**49003 Economic Evaluation**

Assignment 2- Project Evaluation

Standard Gauge Railway (SGR) Line

Tanzania



**Group 3**

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# Executive summary

This report provides an economic evaluation of the Standard Gauge Railway (SGR) line project in Tanzania, East Africa’s fastest railway line project, from both financial and socio-economic aspects. This evaluation is based on various articles and reports related to developing countries’ transportation and economic development by undertaking investment opportunities in infrastructure sectors. The construction of the SGR line in Tanzania is one of the good examples of how a large-scale transportation project can significantly impact the economy of a developing African country. This evaluation shows that the SGR project is not financially viable for 30 years but should be developed only based on economic viability. Through this transportation project, beneficial outcomes such as improved economic activity of the country, job creations and new employment opportunities, cost and time reduction in the transportation of people and freights, improved air quality, upgrades of existing production facilities can be generated. As a result, broad-based economic growth, economic liberalisation, and GDP growth in line with other sectoral developments in energy, agriculture, mining, banking and financial sectors, and industrial services are expected. The transition in the economic system of Tanzania can progress by such reforms in infrastructure projects.

# Project description

### Introduction

The Government of the United Republic of Tanzania (GoT) initiated the construction of a new rail network as part of the East African Railway Master Plan within the country through the state-owned enterprise, Tanzania Railways Corporation (TRC). The main objective of the master plan is to create a railway transportation link between the East African countries of Tanzania, Kenya, Uganda, Rwanda, Burundi and Democratic Congo, and thus, rejuvenate economic growth in Eastern Africa by enhancing the speed and efficiency and decreasing the cost of cargo transportation from interior to the major ports within the cost of Indian Ocean (TRC, 2019).

The major railway line among the East African Railway Master Plan, which is also the focus of this project report, is the Standard Gauge Railway (SGR) line in Tanzania. TRC intended to replace the existing Metre Gauge Railway (MGR) line by constructing a new and separate SGR line with a total length of 1,217 km from Dar Es Salaam to Mwanza (TRC, 2019).

### Project location and background

The implementation of the construction of this SGR line has been undertaken in phases (lots). The project consists of 5 phases, of which 4 out of 5 phases are part of the Central Corridor, whereas the 5th and last phase is the part of the Northern Corridor within the master plan.

Dar Es Salaam – Mwanza SGR Line Project divided into 5 lots (Figure 1):

1. **Lot:** Dar Es Salaam – Morogoro (205 km)
2. **Lot:** Morogoro – Makutupora (336 km)
3. **Lot:** Makutupora – Tabora (294 km)
4. **Lot:** Tabora – Isaka (133 km)
5. **Lot:** Isaka – Mwanza (249 km)

![Map

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generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4SmiRXhpZgAATU0AKgAAAAgABgALAAIAAAAmAAAIYgESAAMAAAABAAEAAAExAAIAAAAmAAAIiAEyAAIAAAAUAAAIrodpAAQAAAABAAAIwuocAAcAAAgMAAAAVgAAEUYc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFdpbmRvd3MgUGhvdG8gRWRpdG9yIDEwLjAuMTAwMTEuMTYzODQAV2luZG93cyBQaG90byBFZGl0b3IgMTAuMC4xMDAxMS4xNjM4NAAyMDIxOjEwOjMxIDExOjE2OjQzAAAGkAMAAgAAABQAABEckAQAAgAAABQAABEwkpEAAgAAAAM5MwAAkpIAAgAAAAM5MwAAoAEAAwAAAAEAAQAA6hwABwAACAwAAAkQAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Figure 1. East Africa Railway Master Plan including SGR Line Tanzania

The main design parameters of the existing MGR line have been improved and applied to the new SGR line. SGR is a single line designed with a speed of 160 km/h for passenger trains and 120 km/h for freight trains. The maximum length of the train is to be 2,000 m with 1,100,000 million passenger capacity per year, which will be a significant advantage for the country considering the population of 57 million people (TRC, 2019).

