



Research Article

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The Impact of Supply Chain Management in the Operations of a Passenger Rail Transport System: A Case Analysis of Passenger Rail Transport from 2009 to 2015

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Abstract

The article looks into the influence that supply chain management has in the operations of a passenger rail company in South Africa. The case analysis was based on desktop research on PRASA annual reports from 2009 to 2015 including the two Corporate Plans from 2015 to 2019. Successes and challenges encountered in the organisation will be analysed. Areas to be analysed include enhancement of technical skills, the refurbishment programme, patronage growth, customer satisfaction and passenger safety among others. The article covers the impact of supply chain management (SCM) on the general corporate performance; analyses the risks and disruptions derived from the various supply chain sources undermining supply chain performance; identified, shared and promoted the uptake of best practice in supply chain management.

Keywords: SCM, Passenger Rail Transport, methodology, case analysis, integrated logistics, mean time between failures

1. Background

The commuters have experienced and still are experiencing general disruptions to the flow of the commuter rail transport system in South Africa. These disruptions have been linked to maintenance, accidents, derailments, budget adequacy & availability and supply chain management discourses. The effect of this has been felt by the commuters (which include school children, working class and the general public). This has been mentioned on a daily basis in the local media for example The Citizen, Thursday 7 April 2011:6; The Citizen, Wednesday 13 April 2011:4, 18; The Sowetan, Monday 11

April 2011:9; The New Age, Wednesday 13 April 2011:3; in government circles, passenger rail transport executive management (PRASA Annual Report 2009/10) and the general public, who are consumers of this service. This article comes at the opportune time when PRASA is going through the rapid transformation from 2009 to 2019 after the stabilisation stage. At passenger rail transport the major causes of poor service delivery are the ages of the trains which have exceeded their life of 33 years, shortage of skilled personnel such as Engineers (Electromechanical and Signals), and artisans (PRASA Annual report, 2009/10, PRASA Corporate Plan MTEF 2015-18 & 2016-19).

In general, the performance issues at the Passenger Rail Transport Operation (PRTO) are on-time performance arrivals and departures, safety, and asset utilisation which look into fleet preventive maintenance and fleet investment through upgrading and replacement; service quality and passenger growth through increased patronage and financial effectiveness measured through fare revenue increase, expenditure management and capital (project) expenditure management. The lack of effective maintenance engineering performance can result in endangering personal equipment, loss of production or service output, high repair costs (spare parts and materials), excessive machine breakdown, poor utilization of maintenance staff, low service quality and shortened life span of assets.

Previous reports from PRASA Corporate Plans (2015-18) stated that the passenger rail transport Fleet Renewal Programme was the catalyst for the transformation of Metrorail services and public transport as a whole. It was the beginning of the rollout of the Government's Comprehensive Rail Programme over the next two decades. The Rolling Stock Fleet Renewal Programme was designed to achieve a number of key Government objectives such as the delivery of quality services to citizens, revitalization of South Africa's rail engineering industry through local manufacturing and ensuring local content (65% minimum local content is set) as part of the Government's Industrial Policy Action Plan (IPAP2), employment creation and skills development as well as Broad-Based Black Economic Empowerment.

The Corporate Plans noted that passenger rail transport's effort to procure approximately 7 224 new rolling stock was well underway. Over the next twenty years, passenger rail transport would spend R123.5 billion, with delivery on new trains expected from 2015. Previous studies done by Passenger Rail Transport in 2011 concluded that the Rolling Stock Fleet Renewal Programme must deliver 5256 coaches in order to satisfy existing rail passenger demand on the current network until the year 2020, 456 vehicles to satisfy growth in rail passenger demand to the year 2030 on the existing network and a possible further 1512 vehicles to satisfy long term rolling stock needs on new corridors to be constructed as part of future expansion of the existing network and the development of a new network. The procurement of new rolling stock was a critical component of passenger rail transport's mandate to provide for modernization and growth. Passenger Rail Transport has since appointed Gibela Rail Transport Consortium (Gibela) to supply 3600 new Metro Rail coaches at a cost amounting to R51 billion (subject to inflation and foreign exchange rate) over a 10 year period (2015 – 2025).

