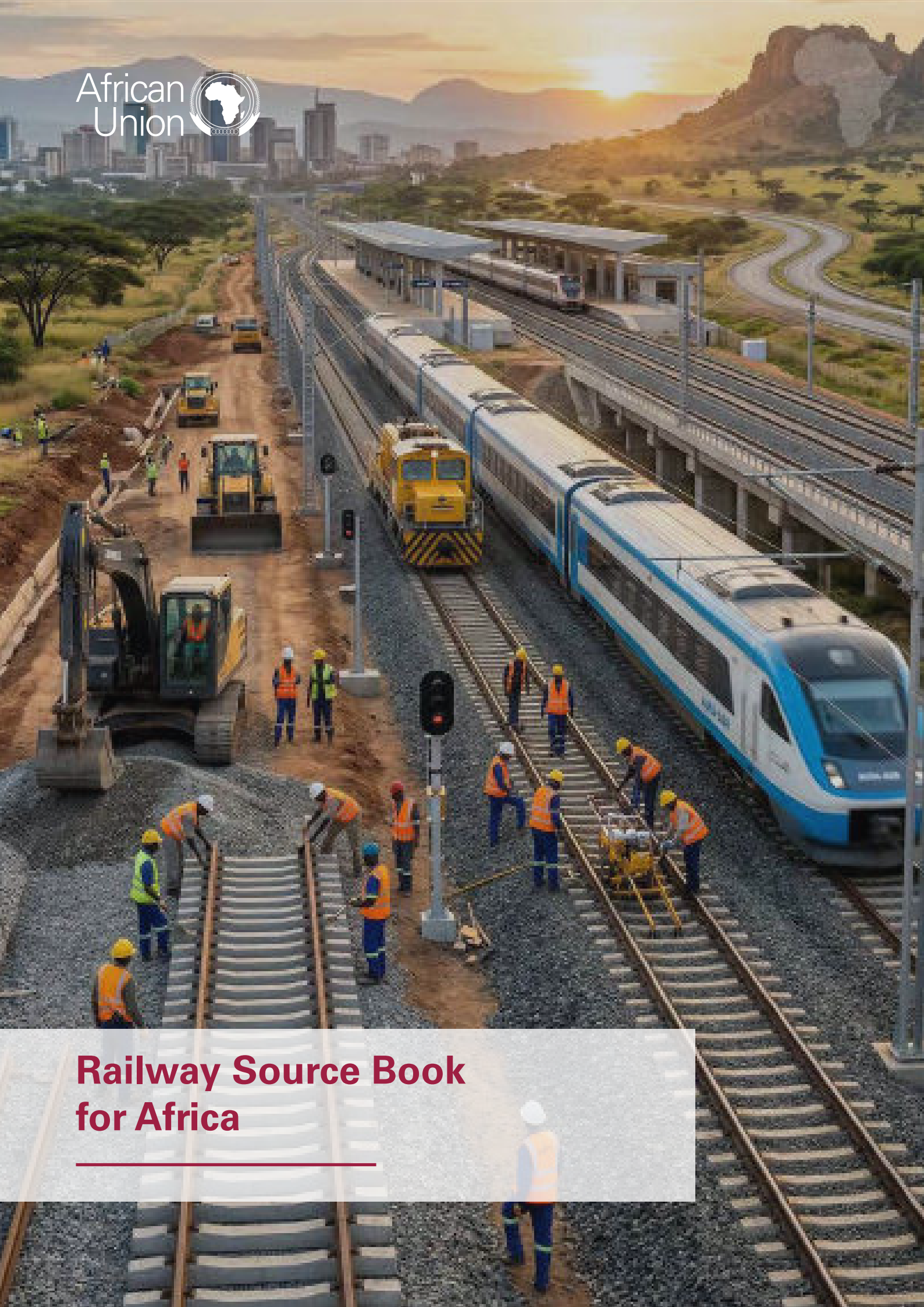
African Union



Railway Source Book for Africa

African Union

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Foreword

It is my honour to present the Railway Source Book for Africa, a practical continental reference developed to support the planning, financing, development, modernisation and sustainable management of railway systems across our continent.

Africa's railway agenda is being shaped by a practical continental reality. The continent must move larger volumes of freight and passengers over longer distances, connect landlocked countries to seaports, support fast-growing cities, serve mining and industrial value chains, and reduce pressure on road networks. Railways are therefore not only a transport mode; they are a backbone for competitive logistics, regional value chains, safer mobility and lower- carbon growth.

Across the continent, governments and partners are investing in the rehabilitation of existing railway networks, the development of new corridors, urban and suburban rail systems, mineral and industrial lines, and multimodal logistics platforms. Under Agenda 2063, the African Integrated High-Speed Railway Network (AIRN) remains a flagship ambition to connect Africa's political and economic centres. This momentum must be supported by strong governance, harmonised standards, reliable financing, modern operations, safety systems, climate resilience and institutional capacity.

The Railway Source Book for Africa responds to this need. It brings together African experience, international best practices and practical guidance for railway stakeholders. It covers the key dimensions of railway development, including governance and regulation, interoperability, spatial planning, sustainable development, infrastructure design, construction, maintenance and operations, financing, intermodality, and capacity development.

Recognising the diversity of African railway systems, including narrow-gauge, metre-gauge, Cape-gauge and standard-gauge networks, as well as passenger, freight and mixed-use systems, the Source Book does not propose a one-size-fits-all model. It offers a flexible framework to help AU Member States, Regional Economic Communities, railway administrations, regulators, infrastructure managers, operators, corridor organisations, investors and development partners adapt solutions to their respective national and regional contexts while advancing shared continental objectives.

I firmly believe that the revitalisation and expansion of Africa's railways represent one of the most effective pathways towards achieving the aspirations of Agenda 2063. Modern railways can reduce logistics costs, improve access to markets, connect landlocked countries to ports, support mineral value addition and industrial corridors, improve urban mobility, reduce greenhouse-gas emissions and strengthen Africa's participation in regional and global value chains.

I welcome the validation of this publication by policy and technical experts from AU Member States, Regional Economic Communities, transport and economic corridor organisations, railway institutions, development partners and sector stakeholders. Their contributions have helped ensure that the Source Book reflects African priorities, practical realities and implementation needs. I wish to also acknowledge the valuable support of GIZ through the Green Corridors for Intra-African Trade (PIDA) support to the African Union, as well as the technical contribution of ALG Global Infrastructure Advisors in the preparation of this Source Book.

I am confident that the Railway Source Book for Africa will serve as a valuable resource for policymakers, regulators, infrastructure managers, operators, investors and practitioners across the continent. Together, we can build a new generation of African railways that connect our people, drive economic growth, support sustainable development and advance the vision of an integrated, prosperous and peaceful Africa.

H.E. Ms. Lerato D. Mataboge
Commissioner for Infrastructure and Energy
African Union Commission

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Acronyms and abbreviations

General terms

AfCFTA	African Continental Free Trade Area
AIHSRN	African Integrated High-Speed Railway Network
AIRN	African Integrated Railway Network
BOT	Build-Operate-Transfer (PPP contract)
BRT	Bus Rapid Transit
CapEx	Capital expenditure
CBA	Cost-Benefit Analysis
COTIF	Convention concerning International Carriage by Rail
EAC	Export Credit Agencies
EIRR	Economic internal return rate
ENPV	Economic net present value
EPC	Engineering, Procurement and Construction
GCU	General Contract for Use of Wagons
GDP	Gross domestic product
GHG	Green-house gas
HIC	High-income countries
HSR	High-speed railway
ICT	Information & Communications Technology
IFI	International financial institution
ILU	Intermodal loading unit
KPI	Key Performance Indicator
LIC	Low-income countries
LMIC	Low-medium-income countries
LVC	Land-Value Capture
MoF	Ministry of Finance
MoT	Ministry of Transport
NDC	Nationally Determined Contribution
NGR	Narrow-gauge railway
O&M	Operations and maintenance
OpEx	Operational expenditure
OSBP	One-stop border post
PCG	Partial Credit Guarantees
PIDA	Programme for Infrastructure Development in Africa
PPF	Project Prioritization Framework
PPP	Public-Private Partnership
PSO	Public service obligation

Railway stakeholders and international organizations

R&D	Research and development
REC	Regional Economic Community
SGR	Standard-gauge railway
SPV	Special Purpose Vehicle
TOD	Transit-oriented development
TSIs	Technical Specifications for Interoperability
VCM	Voluntary Carbon Market
DRC	Democratic Republic of the Congo
RSA	Republic of South Africa
ENR	Egyptian National Railways
ONCF	Office Nationale des Chemins de Fer
PRASA	Passenger Rail Agency of South Africa
RVR	Rift Valley Railways
SETRAG	Societé d'Exploitation du Transgabonais
SNCF	Societé Nationale des Chemins de Fer
TAZARA	Tanzania-Zambia Railway
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West-African States
SADC	Southern African Development Community
UMA	Union du Maghreb Arabe
SSA	Sub-Saharan Africa
AU	African Union
AUC	African Union Commission
CCTTFA	Central Corridor Trade and Transport Facilitation Agreement
CTFM	Comité des Transports Ferroviaires Megrébin
ERA	European Union Railway Agency
EU	European Union
FES	Friedrich-Ebert-Stiftung
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbei
OECD	Organisation for Economic Co-operation and Development
RSR	Rail Safety Regulator
SARA	Southern African Railways Association
UAR	Union of African Railways
UIC	International Union of Railways
UN	United Nations
WBG	World Bank Group
WCO	World Customs Organization
WTO	World Trade Organization

1. Introduction to the Assignment

1.1 Project context and motivation

The African Union (AU) is coordinating the political steering of the Programme for Infrastructure Development in Africa (PIDA), which is a continental strategic framework to address infrastructure impediments through cross-border infrastructure development in the areas of Transport, Energy, Information & Communications Technology (ICT) and Trans-boundary Water Management (TWM).

The GIZ project "Green Corridors for Intra-African Trade (PIDA)" supports The African Union in the development of a Continental Policy on Green Smart Infrastructure as well as the implementation of activities within the framework of the Just Transition Concept.

In order to meet its objective of developing a Continental Policy on Green Infrastructure and implementing the agreed railways-related activities of the Just Transition Concept, GIZ, within the framework of its ongoing "Support to PIDA Programme", engaged ALG to prepare a "Railway Source Book for Africa" (referred to as the "Source Book"), as well as "Policy Recommendations for Green Railways in Africa" that will be part of the Continental Infrastructure Policy.