The construction of the first phase started in April 2017 with the joint venture between the main contractors Yapi Merkezi, a Turkish specialised railway group company, and Mota-Engil, a Portuguese group company, for 30 months. In the later stages of the construction, Mota-Engil was withdrawn from the project, and Yapi Merkezi has become the only main contractor, including the second phase (333 km) of the SGR project (TRC, 2019).

### Micro setting of the project

It is vital to recognise the micro settings of the project as it examines the decision-making behaviour of individual agents, often referred to as households and firms. It focuses on human choices, resource allocation, supply and demand, and the ensuing interactions that occur in markets.

For the Tanzanian Railway Project, a facility agreement with Standard Chartered (SC.com) Tanzania for a US$ 1.46 billion term loan financing to fund the construction of the Standard Gauge Railway (SGR) project from Dar es Salaam to Makutupora was put in accordance (EAWB News, 2020). From a socio-political frame of mind, President John Magufuli has emphasized the importance of boosting the use of local content in development projects by deploying local enterprises to carry out the tasks (AllAfrica Global Media, 2020).

The fact that the project will create more than 8,000 new jobs with 140 local subcontractors ensuring that 80% of the workers are locals, accounts for an immense economic benefit. People are also provided with part-time jobs in the construction of the SGR project. On financial aspects, taxes that the citizens pay are properly being used for bringing about the development of their location (AllAfrica Global Media, 2020).

Many Industries and Subcontractors will be benefited as they get to be a part of this construction project. The joint venture between the main contractors Yapi Merkezi, a Turkish specialised railway group company, and Mota-Engil a Portuguese group company for the construction of the railway was appointed. However, Yapi Merkezi was made the sole contractor (Tanzania Daily News, 2017).

All these individual agents, households and firms are to be factored as the representatives of the micro setting for the current project and further to be considered for evaluation.

### Macro setting of the project

The context of macroeconomics can be assessed with a comparison of the wider economic performance of the Metre Gauge Railway line (MGR), as well as the overall transport systems in place within greater Tanzania. This allows the identification of growth sources and visualisation of growth trends for estimating potential benefits to what the SGR line offers (The World Bank Group, 2019). In application to the SGR, the downfall to the economic performance of the MGR lies within the conversation surrounding sustainability. Growth economically correlates closely to the use of depleting resources unable to be replenished, as well as the financial confidence of all stakeholders involved. Costs of maintenance decrease the longevity of the existing infrastructure and therefore constitute the implementation of innovative projects such as the SGR (Wang et al, 2021).

Economic parameters that contribute country-wide are also indicative of the macro setting that the project delves within. The rise of the transport sector that contributes to the overall GDP; from 1.3bn USD to 2.1bn USD between 2007 and 2015 (Mikomangwa, 2019) attributes to the justification of economic longevity to the project, with multiple industries continuing to rely on mobility for their operations. Multiple industries include internal and external economic relations. This leads to stronger relationships built between neighbouring economies such as Kenya and Mozambique and extends worldwide for international trade of goods relying on the efficiency of Tanzania’s transport infrastructure. With the use by regular citizens, to mining and construction, and many industries alike; the economy-wide structures already in place are set for use upon project completion phase-by-phase.

One short-term disadvantage that the project poses within its inception phase is the broadening of the account deficit (The World Bank Group, 2019). An increase in the import of construction material required during this phase can be attributed to this effect within the macro setting of the project. The longevity of the SGR (during operation) however mitigates this risk with a significant increase in use by export industries (such as mining) experiencing productive output of operations.

# Project evaluation

## Financial evaluation

Financial evaluation is performed to assess the viability and profitability of a project. This section provide a financial view of the SGR project by looking at costs, benefits and various viability indicators.

**Estimated Transportation Demand Forecast in 2030 in Tanzania**

The estimated transportation demand in 2030 and 2040 in Tanzania based on a model is shown Appendix I: Financial Details, Table 3. The unit given is million people trip/day. The number of trips per day estimated in 2030, which is 14.6 million, is almost 1.7 times higher than the one in 2017. The distribution of trips in 2030 has also been cross calculated by using linear interpolation between 2017 and 2040 (Master Plan, 2018).