2. Review of Literature

In other literature, Supply Chain Management is loosely referred to as logistics or integrated logistics management. In this article these terms will be used interchangeably. A passenger rail transport operation (PRTO) is a complex operation and this is in line with a description that a train is a complex system, which includes thousands of parts and components that are derived from three main complementary technological sub-sectors: the electromechanical, electronics and mechanical sectors (Esposito and Passaro 2009). With such a complex operation, it implies that supply chain management has to be complex in nature. In studies by Donaldson Soberanis (2010) revealed that supply chain management (SCM) is an oversight of materials, information and finances which involves coordinating and integrating these flows both within and among companies as efficiently as possible. The author further pointed out that SCM consisted of interconnected components that can be complex and dynamic in nature. This implies that an interruption on one event may have an effect on the other.

Studies in logistics defined it as a management discipline originated in the military and later branched into the commercial sector as business logistics (Russell 2007; Ghiani et al. 2004). The author also stated that integrated logistics in a commercial context is coordinating logistics activities while in a military context, integrated logistics is designing reliability, maintainability and supportability into weapon systems, focusing on customer requirements, coordinating supply support, training, technical data, and all other integrated logistics support elements. Further studies by Manjunatha et al. (2009) defined logistics as the collection of activities associated with acquiring, moving, storing and delivering supply chain commodities (i.e., products in all stages of manufacture, service and information). Logistics encompasses the business functions of transportation, distribution, warehousing, material handling, inventory management and interfaces closely with manufacturing (Ratliff & Nulty 1996 cited by Manjunatha et al. 2009). Logistics deals with the planning and control of material flows and related information in organizations, both in the public and private sectors (Ghiani et al. 2004).

3. The Overview of Passenger Rail Transport

The South African government view is that passenger rail transport must promote rail as the primary mode of mass commuter transportation and generating income. Passenger Rail Transport's main responsibility is to deliver commuter rail services in the Metropolitan areas, long distance (intercity) commuter rail services and bus services (PRASA Annual Report 2014/15). In fact, Passenger Rail Transport, transports more than 532 million passengers per annum across Metrorail 528,204,625 (99.17%), Shosholozha Meyl (intercity trains) 1,263,500 (0.24%) and Autopax (bus transport) 3,146,768 (0.59%) via 468 stations in cities and throughout the country (PRASA Annual Report 2012/13:29). Metrorail takes the lion's share of the commuters and there is opportunity identified to research in SCM as it impacts on the maintenance activities in enhancing organisational performance in this unpredictable and unstable environment.

The socio-economic, political and climatic conditions affect SCM and merit consideration. Such issues as the dynamic issues like the Tsunami and subsequent earthquakes in Japan brought in challenges in the world economy and this included global supply chain management. The Chile volcanic eruptions and recently Costa Rican in 2016 with hordes of ash clouds disrupting air transport around Europe, Australasia, South America and Southern Africa. The wildfires in America and Canada recently in 2016 and natural disasters in Australia and New Zealand add to the list. The uprisings in the Arab world in countries such as Libya, which contributes about 2.5% of the world's oil, Egypt, Tunisia, Syria, Yemen, Iran, Northern Ireland, Greece, the Eurozone economic decline and the threatened split of Britain from the European Union to list just but a few. These unpredictable situations impacted SCM directly and indirectly in the wake of global shipping and sourcing South Africa was not spared in the predicament. In 2009 another dynamics emerged to the world economics with the biggest recession in 70 years, the high rise in fuel price and the scarcity of electric energy in Southern Africa with high demand felt during the 2010 FIFA world cup in South Africa.