Furthermore, this document is anchored within the context of the Continental Agenda 2063 (AU Agenda 2063) and the UN Sustainable Goals. The AU Agenda 2063 is a strategic framework for the socio-economic transformation of the continent over the next decades. It builds on past and present continental initiatives for growth and sustainable development and aims to accelerate their implementation. Within the Agenda 2063, railways are a protagonist sector as one of the key enablers of this Agenda, with the African Integrated High-Speed Railway Network as the main programme for their development.

1.2 Objectives and scope of this document

In this context, the main goal of this document is to provide essential railway sector knowledge to empower policymakers and stakeholders at all project stages for its progress, including:

- Provide in-depth insights regarding the African railway sector, with a focus on sustainability
- Identify key critical aspects to be considered during railway development
- Show lessons learned and global best practices (Africa and worldwide) railway associations, corridor authorities, etc.), as Recommend guidelines and policies for railway development in Africa

- Serve as a starting point for capacity building programs and policy discussions to enhance the African railway sector

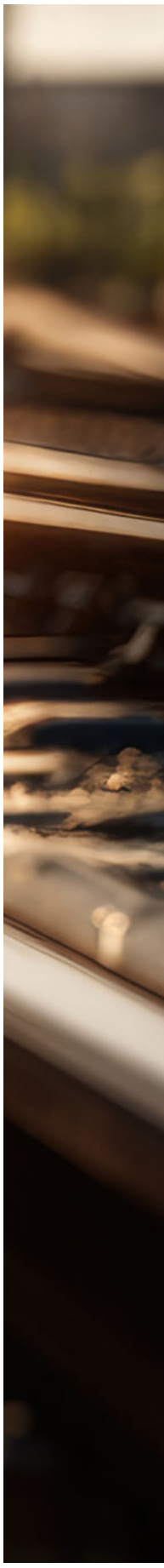
As a result, this Source Book aims to provide essential knowledge across all levels for an effective planning, financing, structuring and economic appraisal of railway infrastructure in Africa.

This Source Book and the derived Policy Recommendations are therefore the result of an extensive literature review, continental-wide technical consultations with the main stakeholders of the sector in Africa (regional institutions, public railway companies, Transport Ministries, private operators, railway associations, corridor authorities, etc.), as well as an exhaustive review of international and regional best-practices for railroad development and operation.

The remainder of this document is structured is as follows:

- **Chapter 2: Rationale and need for rail transport in Africa**, which provides a brief contextualization of railways in Africa, identifying the need and opportunities for future development of the sector
- **Chapter 3: Sector Diagnosis,** which provides an overview of the rail sector in Africa, including its historical evolution and current situation in terms of: existing infrastructure, institutional and regulatory framework, financing, operating models and safety. The chapter concludes by summarizing the key lessons learnt from the sector in recent years, which should be considered in future developments
- **Chapter 4: Pillars for railway development in Africa,** which details, based on the findings of the sector diagnosis, the main considerations for sustainable rail development, structured in eight pillars:
  - Governance and regulations
  - Harmonization of the sector for network interoperability
  - Integration of railway infrastructure into the broader spatial planning framework
  - Integration of sustainable development principles
  - Construction, maintenance, and operation of modern and efficient railway infrastructure
  - Financing challenges
  - Intermodality
  - Limited railway expertise and technical capabilities
- **Chapter 5: Way forward,** which lists and summarizes the main conclusions of the study as well as the key recommendations for the African railway sector going forward

The Source Book has been constructed to ground the sector's sustainable growth. While this document provides preliminary findings and recommendations, these should only serve as the groundwork for further research and development. The pillars on which the Source Book has been built represent the fundamental elements from which more detailed investigations must stem to advance in the development of Africa's railway infrastructure. Further exploration and development within these areas are essential to effectively propel progress and address the diverse complexities of implementing a robust railway network across the continent.



2. Rationale and need for rail transport in Africa





2.1 Background

In the early 20th century, European colonial powers built Africa's first railways for military and commercial purposes. Post-independence, African nations adopted public railway models influenced by their former colonizers, leading to inefficiencies and a generalized decline due to neglect and competition from road transport. Exceptions include South Africa and some Northern African countries, where railway continued to be relevant in both freight and passenger transport.

After many years of deterioration, in the 1990s, many African nations introduced concessions and PPP models with multilateral support. Looking to revitalize the rail transport industry, the entry of private entities into the sector obtained varied outcomes, with many PPPs not living up to their expectations.

Nevertheless, the African continent is now experiencing notable economic, social and institutional developments, which are creating a framework in which railways will play an important role within the continent's transport ecosystem and foster further development.

2.2 Drivers and opportunities for Africa's railway potential

2.2.1 Drivers of railway potential

Despite the many challenges encountered to date and the general state of decay of rail in most regions since the colonial era, railways in Africa retain significant potential to support the economic and social growth of the continent. Africa, with its economic emergence and within its geographic diversity, presents many favorable conditions for the expansion and enhancement of railway networks, offering a promising avenue for sustainable growth and connectivity.

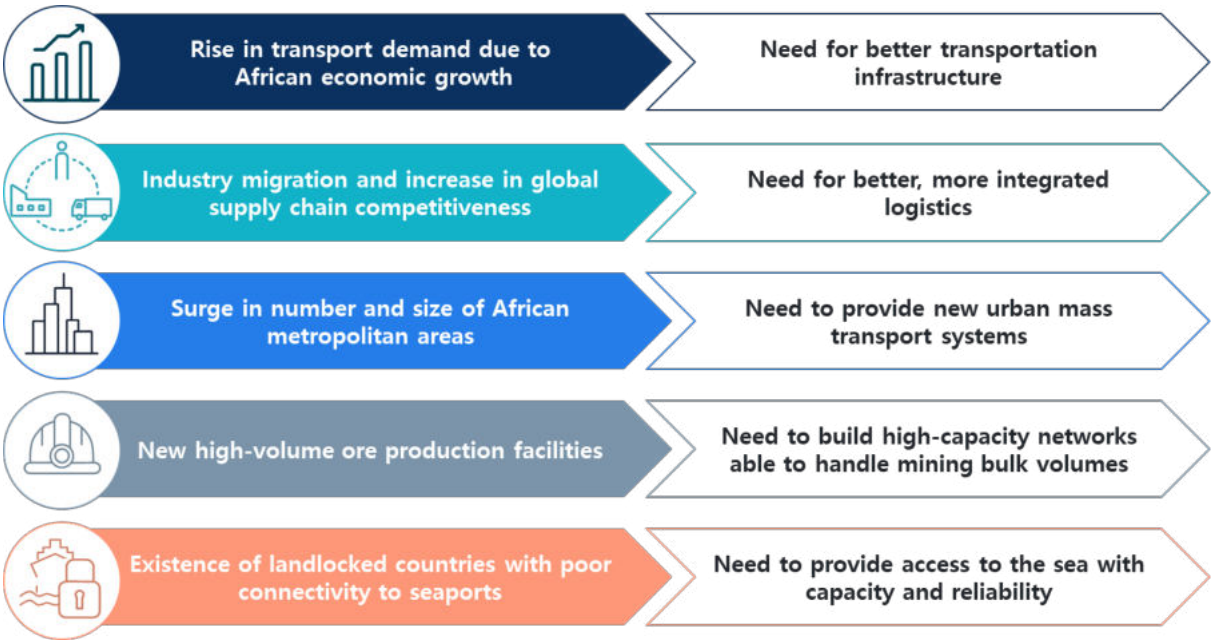


Figure 1: Main drivers of railway potential in Africa



– **Rise in transport demand due to African economic growth**

  The correlation between economic development and the increased movement of goods and people is widely recognized. This relationship results in an escalated need for the development of new transportation infrastructure. As a nation experiences economic growth, there is a simultaneous rise in market activity, encompassing both increased private consumption (demand) and the production of goods (supply). Consequently, this dynamic leads to a surge in the exchange of goods and the mobility of people, thereby driving up the demand for transportation services.

  During the last decade, and despite the financial global crisis in 2008 and the impact of the Covid pandemic, Africa has experienced sustained economic growth well above the world's average; with this trend expected to continue in the coming years. In this context, one can expect the railway sector to take on new dimensions, as in other regions where the railway currently plays a much greater role where there are large distances of travel (freight) and high concentrations of population (passenger).

– **New economic hubs, industry migration and increment in global supply chain competitiveness**

  In the past, the reduction in transport costs and optimization of logistics chains has enabled the relocation of industrial production from the major consuming countries to other regions of the world with lower labor costs. This change has mainly involved movement from Western countries to Southeast Asia, Eastern Europe, Latin America and certain parts of Africa, especially North Africa and RSA. In order to attract and maintain such new industrial developments, these regions have had to develop new infrastructure to remain competitive against other parts of the world. Transport infrastructure is a key component and, in many of these countries, the improvement of connections via rail has been decisive in connecting ports to large industrial areas or purpose-built logistics areas.

Currently, the steady increment of labor costs in the areas currently hosting industrial production makes it reasonable to believe that industry relocations to areas within Africa could accentuate. Thus, one can expect that areas with high potential to host new industries should develop rail freight networks and logistics centers such as dry ports, as it has already happened with seaports in the industrialized areas of South Africa and the Maghreb.