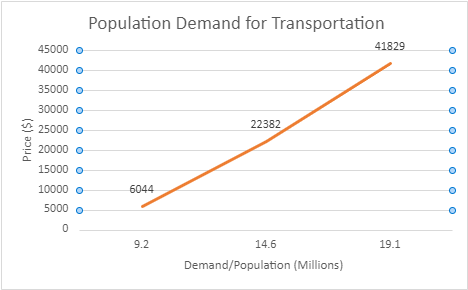


Figure 2. Estimated Population Demand for Transportation

The data given in Table 3 clearly show that Tanzania has been beneficial in terms of investing in mega transportation projects throughout the country. As the railways start functioning, the willingness to use the trains as a prime mode of transportation will increase and the above graph is an estimation of transportation demand developed based on the survey data. This analysis based on feasibility studies presents a high demand for transportation by the residents and the need for improvement on the infrastructure projects in Tanzania.

The project costs and durations phase by phase are detailed in Appendix I: Financial Details and the Implementation Plan for Urban Transportation in Dar Es Salaam can be found in Appendix I: Financial Details.

**Project Viability**

Project viability is associated with the financial and economic evaluation of the project. Costs and benefits are assessed to determine whether the project is worthy to implement. Financial and economic analysis is carried out from an investor and a wider national point of view respectively (Chaponda, 2010).

**Project Evaluation Assumptions**

The Assessment Model

The impact of the Tanzania Standard Gauge Rail project is assessed as net costs and benefits over a period of 30 years with a discount rate of 10 per cent for both financial and economic models. The economic model takes into consideration investment costs, producer and consumer surplus, alleviation of road congestion benefits, accidents and emission reductions. It is compared against the “do nothing” scenario, where it is assumed that the availability of the existing railway will cease operation because of the lack of track maintenance and expired warranty. Consequently, there is a greater cost when using the road option.

Traffic and Revenue

The forecasted traffic levels are used to evaluate the project. The figures used are the likely achievable traffic level. The expected traffic for the 10th year of operation is tabulated in Appendix I Table 4, in tonnes per annum.

Of the 4.5 MTPA (Million Tonnes Per Annum) base scenario traffic forecast, it is estimated that 1.9 MTPA are imported traffic passing the Dar Es Salaam Port and 2.4 MTPA are mining-related exports.

To prevent retaliatory pricing from the trucking industry, the railway tariff is expected to be at least 20% less than the current trucking tariffs. The proposed rates in comparison to the current trucking rate and Tanzania Railways Limited (TRL)’s existing MGR rail tariffs are shown in Appendix I, Table 5.

The annual revenue for freight and passenger transport by rail is estimated to be about 435 million and 5.33 million US dollars respectively (Dun & Bradstreet, 2021). These figures are based on similar rail projects in Tanzania and adjusted specifically for this SGR project.

Operating Costs

The operating costs of the railway consist of regular expenditures for the operations of the railway that serve the estimated traffic. In the annual estimate of the expenditures, the cost of fuel, parts, materials, staff, mechanical equipment maintenance, rolling stock and infrastructures are included. The OPEX estimates of 2029 based on the expected traffic scenario are tabulated in Appendix I, Table 6 (Africa Management, 2014).

Investment Costs

The investment costs consist of the costs associated with the quantity of components, infrastructure and rolling stock required for a 1,217km modern and efficient freight and passenger railway operation (Africa Management, 2014), and are summarised in Appendix 1, Table 7.

**Financial Evaluation Results**

The project is expected to provide a net present value (NPV) of -$1200 million USD at a 10% discount rate. The financial Internal Rate of Return (FIRR) is 6%.

The Benefit Cost Ratio (BCR) for the Tanzania Standard Gauge Rail Project is:

BCR= ((440.3-145.5) \* PVIFA 10%, 30)/3980 = **0.7**

As the NPV for this project is less than zero and BCR is less than one (0.7), it is undesirable to undertake this project with consideration of inflation and returns, and IRR is not so high where a typical IRR for rail projects have IRR greater than 10. Figure 3 below illustrates the financial cash flow for the project.

