EDCF KOREA Economic Development Cooperation Fund

Feasibility Study for the Construction of Modernised Railway Training Center in Tanzania

September 2022

Korea Railroad Corporation

Heerim Architects & Planners Co., Ltd.

This Feasibility Study was conducted by Korea Railroad Corporation and Heerim Architects & Planners Co., Ltd., in collaboration with the relevant institutions of the Government of Tanzania (Tanzania Railways Corporation (TRC)), with support from the Economic Development Cooperation Fund (EDCF) on behalf of the Government of Tanzania. The data, reviews, and conclusions presented in this publication are those of the authors and do not necessarily reflect the official position or policies of the EDCF. This report was prepared based on the information available at the time of writing. Any actions taken based on the information provided in this report must be performed at the user's own risk. EDCF shall not be held liable for any damages arising from the use of this report by the user.

< Project Team >

Feasibility Study for the Construction of Modernised Railway Training Center in Tanzania

Key Personnel

Korea Railroad Corporation

- Ha Hong-Gil(PM)
- Lee Sang-Jae(Educational Planning)
- Oh Gwang-Il(Educational Planning)
- Lee Yong-Jun(Railway Technology)

Heerim Architects & Planners

- Kwon Ki-Jae(Architectural Planning)

Table of Contents

▭ Abbreviations

Abbreviations	Full Name
AAT	Architectural Association of Tanzania
ACCT	Association of Citizen Contractors Tanzania
ACET	Association of Consulting Engineers Tanzania
ADDIE	Analysis, Design, Development, Implementation, Evalutation
AQRB	Architects and Quantity Surveyors Registration Board
AS	Ammeter Change-over Switch
CAI	Computer Assisted Instructor
CATA	Contractors Association of Tanzania
CBD	Central Business District
CCECC	China Civil Engineering Construction Corporation
CCM	Chama Cha Mapinduzi
CHADEMA	Chama cha Demokrasia na Maendeleo
CHC	Conveyor Hopper Car
CRA	Contractor Registration Act
CRB	Contractors Registration Board
CRCC	China Railway Construction Corporation
CTC	Central Traffic Control
DIKKM Project	Dar Es Salaam-Isaka-Kigali-Keza-Musongati Railway Project
DL	Diesel Locomotive
EAR&H	East African Railways and Harbours Corporation
EL	Electric Locomotive
EMU	Electric Multiple Unit
ERA	Engineer Registration Act
ERB	Engineers Registration Board
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
FTS	Full Type Simulator
FYDP	Five Year Development Plan
GST	Geological Survey of Tanzania
IET	Institution of Engineers Tanzania
LATRA	Land Transport Regulatory Authority
LMS	Learning Management System
LTE-R	Long Term Evolution Railway
MC	Motorcar Crane
MGR	Meter Gauge Railway
MTT	Multiple Tie Tamper
NACTVET	National Council for Technical and Vocational Education
NEMC	National Environment Management Council
NIT	National Institute of Transport

Abbreviations	Full Name
O&M	Operation & Maintenance
OSHA	Occupation Safety and Health Authority
PSD	Platform Screen Door
PT	Potential Transformer
PTS	Part Type Simulator
QRB	Architects and Quantity Suveyors Registration Board
RAHCO	Reli Assets Holding Company
RE	Ballast Regulator
SCADA	Supervisory Control And Data Acquisition
SCW	Safety Critical Workers
SGR	Standard Gauge Railway
SP	Sectioning Post
SS	SubStation
STT	Switch Tie Tamper
TACECA	Tanzania Civil Engineering Contractors Association
TANESCO	Tanzania Electric Supply Company Limited
TARURA	Tanzania Rural and Urban Roads Agency
TAZARA	Tanzania Zambia Railways
TIQS	Tanzania Institute of Quantity Surveyors
TIRTEC	Tanzania Institute of Rail Technology
TRC	Tanzania Railways Corporation
TRL	Tanzania Railways Limited
VCB	Vacuum Circuit Breaker

Ⅰ. Project Overview

1. Background

Tanzania, an East African nation with a population of about 61 million[1], is 4.3 times bigger than the Korean Peninsula in size, having a number of globally famous tourist sites including Serengeti National Park, Mount Kilimanjaro, and Zanzibar, and is rich in mineral resources such as gold, diamond, and nickel. Tanzania has continuously posted economic growth for more than 20 years and was converted into a middle-low income country[2] in July 2020. As a result, it has been recognised as a nation with great growth potential.

Based on such rich resources and high growth potential, the Tanzanian government has massively invested in constructing ports and railroads to accelerate economic development by invigorating the logistics sector. In particular, it has implemented large-scale railroad construction projects, with the result that the Dar es Salaam to Mwanza Standard Gauge Railway (SGR)[3] with the network length of 1,219 km is under construction.

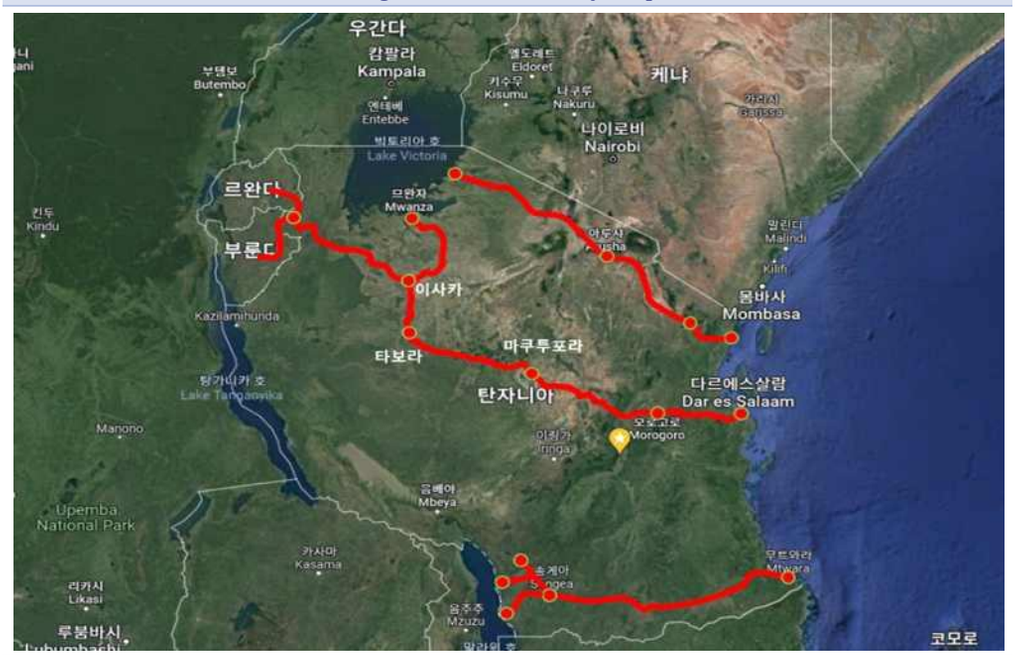
Figure 1. Existing Railway Map

1) Source: World Bank data
https://data.worldbank.org/indicator/SP.POP.TOTL?locations=TZ&view=chart

2) Source: World Bank data on countries
https://www.worldbank.org/en/country/tanzania/overview#:~:text=The%20World%20Bank%20estimates%20a,capita%20GDP%20contraction%20in%202020.

3) Source: Homepage of Tanzania Railways Corporation
https://www.trc.co.tz/pages/about-sgr

Figure 2. SGR Railway Map



For the stable operation of new railways funded by government budget, Tanzania Railways Corporation (TRC), a national railroad authority in charge of constructing and operating railroads, has sought diverse ways to strengthen the competencies of railway employees. To this end, TRC has promoted the establishment of a railway training center and has requested the Korean government's support, including the transfer of operational knowledge and experience.

2. Objectives

On the railway between Dar es Salaam and Dodoma, the Lot1&2 for the SGR project, the operation is ongoing using an electric locomotives. TRC has been recruiting a number of employees for the operation and maintenance of newly-built railways. Considering the Tanzanian government's plan to construct and operate 2,100 km-long SGR by 2030, from Dar es Salaam to Mwanza (Phase I), Tabora to Kigoma and its branch to Mpanda and Musongati, Burundi (Phase II), job competency enhancement training should be systematically offered to employees who will be additionally employed for the future maintenance of railroad infrastructure, as well as for the effective operation of railway systems.

Moreover, efficient training should be provided to railway employees to enable them to be equipped with capabilities to sufficiently understand, operate, and maintain railway systems. To this end, function and career-customised training programmes by employer should be prepared, creating an environment where sufficient training content can be effectively delivered.

Based thereon, this project was proposed for the establishment of customised training programmes and for the cultivation of training agency operation staff, as well as for the construction of facilities including buildings for the railway training center in charge of offering job training to SGR employees. Through this feasibility study, research on related conditions and so forth was conducted.

When advanced training facilities are established through this railway training center construction project and SGR operation employees are cultivated through training programmes for which modernised training systems and materials are offered, the safe operation of trains and the efficient management of railway infrastructure will be enabled, preventing citizens and railroad employees from being exposed to accidents.

Ⅱ. Status Survey and Analysis

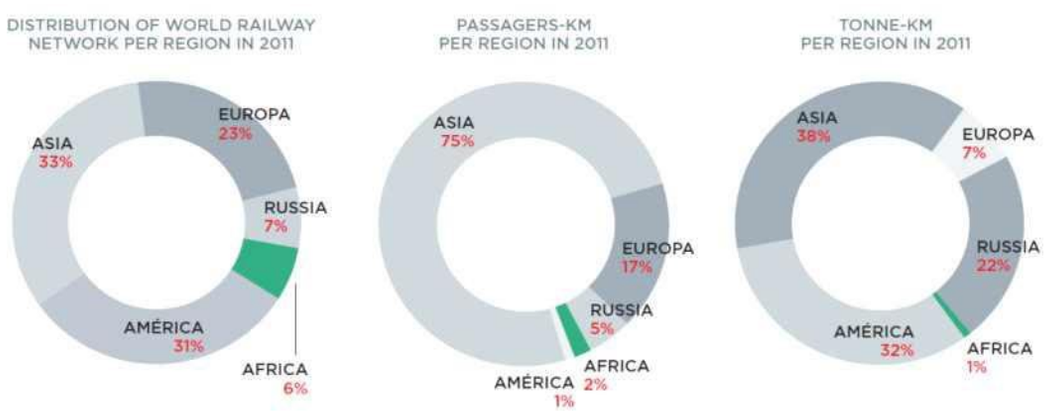
1. Railways

1.1 General information

A. Railways in Africa

Considering networks and railway traffic volume by passenger & freight and by region (Asia, Europe, America, and Africa), the railway traffic volume in Africa is smaller than those in the other regions. The railway traffic volume in Africa as a whole is about 200 billion unit-km, only 2% of the global railway traffic volume. Passengers and freight account for 30% and 70% of the Africa's whole railway traffic volume, respectively. The passenger traffic volume for 2011 is less than 49 billion passenger-km, only 2% of the whole volume. The traffic volume in freight and logistics for 2011 is about 140 billion tonnes, about 1% of the whole volume.

Figure 3. Performances by indicator of regional railways



*Source: UIC

However, the inter-regional trade volume in Africa is small at present but is forecast to significantly grow with the acceleration of economic growth. The so-called African Regional Transport Infrastructure Network (ARTIN) is expected to account for 13% to 18% of freight transport in Africa by 2040[4].