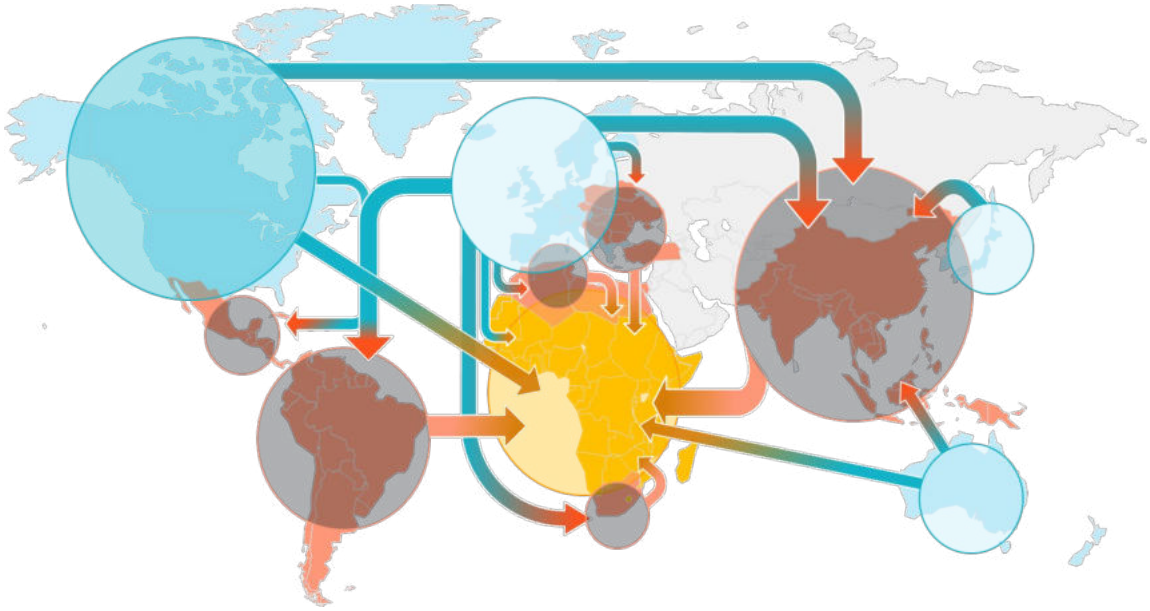
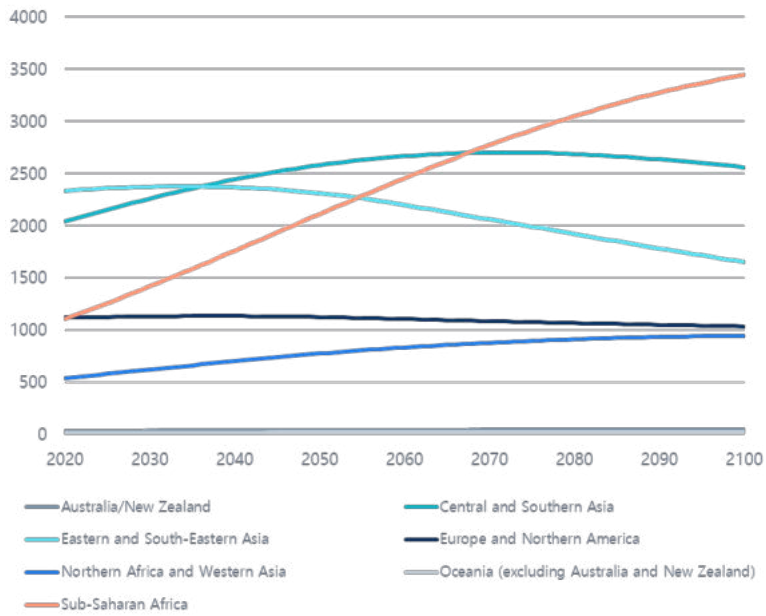


Figure 2: Industry relocation flows between economic powers, developing countries and Africa

- **Surge in the number and size of African metropolitan areas**

  Demographic forecasts for the African continent suggest that the population will increase 70% by 2050, spearheaded by the development of Sub-Saharan Africa. There will be a significant reduction in child mortality and a significant increase in life expectancy. A process of migration will accompany this growth from rural to urban areas that will result in an increase in urban population from 550 million to 1.5 billion by 2050. As a result, it is expected that African cities will experience major growth in both population and size.



#	City	Pop. 2022	Pop. 2050	CAGR '24-'50
1	**Dar es Salaam**, Tanzania	7.5	16.4	**2.8%**
2	**Nairobi**, Kenya	5.2	10.4	**2.5%**
3	**Kinshasa**, DRC	15.8	29.0	**2.2%**
4	**Lagos**, Nigeria	15.5	28.2	**2.2%**
5	**Karthoum**, Sudan	6.2	11.2	**2.1%**
6	**Baghdad**, Iraq	7.6	13.0	**1.9%**
7	**Luanda**, Angola	9.0	14.6	**1.7%**
8	**Karachi**, Pakistan	16.9	26.6	**1.6%**
9	**Lahore**, Pakistan	13.6	21.4	**1.6%**
10	**Surat**, India	7.9	12.0	**1.5%**
21	**Cairo**, Egypt	21.8	32.6	**1.4%**

Figure 3: Population projections for UN SDG regions (M inhabitants, 2020-2100) **and fastest growing cities in the world** (M inhabitants, 2022-2050)

Source: United Nations Data Portal, Institute for Economics & Peace

However, Africa could grapple with most of the challenges of rapid urbanization, including infrastructural deficits, and housing challenges, amidst its exponential growth. In order to ensure that the expansion of these cities is viable and sustainable, new urban transport systems offering greater capacity must be implemented. If not, the growth in the use of the private car, as a preferred means of transport among urban dwellers will have major impacts in terms of traffic jams, congestion accidents, noise and pollution leading to a reduction in the quality of life and economic development, not only for the city but for the whole country. alternative due to its capacity to transport large volumes of passengers at high frequencies. If it is accompanied by a proper promotion policy, the railway could enable a decrease of the use of private vehicles in these cities, as can be observed in many large cities in emerging countries such as New Delhi, Bangkok, Buenos Aires or Sao Paulo.

- **New high-volume ore production facilities**

  Until recently, many mineral deposits in Africa remained untapped due to the high infrastructure costs required to access mining areas. However, with the recent surge in commodity prices, particularly for iron ore, coal, and copper, numerous mining projects have become more financially viable, attracting increased interest from international investors. Additionally, Africa is rich in other minerals such as cobalt, manganese and platinum, crucial for technological advancements like EV batteries. Particularly, Africa holds nearly 50% of global cobalt reserves and currently produces around 74% of global production, mainly driven by DRC. Recent major developments in Africa include the Tendao gold Project in DRC, the Gakara mine in Burundi, the South East Ore Body copper mine in Zambia, the Waterberg Platinum Mine in South Africa and the RHA Tungsten project in Zimbabwe.

  Historically, mining railway projects have involved the establishment of new private rail lines but they have also been some of the main factors for project viability in public and concessioned railways. Rail transport offers a significant cost advantage over road transport when it comes to transporting mining products to ports or industrial areas, mainly attributed to better economies of scale. Consequently, railways are anticipated to play a crucial role in the development of mining areas, leading to a proliferation of rail lines across Africa.

- **Existence of landlocked countries with poor connectivity to seaports**

  Africa is the continent with the largest number of landlocked countries with 16 nations and, consequently, faces a unique challenge in international trade as this relies heavily on maritime transportation. The continent's main gateways to the global community are its ports, including significant ones like Durban, Tangier, Lagos, Suez, or Mombasa. Hence, landlocked countries and interior capitals require specific connections to coastal areas to allow them to trade with the international community.

  Without the existence of such links, the economic potential of these countries is significantly limited due to the loss of competitiveness, for which the creation of freight corridors between such nations and the coast should be a priority for all stakeholders. Additionally, given that the distances involved often exceed 500 kilometers, railway transport emerges as a more competitive option compared to road transport.

  Some countries such as Burkina Faso, Mali, Ethiopia, or those in Southern Africa serve as examples of railway infrastructure as key developments to foster trade through connections to major ports.

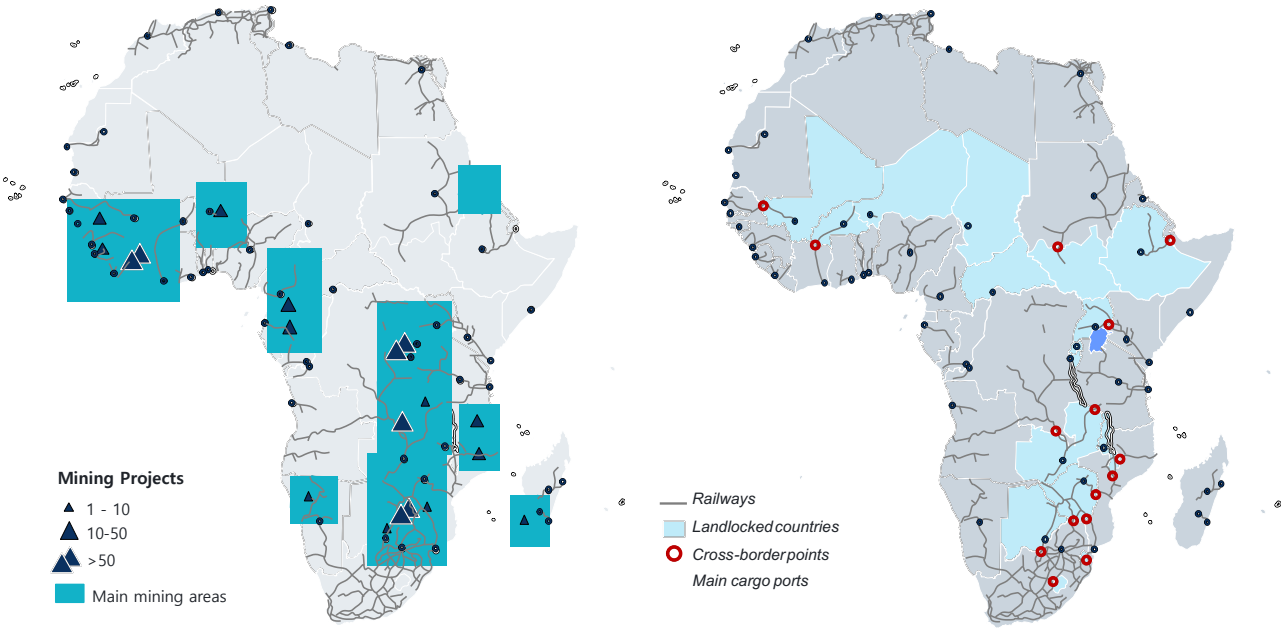


Figure 4: Mining developments and landlocked countries in Africa

2.2.2 Opportunities for the development of railways

Additionally, some of the social, political and development trends in Africa bring associated interesting opportunities for the expansion of railways.