Chart

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Figure 3. Financial Cash Flow Diagram for Tanzania SGR Project

The below shows results from sensitivity analysis conducted via the goal seek function, to see the minimum annual benefits, costs and total investment requirements for NVP to equal zero.

|  |  |  |
| --- | --- | --- |
| **Input Parameter** | **$M USD** | **%Change** |
| Initial Investment ($M USD) | 2779.76 | 30% |
| Annual O&M Cost ($M USD) | 18.13 | 88% |
| Annual Benefits | 567.65 | 29% |

*Table 1. Goal seek output for input parameters to output 0 NVP*

Table 1 shows that the greatest percentage change lies with the annual cost of the project whereas annual benefits are the most sensitive to the SGR project.

## Economic evaluation

Socio-economic evaluation is required to estimate the benefits and costs of the project in national terms and to include both quantified and non-quantified impacts. The economic soundness of infrastructure development from a social perspective can be understood by socio-economic evaluation. More socio-economic benefits are detailed in Appendix II: Social and Economic details.

### Social benefits

The study of historical events of transport construction has made it clear that the construction of railways has led to economic advancements and improvement of people’s welfare levels. Tanzania SGR project is one such transport construction with many social and economic benefits.

The project will reduce road congestion. A lesser number of vehicles on the highways will allow for smooth transportation of optimum vehicles, lower freight costs by 40% by hauling up 10,000 tons of freight (equal to 500 trucks) and minimization of the risk of accidents. It will also reduce the travelling time once the electric train for passengers starts to operate at 160 kmph. For instance, passengers will be able to travel between Dar-es-salaam and Morogoro in one and a half hours (Wang et al, 2021). The cargo trains, designed at 120 kmph, will make the railways an effective mode of transportation and could reduce the costs related to supply, manufacturing, and transportation. This improves market access and establishes an interconnection between rural as well as urban areas (Wang et al, 2021). Traders from within Tanzania and neighbouring countries will be attracted to use Dar es Salaam port since there will be reliable, cost-effective, and quick transportation of their consignments (Mugarula, 2017).

Services such as healthcare, catering, security, and entertainment will be provided to the local communities surrounding the project area as well as the SGR workers (EAWB News, 2020.

Tanzanians are getting the knowledge of technological skills, construction skills and more from this project.It has created more than 8000 job opportunities for a lot of natives and the country folk. The labour ratio for SGR stands at 80% locals to 20% foreigners. Phase 1 alone has employed 8,303 workers, out of whom 7,063 are locals and the rest, 1,234 are foreigners. On the part of key personnel such as engineers, the project is supposed to have 20% locals against 80% foreigners. However, it has exceeded the limit since locals constitute 46.5% (AllAfrica Global Media, 2020).

The completion of the total 1,224 km railway line at the Central Corridor in East and Central Africa will enable land-locked countries such as Uganda and the Democratic Republic of the Congo to transport their rich underground resources. Therefore, this transportation service will result in higher economic growth and social development for Tanzania as well as increase the trade relations between Tanzania and the neighbouring countries (Mugarula, 2017). Political relations with Sweden and Denmark will improve as these two nations are the largest foreign financers of this project.

The construction of such large railway infrastructures has a few negative impacts on the local society that can be regarded as the social costs for the project. It includes the relocation of the population leaving their homes and commercial outlets. The government holds the responsibility of budgeting the affected residents for their rehabilitation. Attention towards the costs for replacement of investment components and annual costs with substantial future investments also drives the social costs for this project.

There have been found some potential impacts on cultural heritage as well as Archaeological heritage (Mabulla & Bower, 2010). The Serengeti National Park (SENAPA) is in three regions, namely, Mara, Mwanza, and Shinyanga regions in northern Tanzania and the Ngorongoro Conservation Area Authority (NCAA) in the Arusha region in northern Tanzania can be viewed as an ecological extension of SENAPA (Ichumbaki & Mjema, 2018).