The growth in transport volume in Africa is expected to be very limited due to lack of inter-regional freight networks. Freight transport expenses for inland areas are found to be more than 30% bigger than export revenues, with the average trade cost for Africa being 65% and 95% higher than those for Latin America and East/South Asia, respectively.[5]

4) Source: Rail Infrastructure in Africa, African Development Bank, 2015

5) Source: Rail Infrastructure in Africa, African Development Bank, 2015

Road traffic is generally found to be much more flexible than railway traffic. However, railway transportation is more efficient in transporting hydrocarbon, minerals and agricultural products in large quantities. Railway networks in Africa have yet to be fully established and therefore have great potential for improving productivity significantly via active public policies. In this regard, the growth of the global railway industry, driven by large-scale railway projects under consideration or in progress, can be viewed as a positive factor.[6)]

The lack of cross-border railway connectivity acts as a major bottleneck for rail development in Africa. Railway gauges used in Africa vary from 600mm to 1,435mm. Specifically, the 1,067mm gauge is prevalent in Sonthern and Eastern Africa, while the 1,435mm guage is primarily used in North and West Africa. Currently, African nations are prioritizing the construction of Standard Gauge Railways (SGR), which utilieze the 1,435mm gauge. Therefore, projects are more likely to succeed when they involve countries that have the same gauges or established cross-border facilitation agreements.

B. SGR projects in east African nations

Kenya's railway systems consist of the existing Meter Gauge Railway (MGR) and the new SGR. Both systems connect inland areas to Mombasa, a key port city, passing through Nairobi, the capital of Kenya. The Mombasa-Nairobi SGR was completed in December 2016 and launched in May 2017. The project for extension of the Nairobi-Suswa railway was completed in 2019, with the total length of Kenya's SGR becoming 578.8km. Kenya's railways are owned by Kenya Railways Corporation (KRC), a state-run company. Africa Railway Operations Company (Afristar), a railroad constructor and subsidiary of China Road and Bridge Corporation (CRBC), is in charge of the operation and maintenance of the line.

Ethiopia is currently operating three SGR lines such as Addis Ababa-Djibouti, Awash-Welldiya, and Weldiya-Mekelle, planning to construct other lines. The first light railway system in sub-Saharan Africa opened in Addis Ababa, the capital of Ethiopia, in 2015 and has since operated successfully. Ethiopian Railway Corporation (ERC), a public railway company, controls and operates all the railroads in Ethiopia.

Tanzania has promoted the construction of 2,561km-long SGR networks connecting Dar es Salaam/Mwanza/Kigoma to its neighboring countries including Rwanda, Burundi, and the Democratic Republic of Congo (DRC). The railway system enables electric locomotives for passenger transport to run on tracks at a maximum speed of 160 km/h, the first in east Africa. At present, the 1,219 km-long Dar es Salaam to Mwanza line is under construction, consisting of the following five lots.

6) Source: A NEW LEASE OF LIFE FOR AFRICAN RAIL, UIC, 2014

Lot 1 Dar es Salaam – Morogoro (202km)
Lot 2 Morogoro – Makutupora (344km)
Lot 3 Makutupora – Tabora (294km)
Lot 4 Tabora – Isaka (130km)
Lot 5 Isaka – Mwanza (249km)

1.2 Railway agencies

A. Ministry of Works and Transport (MoWT)

MoWT is in charge of establishing and implementing main policies for railway development in Tanzania. MoWT, an organisation for controlling the establishment and implementation of construction-/traffic-/transport-related national policies, manages roads, bridges, vessels, public projects, government offices, engineering/design, material labs, airport development, civil aviation, water/marine/air/railway transport, ports, traffic safety, climate, and human resources (HR) development for the ministry and its affiliated agencies.

In connection with basic railway networks, the TAZARA Act and the Railway Act were enacted in 1975 and 2017, respectively. Via affiliated organisations such as Tanzania Railways Corporation (TRC) set up pursuant to the Railway Act and TAZARA established in accordance with the TAZARA Act, MoWT plans and manages railway-related policies.

B. Tanzania Railways Corporation (TRC)

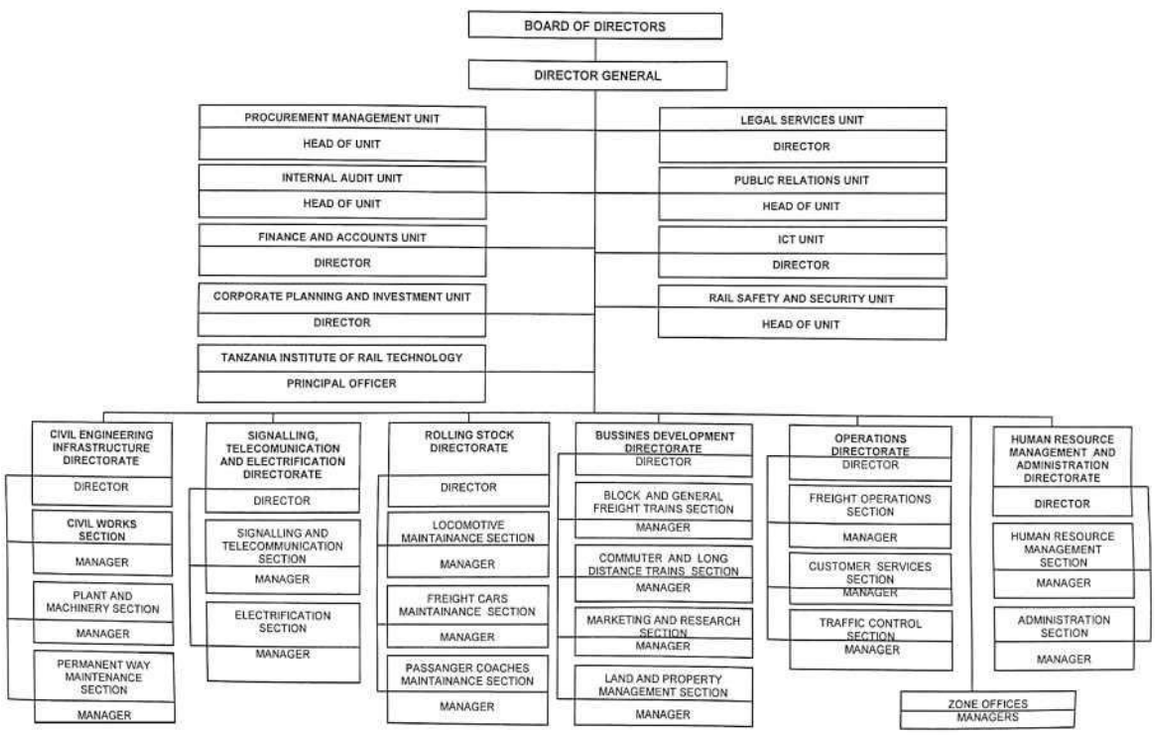
Establishment background

TRC is a state-run company set up in 2017 in accordance with Article 10 of the Railway Act to provide railway transport services and to manage/develop railway infrastructure efficiently. Before the establishment of TRC, national railways were controlled by Tanzania Railways Limited (TRL), a private and public joint corporation from 2007 to 2010. India's RITES acquired rights to operate railways in Tanzania for 25 years through bidding processes in 2006, thereby establishing TRL which is 51% and 49% owned by RITES and the Tanzanian government, respectively. At this time, Reli Assets Holding Company (RAHCO) was founded for the management of railway assets. TRL started to take charge of the operation and maintenance of railways in October 2007 but the Tanzanian government cancelled its agreement with RITES in 2010 due to RITES' failure to comply with the contract, retrieving RITES' stake in TRL and nationalising the railway systems again in 2011. In accordance with the Railway Act, the current TRC was born in 2017 via functional integration between TRL and RAHCO.

Organisational structure

TRC is in charge of the operation of passenger and freight railway services and the maintenance of railway infrastructure. Under the control of the director general representing the board of directors and the corporation are departments for maintaining railway facilities, signal/telecommunication/electrification systems, and rolling stocks for operating trains, stations, and traffic control systems, and HR for management, financing, and procurement.

Figure 4. Organisational structure of TRC



Employee status

TRC has a total workforce of 2,807 employees, classified as follows.

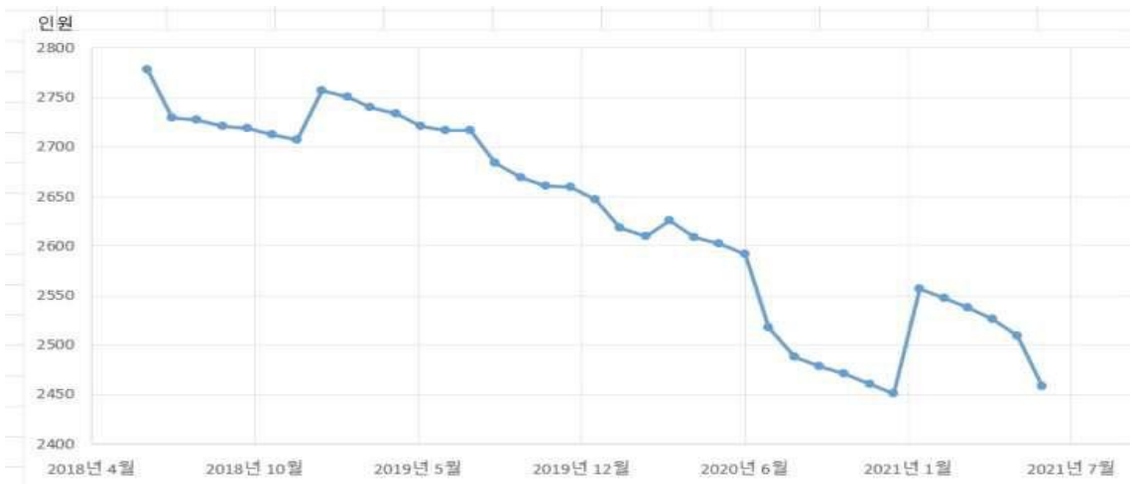
Table 1. TRC employee status

Headquarters (Administration support)	Civil Engineering	Signal/Telecom/ Electrification	Rollingstock	Railway operations	TIRTEC (Tanzania Institute of Rail TEChnology)
490	1166	173	475	461	42

*Source: TRC

Between June 2018 and June 2021, employees numbered 2,672 on average, with the number of employees falling because retirees outnumbered new recruits.

Figure 5. TRC employee status



As of June 2021, employees numbered 2,458 but the number of staff rose to about 2,800 as a result of recruiting employees in preparation for SGR operation after the second half of 2021. This can be checked via the TRC announcement (November 2021) for recruiting 353 persons. Recruitment areas include IT, electrification, rollingstock, civil engineering, and marketing, targeting diverse levels of personnel ranging from highly skilled personnel with bachelor's degrees to certified technicians.[7)]

Budget status

According to the report of African Development Bank titled 'Rail Infrastructure in Africa' (2015), the required capital expenditure of TRL was expected to reach 1.1380 trillion shillings (US$ 711.50 million) for three years from 2013 to 2015. Also, the working capital for 2013, 2014, and 2015 were forecast to reach 3.6 billion shillings, 12.2 billion shillings, and 6 billion shillings, respectively. The Tanzanian government offered subsidies for paying wages that were projected to amount to 12.0 billion shillings, 23.5 billion shillings, and 15.6 billion shillings in 2013/14, 2014/15, and 2015/16, respectively.[8)]

7) Source: TRC announcement, Ref.No.JA.9/259/01/98 (Nov. 15, 2021)

8) Source: Rail Infrastructure in Africa, African Development Bank, 2015

Railway operation

The length of MGR currently in operation is 2,707km, transporting freight and passengers. The following table shows the transport performance of TRC.