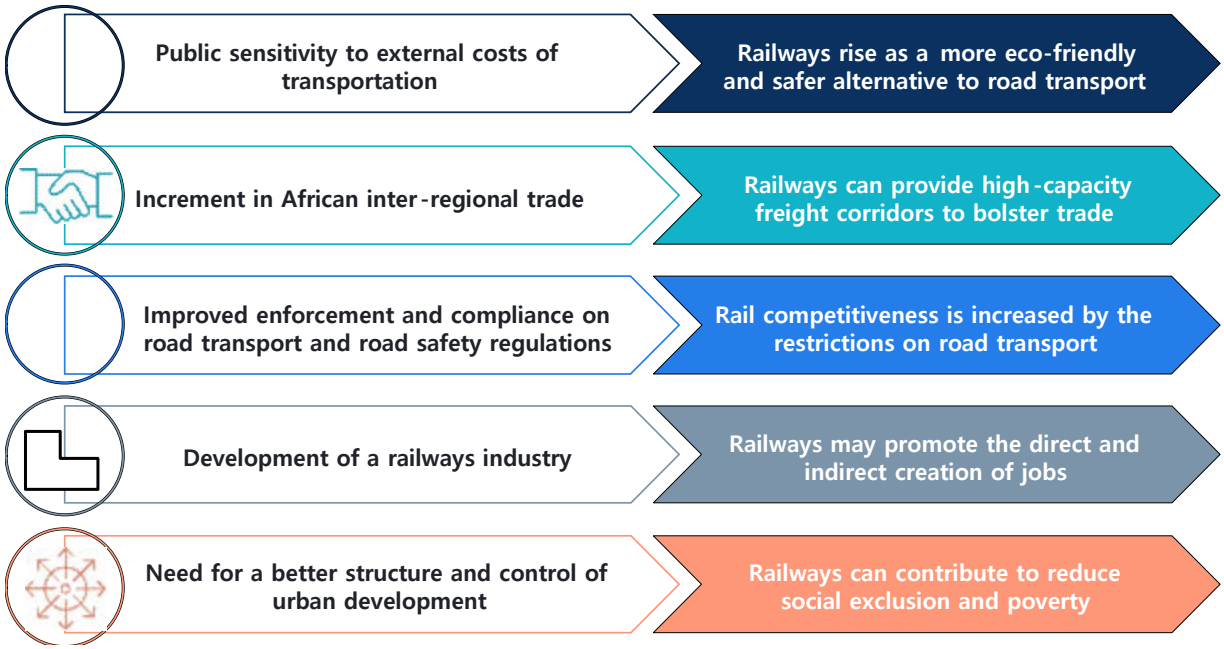


Figure 5: Main opportunities for railway development in Africa Reduction of external transport costs

- **Railways as a greener and safer alternative to road transport**

  Compared to most regions worldwide, the African road network is generally in poor condition and carries large volumes of heavy trucks, resulting in significantly high maintenance costs. These conditions, together with a lack of regulation enforcement, have led to an extremely high level of accidents and environmental impacts (noise, air pollution, climate change).

  Given the urgency of addressing climate change, an increased public sensitivity for safety and environmental concerns, and with African Governments placing more emphasis on reducing the external costs of transportation, railways rise as the better alternative to reduce such costs. Additionally, a greater use of railways would transfer goods from trucks and passengers from cars thus decreasing road damage and the associated maintenance costs.

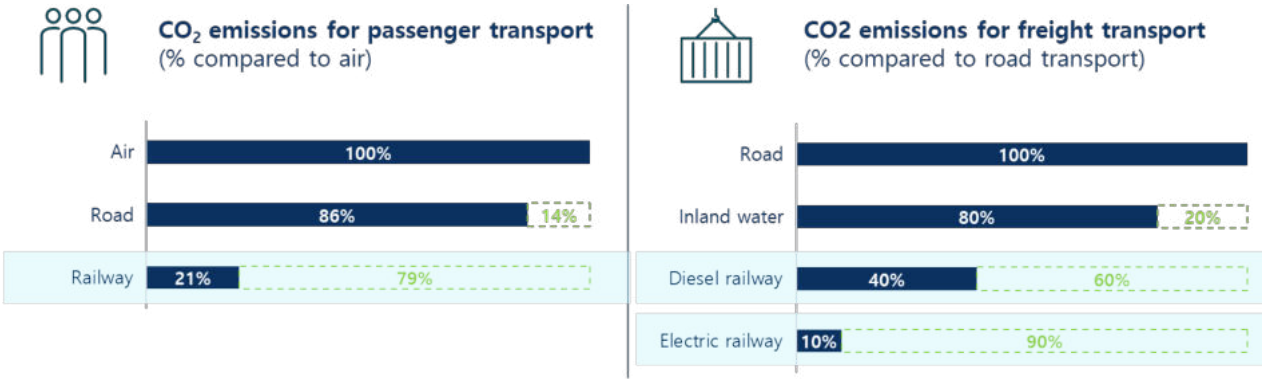


Figure 6: CO2 emissions for passenger and freight transport *Source: European Commission*

In 2016, external costs (excluding congestion) amounted to €716bn in Europe, i.e. 4.8% of the total GDP of the region, and congestion costs were estimated to be about an additional € 270bn. Of these total costs, rail only accounts for about 2% when road transport's share is 83%. When considering congestion, railways present an even bigger opportunity. The growth of urban agglomerations in Africa without effective mass transit systems, including railways, could further increase congestion costs. In Cairo, congestion costs are responsible for 4 to 5% of GDP, while efficient public transportation systems such as in Barcelona reduce this to between 0.3 and 0.6% of GDP.

- **High-capacity corridors for Africa's increasing inter-regional trade**

  Although African interregional transport is not significant at present, it is expected that economic progress will cause trade among African countries to grow exponentially. However, the growth potential for these flows is currently significantly restricted by the limitations of freight corridors between African countries, which are frequently deficient or non-existent. While road transport generally offers more flexibility than rail, certain African corridors are conducive to efficient freight transport, particularly for bulk goods such as hydrocarbons, mining products, or agricultural produce.

  The disparities in rail infrastructure among countries may pose an additional challenge to the development of these rail corridors, similar to occurrences in other parts of the world or within the African continent itself. Consequently, countries that share gauge compatibility or have bilateral agreements to facilitate border crossing, as observed in some corridors like Senegal-Mali, are more likely to succeed in the development of inter-African rail corridors.

- **Increased rail competitiveness due to rising restrictions on road transport**

  One of the largest historic challenges that the African transport sector faces is to regulate toad transport, which as seen previously, have large impacts on society, infrastructure costs and the environment. Too often, road transport has thrived in an environment with virtually no rules, being able to operate with much lower unitary costs. Factors that contribute to road transport's high competitiveness include the ability to have excessive axle loads, few speed controls, inadequate vehicle technical inspections and unclear procedures to obtain transport licenses.

  However, recent developments have seen many African countries (For instance, Tanzania, Kenya and Cameroon) start to introduce regulation measures to address such problems. These initiatives, supported by an efficient control system, can be very beneficial for African railways because they may imply a reduction in road transport margins, leading to the transfer of heavier goods to rail. For instance, thanks to the implementation of axle load control, the transport of goods such as bulk mineral ores or heavy machinery - which in many cases are being transported by truck – will most likely perform a modal change from road to rail.

- **Creation of direct and indirect jobs derived from the railway and associated industries**

  The advancement of railways is associated with a diverse array of supplies and services that possess significant added value. Specifically, ensuring the reliable service of tracks and rolling stock through essential maintenance relies on a high-performing industry led by skilled workers, which at the moment are mostly outsourced to international stakeholders given the lack of in-house skill and industry. The incorporation of these skills and the growth of the industry represent not only crucial elements for the successful development of railways in Africa but also an opportunity to cultivate an industry capable of yielding substantial economic and social benefits.

  Additionally, the railway industry relies on other core industries, such as steel, energy and ITC. The development of railways can therefore have effects in other sectors, contributing to the overall growth of industry. Railways should therefore be seen as part of wider industrial development plans.



- **Railroads as a direct contributor to the reduction of social exclusion and poverty**

  The rapid process of urbanization has resulted in most cases in the proliferation of slums, increasing urban poverty and generally poor living conditions. The situation has been exacerbated by inadequate urban development strategies. There is a pressing need for a more active role from the Government in urban expansion, coupled with the implementation of mass-transport schemes. It is crucial to highlight that underground trains (metro), light rail (above ground), and BRT (Bus Rapid Transit) typically exhibit significantly higher throughput capacity than other alternative modes, such as conventional buses.

  The development of mass transit systems in urban areas presents an opportunity to exercise better control over development. Given the scale of investment and construction work involved, careful planning is essential to seamlessly integrate these systems into the urban environment. Railway transport, by reducing travel times and enhancing land values, can be perceived as a means to economically, sustainably, and socially structure urban space.

2.3 Summary of the key benefits of railways in Africa's context

Railway development in Africa holds significant opportunities due to various factors:

- The continent's growing urbanization and industrialization are expected to present significant transportation challenges that railways are well-positioned to address

- Additionally, as Africa becomes a major exporter of bulk minerals and commodities (due to new mineral deposits and growing export and industrial capacity), railways emerge as natural markets for efficiently transporting these products

- The vast continental mass of Africa, coupled with numerous landlocked countries, necessitates the development of high-capacity and efficient transport corridors

- The increasing awareness of environmental and safety issues further contributes to the favorable context for railways, gaining public attention and social support

- Moreover, railways can play a crucial role in reducing external costs associated with private vehicle use and truck transport, especially amid rising motorization in Africa. This, in turn, can benefit both the structuration of urban development and the rail industry

Despite the promising prospects for railway development in general, strategic focus should be placed on segments where railways offer higher efficiency and lower costs compared to alternative modes of transportation. Specifically, major African metropolises can benefit from urban and suburban passenger railways, while densely populated areas and corridors provide opportunities for high-volume passenger or freight transportation, respectively. Corridors connecting ports to inland markets are ideal for freight trains moving containerized or bulk materials over long distances. Lastly, major mining basins offer potential for freight trains transporting minerals and raw materials to export ports. By concentrating railway projects in these identified areas, Africa can harness the full potential of railways for efficient and effective transportation solutions.



3 Sector Diagnosis. Short overview of African railways





3.1 Snapshot of the evolution of the African Railway Network

In the early 20th century, first railways were built in Africa by European colonial powers to facilitate military movements and commercial operations within the mining and agriculture sector. After gaining independence, many African nations assumed control of their railway networks and embraced public railway models inspired by their respective European colonizers' practices. Such public bodies soon became inefficient and overstaffed. Since, African railways suffered a substantial decline due to inadequate maintenance of both infrastructure and rolling stock. Competition from a thriving road transportation sector also exacerbated African railway degradation. The Republic of South Africa and some countries in Northern Africa, where railways continued to play a relevant role in freight and passenger transportation, are the few exceptions to a generalized decayed railway sector.