### Environmental Evaluation

The environmental evaluation considers the conditions that together shape and characterise the environment in a certain area, such as the landscape, soil quality and geology, water, climate, and ecosystems, vegetation, animals, habitats, air quality, noise, pollution, and other disturbances. The quantification of these indicators enables to add environmental impacts to the financial indicators providing an overall project evaluation.

The costs associated with the ecological impacts of the project rest predominantly on biodiversity that surround the projected sites of the SGR construction. The disturbance to the surrounding vicinities is inevitable when considering the scale of construction of the railway through Tanzania. The linear length covered by phase one of the SGR track is approximately 202km, with phase 2 around 332.69km. Studies surrounding the habitation of land that the track passes through found a ratio of 39:61 split for phase 1, and 64:36 split for phase 2 between modified and natural habitat[[1]](#footnote-2).

Minimisation of such impacts needs to be conducted through effective stakeholder management. Focus groups must be actioned as well as consultations with local villagers throughout the construction stages, and meetings with community leaderships to be informed of local ecological presence (Vogelsberger et al, 2019)*.* The mobilisation of the Tanzania Wildlife Research Institute (TAWIRI) in data collection and analysis in this regard will aid in the alleviation and avoidance of any negative impacts of the project(Wang et al, 2021).

Transport mechanisms required for construction (whether equipment or material) are forecasted to project high levels of ecological disturbances through the terrains of Tanzania. This can include soil, water, air, and light pollution (Vogelsberger et al, 2019).Although it is important to consider (and alleviate) the negative impacts of the construction phase of the project, the cumulative impacts post-construction must also be studied after the SGR is operational.

Table 8 in Appendix III summarizes the environmental impacts of the project during both construction and operation phases. Most of these impacts are secondary and have not been quantified for this economic evaluation, but their mitigation is essential to lower the project impacts on its environment.

Even though the project has numerous negative impacts, it also presents a major environmental benefit regarding the current climate crisis. The construction of the SGR line will decrease the number of lorries on the road. This will lead to significant CO2 emissions-cutting, especially as the new railway will mainly use electricity and reduce the importation of diesel (Tanzania Railways Corporation (TRC), 2018).

To quantify this benefit for the economic evaluation of the project, assumptions have been made regarding the number of trains travelling during a year, the quantity of freight and people transported (Vogelsberger & Militschenko, 2019), the CO2 emissions factors (F. Coloma & García, 2016) (Climate Chance, 2018), as well as the CO2 prices (OCDE, 2021) (Appendix III, Table 9). This has led to an estimated emission cut of 3 million tCO2/year, equivalent to 2,700 million dollars saved every year (Appendix III, Table 10). However, those results must be taken cautiously as they do not consider the CO2 emissions due to electricity production when still more than 60% of the energy mix in Tanzania comes from non-renewable sources (International Trade Administration, 2021) (Appendix III, Table 11).

### Economic Evaluation and Results

In the economic analysis, the project’s costs and benefits are analysed from the perspective of society. The benefit considered for this railway project is the CO2 emission reduction. In terms of implicit costs, 10% of the financial costs have been taken into account.

The Benefit Cost Ratio (BCR) for the Tanzania Standard Gauge Rail Project is:

BCR = ((3140-160) \* PVIFA 10%, 30)/4378 = **6.4**

The project is expected to provide a net present value (NPV) of $23,717 million USD at a 10% discount rate. The Economic Internal Rate of Return (EIRR) is 68%.

As the NPV for this project is greater than zero, this project should be undertaken with consideration of inflation and returns, and the fact that the IRR is extremely high at 68%. Figure 4 below illustrates the economic cash flow for the project.

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Figure 4. Economic Cashflow Diagram for economic evaluation

# Recommendations and suggestions for further analysis

Based on the financial and economic analyses, the project viability indicators suggest that the project should be developed only on the basis of economic viability considering a 30-year project life. It is not financially viable. It is worth highlighting that the financial evaluation inputs are based on scaled costs and benefits of a similar railway project in Tanzania, and a set of assumptions made. The financial and economic evaluations are sensitive to the input such as the initial costs, O&M costs, benefits, discount rates, and implicit costs and benefits. Thus, a degree of weakness is inherent in the analyses.