Table 2. Operation of Tanzania Railways Corporation (2013-2020)

	Unit	2013	2014	2015	2016	2017	2018	2019	2020
Total length	Km	2,707	2,707	2,707	2,707	2,707	2,707	2,707	2,707
Locomotives (available)	units	45	45	30	44	44	30	30	30
Diesel locomotives	units	45	45	30	44	44	30	30	30
Mainline Locomotives	units	38	38	21	40	40	28	28	28
Shunting locomo-tives	units	7	7	9	4	4	2	2	2
Passenger & freight cars (available)	units	1,200	1,214	1,155	426	426	327	329	380
Passenger cars	units	91	91	56	56	56	71	71	115
Freight cars	units	681	590	561	22	22	18	22	0
Tankers	units	178	203	196	123	123	95	93	147
Tank cars	units	39	64	64	27	27	27	27	91
Others	units	211	266	278	198	198	116	116	27
Transport statistics									
Passengers	1,000 persons	373	170	196.4	1,707	2,150	6,012	3,449	3,069
Freight	1,000 tonnes	185	127	282.6	102	170	357	374	340

*Source: TRC

When SGR projects are completed, Tanzania railways are projected to improve significantly in traffic volume and passenger operation. Also, due to gauge disparity with existing MGR, new rolling stocks will be deployed for the SGR. TRC contracted with Korea's Sung Shin RST in July 2020 for delivering 150 SGR passenger cars, and also with Korea's Hyundai Rotem in July 2021 for supplying 17 electric locomotives (EL) and 80 EMUs (Electric Multiple Unit).

C. Tanzania Zambia Railways Authority (TAZARA)

Establishment background

Established under the TAZARA Act(1975), the Tanzania-Zambia Railway Authority—commonly known as TAZARA—is a railway operator that manages an 1,860 km narrow-gauge line. This railway serves as a link between Dar es Salaam in Tanzania and Kapiri Mposhi in Zambia. Of the TAZARA's network's total length, 975km is located in Tanzania and 875km in Zambia. The railway utilizes a 1,067 mm gauge and is designed with an axle load capacity of 20 tonnes. Using a Chinese loan, the governments of Tanzania and Zambia constructed the railway from 1970 to 1975. At the time of its inauguration, it stood as the longest railway in sub-Saharan Africa.

Railway operation

The following table shows the transport performance of TAZARA

Table 3. TAZARA operation (2013-2020)

	Unit	2013	2014	2015	2016	2017	2018	2019	2020
Total length	Km	1,860	1,860	1,860	1,860	1,860	1,860	1,860	1,860
Locomotives	units	14.8	16	17.2	21	21	18	18	17
Mainline locomotives	units	10.8	12.8	11.7	14	12	13	13	13
Shunting locomotives	units	4	3.2	5.5	7	7	5	5	4
Total number of passenger cars	units	52	50	51	56	49	60	61	47
Passenger cars	units	45	44	43	48	40	51	52	35
Dining cars	units	3	3	3	4	4	4	4	5
Passenger/ freight cars	units	4	3	5	4	5	5	5	7
Total number of freight cars	units	1,391	1,101	1,142	1,221	1,033	1,118	1,113	803
Freight cars	units	1,229	966	1,007	1,077	972	998	992	659
Covered cars	units	0	0	0	0	0	0	0	0
Tankers	units	104	82	82	89	26	70	72	94
Refrigerator cars	units	5	5	5	5	0	0	0	0
Others	units	1	1	1	1	1	1	1	2
Brake cars	units	35	30	30	32	30	34	34	34
Hopper cars	units	17	17	17	17	4	15	14	14
Transport statistics									
Passengers	1,000 persons	654	287	327	440	443	154	510	534
Freight	1,000 tonnes	245	33	81	96	171	268	155	224

*Source: TAZARA(Tanzania Zambia Railway Authority)

D. Land Transport Regulatory Authority (LATRA)

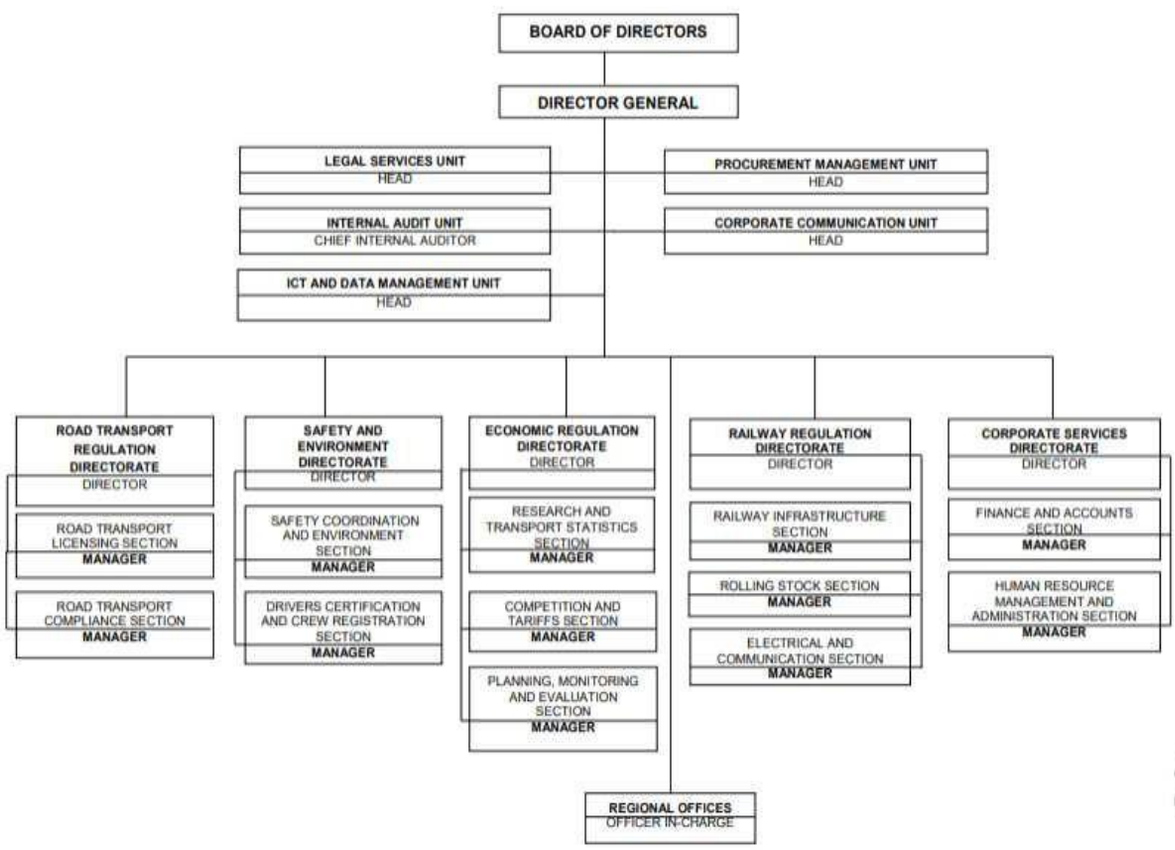
Establishment background

Land Transport Regulatory Authority (LATRA), an institute established pursuant to the Land Transport Regulatory Authority Act (2019), is authorised to enact regulations by the legistrative body of Tanzania in order to deliver land transport services (roads, railways, etc.) in an efficient and safe way. LATRA's duties include the issuance, renewal, and cancellation of permits or licences, the establishment of criteria for land transport conditions, fare control, safety instruction, the certification of crews and engineers, the certification of rolling stocks and roads in reliability, various standardisation processes, and discussions with other regulatory authorities or agencies.

Organisational structure

LATRA is controlled by the board of directors under the control of the Minister of Works and Transport. Under the control of a Director General are five units and five directorates including railway regulation directorate.

Figure 6. LATRA organizational chart



1.3 Key development plans and projects

A. East African Railway Master Plan

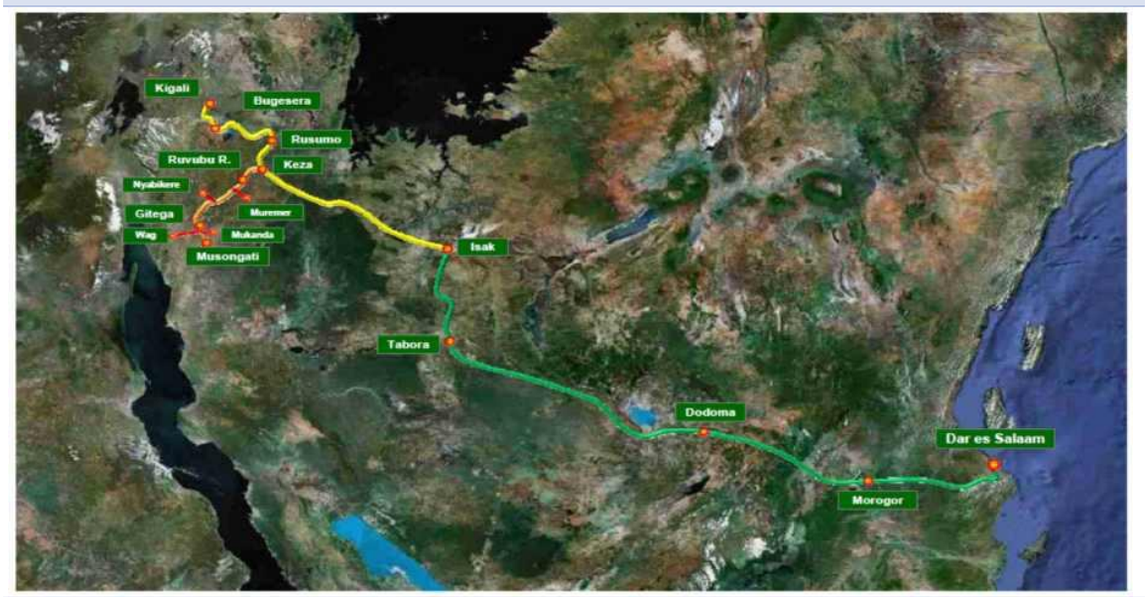
The East African Railway Master Plan (2009) is a policy proposal for rehabilitating railways connecting Tanzania, Kenya, and Uganda and adding railways connecting Rwanda and Burundi. This is designed to promote economic development in East Africa by reducing costs and improving the efficiency and speed of freight transport between key ports on the coast of the Indian Ocean and inland areas. This report proposes changing the existing 1,067mm or 1,000mm narrow gauge track to 1,435mm standard gauge track in order to expand traffic volume, along with constructing international railway lines. Related countries including Tanzania, Rwanda, Burundi, Kenya, and Uganda have promoted or planned SGR construction projects based thereon.

B. Tanzania-Burundi-Rwanda Railway Connectivity Project

Tanzania, Rwanda, and Burundi developed traffic policies together with the goal of enhancing the efficiency of traffic systems by diversifying traffic means. For the implementation of such policies, the three nations crafted plans to improve traffic infrastructure, especially railway infrastructure for the purpose of delivering transport services not only to mineral mines but also to industrial and farming areas.