3.1 Political Environment

The government of South Africa showed political will in transforming the South African Rail Commuter Corporation (SARCC) into a new entity called PRASA in order to enhance more accountability. The government gave a green light for a multi-year, multi-billion rand recapitalisation of both freight and passenger rail. Metrorail would get 7224 new coaches which are equivalent to 602 new train sets over 40 years at least with first 3600 earmarked for the next 10 years beginning in 2015 (PRASA Annual Report 2012/13:19-20). This is on the background that Metrorail has 2200 obsolete coaches which have exceeded their useful life of 33 years for all undercarriages. The government has tried to spearhead in the promotion of rail passenger transport by putting in place the relevant statutes such as the National Land Transport Transition Act, 2000 (Act No. 22 of 2000). PRASA is the first and only Government-owned vehicle in public transport and the government is committed to continue subsidising and regulating public transport operators. To this end, Metrorail has an array of needs like capacity building, infrastructural support, financing, technological upgrading, quality improvement, research and development, commuter access as explained in the PRASA Annual Report of 2009/10 financial year.

3.2 Economic Environment

In South Africa during the 2009/10 financial year economic crisis was caused by the severe impact of the global economic down turn. The then Minister of Finance described it as the worst recession in 70 years. There was an increase in traction energy requirements for commuter rail operations by 33% and the energy bill increased by R100 million. Cumulatively passenger rail transport had a funding shortfall of about R1 billion. Passenger Rail Transport continued to face challenges like high electricity and energy costs, rising material cost and critical shortage of critical skills like engineering, train drivers, and traffic control officers. A proposed fare increase of 10% amounting to R134 million was not approved, making it impossible for Metrorail Regions to meet their budgets requirements. This was the sixth successive year without any fare increase for Metrorail (PRASA Annual Report 2009/10:25). In general Passenger Rail Transport remains a going concern. Due to the cash-flow challenges, management renegotiated the cost of key contracts, reduced the number of coaches to be refurbished, rescheduled payments with suppliers, and delayed implementation of key projects (PRASA Annual Report 2009/10:25). Passenger Rail Transport infused a business approach principles such as localisation, industrialisation, broad economic empowerment, skills development and women empowerment in line with the National Development Goals (PRASA Annual Report 2014/15).

3.3 Social Environment

South Africa is characterised by a high unemployment rate which is currently about 25.2% seemingly increasing and is one of the highest deadly disease in the South African economy and this has left many families living below the poverty datum line. The Government has been forced to decline the fare increases for that past six years. Passenger trips were on the decline towards the end of 2009/10 financial year. The evidence was seen in Metrorail's decline in patronage and revenues. According to the COSATU 10th Congress Secretariat Political Report as mentioned in PRASA Annual Report 2009/10:21, 16.7% of all employed people in South Africa earn less than R500 per month, 34.3% earn under R1000 per month and a total 60% of all workers earn less than R2500 per month and many of whom are sole income earners in their households.

3.4 Technological Environment

The strategic role for passenger rail transport is to create a modern public entity by 2017 that would be able to deliver quality passenger services on a more sustainable basis (PRASA annual Report 2012/13:14-15) which will be achieved through investing in modern trains, signalling and telecommunications systems, infrastructure, transit orientated developments and new generation stations, access control and other operating systems..., and effecting key operational efficiencies for improved service delivery as well as the modernisation of operations through the introduction of technologies in critical areas. Metrorail needs to undertake a major technology upgrade (PRASA Annual Report 2009/10:26) and was said as far back as 2009. The then Group Chief Executive Officer of PRASA summed it up in 2009, "The modernisation of the asset base through the Fleet Renewal Programme and Signalling and Telecommunications as well as Network Extension Projects will continue to play a major role in the coming five years" PRASA Annual Report 2009/10:27. This was superseded by the Gibela Transport Consortium to deliver new modern coaches worth over R59 billion over the next few years (PRASA Annual Report 2014/15). The report further decried that there were serious weaknesses in compliance with supply chain management processes and years of under-investment in rail infrastructure (PRASA Annual Report 2014/15).