The Tanzanian Government has demonstrated its commitment and accountability by funding the SGR project in conjunction with international loans. Though, the potential economic benefits of the project are still questionable since foreign companies such as China, Portugal and Turkey have been awarded huge construction contracts (LSE, 2021). It is recommended that an experienced and competent local company be awarded the contract for subsequent phases to boost the economic benefits. For more sustainable economic growth, the transfer of highly skilled knowledge to the locals as part of the contracted deliverables should be considered.

As there is political pressure and economic urgency to deliver the project quickly, environmental impact assessment and the use of the national supply chain were not carried out (LSE, 2021). It is suggested that the country should not lose sight of sustainable outcomes. Recommendations for the construction and operation phases have been made in Appendix III.

Overall, this evaluation presents some weaknesses. Indeed, to assess both financial and socio-economic costs and benefits many assumptions have been made that may include mistakes that could slightly change the results. The evaluation of environmental benefits linked to CO2 emissions is sensitive to the number of lorries that are considered removed for the road thanks to the railway transport, and do not consider all CO2 emissions involved in the project (construction phase, energy mix, reduction of car use for personal transports, etc.). Quantification of studies conducted through all environmental perspectives would assist in presenting a conclusive evaluation.

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# Appendix I: Financial Details

The project costs and durations phase by phase is shown in the table below (Table 2). The project costs for phases 3, 4 and 5 have been estimated in correlation with phases 1 and 2 as the projects are still in the tender stage. Project durations for phases 3, 4 and 5 have also been adopted in correlation with phases 1 and 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Phases** | **Connection Ports of SGR Line** | **Alignment (km)** | **Project Cost (US$)** | **Project Duration** |
| Phase 1 | Dar Es Salaam - Morogoro | 205 | 1.1 billion | 30 months |
| Phase 2 | Morogoro - Makutupora | 336 | 1.8 billion | 36 months |
| Phase 3 | Makutupora - Tabora | 294 | 1.6 billion | 34 months |
| Phase 4 | Tabora - Isaka | 133 | 700 million | 20 months |
| Phase 5 | Isaka - Mwanza | 249 | 1.4 billion | 32 months |

Table 2. Project Costs and Durations for 5 Phases of SGR Line

Table

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Table 3. Estimated Transportation Demand 2030 & 2040

**Implementation Plan for Urban Transportation in Dar Es Salaam (Master Plan 2018):**

**Short Term Policy until 2025:**

The focus of this term is to manage traffic movements more efficiently within the provision of insufficient transportation infrastructure.

**Long Term Policy until 2030:**

The focus of this term is to target to complete the mass transit network by completing ongoing major infrastructure projects and accommodate grand transport demand generated by the population of approximately 10 million in Dar Es Salaam.

Table

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Table 4. Expected traffic forecast for the 10th year of operation (in tonnes per annum).

Table

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Table 5. Tariff Comparison between truck, existing and new rail in $/T.km

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Table 6. OPEX estimates of expected traffic scenario in 2029

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Table 7. Quantity of components and total investment cost

# Appendix II: Social and Economic details

**Economic/Socio-economic evaluation**, a process of systematically identifying, measuring, and assigning a value to the inputs and outputs of two alternative activities, and then conducting a comparative analysis of these details. It is used to determine the best course of action based on the evidence we have available and is not the same as financial evaluation which only considers monetary gains and losses.