To this end, the three nations first identified the need for connecting the Isaka-Kigali/Keza-Musongati line to the Dar es Salaam-Isaka line in 1998, a commitment reaffirmed in 2003.[9)] To implement this project - commonly known as the DIKKM project, an acronym derived from the names of the key locations - the three nations conducted the Phase II of the Study for the Dar Es Salaam-Isaka-Kigali / Keza-Musongati Railway Project in 2014.

Figure 7. DIKKM lines (Source: Africa Development Fund)



9) Phase 2 DIKKM Research Report (PHASE II DAR ES SALAAM-ISAKA-KIGALI/KEZAMUSONGATI RAILWAY PROJECT STUDY, 2009, AFRICAN DEVELOPMENT FUND)

Thereafter, to promote the DIKKM project as a private-public partnership (PPP), the three nations posted a public notice in 2015 to invite investors.[10] This notice contains plans to construct a new 970km-long SGR (1,435mm) line between Dar es Salaam and Isaka, in parallel with the existing metre gauge (1,000mm) central line, and to newly build Isaka-Kigali line (494km) and Keza-Musongati line (197km).

C. Tanzania Central Line SGR Project

The Tanzanian government has promoted the construction of 1,219km-long electrified SGRs including the Dar es Salaam-Isaka line and the Isaka-Mwanza line regarded as part of the DIKKM project. The central SGR construction project connecting Dar es Salaam to Mwanza consists of the following five lots: Lot 1 (Dar es Salaam – Morogoro, 202km), Lot 2 (Morogoro – Makutupora, 344km), Lot 3 (Makutupora – Tabora, 294km), Lot 4 (Tabora – Isaka, 130km), and Lot 5 (Isaka – Mwanza, 249km).

The central line SGR project is designed to enable passenger and freight trains to run on tracks up to 160km/h and 120km/h, respectively. The project will introduce electric traction systems, replacing traditional diesel locomotives with electric locomotives and EMUs powered entirely by electricity. Alongside the construction works, the procurement of locomotives is also ongoing. The railway signaling system is being installed based on European Rail Traffic Management System standards.

Figure 8. Tanzania's central SGR line

10) Rwanda Transport Development Agency notice (Kigali,1470/Corp/015, July 16, 2015)

D. Investment in railway development

The Tanzanian government has made massive investment in railway development. Specifically, it allocated about 45% of the MoWT budget to the central SGR project in 2019. From 2016 to 2021, 28.7% of the total construction budget was used for the central SGR construction project. Moreover, from 2016 to 2021, 1.2% of the MoWT budget was allocated to modernising MGR, showing that the process of developing railways with MGR modernisation is also under way.

2. Project sites

2.1 Overview

After reviewing four candidate sites for the construction of railway training center (two sites each in Dodoma and Dar es Salaam), the final candidate was chosen in consultation with TRC.

Figure 9. Candidate sites (Dar es Salaam and Dodoma)

A. Site location

The target site is located in Ihumwa region near Dodoma, the capital of Tanzania and is adjacent to Ihumwa camp where SGR is being constructed.

Dodoma, the new administrative capital, is located at the center of Tanzania, 445km and about 7.3-hour drive away from Dar es Salaam, the economic capital. Ihumwa site is accessible via a domestic flight from Dar es Salaam to Dodoma, followed by a short transfer by road.

B. Site conditions

The site is 12km east of Dodoma (administrative capital) Central Business District. The construction of Msalato International Airport is planned for the north of Dodoma, located 19km away from the project site. The site is conveniently located adjacent key transport facilities – including Ihumwa Station and the bus terminal – as well as the B129 road and the Dodoma ring road.

C. Accessibility

Dodoma City takes about 7 hours and 30 minutes from Dar es Salaam by car along the paved round-trip two-lane arterial road A3 and T3 (B129). When traveling by domestic flight, it takes about 1 hour between each city airport.

An unpaved access road with a width of 10 m has been built along the SGR route currently under construction. It is connected to the 4-lane Middle Ring Road at 2km west. In addition, the Lyumbu residential complex, a planned city, is being built on the west side of the site, but it is only connected by an unpaved local road.

D. Topography and area

The target site is a flatland about 1,134 ~ 1,140 metres above sea level and with a slope of 1.5% or less. It also has a dry stream that flows only during rainy seasons from east to west. The site is located in a grassland lying west of the land owned by TRC and in the direction of Dodoma.

The site presented by TRC borders the existing MGR in the north and Lyumbu New Town under development in the west, having no physical boundaries in the west and south.

Figure 10. Coordinates of the target site offered by TRC

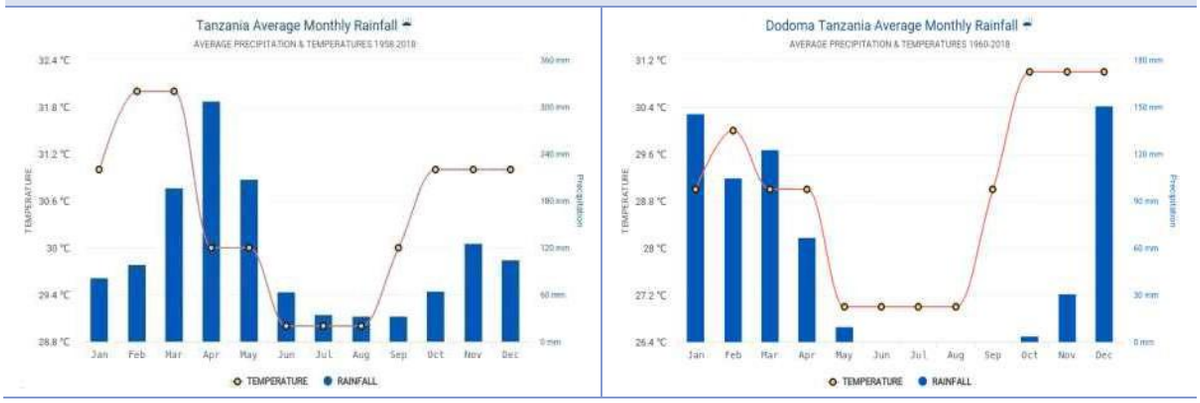
D	N	E
RM10	9316487.491	816759.774
IPC3	9315381.987	816388.231
02AAP700	9316811.596	816394.915
02AAP701	9316625.38	816547.754
RM7	9316585.202	816588.308
RM8	9316542.129	816647.547
RM9	9316507.582	816710.436
RM6	9316079.452	816391.241
RM5	9315381.398	816578.223
RM11	9315380.986	816759.774

E. Climate

In the area of Dodoma City, December to March is the rainy season and the other seasons are dry season. The average maximum temperature between October and February is 29-31 degrees Celsius, and the average minimum temperature between March and September is 18-23 degrees Celsius. The temperature is consistent throughout the year; however, rainfall fluctuates significantly between the rainy and dry seasons.

The climatic conditions of the surrounding areas, such as Dodoma and Ihumwa, have relatively little precipitation compared to other areas in Tanzania, and construction can be carried out even in the rainy season except for heavy rains.

Figure 11. Average monthly precipitation and temperatures in Dodoma, Tanzania



F. Physical Factors Impacting Future Planning

The flow of the aforementioned seasonal waterways passing through the site can affect earthwork construction costs, which can be adjusted depending on the layout of railway training center.

2.2 Geological survey

The geological survey on the site was conducted by a local engineering company. According to the result, the ground is deemed to be solid enough to construct the railway training center.

The survey consists of onsite inspection, soil research, standard penetration tests (2 sites), and 3-metre-deep trial pits (6 sites). The results are as follows:

Table 4. Coner Points, Dynamic penetration light, Trial pits and Boreholes drilling coordinates (WGS84)

Point Name	Coordinates		Elevation(m)			
	East	North				
C 01	816358	9316360	1143			
C 02	816769	9316328	1140			
C 03	816748	9315936	1139			
C 04	816377	9315941	1142			
Point Name	Coordinates		Progress	Total Penetration Depth (m)	Depth (m)	Remark
	East	North				
DPL 01	816554	9316256	100	10	1.5	Done
DPL 02	816677	9316164	100	10	1.9	Done
DPL 03	816593	9316049	100	10	2	Done
DPL 04	816473	9316009	100	10	1.2	Done
DPL 05	816490	9316117	100	10	1.6	Done
DPL 06	816423	9316243	100	10	1.1	Done
TP 01	816475	9316294	100	3	3	Done
TP 02	816661	9316283	100	3	3	Done
TP 03	816437	9316150	100	3	3	Done
TP 04	816542	9316180	100	3	3	Done
TP 05	816577	9315962	100	3	3	Done
TP 06	816706	9316032	100	3	3	Done
BH 01	816595	9316137	100	15	3	Done
BH 02	816456	9315965	100	15	3.9	Done

2.3 Utilities

The site is well-positioned for communication network integration, as fiber-optic cables run parallel to the SGR lines. Existing connection interfaces are situated 120m west, ensuring easy connectivity to the communication backbone network.

Power and underground water can be supplied via existing power lines and underground water wells for Lyumbu town near the target site. Three phase power lines and transformers are installed in the southwest area of the site and can be easily connected. Underground water wells are next thereto, enabling water supply. However, sewer pipe networks are yet to be set up around the site, making it necessary to discharge sewage via a separate purification system.

Figure 12. Infrastructure around the target site

① Water Borehole 1

② Water Borehole 2

③ Water Borehole 3

④ Beacon 02AAP 699

Ⓟ POWER

Ⓣ ICT Inspection Point

3. Local taxes

Tanzania's tax system is based on the Income Tax Act (2004), the VAT Act (2014), the East African Tariff Management Act (2004), the Stamp Tax Act (1972), the Vocational Training Act (2000), and Finance Acts. Tanzania Revenue Authority (TRA) is in charge of the tax system.

TRA, a semi-autonomous government agency, was set up in accordance with Tanzania Revenue Authority Act. To this end, on behalf of the government, it is responsible to assess all revenues subject to laws, to collect taxes, and to implement accounting procedures.

3.1 Corporation tax

Corporation taxes are subject to the Income Tax Act (2004). The taxes are levied on the total income for the year and the previous two years or on the total income of local companies whose income was transferred to their home counties or was subject to withholding taxes for the income year. The corporation tax rate is 30%, with the taxes being equally divided into four installments and paid during the income year.

3.2 Value added tax (VAT)

Construction contractors are required to charge sales tax (VAT) when supplying and purchasing materials used in construction. The threshold for VAT registration is an annual turnover of 100 million Tanzanian shillings (US$43,500). VAT on the supply of goods and services is 18%, VAT on exports is 0%, and VAT on imports of goods is added at the time the customs duties are paid. Professional service providers and government agencies engaged in economic activities must register VAT regardless of their sales.

3.3 Withholding tax

Withholding tax applies to all payments originating in Tanzania, including services, dividends, interest, natural resource payments, rents and royalties. A 5% service fee applies to contractors or individuals originating in Tanzania and paid for residency. 15% of service fees paid to non-resident contractors or individuals, 10% of interest withholing tax, and 10% of withholding tax when paying rent. Withholding tax must be paid to the TRA within 7 days after the last day of the month in which withholding is withheld.

3.4 Employment taxes (Pay As You Earn, PAYE)

Personal income from employment is subject to different tax rates, depending on the scope of income. PAYE varies from 0% to 30%. The taxes are levied after deducting 10% of the compulsory pension fund contribution.