Passenger Rail Transport was tasked with the delivery of a high speed link between Johannesburg and Durban with this vision also introducing high speed rail between Johannesburg and Polokwane as well as Johannesburg to Cape Town in the medium to long-term. The upgrades of rolling stock, stations and the resultant recapitalisation will assist in increasing the value of the fixed assets. There was delivery of 505 upgraded coaches through the Accelerated Rolling Stock Investment Programme.

With the rapid focus on technology upgrade at Metrorail there is opportunity for Supply Chain Management to be upgraded to match the developments using enabling technologies i.e. Enterprise Resource Planning (ERP) softwares are vast and they are found on shelves but a proper SCM model needs to be developed first before any selection is done in order to customise it to the passenger rail transport situation. These softwares assist the integration of key departments such as Maintenance Stores, Supply Chain Management, Maintenance, and Management. Within the stores they will be real-time information on stock levels, ABC lists and the integration of all stores in the Metrorail's five regions and depots into a single virtual store while maintenance will have the history on maintenance of each rolling stock and also establish the fast moving stock. This information will be important to SCM and executive reports should be generated.

3.5 Legal Environment

PRASA is a legal persona and it operates autonomously. Its main commuter rail division is Metrorail. Metrorail is wholly owned by PRASA a government entity tasked as a commuter rail. There are several statutes which guide the operations at Metrorail some of which are the Legal Succession Act to SATS Act (Act 9 of 1989) to ensure that, at the request of the National Department of Transport or any sphere of government, rail commuter services are provided in the public interest, and to promote rail as the primary mode of mass commuter transportation. This gives Metrorail the custodianship of all commuter and passenger rail assets such as land in and around stations, infrastructure and rolling stock. The Public Finance Management Act 1 of 1999 (PFMA) which regulates financial management in national and provincial government, the Treasury Regulations 16 of 2005 which encompasses supply chain management guidelines, Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003), Supply Chain Management Policy among many others. The legal operating structure is shown in Figure 1.

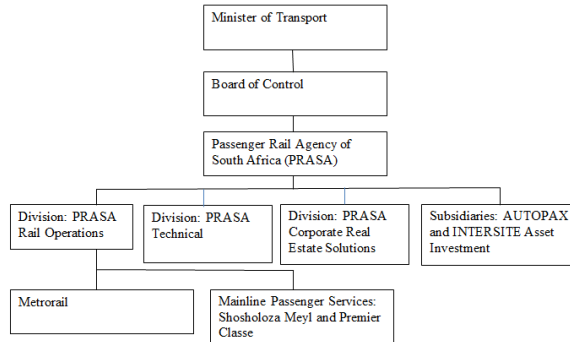


Figure 1: Legal Operating Structure, Adapted from PRASA Annual Report. 2014/15:7

4. Methodology

This section covers the investigative approach, the chosen research framework and the data collection methodology followed. The data collected centred on parameters and variables across the supply chain as it affects corporate performance. An in-depth investigation into passenger rail transport supply chain parameters and variables, SCM policy, costs, risks, service level, stores management and maintenance policies, management practices and the adherence to the policies by the organisation was done. The author did an in-depth desktop research into passenger rail transport looking at the developments from 2009 to 2015 through PRASA annual reports, PRASA corporate Plans 2015-19 and electronic media. Critical to the research was the success stories and the challenges faced in that period. These issues had a greater impact on the performance of passenger rail transport especially where commuter rail required more traction energy. The studies revealed that there were numerous factors affecting passenger rail transport as a parastatal organisation which needed to be identified, understood and analysed to achieve optimum performance. Political, Economic, Social, Technological and Legal (PESTL) strategic management tool was used to scan the background of the research. PESTL gave a helicopter view of the whole environment.

The data collected catered for the whole supply chain uncertainties with objectives of the PRTO identified. Identification of the controllable and uncontrollable variables of the system to be studied was spelt. In the passenger rail transport, the variables included the upgrade and replacement of fleet decisions, availability of spares, skills availability, information process flow and information technology (IT) used.