In line with the production of stations, alignments, and structures in the SGR project, the demand for various local industries such as cement industries, steel production industries in the country have increased. The number of construction companies and supply of subcontractors has been benefited from the opportunities to supply and hire equipment, workmanship, and earthworks. The benefits associated with these evolutions formed by this railway line project are summed up below (TRC Presentation 2017);

* 150 new permanent employments are estimated to be created as an estimation for the first lot alone
* Additional human development activities have been raised in the new areas where railway line traverse will be connected
* Road maintenance costs have decreased as the heavy freights can be transported by the railway instead of highways
* Commodity prices drop 40% in destination markets due to access to transport
* The new railway line is being constructed relatively environmentally friendly as it was designed as an electric train and will reduce the importation of diesel; as a result, forex will be conserved
* Significant travel time reduction between the cities will come off. For instance, the time travelling between Dar Es Salaam to Dodoma is 10 hours, which will reduce to 3 hours. According to the director-general of Tanzania railways cooperation, by using the new railway, passengers will be able to travel between Dar-es-salaam and Morogoro in one and a half hours, which is three hours less than using a bus (Wang et al, 2021).

With such high social benefits and considering both macro and microeconomics, Tanzania’s SGR is more advantageous not only on the output level of mobility and transport but also predicted to create 600,000 direct employments when it is fully operational (Wang et al, 2021). The completion of the Tanzanian Rail Project will indeed increase the trade relations between Tanzania and the neighbouring countries immensely and this news is a heads-up for Tanzania traders, service providers, clearing and forwarding companies as well as all other stakeholders in the transportation sector to boost their businesses at both local and international level (Mugarula, 2017)

The Serengeti National Park (SENAPA) is in three regions, namely, Mara, Mwanza, and Shinyanga regions in northern Tanzania and the Ngorongoro Conservation Area Authority (NCAA) in the Arusha region in northern Tanzania can be viewed as an ecological extension of SENAPA (Ichumbaki & Mjema, 2018). Both these national parks are considered as multiple land-use areas designed to promote tourism and conservation of wildlife and other natural resources, as well as the interests of Indigenous resident pastoral people. The railway project will affect such cultural heritages as the construction progresses (Ichumbaki & Mjema, 2018). As the governments in Africa implement various development projects to improve livelihoods, both large- and small-scale projects involve land disturbance and have the potential to destroy archaeological heritage particularly when not accompanied by salvage studies (Mabulla & Bower, 2010).

# Appendix III: Environmental details

### Environmental costs

The following table summarizes the environmental impacts of the SGR project during both the construction and implementation phases.

|  |  |  |
| --- | --- | --- |
| **Environmental topic** | **Project Phase** | **Details / Commentary** |
| **Terrestrial biodiversity** | **Construction: yes** | **Construction:** habitat loss or fragmentation, injury, or mortality due to the use of trucks and machinery. Potential noise, vibration, or light disturbance. Potential pollution impacts through fuel runoff.  The potential destruction of ecosystems or impact on natural reserves on the construction site. (Wang et all, 2021) |
| **Operation: yes** | **Operation:** habitat loss or fragmentation due to fences around the site, injury, or mortality due to train accidents. Noise, vibration, and light pollution. Risk of fire. Potential development of human activity due to easy accessibility. |
| **Landscape** | **Construction: yes** | **Construction: a** major change in the landscape to create access to the construction site for trucks and machinery. |
| **Operation: yes** | **Operation:** permanent changes in the landscape through the building of the railway, fences, train stations |
| **Air Quality** | **Construction: yes** | **Construction:** dust emission on construction site. CO2 emission due to transport and the use of machinery and building materials such as cement. Potential odours due to chemical elements? |
| **Operation: No** | **Operation:** No further local CO2 or microparticles emission as the train will be running on electricity. **However, if electricity production does not come from renewable sources, CO2 emissions will have to be considered.** |
| **Noise, vibration disturbance** | **Construction: yes** | **Construction:** noise and vibration from the construction site and transport |
| **Operation: yes** | **Operation:** noise and vibration from trains and human activity |
| **Ground, geological, soil quality** | **Construction: yes** | **Construction:** potential effect on geological resources, pollution (fuel, chemicals, etc.). Potential soil pollution (dumped waste) and erosion (also due to contamination) (Wang et all, 2021). Land-use change. |
| **Operation: no** | **Operation: the** passage of trains impact is considered negligible, as it shouldn’t lead to consequences on ground quality |
| **Water resource, water quality** | **Construction: yes** | **Construction:** water pollution due to the direct use of water during the construction phase or to water runoff on the construction site and drainage of waste and chemical products. Potential pollution of underground water. Perturbation of water cycle due to soil impermeabilization. Water pollution due to soil degradation or erosion. Impact on wetlands. (Wang et all, 2021) |
| **Operation: yes** | **Operation:** disturbance of water runoff due to the railway and infrastructure. Perturbation of water cycle due to soil impermeabilization. |
| **Resources and waste management** | **Construction: yes** | **Construction:** Potential environmental impacts (pollution, non-sustainable exploitation, etc.) due to production, transport, processing, use and disposal of resources and waste. (AllAfrica Global Media, 2020) |
| **Operation: no** | **Operation:** The amount of resources and generated waste during the operation phase of the project is considered minor quantities and are therefore not considered here. |
| **Climate change** | **Construction: yes** | **Construction:** Greenhouse gases emissions due to construction activities. Drought, high rainfall and winds could impact the construction phase and increase risks (accidental, dust or water pollution, flood, fires, landscape damages, etc.). Possible direct and indirect land-use change emissions (agriculture relocation, deforestation, etc.). |
| **Operation: yes** | **Operation:** Greenhouse gases emissions on-site will mainly be linked to electricity production. Climate adaptation should take into account the potential impacts of extreme events on the project to ensure its resilience through the years. |

