the participants to explore the topic, allows them to give their opinions and ideas in their own words.

##### a) The semi-structured group interview

At the outset of the group interaction, the researcher assured the interviewee that confidentiality would be guaranteed to encourage interviewee to speak freely. The discussions were aimed at getting an individual overview of the possible causes of the delays of turnaround time of wagons in general and the effect on the company and on the customer.

##### b) Questionnaire Design

In this study, the questionnaires was designed and followed according to a quantitative approach. The questionnaire contained eight (8) section to which the employees and managers will be asked to comment on.

The Likert Scale was a useful device to build a degree of sensitivity and differentiation of responses while generating numbers and the respondent will indicate agreement or disagreement with the statement. The internet was also used to retrieve information and reports of previous years, which will

be helpful. Cross-tabulation was used for statistics and to reveal formerly hidden relationships that helped to explain the data mare clearly. These tables were presented at the end of the research after data was collected.

#### VI. RESULTS AND DISCUSSIONS

According to the majority of the respondents, Transnet Frieght Rail does not run a scheduled railway. The Turnaround Time of wagons exceeds the the expected time and sets a bad record onto customer's setisfaction. Their feelings of frustration, not only concerning the Turnaround 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.

The following deviations were observed and listed:

- a) Locomotive issues: some of the locomotives are being out worked or being over used to pull oversized load than the required quantity. Some of the locomotives are not being serviced as required because of the demand of loads from the customer.
- b) Wagons that fails on rail: the company is experiencing some of the wagons being out of the service and not being maintained as supposed to.
- c) Cable theft that causes the trains to stage at the sections.
- d)The flow fo communication between Transnet and the Mine is not effeective enough and its impacting on the Turnaround time of wagons because sometimes wagons are placed for loading but the client will leave it to load other prioritized trains.
- e)Scheduling of trains does not match with the booking of resources and personnel, resulting in trains staging at the sections waiting for locomotives or presonnel.
- f) Lack of Management support which most the junior employees pointed out to say that some of the management does not take the moving of tonnages too seriously.

According to most respondents top management should be responsible for delivering as 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, most do not have the credentials resulting in priority issues being handled inefficiently.

#### VII. CONCLUSION

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

The main objective of the research was to find ways to improve the train turnaround time of 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 turnaround time of wagons 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 applicability of some still has to be determined. This project depicts and recommends possible methods that could be used to solve the turnaround time of wagons [11].

It was evident that there is a delay between Sishen and Postmasburg that causes the loads to be delivered late resulting to poor service delivery. The customers are not happy and even transporting some of their loads by road. Again the lack of communication between TFR and Sishen mine results in not keeping up with the design of service that deals with the total supply of wagons and locomotives.

Firstly 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 must 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 is not properly done as to where and when the locomotives and wagons must be sent to the mine with train slots booked accordingly. They also felt that the service or maintenance book for all the resources is done prior to the time they need to go and be serviced, thus the locomotives failures and wagons being withdrawn for the service at the most critical time, and its when its loaded with the customer's product.

#### ACKNOWLEDGMENTS

The authors' wishes to thank all the Transnet employees who participated in the questionnaires completed it and returned the questionnaires. We also appreciate the staffs of Statkon, university of Johannesburg for the assistance with the data analysis and in particular Mrs. Jaclyn De Klerk for her input and guidance.

#### REFERENCES

- [1]. Munshi, R. (22 March 2013). *How Transnet's R300bn plan is taking off. Speeding up Freight*. [Online] Available at: <http://www.fm.co.za/business/2013/22/>.
- [2]. Kumba Resources. Sishen Iron ore. Cape Town. Dyason Design & Print: 12. 2002.
- [3]. Delivering development and growth for a nation. Transnet. Available at: <http://mg.co.za/print/2011-10-28-delivering-development-and-growth-for-a-nation>
- [4]. Transport News. (25 March 2013). *Transnet plans to speed up freight*. [Online] Available at: <http://www.bizcommunity.com/Article/196/582/91098.html>.
- [5]. Rail Planning Blog. Available at: <http://www.railplanning.com/CP-MultiModal-IOP-Project%20Rev%201.PDF>
- [6]. Railway Union Reports. (Dec 2009). *The impact of the worldwide recession on freight rail in SA ans SAEAWU's response*. Issue 11. [Online] Available at: <http://www.itfglobal.org/railway/unionreports-issue11.cfm>
- [7]. International Transport Worker's Federation (itf). Available at: <http://www.itfglobal.org/en/global/>

- [8]. Nelson, E. (2006). *Indian Railways runs right under Yadav's leadership*. Available at: <http://www.washingtontimes.com/world/20060414-110533-6362r.htm>
- [9]. Robbins, K. and Pearce, J. 'Turnaround: Retrenchment and Recovery' *Strategic Management Journal* 13: 1992, pp. 287-309.
- [10]. Mkhathswa, N. *Improvement of Coal Tonnages with Minimum Capital Investment at Transnet Freight Rail Coal Export Line*. Department of Industrial and Systems Engineering: University of Pretoria. 2010
- [11]. Nkosinathi Mkhathswa. *Improvement of Coal Tonnages With Minimum Capital Investment At Transnet Freight Rail Coal Export Line*. Bachelor's dissertation, Industrial Engineering department, University of Pretoria, South Africa.
- [12]. Admin. *Localisation for Africa*. [Online] Available at: <http://localisationforafrica.com/article/view/fast-tracking-freight>
- [13]. Bang-Yan, W., Jun-Meng, W., and Y. U. Hong-ping. Y. U. Study on Track Alignment in Huangguoshu-Beipanjiang Section of Shanghai-Kunming Passenger Dedicated Line. *Journal of Railway Engineering Socitey*. 157(10): 2011, pp. 19-24
- [14]. Kgale, T., Raballand, G. and Ittman, H. 'Cargo Turnaround time in Durban: Lessons for Sub-Saharan African Ports. The world bank Africa Region. Transport Unit. 2011
- [15]. Transnet. (2009), Transnet Limited: Annual report 2009.