In the 90s, the situation became unsustainable and, with the support of multilateral institutions, concessions and PPP models were introduced in many African countries (mainly Sub-Saharan Africa) as a possible solution to take on investments and were increasingly replacing State-owned railways through different schemes. While PPP arrangements prevented the dismantling of many rail lines, most of these initiatives either failed to perform as expected, and/or became very unstable. SETRAG in Gabon, Camrail in Cameroon and Sitarail in Burkina Faso and Ivory Coast present widely accepted examples of success stories of PPP concessions in Africa, while Kenya, Uganda and Tanzania Railway Corporations present valuable examples of the opposite (failure cases).

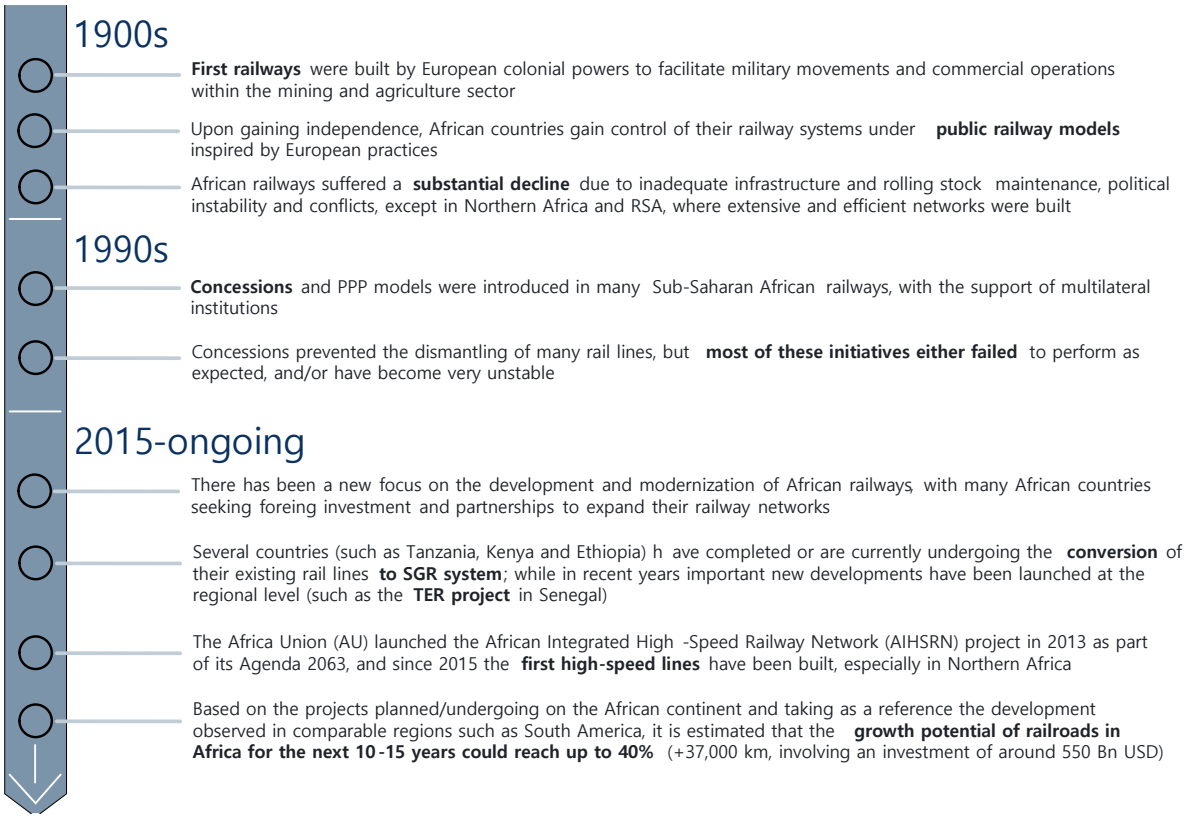


Figure 7: Snapshot of the evolution of African railway network

After years of underdevelopment, limited maintenance and declining quality, the African railway network is now experiencing notable improvements driven by economic, social, and institutional developments, together with increased foreign investment. During the last decade, several countries (such as Tanzania, Kenya, Uganda, Ethiopia, Cameroon, etc.) have completed or are currently carrying out renovation or development projects of new railway lines, mainly using standard gauge. At the same time, the Africa Union (AU) launched the African Integrated High-Speed Railway Network (AIHSRN) project in 2013 as part of its Agenda 2063, which encompasses an ambitious plan to link all the continent's political and economic capitals over the next 30 years.

3.2 Overview of the railway sector in Africa

3.2.1 Existing rail infrastructure landscape

The African railway network currently spans just over 85,000 line-km (although only 70% is fully operational), using multiple track and loading gauges, traction systems and other technical parameters (couplers, maximum permissible axle load, etc.).

Africa has the lowest railway network density in the world compared to its landmass and population. Despite covering 23% of the world's surface area and being home to approximately 18% of the global population, the continent accounts for only around 8% of the world's total railway length. This disparity highlights the need for concerted efforts to improve and expand Africa's railway infrastructure to support economic growth and connectivity.

Furthermore, infrastructure fragmentation is a significant issue across much of Africa's railway systems. Unlike Southern and North Africa, where extensive networks exist, many countries on the continent have disjointed railway lines. These lines were historically constructed by private or military entities to connect inland cities and production centers to seaports. As a result, there's a lack of connectivity between neighboring countries' railway systems, leading to inefficiencies and barriers to trade and development.



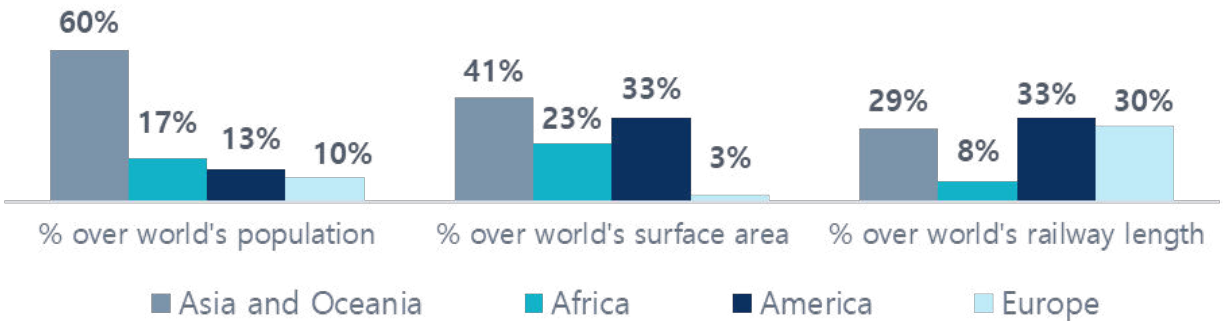


Figure 8: World distribution of railway (2020)

Source: African Union and ALG analysis

The norms and standards of construction and operation depended largely on the European country with influence in the area, as well as the source of funding, which resulted in a generalized lack of interoperability across the continent.

The vast majority of the network concentrates in southern Africa, presenting the densest network mainly with interconnected cape gauge tracks (1,067 mm) spanning multiple countries (South Africa, Namibia, Botswana, Zimbabwe…). Meter gauge tracks (1,000 mm) predominate in Eastern (Kenya, Tanzania and Uganda) and Western Africa (Ivory Coast, Burkina Faso, Togo, Benin…), while most of SGRs (1,435 mm) can be found in the northern countries of the continent (Morocco, Algeria, Tunisia and Egypt, partially interconnected) and for most new rail projects (Nigeria, Ethiopia, AIHSRN…

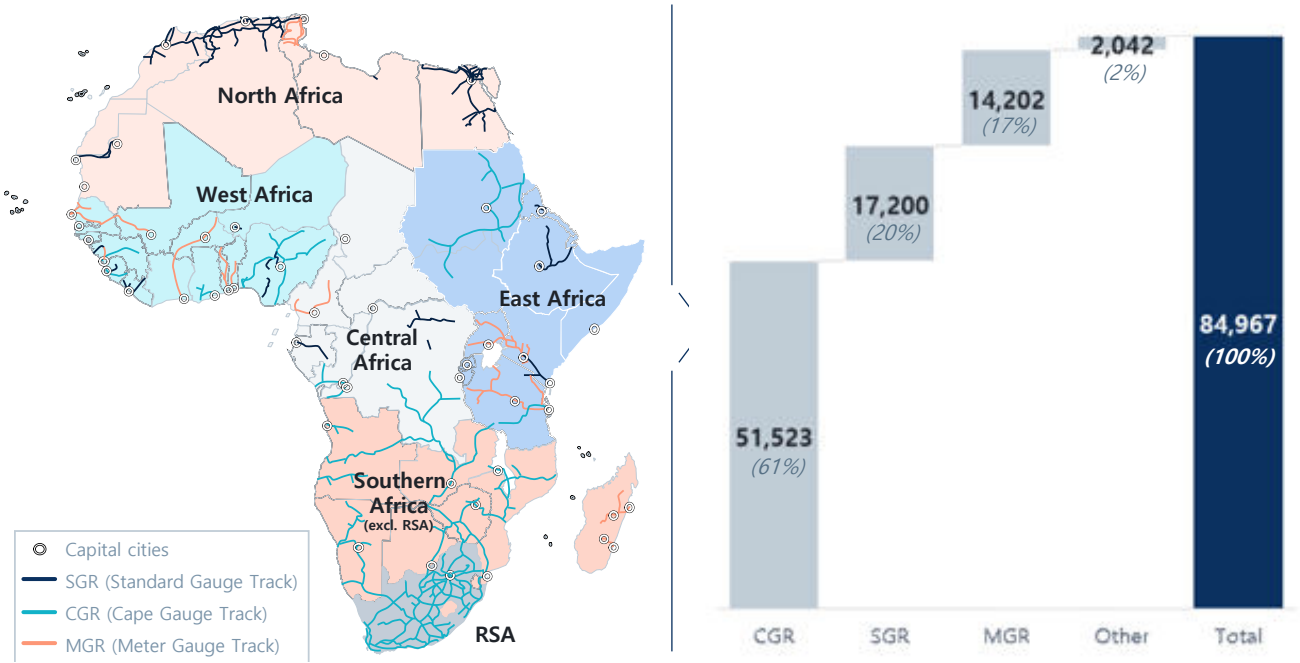


Figure 9: Railway network in Africa by track gauge

Source: African Union and ALG analysis

Most countries in Africa use diesel traction, while only 8 countries have electrified lines, representing approximately 15% of all lines in Africa. 3 kV direct current (DC) is the most common standard followed by 25 kV alternating current, while 50 kV AC is only used in South Africa.