5. Results and Discussions

The time under review brought aspects which must be considered and which were impacted by SCM through general logistics or integrated logistics management. The breakdowns of the strategic imperatives are given in Table 1.

Table 1: PRASA Strategic Deployments

Time Period (Year (s))	Strategic Deployment
2010-2012	Stabilisation of Commuter Rail
2013-2014	Replacement of Old Rail Infrastructure
2015-2018	Growth and Expansion

The three time periods require a comprehensive SCM strategy that will assist in achieving better results be it the refurbishment, replacement or upgrading of old infrastructure (Table 1). The different aspects analysed from PRASA annual reports will be explained below as they are impacted by SCM.

5.1 Total Revenue Decrease or Increase

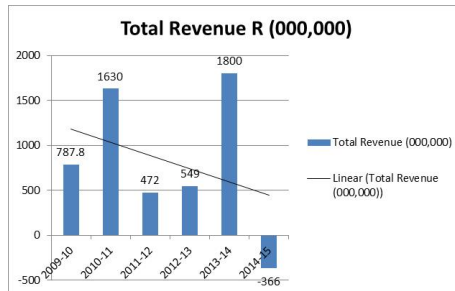


Figure 2: Total Revenue Decrease or Increase

Figure 2 shows that there was high total revenue collected during 2010 FIFA world cup where many commuters used trains to attend matches and during 2013-14 financial year where the focus was given to the property portfolio utilisation around major train stations and depots. The total revenue linear regression outlook is on the decline yet more revenue is required for the refurbishment, replacement and upgrading of old and obsolete rail infrastructure.

5.2 Operational Subsidy

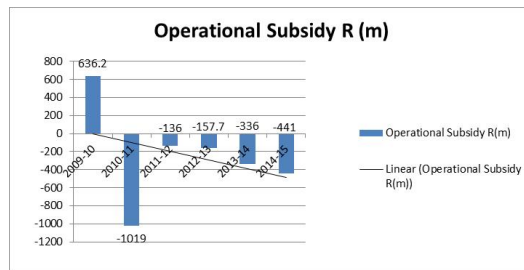


Figure 3: Operational Subsidy Decrease or Increase

Passenger Rail Transport is 100% owned by government through the Department of Transport. This means that any operational budget shortfall must be subsidised by government. In 2009-10 government was assisted by FIFA funding and had a positive subscription to the budget required. There after as in Figure 3, the Government could not provide enough revenue to Passenger Rail Transport to cater for the operational budget requirements. This has impacted the supply chain management system could not meet with the requirements.

5.3 Technical Skills Enhancement

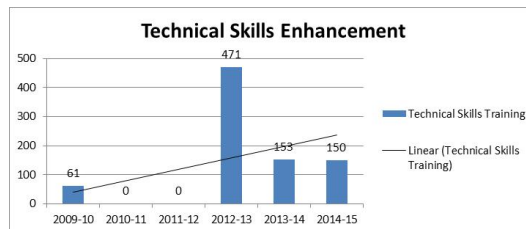


Figure 4: Technical Skills Enhancement

South Africa got independent in 1994 and since then a number of changes have been taking place including in the education sector. The country still faces a lot of skills shortages which is attributed to a poor education system. According to the National development plan (2030:317), South African universities are mid-level performers in terms of knowledge production with low participation, high attrition rates and insufficient capacity to produce the required level of skills. It is further stated that the problem of graduate employment in the face of skills shortages is an indication that universities produce graduates who do not meet the needs of society. This is coupled by the need to expand access to university education. Against this analysis, the proposals for universities to increase the throughput rate for degree programmes to more than 75%, increasing the number of graduates to 425000 by 2030 from 165469 currently with more in science technology, engineering and mathematics (NDP 2030:319).