Table 5. PAYE Figures in Tanzania Shillings

Income (Tanzania Shillings)	Tax rates
0 to 270,000	0%
270,000 to 520,000	8%
520,000 to 760,000	20%
760,000 to 1,000,000	25%
above 1,000,000	30%

3.5 **Skills & development levy (SDL)**

SDL is subject to the Vocational Training Act. SDL is paid to all companies employing 10 or more persons.

3.6 **Stamp duties and importation duties**

Stamp duties, a kind of transaction taxes, should be paid within 30 days after the date on which certificates are signed.

- 1% of the product amount in connection with lease agreements.
- 1% (up to 10,000 shillings) for legal and commercial certificates including loan agreements
- 1% for stock transfer
- 1% for property exchange

3.7 Custom duties importation

Tanzania is a member of the East African Customs Union. Custom duties are subject to tax rates prescribed in the East African Community Customs Management Act (ECMA), which apply to member nations (East African Partners). Generally, semi-finished products, finished products, and capital goods/raw materials are subject to import duties of 10%, 25%, and 0%, respectively. Customs duties are subject to varying rates depending on the specific items stipulated in EMCA and customs processing fees account for 0.6% of FOB value.

4. Project executing agency and project implementation systems

4.1 Project executing agency

A. Government organization

MoWT is responsible for establishing and implementing major railway development policies in Tanzania. MoWT was established as an organization commissioned by the President to manage the establishment and implementation of national policies related to construction, transportation which includes airport development, civil aviation, water, ocean, air and rail transport, ports, traffic safety, meteorology, and manpower training for ministries and agencies.

Regarding the implementation of the EDCF project, MoWT discusses the progress with Ministry of Finance and Planning (MoFP) which is in charge of the loan project of the Tanzanian government.

Loan projects conducted by MoFP and related ministries are based on the 'Government Loans, Guarantees and Grants Act' of the Tanzania and are planned and evaluated according to the Guidelines for Project Planning and Negotiations for Raising Loans, Issuing Guarantees and Receiving Grants.

B. Project Executing Agency, PEA

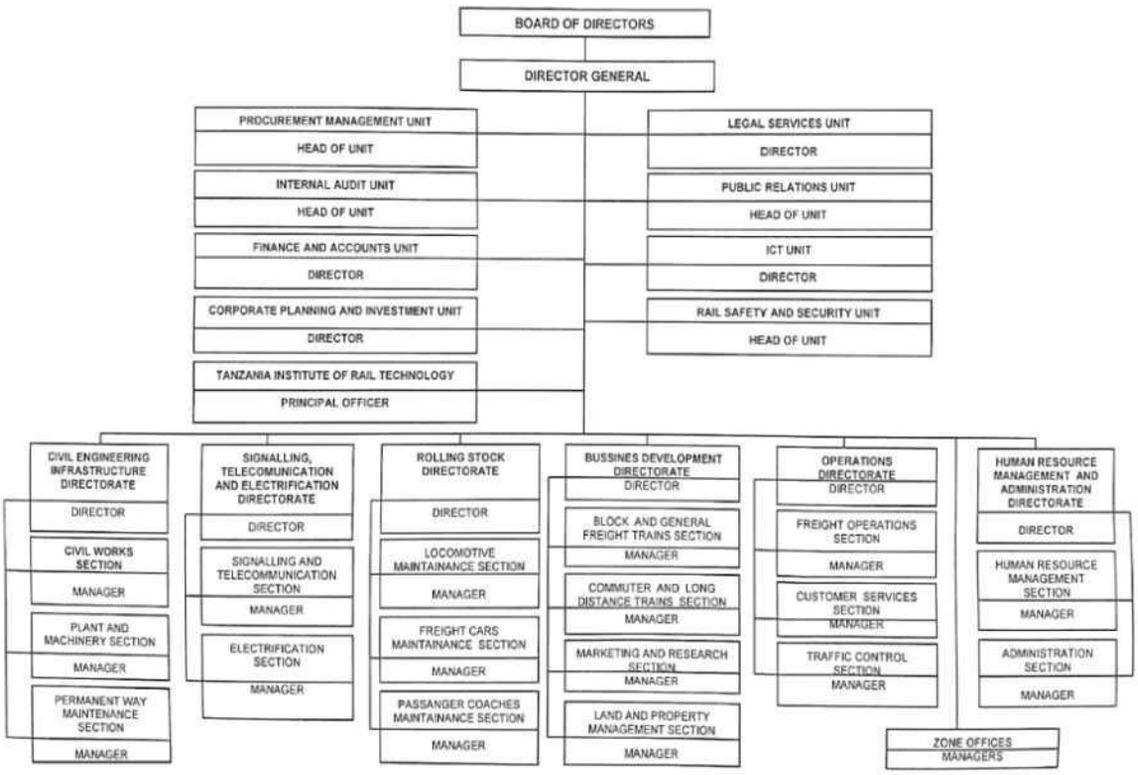
TRC, one of the affiliated organizations of the MoWT, is a state-owned company established in accordance with the Railway Act No. 111 in October 2017.

TRC consists of nine units, six directorates, and zone offices under the control of director general and the board of directors. The nine units are composed of legal services, public relations, ICT, rail safety/security, procurement management, internal audit, finance/accounts, corporate planning/investment, and TIRTEC while the six directorates consist of civil engineering infrastructure, signalling/telecommunication/electrification, rolling stock, business development, operations, and human resources management.

The total number of employees of TRC is 2,807, and the Directorate of Civil Engineering Infrastructure has the largest number of employees.

In addition, there are a total of 1,814 employees in the civil engineering electrification and rollingstock directorates, which 64.6% of the total employees are in maintenance works.

Figure 13. TRC Organisational Chart



TRC is in charge of the implementation of the SGR project, a national project, and the railway training center project was proposed as a measure to solve the problem of manpower training for railway operation after the completion of SGR construction. TRC is the only railway organization in Tanzania that directly implements railway development according to government policy, and is also in charge of operation and maintenance of facilities after railway construction. Although different in nature from the railway training center project, TIRTEC, which is in charge of nurturing railway experts, is also managed as an organization under the TRC. In light of this, it seems reasonable to designate TRC as the project executing agency for the project, and the current feasibility study is also being carried out with the participation of TRC.

Currently in Tanzania, there are no vocational training institutes specialized in railway that directly aim to develop HR for railway operation. Therefore, upon the completion of this project, TRC will be responsible for the operation of the railway training center. Through the training center's activities, the training system for railway personnel will be further strengthened by developing and retaining qualified teaching staff.

C. Project Management Unit, PMU

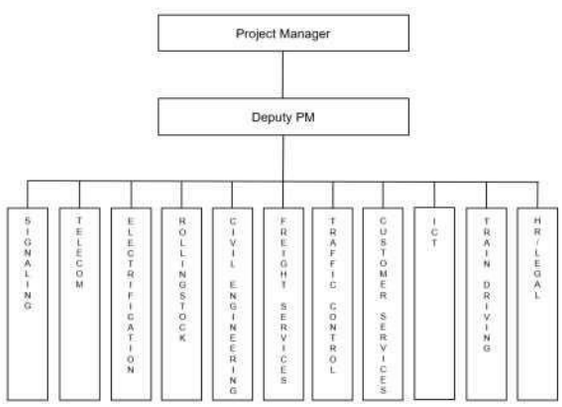
All TRC project is carried out in accordance with the procedures set forth in Tanzania's Public Procurement Act No. 7 of 2011 and Public Procurement Regulations, 2013 – Government Notice No. 446. In accordance with the procedure, each project execution organization is required to establish a Project Management Unit (PMU), an organization exclusively for procurement. To enhance the transparency of the public procurement process, the Tanzania National e-Procurement System (TANePS,

https://www.taneps.go.tz), was introduced, and bidding by government organizations including international bidding was implemented.

TRC has experience in signing a number of mega projects, including a $1.98 billion construction contract for the construction of the SGR Lot3. In addition, with US $300 million supported by the World Bank, the Tanzania Intermodal and Rail Development Project (TIRP) is in progress for the improvement of existing lines. As such, there will be no difficulty in carrying out the construction of the EDCF Railway Training Center by forming a PMU inside the TRC, which has experience in promoting large-scale projects and loan projects.

Based on established precedents, a PMU is expected to be newly established as a dedicated project organization prior to implementation. The PMU will be led by an appointed Project Manager and a Deputy Project Manager, and is anticipated to comprise approximately 11 members covering various sectors within the railway system.

Figure 14. TRC PMU orgainsation chart



4.2 Related agencies

Related agencies for the railway training center construction project include TIRTEC, LATRA, and National Council for Technical and Vocational Education (NACTVET).

TIRTEC has its main branch in Tabora and sub-branch in Morogoro, operating certificate and diploma courses in railway technology. Courses currently in operation are for maintenance of diesel-electric locomotives and rolling stock. TIRTEC is open to all public and employees, and the tuition is borne by the students. Even though acquiring certificates does not ensure students to be automatically employed by railway agencies, number of trainees are continuously rising due to the aniticipation of opening of SGR. After opening of railway training center, TIRTEC will continue to offer education of various railway technologies.

LATRA is in charge of establishing and amending land (roads, railways, etc.) transport-related laws and regulations. In the field of railways, it is responsible for managing the Railways Act (2017) and Railways Regulations (2018), as well as Safety Critical Workers (SCW) training requirements.

NACTVET, which is in charge of reviewing, assessing, and approving technical training programmes and content, was set up to devise regulatory systems for ensuring the quality of technical education and to monitor the maintenance of training programmes in quality.

5. Similar projects

Existing projects similar to the construction of the Tanzania Railway Training Center (TRTC) include the programme to improve the management competencies of civil aviation and to build a training center in Phnom Penh, Cambodia. Its aim was to set up a civil aviation training center and an HR development master plan. The project cost $ 10.1million USD funded by KOICA and was until 2013 to 2018.

According to the final assessment, the project was found to have following problems: 'insufficient mid-to-long-term planning,' 'necessity to allocate dedicated staff for curricula and equipment,' 'necessity for speedy actions for handling building defects,' 'requirements for training programmes for students and the general public of neighbouring countries to use the center more effectively.'

Based thereon, the following implications for this project are identified and presented.

First, mid-to-long-term plans should be ready for the in-house operation of railway training center when completed. In case focusing on short-term plans including the construction of railway training center, in-house operation may not be feasible due to the project excuting agency's lack of experience in operating such center and systems. Therefore, when executing the project, related plans should be thoroughly devised to enable the project excuting agency to operate the center on a mid-to-long-term basis.

Second, follow-up management is deemed to be required, which includes training programme consultancy service and railway equipment training. After the railroad education center is built, if the operation ability for its own training courses and equipment is insufficient, it is difficult to operate as the purpose of the establishment. Technology transfer is essential to acquire planning and management know-how for educational program operation and to maintain training equipment and contents.

Third, building defects should be minimised and be actively handled via thorough construction supervision. In case defects are found after completion of construction, the project can be delayed, causing problems in operation.

Fourth, it is essential to incorporate regional demand from neighboring countries into the educational demand forecasting process. The SGR project is expected to have a significant impact on the spread and standardization of railway technology between neighboring countries, and the demand for education in neighboring countries is also predictable to some extent. Therefore, in line with the completion of the railway education center, it is necessary to review the project execution plan, such as operating a training program for railway officials from neighboring countries in addition to the railway officials in Tanzania.