Table 8. Environmental impacts on the project during construction and operation phases

**Recommandations for environmental impacts mitigation:**

**Construction phase:** awareness of the stakeholders and workers, reduction of the area used as roads by machinery, application of Avoid, Reduce & Compensate regarding the resources management, forecasting of waste management, follow accurate environmental regulation (pollution rate while rejecting products), maximisation of transport efficiency;

**Operation phase:** ensure renewable energy supply, or work to develop it, settle blue and green network, rebuild/repair damaged ecosystems, optimise the number and hours of train.

### Environmental benefits

**Calculation of CO2 emissions avoided thanks to the project:**

The frequency of the train has been forecasted according to the following: 20 freight trains will travel every month and 4 passenger trains will travel every day, gathering 400 passengers. A freight train will correspond to 25 lorries taken off the road, which would transport 20 tons of freight (Vogelsberger & Militschenko, 2019).

The mean distance travelled during a year by a train is estimated to be half of the total SGR line, i.e., 406km. It is considered that the lorries taken off the road thanks to freight transportation by train would have travelled the same distance as for the railway (406km) minus 10% of this distance as when the freight arrived it still has to be transported to its final destination (road and railway map are similar) (Japan International Cooperation Agency, 2014).

CO2 emissions have been calculated according to the corresponding emission factor. For the freight trains of our project, both electric train and diesel train emission factors have been considered respectively at 80% and 20%, as the trains will not be run 100% through electric power (F. Coloma & García, 2016) (Climate Chance, 2018).



Table 9. Data and assumptions for CO2 emissions calculation.

CO2 prices have been estimated at 60€/tCO2, i.e., 69.60$/tCO2 according to the current exchange rate, as it corresponds to the CO2 prices forecasted by OCDE (2021) for 2030.

With those assumptions, emissions saved on the project have been estimated at 3 million tCO2/year, which provides benefits of $2,700 million USD per year for socio-economic evaluation.



Table 10. Environmental Benefits for SGR line Project

This evaluation of the CO2 emissions avoided thanks to the project are estimated without considering the reduction of car traffic thanks to passenger trains and the CO2 emissions due to electricity production when still more than 60% in Tanzania comes from non-renewable sources (International Trade Administration, 2021).



Table 11. Tanzania Energy Mix.

1. Natural habitat is defined by continuous vegetation witnessed on either side of the tracks and modified vegetation applies to all other areas. Solutions to address this should be tackled to attain no net loss of the surrounding biodiversity (Cauldwell et al, 2019). [↑](#footnote-ref-2)