Additionally, each country has developed a set of standards for coupler design and height above the top of the rail, which limits interoperability of the railway network across the continent. Association of American Railroads (AAR) (Janney) type couplers are the most common in Africa, followed by CBC

system couplers, associated to legacy rolling stock, and SA-3 couplers.

Axle load standards also vary from one country to another, given that most new and refurbished rail networks allow for maximum axle loads of 22.5 tons per axle or greater, while networks in poorer conditions might have their maximum axle loads limited to 12.5 tons per axle.

Non-physical railway systems for signaling and control also differ between different lines and regions. While these discrepancies do not outright block the movement of rolling stock between different networks, they do pose challenges to interoperability. Specifically, they impede efficient information sharing processes between networks, hinder coordination efforts, and complicate the transfer of operators between them, as operators from one network might not be familiarized with the operation of alternative systems.

Given the importance of freight transport and international trade for African railways, efficient points for intermodal exchange play a crucial role in enhancing rail performance. In Africa, however, intermodal connectivity is still very poor. For one, there has been a generalized lack of comprehensive intermodal planning, which has failed to integrate operational considerations from the private sector, among other. This, in turn, has resulted in limited interoperability with other modes of transportation and last-mile challenges. A lack of inland ports has also resulted in congested seaport cargo terminals. Furthermore, there appears to be an absence of clear standards governing the design and operation of these intermodal stations, ports or dry ports. This lack of standards extends to performance-monitoring criteria.

While infrastructure fragmentation, the absence of common standards and harmonization or an improper integration into the multimodal chain are significant hinderances for the sector, the most prominent issue for African railways has historically been and continues to be its poor condition.

The main issue in this sense is that insufficient funding dedicated to railway maintenance, combined with a lack of expertise, has resulted in substantial neglect of infrastructure. This neglect is evidenced by widespread issues including severe track wear, inadequate ballast, deteriorating earthworks, subpar condition of critical structures like bridges and tunnels, outdated signaling and telecommunication systems, and persistent bottlenecks leading to high accident rates. Furthermore, there is a generalized lack of monitoring tools and expertise that hinders the detection of deterioration processes in rail infrastructure, which in turn increases maintenance and repair costs.

On the other hand, African railways have also been subject to many vandalism episodes. Lack of security and monitoring have resulted in the theft of thousands of kilometers of track and cable, which were rebuild using funds that could instead be used for proper maintenance. In particular, South Africa's railway network has lost a large portion of its capacity due to theft and vandalism episodes after the Covid-19 pandemic shutdown and a poor management of security lead to an "open season" for looters[1]. Conversely, the TER Dakar in Senegal offers an example of good practices in security terms. There, a great coordination between railway monitoring stations and police officials has resulted in few security threats whatsoever.

The persistent challenges of poor infrastructure condition and low density in Africa's railway networks consistently position the continent among the lowest-ranked regions in terms of rail infrastructure quality.



[1] South Africa's railways: How thieves have destroyed the network - BBC News; Train infrastructure theft still rampant, rail regulator report shows

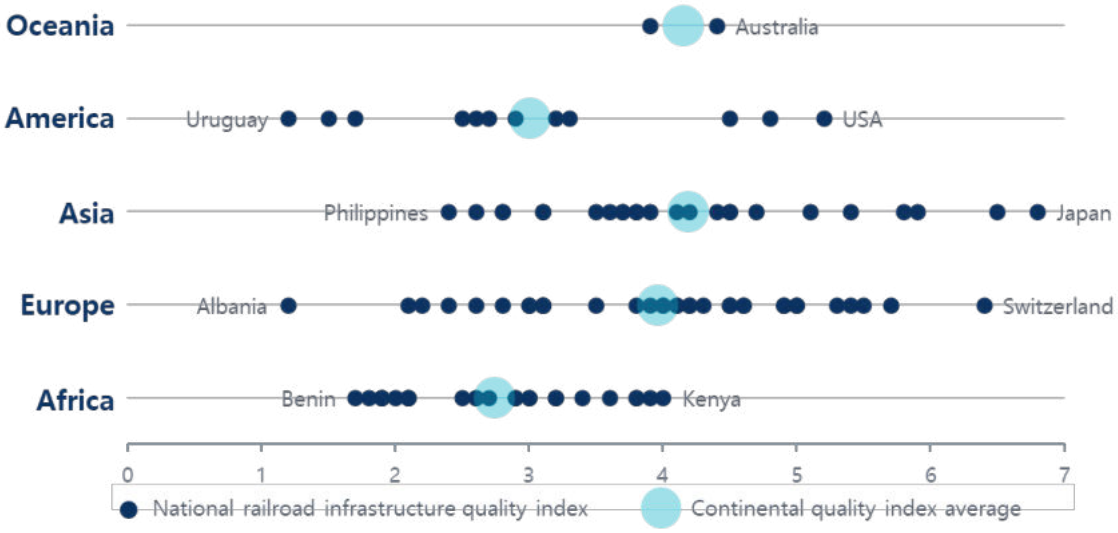


Figure 10: Quality of rail infrastructure index. A low index represents poor infrastructure extensiveness and condition, while the highest index (7) represents extensive coverage and perfect condition *(2012-2019)*

Source: World Economic Forum: The Global Competitiveness Report

Key takeaways

- Africa has a **fragmented network** of independent railway lines, particularly in regions outside of Southern and North Africa. Consequently, the continent exhibits low railway network density, accounting for only 8% of global railway length despite its landmass and population share, which limits the economies of scale needed in railways
- There is a generalized **lack of technical standards and harmonization** regarding track gauge, electrification, axle load, coupling systems, ICT and other design standards
- **Intermodal connectivity in Africa remains poor** due to a lack of comprehensive planning, a lack of design standards, insufficient or inefficient dry ports and no performance-monitoring criteria
- **Poor condition of railway infrastructure** has been the most prominent issue for African railways
    - Insufficient funding, monitoring tools and expertise have led to a lack of maintenance and neglect of African railway infrastructure, causing severe track wear, inadequate ballast, deteriorating earthworks, poor bridge and tunnel conditions, outdated signaling systems, persistent bottlenecks, and frequent accidents
    - Theft and vandalism pose significant obstacles to numerous railway lines in Africa, with South Africa's network being the most prominent example

3.2.2 Institutional and regulatory framework

African rail transport systems are often managed at a national level, with some significant differences between countries. Only recently have there been regional and continental initiatives to coordinate efforts and develop railways in a cooperative manner, but they lack concurrent institutional and legislative backing. The railway system therefore operates within an institutional framework composed by the different individual institutional and regulatory frameworks of each of the African States, but their distinct objectives and situations have led to a fragmented development across the continent.

Such division, evident in both the physical infrastructure and governance structures of African States, may impose limitations for the establishment of a unified railway network and impede collective development

efforts. In this sense, the African continent might face similar problems of fragmentation and decline to those of the European Union in the 1980s and 1990s, despite most likely at a higher degree. Much like its European counterpart, the African Union Commission (AUC) has made clear that its aim is to create a unified African network to use the full potential of the railway system.

Observations from successful models elsewhere underscore the pivotal role of continental or regional agencies in fostering the development of railway networks, akin to the European Union Railways Agency (ERA), along with continent-wide policies such as shift2rail. In Africa, the Comité des Transports Ferroviaires Megrébin and SARA (the railway arm of SADC) offer good examples of successful regional agencies supporting the railway sector development within its Member States.

Despite having a dedicated transportation branch (Department of Infrastructure and Energy) and a specialized agency (Union of African Railways, UAR), the African Union lacks a strong institutional arm in the railway sector, especially considering the fact that the UAR is currently underdeveloped and mostly inactive. However, the African Union has demonstrated efforts to reinvigorate the agency concurrently with the implementation of continental plans for railway development.

The Union of African Railways was founded in 1972 with the objectives to pursue standardization, expansion, coordination, and enhancement of railway services among the members of the Union. Furthermore, according to its Constitution, UAR also aims to facilitate mutual assistance and improve connectivity with other modes of transportation, integrating Africa into the global network. However, the Union has been practically inactive for years. Since 2018, the agency has been under revision and is expected to undergo a process of revitalization, but no signs of progress have been identified.

Showing limited power on railway development, neither the UAR nor the African Union have legal authority to introduce and enforce regulations upon Member States, for which regulations at continental level specific for railways are inexistent. However, none of the treaties promoted by AU are specific to railways.

International best practices have been integrated into the African continent for other transportation modes, with particular emphasis on the air transport sector. In aviation, the establishment of a continental and global network has been accompanied by the implementation of robust institutional and regulatory frameworks. As the African rail sector aspires to evolve into a more expansive continental network, considering the establishment of a corresponding continental framework could foster favorable conditions for this growth.

Year	Main European Directives	Main changes and inclusions
1991	**First Railway Directive** 91/440/CEE	– Mandatory separation between network operators and service providers
2001	**First Railway Package** 2001/12/CE 2001/13/CE 2001/14/CE	– Framework for open access – Establishment of railway regulatory agencies
2004	**Second Railway Package** 2004/49/CE 2004/50/CE	– Harmonization of safety principles and interoperability – National & international open access in freight services – Creation of the European Railway Agency (ERA)
2007	**Third Railway Package** 2007/58/CE 2007/59/CE	– Creation of an integrated railway area
2013	**Fourth Railway Package** COM (2013) 25 to COM (2013) 34	– Creation of a unique railway space – ERA turns into European Union Agency for Railways and becomes the authorizing authority (not network owners)

Figure 11: Main developments of integrated European railway regulations

Continuing at the continental level, numerous international and continental organizations actively coordinate and advocate for railway policies throughout Africa. These include the African arm of the International Union of Railways (UIC), and specialized initiatives such as the Programme for Infrastructure Development in Africa (PIDA). Led collaboratively by the African Development Bank (AfDB), the African Union Commission (AUC), and the New Partnership for Africa's Development (NEPAD), these entities collectively work to shape and advance the railway agenda across the continent.