Ⅲ. Project Execution Plan

1. Basic direction

The Tanzania railway training center project aims to train and cultivate railway professionals who will operate and manage the new SGR in a stable and efficient way. In terms of workscope, the project includes construction, supply of training equipment and consultancy services in project management, content development, training equipments and construction engineering.

2. Training center training course plan

2.1 Analysis for training demand and size

Organizational structures of railway companies generally follow a similar framework. Given KORAIL's completed participation in the Operation and Maintenance (O&M) advisory project for the Tanzania Central Line SGR, it is anticipated that the Tanzanian railway's organizational system will be aligned with Korean standards. Consequently, the calculation criteria from KORAIL's 'Mid-to-Long-term Organization and Manpower Plan Research Report' were applied to this analysis.

As a result, the O&M manpower required for a 1,219 km SGR section is estimated at 5,881 personnel, representing a density of 4.8 people per kilometer. Applying this ratio, the total O&M manpower required for Tanzania's entire 4,176 km SGR network is projected to be 20,147.

2.2 Training course plan

This feasibility study focused on developing detailed training courses by job duty to foster growth of quality human resources needed to ensure stable and efficient operation of Tanzania's SGR. Training courses by job duty were classified into entry-level courses for new assignees; mid-level courses to strengthen professional expertise; and high-level courses to develop managers. Each course is made up of theoretical classes on relevant areas that were developed in consideration of the SGR electric railway operation environment along with practicum OJT needed to undertake day-to-day work.

Table 6. Overview of training courses at Tanzania railway training center

No.	Job duties	Skill level	Job position (English)	Offered to	Duration (weeks)
1	Station service	New	Station service / entry-level course	New assignee	4
		Retraining	Station service / mid-level course	Finished entry-level course	2
		Manager	Station service / high-level course	Manager level	2
2	Shunting work	New	Transport / entry-level course	New assignee	4
		Retraining	Transport / mid-level course	Finished entry-level course	2
		Manager	Transport / mid-level course	Manager level	2

3	Train crew	New	Train service / entry-level course	New assignee	6
		Retraining	Train service / mid-level course	Finished entry-level course	2
		Manager	Train service / high-level course	Manager level	2
4	Driving (DL)	New	Driving / entry-level course	New assignee	12
		Retraining	Driving / mid-level course	Finished entry level course	2
		Manager	Driving / high-level course	Manager level	2
5	Driving (EL)	New	Driving / entry-level course	New assignee	12
		Retraining	Driving / mid-level course	Finished entry-level course	2
		Manager	Driving / high-level course	Manager level	2
6	Driving (EMU)	New	Driving / entry-level course	New assignee	12
		Retraining	Driving / mid-level course	Finished entry-level course	2
		Manager	Driving / high-level course	Manager level	2
7	Local traffic control	New	Local traffic control / entry-level course	New assignee	4
		Retraining	Local traffic control / mid-level course	Finished entry-level course	2
		Manager	Local traffic control / high-level course	Manager level	2
8	Central traffic control	New	Central traffic control / entry-level course	New assignee	12
		Retraining	Central traffic control / mid-level course	Finished entry-level course	2
		Manager	Central traffic control / high-level course	Manager level	2
9	Civil engineering	New	Civil engineering / entry-level course	New assignee	4
		Retraining	Civil engineering / mid-level course	Finished entry-level course	2
		Manager	Civil engineering / high-level course	Manager level	2
10	Construction	New	Construction / entry-level course	New assignee	4
		Retraining	Construction / mid-level course	Finished entry-level course	2
		Manager	Construction / high-level course	Manager-level	2
11	Electric railway power	New	Electric railway power / entry-level course	New assignee	4
		Retraining	Electric railway power / mid-level course	Finished entry-level course	2
		Manager	Electric railway power / high-level course	Manager level	2
12	ICT	New	Information communication / entry-level course	New assignee	4
		Retraining	Information communication / mid-level course	Finished entry-level course	2
		Manager	Information communication / high-level course	Manager level	2
13	Signalling	New	Signalling / entry-level course	New assignee	4
		Retraining	Signalling / mid-level course	Finished entry-level course	2
		Manager	Signalling / high-level course	Manager level	2
14	Rolling stock	New	Rolling stock / entry-level course	New assignee	4
		Retraining	Rolling stock / mid-level course	Finished entry-level course	2
		Manager	Rolling stock / high-level course	Manager level	2

3. Equipment procurement plan for the railway training center

3.1 Training equipment for traffic control

For traffic control training equipment in the TRTC, it is proposed to set up with Full Type Simulator (FTS) and Computer Aided Instruction (CAI) in line with the control system configuration of Bombardier, which is being installed in the current central railway line. For CAI, Part Type Simulator (PTS) can be added to allow the training of basic functions of the control system.

It is also proposed that the local control training equipment be designed similarly to the central control system, integrating a simulated control system with basic PTS functions. Developing training modules for designated representative local control sectors is also required. Furthermore, it is necessary to set up the control facility of line switcher in the outdoor track site to provide training for line switcher operation for emergency.

3.2 Training equipment for driving

Training in the operation sector can be classified into actual driving training of a real train, and simulator training using a simulator. The advantage of driving training using an actual train lies in the rapid adaptation to various on-site terrains and the precise control of acceleration and deceleration, but there are disadvantages in that it is not possible to have various training on the ways of handling unusual circumstances such as accidents. Therefore, it is proposed for training in the driving sector for FTC to implement simulator training.

As for the FTS in the driving sector, training is to be provided to allow the operation in similar environments with the actual situations by setting up the same driving functions and control panel of the train for actual operation, such as diesel locomotive, handling shunting in the yard, electric locomotive to transport passengers and cargo, and electric trains. In addition, with installation of PTS for basic functions to train specific operational functions with focus as well as operating procedures and diagnosis of failures, it will be possible to enhance the engineer’s capabilities to take measures in the driving sector. At the same time, by setting up CAI in each rolling stock, self-directed learning can be done for theory in the operation sector, structure of each rolling stock, driving related regulation and procedures.

3.3 Training equipment for rolling stocks

For efficient training and practice in FTC, the equipment for practice in the rolling stock sector can be supplied first with the equipment with higher frequency of use and low prices, and it will be desirable to use the rolling stock that is scheduled for maintenance for practice, as well as to set up additionally depending on the future environment and conditions.

For the rolling stock training equipment at the Tanzania Railway Training Center, it is advisable to prioritize cost-effective equipment with high utilization rates to ensure efficient education and practice. Practical training should utilize vehicles scheduled for maintenance, with further expansion of the facilities carried out incrementally based on future conditions. Based on an analysis of the equipment currently operated by similar institutes, the following training resources are proposed for the Tanzania Railway Training Center.

Table 7. Details on equipment in rolling stock sector in TRTC (Proposal)

No.	Details of practice equipment in rolling stock sector (proposal)	Quantity
1	Workbench to use work tools	1
2	Industrial vacuum cleaner	1
3	Movable container for scrap metal	1
4	DC power supply	21
5	Oscilloscope	21
6	Digital multimeter	21
7	Device for electric and electronic practice	21
8	Device for electric air pressure practice	5
9	Device for electric fluid pressure practice	5
10	Cab signal device	1

3.4 Training equipment for facility

TRC plans to procure and maintain about 20 types of railway equipment for SGR maintenance. Modern railway maintenance vehicles - including track inspection car, track repair car including ballast, and overhead catenary repair car - will be introduced. For the maintenance of SGR infrastructure, the following equipment is proposed for Tanzania Railway Training Center.

Table 8. Details on equipment in facility sector of TRTC (proposal)

No.	Equipment (proposal)	Quantity	No.	Equipment (proposal)	Quantity
1	Hand tie tamper	1	11	Schmidt hammer	1
2	Railroad switch tongue rail grinder	2	12	Rail gauge	1
3	Generator	1	13	Torque wrench (for maintenance work)	2
4	Hydraulic jack	1	14	Torque wrench (for test)	2
5	Rail drill	2	15	Steel tendon detection	2
6	Rail stressor	1	16	Survey instrument (level) set	1
7	Emergency rail joint device	1	17	Survey instrument (light wave instrument) set	2
8	Fluid pressure practice panel	2	18	Phased array rail ultrasonic equipment	1
9	Air pressure practice panel	1	19	Rail straightness tester	1
10	Excavator	1	20	MTT simulator	1

3.5 Training equipment for the electrical sector

The electrical sector for TRC is categorized into three main fields: power supply for electric railway, information and telecommunications (IT), and signal control.

Power supply for electric railway can be further subdivided into electrical power, overhead catenary, and substation areas. For electrical power sector, training focuses on enhancing the understanding and operation of various measuring instruments, equipment, and SCADA systems. In contrast, since the catenary and substation sector primarily involve field maintenance, hands-on training at outdoor facilities is essential. Similarly, the IT and signaling sectors require practical education on the operation and maintenance of their core infrastructure."

3.6 Training equipment for outdoor practice track

It is proposed that a realistic maintenance environment at the Tanzania Railway Training Center is implementd by installing replicated facilities for electrification, signaling, and infrastructure that are identical to those on the actual SGR.

3.7 Training equipment for the safety experience center

As TRC operates the electric railway for the first time, it is necessary to put focus on the training on electrical safety including electric shock and other elements. It is proposed that, in the Tanzania Railway Training Center, a training facility needs to be set up for operation, and it can be used as a safety training center on railway-related facilities not only for employees working in the railway sector but also for the general public.

3.8 Training equipment for aptitude test

TRC has been conducting legally required physical tests for essential safety workers, and checking the relevant requirements such as drinking, misuse of drug, etc. to prevent any human errors and accidents. Under the SGR operation environment, there will be higher operational frequency compared to the current railway operation situation, with shorter intervals. It means the risk of potential accidents may increase. Therefore, TRC needs to implement aptitude tests for engineers who operate the rolling stocks as well as equipment operators and workers in control areas handling signals, to prevent any accidents caused by human errors.

4. Training center construction plan

The size of the site is 100,018m^2 and total floor space is 14,051m^2 to accommodate training, administration and residential usage. An outdoor sports field, plaza, car park, and space for landscaping will be built. The Tanzania Railway Training Center can accommodate up to 417 people, and it consists of the main building (2F), conference hall (1F), lecture rooms (3F), training

lab (3F), cafeteria (1F), library (2F), dormitory (4F), and gym/F&B(1F).

Figure 15. Training center – aerial view

Table 9. Overview of Training center

Classification	Details	Comments
Location	Near Ihumwa Camp in Tanzania	-
Area	100,018m^2	-
Building area	6,671 m^2	-
Total floor area	14,051 m^2	-
Building-to-land ratio	7%	Under the law: 50% or less
Floor area ratio	14%	Under the law: 250% or less
Size	1-4 floors	-
Capacity	417 people	Dormitory 310 (Professor 10 & students 300) + Admin 77 + Reserve 30
Structure	Reinforced concrete	-
Parking capacity	205 cars	Under the law: 141 (1 vehicle /100 m^2)

Figure 16. Layout plan

5. ICT plan for the training center

5.1 Network set-up plan for the training center building

To enhance work efficiency, it is essential to set up the internet network in the lecture and administrative buildings. It is necessary to set up an environment with integrated wicnering to allow basic internet access in the dormitory and cafeteria. It is also proposed to install a satellite TV antenna and distribution system.

With CCTV to be set up outdoors, in the lobby, lifts, and corridors, unauthorised access can be restricted to protect facilities and trainees. In addition, with the installation of intercoms and public address equipment in the lecture and accommodation buildings, it will be possible to disseminate any notice for group activities and to have effective control in any emergencies such as fires.