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PRASA Corporate Plan 2015-18 mentioned that passenger rail transport was unable to compete for skills, resources and expertise in technical and professional skills more so to even retain the limited resources they have. Figure 4 shows that passenger rail transport has been training internal staff from 2009 to date and there is a linear upward trend in the number of technical and professional skills being produced. The numbers have not been meeting with the skills requirements. These skills are required in the formulation of proper specifications for procurement to be done, the evaluations of tenders and proposals and to be part of the whole supply chain management process since most procurement in passenger rail transport is technical in nature.

5.4 Metrorail Refurbishment Programme

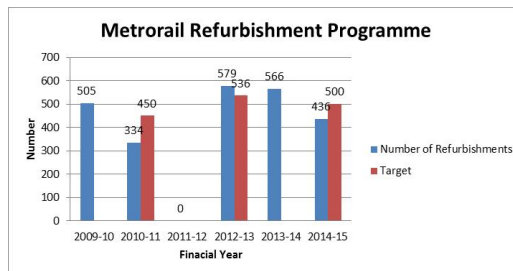


Figure 5: Metrorail Refurbishment Programme

The 2010 FIFA world cup had an influence in the refurbishment of trains which amounted to 505 without any target set. Figure 5 shows the preceding years passenger rail transport was not meeting its targets serve for 2012-13. This lack of meeting targets is attributed to lack of proper SCM processes, under budgeting and lack of enough skills in the company.

5.5 Rolling Stock Renewal Programme

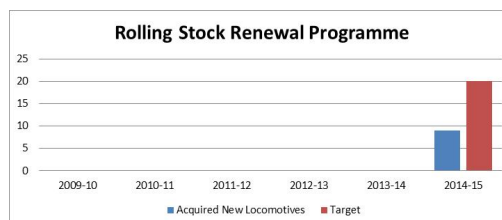


Figure 6: Rolling Stock Renewal Programme

Passenger Rail Transport in its Corporate Plan 2015-18 mentioned that they required 7224 coaches over 20 years costing about R123.5 billion. Out of these 5256 coaches would be for meeting the existing demand on the existing infrastructure. The projection for growth is having 456 coaches per annum up to 2030. In Figure 6 the target set for 2015 was 20 but only 9 were successfully delivered and the other nine are undergoing testing. At this rate passenger rail transport will take many decades to just stabilise on the existing demand. The SCM processes need to be up-scaled in order to meet the demand and the projections made.

5.6 PRASA Patronage Growth

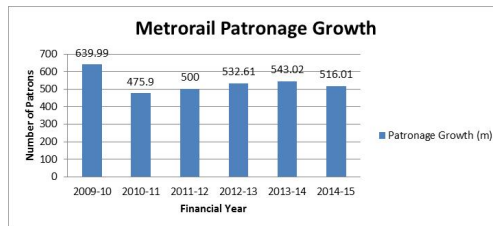


Figure 7: Metrorail Patronage Growth

Figure 7 shows the general decline in patronage over the time period. Patronage growth is correlated to the customer satisfaction; an increase in patronage is directly proportional to higher customer satisfaction. Figure 7 shows a general decline in patronage which can be attributed to train delays, unreliable time tabling, derailments, thefts and strikes which breeds customer dissatisfaction. Some of these have a bearing from SCM directly or indirectly.

5.7 Train Delays

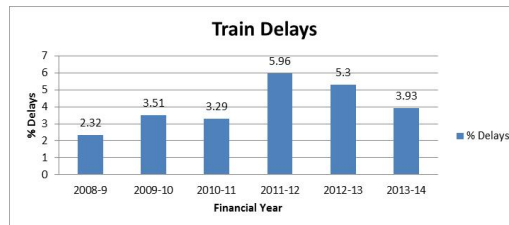


Figure 8: Train Delays Rate

Figure 8 shows train delays caused by different train-set failures. There has been an increase in train delays from 2008 to 2012 and a decrease from 2012 to 2014 but has not reached the 2008 level of 2.32%. This might have been one of the causes of patronage decline. When train-sets have fewer faults the mean time between failures will increase and higher availability rate.