At a regional level, the Regional Economic Communities (RECs) also hold crucial roles in the promotion and development of infrastructure development in their respective areas of influence. RECs typically work towards harmonizing regulations, standards, and policies to facilitate economic integration and cross-border operations. In this context, they encourage Member States to collaborate on joint projects, funding mechanisms, and the sharing of best practices, recognizing the importance of a cohesive and integrated approach to rail infrastructure development across the continent.

However, most RECs have struggled so far to effectively develop regional harmonized protocols and policies specific for railways. Furthermore, they also lack legislative and enforcement capacity. Notably, UMA, ECOWAS, and ECCAS appear to lack specific regional infrastructure protocols, initiatives, or guidelines, setting them apart from the more advanced communities of SADC and EAC.

EAC has no specific railways institutions nor treaties. However, in Article 91 of its constitution treaty, EAC includes a diluted policy framework specific for railways, promoting regional integration of standards, policies and financing. Later, EAC published its Master Plan in the 2000s, but failed to convert the guidelines embedded in it into a more particularized regional policy, legislative and institutional framework.

Conversely, while the region also lacks specific regional regulations, the Southern African Railways Association (SARA) serves as the main institutional focus for regional integration of railways in Southern Africa. Furthermore, SADC passed in 1996 the Protocol on Transport, Communications and Meteorology. This document acts as a policy framework with agreements from Member States on sustaining a safe, secure, and reliable transport system in the region. Notably, the protocol includes two dedicated chapters on railways, outlining strategic goals, policies, and the institutional framework required for implementing an integrated network. Spearheaded by SARA, SADC has been able to progressively carry out significant developments towards the goal of achieving an integrated regional network. The community is currently working on a Rail Master Plan.

Corridor authorities are multi-national treaties of similar characteristics to RECs, but with rather more specific purposes involving the creation of individual transportation corridors to foster trade within specific groups of nations. Such entities often collaborate with their respective Member States, public railway companies and concessionaires to streamline cross-border transportation, ensuring seamless movement of goods and passengers.

It can be observed that there is a generalized lack of railway regulation at corridor level too. While some corridors have established guidelines, they often lack specificity for railway operations. For instance, the Central Corridor has some protocols in place, albeit limited in scope and applicability. Similarly, the Northern Corridor has a guide for Public-Private Partnerships (PPPs), which provides some framework but falls short of addressing railway-related concerns. Overall, the existing regulatory frameworks within these corridors offer some direction, but there is still room for more comprehensive and tailored regulations specific to railway infrastructure and operations.

Overall, the absence of both continental and regional legislative frameworks for railways has been identified as a possible limitation to the sector's development, mainly in terms of standardization, regulation, and competitiveness. However, several international initiatives, some of which are already implemented in some African countries, have significantly strengthened or are expected to bolster the global railways sector, mainly the European market for which they were formulated. If embraced by African nations, these initiatives could have a positive impact on the continent as well.

The list below outlines the main active international treaties and policies that influence the African continent. Additionally, the compilation includes treaties set to enter into force in the near future.

- **COTIF-CUV and General Contract for Use of Wagons (GCU)**

  The Convention concerning International Carriage by Rail (COTIF 99) and its respective Appendix D - CUV (Contracts of Use of Vehicles in International Rail Traffic) oblige wagon keepers and railway undertakings to define rules of utilization. In this context, the General Contract for Use of wagons (GCU) provides an international multilateral contractual framework for the use of wagons based on such Appendix, containing all relevant mutual right and obligations regarding the use of wagons. Such contract saves the involved parties the requirement to negotiate numerous bilateral agreements thereby promoting wagon interoperability in liberalized rail markets (Europe). The contract has been in place in Europe for almost two decades to very positive results.

- **The Luxembourg Rail Protocol,** UNIDROIT & OTIF; *Luxembourg, February 23rd, 2007*

  The Luxembourg Protocol to the Cape Town Convention on International Interests in Mobile Equipment (the Luxembourg Rail Protocol) is a global treaty on the recognition and prioritization of security interests held by creditors on railway equipment, in a similar manner to the aviation sector's practices that have been put in place since the early 2000s. Its purpose is to increase certainty and reduce risks in asset-based financing for the acquisition and use of railway rolling stock, through a world-wide legal framework providing international recognition and enforcement of creditors' rights.

  The Luxembourg Rail Protocol entered into action on March 8th 2024 and is only ratified by Gabon. South Africa is willing to participate but the ratification of the treaty is proving to be a lengthy process. Mozambique has also signed the treaty but not ratified. The Luxembourg Rail Protocol has the full support of the African Union, the UN Economic Commission for Africa, and other multilateral institutions around the world.

- **Agreement on International Railways between Arab Mashreq,** *UN; Beirut, April 14th, 2003*

  The treaty, which entered into force on May 23rd, 2005, sets the strategy for regional railway development of all signing nations, including the definition of common technical specifications. African signing parties include Egypt and Sudan, with the first being one of the original members of the treaty.

At a national level, the governance of most railways across Africa is shaped by ministries of transport (MoT) in each host country. These ministries, present at the central Government level, function to devise and implement policies that advance public interests across various transport modes. Their overarching objective is, on paper, to craft integrated national transport policies that surpass or complement individual modal interests, thereby fostering a cohesive and comprehensive approach to transportation development. In this sense, most countries comply with what is considered to be the best practice for **joint-up transport governance**, based on the experiences of developed countries such as France, Germany, Spain, Australia or Canada. The People's Republic of China and Japan, where railways are governed by a Ministry of Railways solely dedicated to the railroad sector, are the main successful exceptions.

However, not all countries follow the best practices of having a dedicated railway unit within their Ministry of Transport, such as a Directorate of Rail Transport. Senegal, for example, lacks a specific directorate for railways at its Ministry of Transport, relying instead on a smaller agency (ANCF) focused on new projects. In Morocco, the public operator ONCF serves as the railways unit. This lack of clear delineation of responsibilities between the Ministry and the service delivery deviates significantly from optimal railway governance standards. While in most other states interferences between the definition and enforcement of policies and the provision of services appear to be minor, the issue is especially exacerbated by the fact that most railways are self-regulated. The absence of clear separated roles could raise several concerns:

- Firstly, the absence of separation means that policymakers, who are also responsible for the commercial outcomes of a service provider, may face conflicts with public interest policies. These conflicts can potentially hinder the achievement of targets, such as reducing entry barriers or implementing consumer protections

- Secondly, there exists a substantial disparity in the required professional and institutional skills for formulating and analyzing public interests and policies, as opposed to efficiently running a commercial enterprise

- Lastly, the separation of responsibilities allows for more streamlined organizational structures for entities involved in service delivery

Although the official ministry supervising railways is, in theory, the MoT, some Governments delegate the responsibility of monitoring to, for example, a board of the concessionaire (as in the cases of Senegal and Cameroon). Furthermore, quite often the Government's representative in the board of the concessionaire is not from the MoT but from the Ministry of Finance (MoF), due to the great financial burden that originates from subsidies required. A good coordination may be an indicator for a clear and transparent regime of the sector's supervision, but this configuration might indicate a lack of technical expertise in the supervision of concessions, nonetheless.

In the last level of governance, **regulated markets** in benchmark countries rely on three pillars for their efficiency and transparency. On one hand, regulatory agencies enforce the policies of administration and play a key role in the separation between policy-making and service delivery. Meanwhile, in the service-provision end, agencies adopt corporate structures and the market is characterized by specialization and competitiveness in operations.

Only a handful of countries have put up independent regulatory bodies in place to monitor market performance, competitive situation and even safety issues. Moreover, in many cases, regulations are made by rather inadequate bodies, as in the case of Kenya. In the case of the international Dakar-Bamako concession, the transnational monitoring body has never formally met. In other countries, the aforementioned are non-existent, as in Botswana, Benin, Morocco or Zambia, where railways are public owned. Overall, the sector lacks adequate tools and agencies for monitoring and regulation of the market, which are a cornerstone for a safe, competitive and sustainable development of the sector.

Among the few existing ones, noteworthy regulators in the continent include the Railway Safety Regulator (RSR), South Africa's safety regulator, which was established by the National Railway Safety Regulator Act No. 16 of 2002. The mission of the RSR is to oversee and promote safe railway operations through appropriate support, monitoring (audits and inspections) and enforcement, guided by an enabling regulatory framework. The RSR acts in South Africa, Botswana and Swaziland, and is mostly the referral best practice for other regulators in SADC region. Nevertheless, its autonomy from service providers, both of which are public corporations, may be perceived as insufficient. This is especially suggested by the resolution of conflicts involving PRASA following specific accidents and negative safety audits, which suggest that the regulator might be influenced by broader political interests related to the operator.

On the other hand, in accordance with best practices observed in Europe, Australia and the United States, most countries have established a publicly-owned Railway Authority through legislation such as the Railway Act. Still, it is crucial to address that there are still some countries – some of which are soon to own railway limes - have no institutional framework specific to railways, such as Rwanda or Burundi.

Irrespective of ownership and organizational structure, the predominant model for Railway Authorities and operators in the majority nations involves operating as corporations or subsidiaries of larger entities. This holds true whether they receive minimal or substantial budgetary support and regardless of whether they are involved in freight, passenger, or a combination of railway services. Even Morocco's national operator ONCF, which sometimes also rather acts as a department of the Ministry of Transport, is quite segmented and has separate management for infrastructure and service provision, similarly to its French counterpart and role model SNCF. However, while numerous public railways in Africa have transitioned into corporate entities, only some meet all standards typically expected in the private sector. These standards include having professional directors and top management staff, as well as publishing independently audited annual reports and financial statements for transparency and accountability.

The preference for corporatized entities is not surprising, as history demonstrates that, across various production and service industries, companies have proven to be the most successful formula within modern economies for efficiently managing large commercial enterprises in competitive markets, even when these companies

remain under state ownership. Nevertheless, it is important to consider that state-owned enterprises require stronger corporate governance than other corporations, as per the recommendations of the OECD Guidelines on Corporate Governance of State-owned Enterprises.