To enhance the accessibility of administrative staff and trainees to the facilities, the functionality with a tag to allow building accessibility can be added to staff or student IDs. For facilities with higher security levels, differentiated security levels can be granted to each person. As such, by adding a function to determine accessibility depending on the security level of each facility, the overall level of security will increase.

5.2 Network set-up plan as training equipment

In order to establish an internet environment, a firewall, server, wireless access point (AP), etc. are built to configure the intranet. Securing network connectivity with the outside by connecting to the LAN network of the education center by receiving the Internet from Tanzanian Internet Service Providers (ISP).

5.3 Academic management system (AMS)

The primary purpose of the academic management system (AMS) is to efficiently manage various administrative tasks within the training center using specialized IT software. The system's functions and architecture are designed to be flexible, taking into account the scope of eligible trainees, compatibility with existing management information systems, user requirements, technical feasibility, data processing classifications, and overall system capacity. Considering the operational environment and educational scope of the TRC, it is proposed to establish an AMS similar to the system currently operated in Korea.

The AMS platform can be acquired either through custom development or by purchasing licenses for a commercial off-the-shelf system. To ensure ease of maintenance and seamless software updates, the latter—procuring an existing system—is highly recommended. However, it should be noted that the strategic planning of the system’s content and the development of specific online

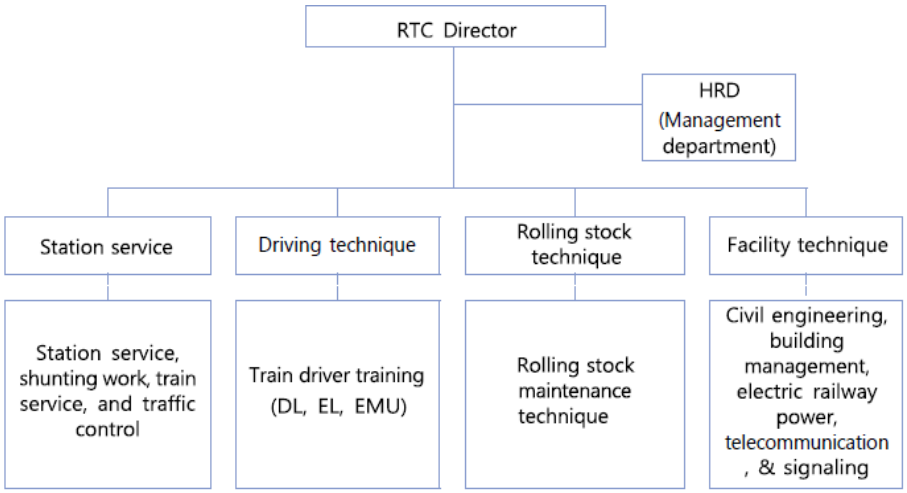
learning modules will require a separate, customized development process.

6. Training center operation and maintenance plan

Upon the establishment of the TRTC, TRC is expected to serve as the lead entity for its operation and maintenance. Technical expertise related to railway systems is specialized and not universal; in particular, techniques in railway operation and system maintenance must be based on the internal regulations and know-how of the railway institutions that operate and maintain the system. Therefore, considering the objective of achieving competency enhancement for those working in the railway sector and the unique nature of the sector, it is desirable that the TRTC be managed and operated by experienced internal personnel from TRC

The operational organisation of the TRTC comprises the director, administrative staff, trainers, and system maintenance perseonnel. Depending on the task and training areas, the organisation structure can be charted as follows.

Figure 17. Tanzania Railway Training Center Origanization (proposed)



7. Consultancy service

7.1 Consultancy service for project management

This project requires the simultaneous implementation of i) construction components (building construction and equipment installation) and ii) functional components (operational planning, human resource training, and educational content development). While each element maintains its distinct identity, they must remain closely interconnected. To ensure seamless execution without delays and to maintain integration between these independently managed factors, a consultancy service with extensive experience in similar projects is essential. The consultant must be composed

of experts capable of interfacing with the main contractor, including specialists in schedule, contract, budget, quality, safety, document control, and administration.

7.2 Consultancy service for training programme

In this project, training content development, training of employees in charge of operation and maintenance of the training center, and the competency enhancement of faculty members are of paramount important. To achieve these, a training programme development plan must to be established prior to excuting the project. Additionally, the operation and maintenance plan for the training center must to be finalised, and a basic proposal for equipment installation and building construction should be completed during the preparation stage.

In addition, training content will be developed so that an online and offline teaching plans, the academic management system, and lecture materials can be prepared in line with the execution plan before the completion of the training center. Furthermore, training should be provided to management personnel, maintenance staffs, and faculty members to build the capabilities of the training center operators.

7.3 Consultancy service for training equipment

The scope of training should encompass all equipment installed within the railway system. However, the decision to install specific equipment within the training center can be made by assigning priorities based on factors such as task criticality and the limitations of On-the-Job Training (OJT). To maximize the utilization of these training equipment, it is essential to engage consultants who possess extensive knowledge and practical experience in railway operations

7.4 Consultancy service for construction engineering

Consultants for construction will provide consultancy services for approximately 30 months, spanning from detailed design to the defect liability period.

8. Capacity building and technical advisory

8.1 Advice for operational plan of TRTC

Prior to the detailed design phase of TRTC, the consultant shall provide advisory services regarding the center's operation and maintenance plan. TRC is to establish the TRTC organization and designate internal operational personnel in advance to facilitate effective knowledge transfer from the consultant.

Furthermore, the consultant will develop a proposal for an AMS to oversee overall administrative tasks - including curriculum development, enrollment, and training records - and obtain approval from TRC. Additionally, based on the basic training program plan, the consultant shall establish a plan for the training system, including training equipment and outdoor practice sites, and secure official approval from TRC.

8.2 Training programme development

The consultant shall develop specialized curricula for each sector in accordance with the basic training program plan. These curricula will be designed based on the training needs of each TRC department and will encompass learning objectives, schedules, subjects, faculty, trainees, textbooks, and instructional aids. Upon finalizing the curricula, the consultant will produce textbooks for trainees and lecture materials.

In consultation with TRC, the consultant will also develop online learning content. This content will consist of multiple learning modules, each including a learning overview, instructional content, learner activities, assessments, and reference materials. Furthermore, the consultant may provide advisory services regarding copyright registration and standard guidelines for content development to TRC.

Following the AMS implementation plan, the consultant will secure the necessary information for system setup and integrate the developed online content into the AMS. Finally, the consultant will collaborate with TRC to develop an aptitude testing program tailored to the Tanzanian railway environment and provide advisory support to ensure its efficient execution.

8.3 Training programme development

To enhance the competency of operational personnel, the project will include invitational training for managers, invitational training for faculty members, as well as operation and maintenance (O&M) consulting.

Invitational training for managers is planned as a two-week program in Korea, focusing on theoretical education in railway policy and site visits to major railway facilities. Additionally, invitational training for TRC staff selected as faculty will be a one-month program at similar railway training institutions in Korea, which includes practical, hands-on training. Training curriculum may comprise modules on human resource development systems, pedagogical theories, teaching practice, and site visits. During the operational phase of the training center, the consultant will perform lecture observations and diagnostics, review the utilization and suitability of training equipment, and assess educational content from a learner’s perspective. Furthermore, the consultant will be responsible for analyzing project performance, diagnosing issues, and deriving comprehensive improvement plans.

Ⅳ. Project Feasibility Analysis

This chapter provides an anlaysis of the following items for this project: i) whether this project is deemed to be appropriate as public goods and a state-funded project; ii) whether this project can be consistently carried out in line with the Tanzanian government's policies; iii) whether the project executing agency can present specific implementation plans before enforcing the project; iv) whether there are any constraints in legal and financing contexts; and v) whether alternative plans can be devised to resolve issues. Also, economic feasibility and sustainability are analysed, identifying economic benefits from the construction of the training center and comparing them with project execution costs.

1. Technical feasibility analysis

1.1 Adequacy of project site

In order to select the construction site for the project, four candidate locations were evaluated, and the accessibility, infrastructure and development effect of each candidate location were comprehensively analyzed to select the Ihumwa area, which had no adverse conditions. The target project site is managed by TRC, and part of the area is being used as a railroad construction camp for the SGR project. Compared to the other three candidate sites, it has the largest land size, so it is possible to expand the education center in the future without difficulty.

1.2 Adequacy of project scale and scope

This project is a national project of the Tanzanian government, and the direct purpose of this project is to train employees for operation and maintenance of the SGR. Therefore, the scope and scale of the project were proposed in consideration of the size of the workers to be hired in the future and related jobs for the SGR. Construction and educational equipment to be procured were proposed in specifications and scales that can support effective learning of essential training courses required to strengthen workers' competency. As the Tanzanian government promotes the SGR construction project with a length of more than 4,000 km, this project has been launched with a clearly established and sufficient demand for education and training.

1.3 Adequacy of estimated project cost

The construction cost seems to be calculated appropriately when compared with the unit construction costs of buildings in Africa. The cost for educational equipment were calculated in accordance with EDCF guideline, including expenses for customs clearance, installation, and user training. The consulting service cost was estimated by analyzing the roles of consultants as each project stage to determine the appropriate manpower, then applying engineering labor cost unit rates. The training programs were proposed based on Korea Railroad Corporation's past training cases for foreign railway officials, with costs calculated in accordance with KOICA's training expense standards.

Among taxes and duties, VAT was applied at 18% in accordance with the Tanzania laws. For customs duties, a rate of 11.68% was utilized, based on the World Bank's average tariff rate for industrial products in 2018-2020. Project management expenses reflect both the personnel costs for the Tanzanian PMU and the budget for the environmental impact assessment to be conducted by the Tanzanian government.

The contingencies consist of a physical contingency and a price contingency. The physical contingency is 5% of the direct project cost according to the EDCF guidelines, and the price contingency is calculated considering the inflation rate of Korea, Tanzania, and third countries.

1.4 Adequacy of project implementation period

The implementation period of the project is planned to span 52 months in total, 4 months for consultant selection, 12 months for construction design, 6 months for contractor selection, 24 months for construction, and 6 months for operation and management support.

The procurement period for consultants and contractors was calculated based on the PEA's previous tender experiences and was confirmed as adequate during the final report meeting.

The construction period was estimated in accordance with Table 1(Design period compared to the construction cost by design stage) of the Detailed Enforcement Criteria for Basic Design, etc. announced by the Ministry of Land, Infrastructure and Transport (MoLIT) of Korea. For detailed design period was determined with reference to the same criteria announced by the MoLIT of Korea.

The estimated construction period, 24 months, is deemed appropriate, considering that similar projects in Tanzania typically require approximately 24 months. Regarding O&M support, a 6-month consulting period is considered sufficient to provide comprehensive feedback on the outcomes of each training course, as the individual training courses range from 2 to 12 weeks in duration.

2. Economic and financial feasibility

2.1. Economic feasibility

A. Major Assumptions

In accordance with the EDCF F/S Guidelines, a discount rate of 9% was applied. The base year for the analysis was set to 2021, the completion year to 2027, and the operation period was calculated from 2027 to 2057.