5.8 Passenger Safety

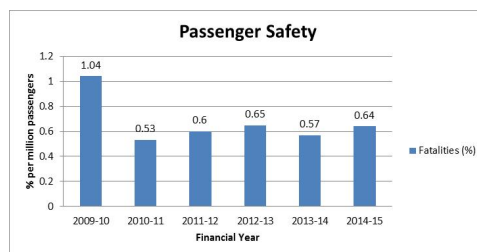


Figure 9: Passenger Safety Rate per Million Passengers

The high fatality rate in 2009-10 was caused by the huge accident that happened on the 7 December 2009, otherwise there has been a consistent level of fatalities thereafter.

5.9 Customer Satisfaction

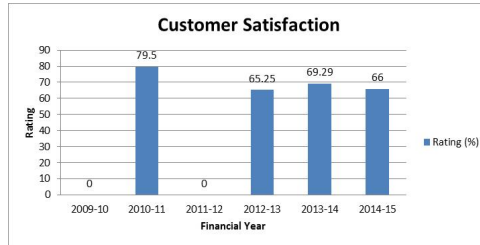


Figure 10: Customer Satisfaction Rating

Customer satisfaction has been on a downward trend from 2010 to date as depicted in Figure 10. The factors pointed out being defilement, thefts, burning of trains, train delays, cancellations and unreliable trains with significant derailments happening.

5.10 Mean Distance between Failures

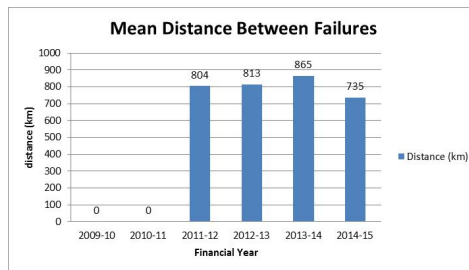


Figure 11: Mean Distance between Failures

The distance travelled by a train before failing is very significant to customer satisfaction. That distance has been increasing positively from 2011 to 2014 but it decreased significantly from 2014 to 2015. This means that there will be more trains being repaired than anticipated which will impact on SCM requirement, the operations budget required will increase, patronage will decline, more train delays, more technical skills required and total revenue collected will decrease.

6. Conclusions

The article exposed a number of issues which were impacted by SCM as summarised in the 2009 to 2015 annual reports. Key issues raised are outlined as follow:

- Passenger rail transport was under spent on technical training.
- Staff turnover was above 30% for permanent staff comprising of 42% retirements, 33% resignations and 20% deaths.
- Major strike actions which caused cancellations of trains.
- The Enterprise Resource Planning System was implemented (i.e. SAP ERP)
- Age of the rolling stock and infrastructure has become obsolete and end of life.
- Economic and market conditions resulting in passenger demand decreasing.
- Rail fatalities caused by pedestrians crossing rail tracks, animals and encroachment on rail reserves.

- The multiplicity of work being done on the infrastructure causing delays.
- Vandalism and theft of rolling stock resulted in 500 coaches out of service.
- The Auditor General's findings indicated that a contract of R3.5 billion for new locomotives and the evaluation criteria was not fully aligned to the request for proposal (RFP).
- Fruitless and wasteful expenditure amounted to R19 million.
- Irregular expenditure amounted to R38 millions of which R9 millions was attributed to unauthorized contract extensions.
- Challenges relating to the evaluation and appointment of contractors were missed which caused spillover of projects.

The Passenger Rail Transport has developed a Corporate Plan for Medium Term Expenditure Framework (2015-2018)

- The significant growth in passenger rail transport's capital budget is not matched by the growth in operating budget requirements.
- Passenger rail transport is unable to compete for the limited skills, resources and expertise in technical and professional skills and to even retain the limited resources.
- The multiplicity of major projects taking place across passenger rail transport presents many risks and implementation challenges.

In conclusion, the article has shown that SCM has a significant impact on the operations of a passenger rail transport operation in South Africa. The improvement in SCM processes will significantly reduce the operational challenges faced by passenger rail transport.

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