B. Benefit

While the ideal approach to assessing the benefits of a railway training center is to monetize improvements in job competency and performance, quantifying these factors presents significant methodological challenges. Although the Willingness to Pay (WTP) method is often used for public facilities, it is ill-suited for this project because the center serves specialized employees rather than the general public. Furthermore, since trainees do not pay out-of-pocket for their education, direct WTP estimation is impractical. Instead, following the precedent set by most preliminary feasibility studies in Korea, this research utilizes opportunity costs as a proxy for benefits. Specifically, the analysis focuses on the opportunity cost of training hours and the subsequent effects on wage increases as measurable indicators of the center's value.

In addition to offline training, this project includes the production of online educational content, which is expected to generate supplementary benefits. Since the export of such content to neighboring countries represents a national economic gain, the revenue from online content sales has been incorporated into the analysis as a distinct benefit item.

C. Cost

Construction costs, consulting services costs, contingencies, and operation and maintenance (O&M) costs were included as cost items.

D. Analysis Result

The analysis yielded a Benefit-Cost (B/C) ratio of 1.29, a Net Present Value (NPV) > 0, and an Internal Rate of Return (IRR) of 11.52%, leading to the conclusion that the project is economically feasible.

2.2. Financial feasibility

As this is a government-funded project with no expected substantial revenue, the financial feasibility analysis was not conducted as it would provide no practical utility.

Ⅴ. Environmental and Social Impact Survey and Analysis

1. Environmental and social impact-related laws and regulations in Tanzania

1.1. The Environmental Management Act (2004)

The Environmental Management Act offers a legal and systematic framework for the sustainable management of the environment in terms of the implementation of national environmental policies. National Environment Mangement Council (NEMC) is responsible for managing and executing national environmental policies.

NEMC has the legal authority to determine 'whether to apply environmental impact assessment to proposed projects,' to approve consultants' assessment of environmental impact, to gather the opinions of the public, and to recommend the approval of environmental impact assessment and related issuance to the Minister.

1.2. The Environmental Impact Assessment and Audit Regulations (revised in 2005 and 2018)

The regulations specify procedures and regulation systems for conducting Environmental Impact Assessment (EIA) in Tanzania. EIA consists of project registration in NEMC, screening exercise, scope report preparation (including ToR development) and Environmental Impact Statement (EIS).

EIS report includes identifying expected impact, analysing alternative options, proposing mitigation actions, and developing management plans in consideration of environmental, social, cultural, economic, and legal considerations.

Applicants should submit the EIA certificate (issued by the Minister) to the authorities in Tanzania in order to receive their project-related certificate.

Projects subject to EIA are divided into three categories depending on their impact on the environment as follows.

Table 10. Project categories based on EIA/supervision regulations

Type A	Projects that can significantly affect the environment and require in-depth research for determining size, scope, and importance and identifying proper mitigation measures.
	Transport and infrastructure a. Construction and/or extension of main roads b. Construction and/or extension of airports, runways, and attached facilities c. Construction and/or extension of existing railway lines d. Construction and/or extension of ports Construction and civil engineering a. Industrial and housing complexes b. Coast development
Type B1	Mid-to-high level impact for classification into type A or B2
	Transport and infrastructure a. Reconstruction of main roads, airports, airstrips, and attached facilities b. Piers, docks, and fishing sites c. Construction of inland container depots and freight facilities Construction and civil engineering a. Major city projects (multi-storey buildings, auto-terminals, markets. etc.) b. Construction of housing/commercial facilities, hospitals, religious facilities equipped with chapels, and community centers c. Schools, clinics, and health centers (schools having a dormitory accommodating 360 persons or more)
Type B2	Small-scale projects not requiring environmental impact assessment 'Screening' and 'scope' are not designated, evaluating 'overview' and issuing an environmental impact assessment certificate.
	Construction and civil engineering Schools, clinics, and health centers: a. Pharmacies and health centers b. All school projects (l < 360 persons)

2. EDCF Safeguard Policy

EDCF Safeguard Policy (2020) aims to identify, avoid, and minimise the negative impact of EDCF projects on the environment and community residents and thereby to contribute to sustainable development. EDCF Safeguard Policy should apply to all of EDCF's programmes, classifying risk levels from the phase of F/S, preparing necessary reports, and checking the period for preparing ESIA reports, as well as budget, appropriate TOR, and scoping, in advance.

EDCF Safeguard Policy divides proposed projects into four categories in accordance with type, location, sensitivity, size, potential impact, and the degree/characteristics of risks.

Table 11. Environmental risk classification criteria (EDCF's guidelines for feasibility studies)

Level	Groups
Category A (High Risk)	Projects whose environmental risks are serious and that can affect extensive areas. ESIA is required.
Category B+ (Substantial Risk)	Projects whose risks are less serious than those of category A but whose environmental and social impact is deemed to be significant. ESIA is required.
Category B (Moderate Risk)	Projects whose environmental risks are less serious than those of categories A and B+ and whose impact is limited to project sites, ensuring easy mitigation and restoration. IESE is required.
Category C (Low Risk)	Projects whose environmental risks are extremely insignificant or almost zero. ESIA and IESE are not required.

3. Project site survey

The project site, an idle land as big as about 100,000m^2, is located in Ihumwa near Dodoma, the capital of Tanzania and is 3.5km away from the Ihumwa camp where SGRs will be newly constructed. The site mostly consists of flatland, where there are traces of dry streams. Around the site are no facilities causing noise and pollution. The 10m road in the north of the site acts as the main access way while in the west thereof is a residential district whose construction is under way. The Ministry of Land and Infrastructure of Tanzania owns the site, of which ownership transfer to TRC is under way.

Figure 18. Panoramic view of the target site (Northern SGR→target site)

Figure 19. Status of the target site

3.1 Analysis of the subsequent effects of the project

At present, the project site owned by TRC has never been developed or used. The project is not expected to cause non-voluntary resettlement and deforestation, having no effects on locals.

Table 12. Subsequent effects of the project

Subsequent effects	Scale
Non-voluntary resettlement	N/A
Impact on natives and other vulnerable social classes	N/A
Underground water abstraction	Not checked
Land reclamation, development, and readjustment	N/A
Deforestation	N/A

3.2 Matters relating to the environmental and social impact of the target site

Taking into account the locations and status of the target site, it is not likely to have significant effects on the environment and society.

Table 13. Socio-environmental impact of the target site

Classification	Status of the site	Remarks
Environmental context	Virgin or tropical forest	N/A
	Wetlands/coast, native land, or shelter protected or designated by the government	N/A
	Ecological habitat (coral reef, mangrove habitat, wetlands, etc.)	N/A
	Habitat for rare species protected by local laws or international agreements	N/A
	Areas that are highly likely to be affected by soil erosion	N/A
	Areas clearly affected by desertification	N/A
	Areas including national parks protected by national laws	N/A
Social context	Valuable areas in archaeological, historic, and cultural contexts	N/A
	Living spaces for minorities, natives, and nomads maintaining traditional lifestyles	N/A
	Other socially valuable areas	N/A

3.3 Considerations in socio-environmental impact

Table 14. Considerations in socio-environmental impact

Projects	Remarks
1. Does the project affect ecologically sensitive areas?	N/A
2. Are there any aesthetically valuable buildings near the site?	N/A
3. Is the project carried out in culturally and historically significant regions?	N/A
4. Does the project include or transform valuable areas requiring ecological considerations?	N/A
5. Does the project require the massive use of water, energy and other resources at the phases of construction and operation?	N/A
6. Does the infrastructure for the project (water / waste water capacity and transportation infrastructure) exceed the existing scope of infrastructure?	Need to be checked
7. Does the project generate a quantity of waste, especially dangerous or toxic materials?	N/A
8. Does the project cause air pollution, generating a quantity of waste water?	N/A
9. Does the project negatively affect river areas?	N/A
10. Is the project site located in areas that may significantly affect surface and underground water in quantity and quality?	Need to be checked
11. Does the project require a variety of convenient facilities at the phases of construction and operation?	N/A
12. Does the project require the massive use of chemicals including fertilisers and pesticides?	N/A
13. Does the project require the introduction of exotic species?	N/A
14. Does the project cause the massive inflow and outflow of population, as well as related economic activities?	N/A
15. Is it possible for the project to generate vectors?	N/A
16. Is the project site located in a densely populated area? Does it generate air pollution, noise, vibration, and offensive odors?	N/A
17. Considering the characteristics of the site, does the project cause serious soil erosion or pollution at the phase of operation?	N/A

4. Preliminary review of socio-environmental impact levels

4.1 EIA

According to a related agency in Tanzania, this project belongs to 'Type B1' (item C in construction and civil engineering: school having a dormitory accommodating 360 or more persons). It was originally deemed to belong to 'Type B2' (school having a dormitory accommodating up to 310 persons: 300 students + 10 faculty members) but according to the agency's reply, the standard in the number of persons (360) means not the capacity of a dormitory but the total number of users. As a result, when applying for environmental impact assessment, a scope designation report, as well as ToR, should be submitted. The final judgment is made after the project brief is submitted and checked.

Table 15. Criteria for type B1 based on EIA/supervision regulations

Type B1 Projects	Mid-to-high level impact for classification into type A or B2
	Transport and infrastructure a. Reconstruction of main roads, airports, airstrips, and attached facilities b. Piers, docks, and fishing sites c. Construction of inland container depots and freight facilities Construction and civil engineering a. Major city projects (multi-storey buildings, auto-terminals, markets. etc.) b. Construction of housing/commercial facilities, hospitals, religious facilities equipped with chapels, and community centers c. Schools, clinics, and health centers (schools having a dormitory accommodating 360 persons or more)

4.2 EDCF Safeguard Policy

According to EDCF Safeguard Policy, this project is expected to be classified as cateogory B as its potential adverse environmental and social impacts are less adverse than those of category B+ projects. These impacts are site-specific, and in most cases mitigation measures can be designed more readily than for category B+ projects.

* Environmental and social category, based on the review of relevant documents (such as Screening Form), will be finalized upon approval of the EDCF project.

Table 16. Feasibility study guidelines: category B

Category B (Moderate Risk)	Projects whose environmental risks are less serious than those of categories A and B+ and whose impact is limited to project sites, ensuring easy mitigation and restoration. IESE is required.

4.3 Compliance with Environmental Safeguard Policies

The railway training center is required to conduct an Environmental Impact Assessment (EIA) in accordance with EDCF Safeguard Policies and Tanzanian legislation, necessitating the preparation of documentation that fulfills NEMC's regulatory requirements

4.4 Environmental impact assessment agencies and procedures in Tanzania

Table 17. process in Tanzania

Apply for environmental impact assessment	Manager: NEMC Method: online application (https://eia.nemc.or.tz/) Document: scope designation report, commission (TShs 200,000) Categories A and B1: the scope designation report and ToR should be submitted.
↓	
Review NEMC's report	After reviewing within 14 days, decisions are delivered to the proposer or developer.
↓	
Professionals conduct EIA after the approval of NEMC	Conducted by a professional or company officially certified and registered in Tanzania pursuant to environmental (environmental experts) regulations (amended in 2005 and 2021). In case a foreign firm implements the process, it should collaborate with a local professional or company.
↓	
Submit the environmental impact assessment report	Visit the site together with NEMC employees, the developer, and the proposer, after submitting the environmental impact assessment report. The developer should pay travel costs when visiting the site.
↓	
NEMC organises Technical Advisory Committee (TAC) and reviews documents	NEMC employees, the developer, consultants, and other stakeholders attend the TAC meeting.
↓	

Issue the certificate after the approval of the Minister	Decisions are made within 30 days after NEMC's recommendation is received. The environmental impact assessment certificate is issued after the approval of the Minister.