When it comes to service provision by such Authorities, a key principle in reference railway systems is specialization of such services, referring to the division between infrastructure, which is a natural monopoly, and between each of the operative markets, where competition is possible.

The division between infrastructure management and operations was first enforced across European markets in 1991 and adopted as the prevailing model in regions like Australia. This approach excels in cultivating healthy market dynamics and driving innovation in service delivery to meet the evolving needs of passenger and freight transport. Furthermore, vertical segregation ensures that infrastructure management remains impartial and conducive to broader market participation, ultimately leading to improved quality and responsiveness in railway operations.

On the other hand, past experience in Europe, America and Asia has evidenced that freight and passenger management under one single business becomes increasingly ineffective in competitive environments, and that market needs differ for passenger and freight services even if running on the same tracks. Furthermore, hybrid structures also pose challenges in delineating the profitability of each market, making performance monitoring more complex. Additionally, when profits from a thriving sector are automatically funneled into a less successful sector through shared accounts, it diminishes the incentive for the prosperous sector to continue enhancing its performance and weakens the imperative for the struggling sector to improve.

In this sense, contrary to lessons learned from global best practices, most Railways Authorities in Africa condensate both the management of infrastructure and the operation of rolling stock, even if in different managing branches of the company. Furthermore, most heavy-line operators in Africa (-80%) still carry out the responsibilities of operating both passenger and freight services under a unique management structure. Only few enterprises separate their operations, mainly South Africa and Cameroon's Camrail, who offer segregated services for passenger and freight under two different corporations, (Transnet and PRASA) or under subsidiaries of one sole corporation (Cameroon[2]).



[2] After almost failing due to PSO issues, Mobirail (not a separate company but with differentiated management and costs unit within Camirail) handles Passenger services in Cameroon as to insulate passenger operation deficits from the main source of activity

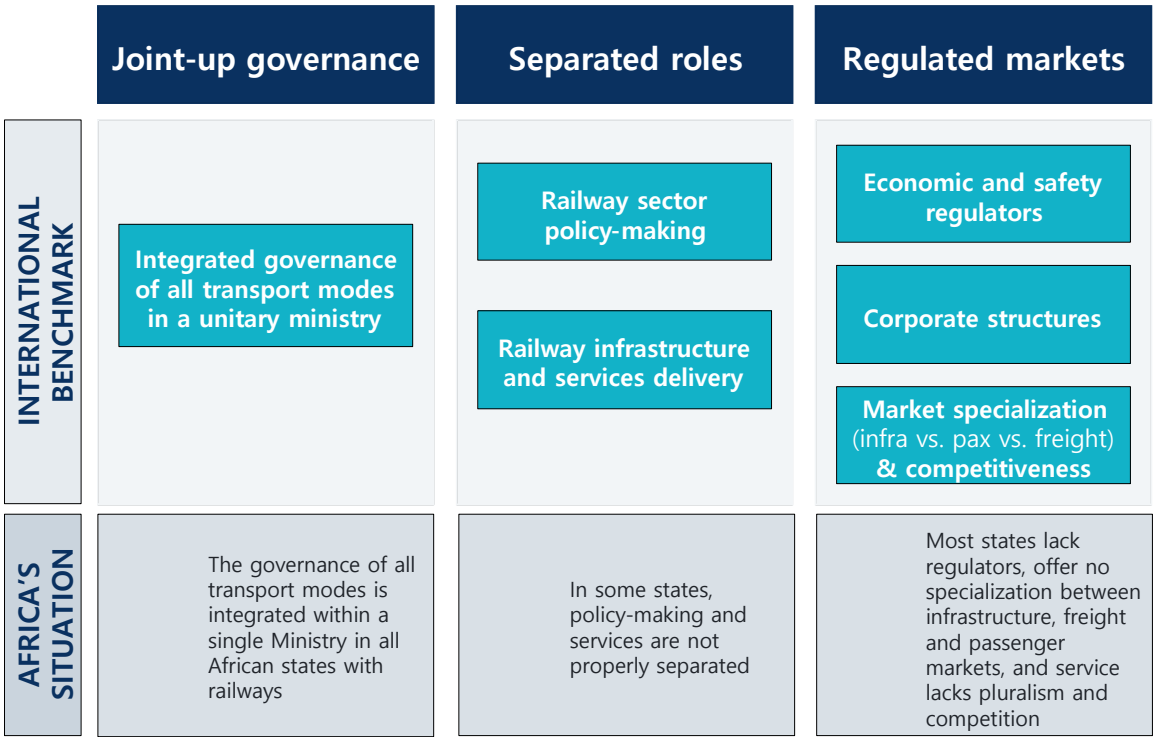


Figure 12: Summary of the evaluation of general governance and institutional framework in African countries

Source: World Bank, ALG Analysis

Key takeaways

- The African rail transport is **primarily governed at a national level, lacking railway-specific regional and continental institutions** for coordination and development. UAR, the UAC's railway arm, has been fairly inactive for the past years but looking to be revitalized. The generalized absence of such institutional and legislative organisms limits the establishment of a cohesive continental railway network

- Examples in **European integration (ERA, shift2rail, etc.)** or from other transport modes **in Africa,** mainly **aviation (AFCAC),** could serve as **building points** for the development of a continental regulatory framework. **SARA** also **showcases as a solid example** of a functioning regional institution for a harmonized development of the railway sector

- **Multi-national treaties and policies** (corridors and RECs) are often **not specific for railways**

- Some international treaties such as GCU and the Luxembourg Rail Protocol present interesting opportunities for sector standardization, interoperability and financing of railways infrastructure and rolling stock

- Most railways in Africa are **governed by an overarching Ministry of Transport** or equivalent governing all transport modes, but most countries lack dedicated railways units within it

- The **delivery of services and policy-making are not properly segregated** in some countries, with apparent interference between policy-making, operators and infrastructure management

- While they use corporate structures, many African countries fail to meet all standards of such type of companies, primarily in terms of transparence and accountability. Furthermore, contrary to best practices elsewhere, most African operating companies have **no corporate separation between freight operations and passenger services**

- **Limited independent regulatory bodies** and **inadequate monitoring tools** pose challenges for ensuring safety, competitiveness, and sustainable development in the African railway secto

3.2.3 Market models for infrastructure administration and operations

In terms of ownership and governance, most heavy rail-lines are both owned and operated by the Government (~65%) through a national railway company, despite some have opened third-party access to other operators. Only in some cases (~25%), the operation and maintenance is outsourced to the private sector by means of a PPP arrangement. The remaining lines are privately owned (~10%), with the private sector retaining both ownership and O&M of the infrastructure. This typically corresponds to mining projects, with the railway line developed specifically for this purpose.

Analyzing the various operational rail lines, a diverse array of distinct business models has been identified. While countries such as the RSA, Morocco or Botswana seem strongly committed to public sector delivery, various approaches to privatization are being considered in other countries such as Tanzania, Senegal, Cameroon. The various business models reflect the multifaceted nature of the African rail sector's operational frameworks, each embodying unique approaches, and strategies.

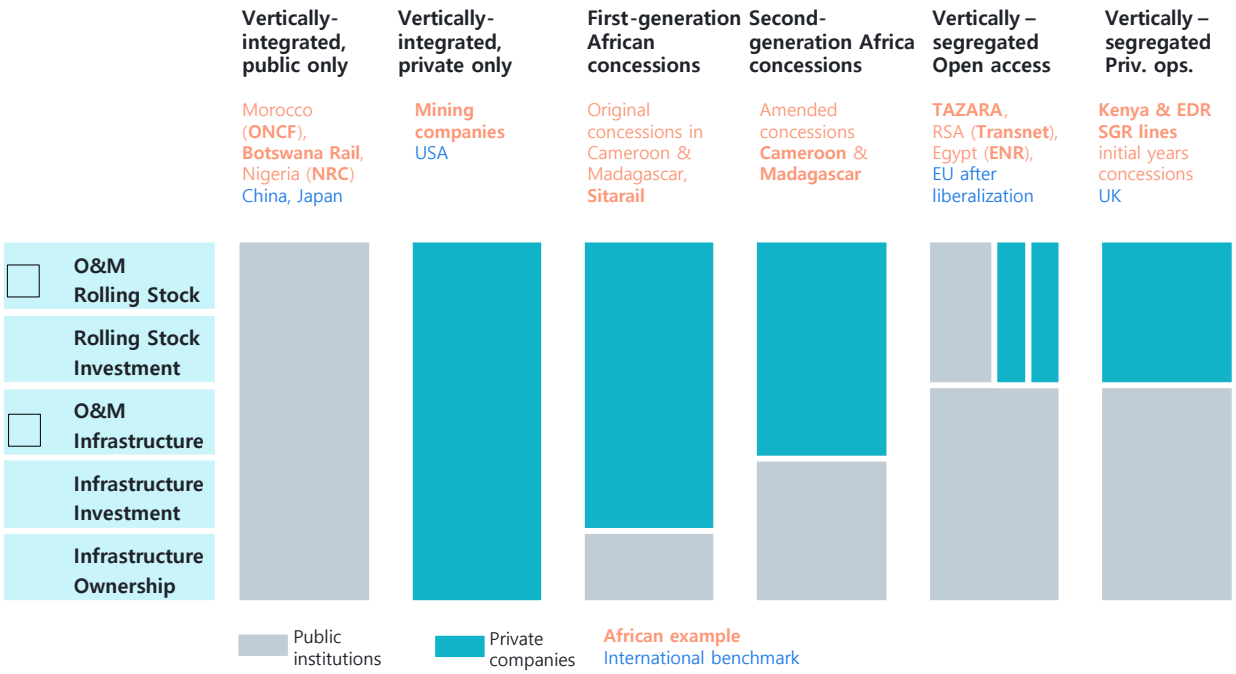


Figure 13: Governance models of railways in Africa

Vertically-integrated railways have the advantage of there being a single company controlling the full value chain in the railway business. That means that coordination between railway operations and infrastructure is maximized. The main drawback of this model is that it is inherently monopolistic, and it thus may not allow more than one operator, even if the existing one is not performing satisfactorily.

Railways that are publicly owned and managed as well as vertically-integrated are still the most common pattern found in the world and Africa, accounting for more than 60% of all African railway systems. It is the current model in Botswana, Nigeria, Algeria and Morocco's rail networks, among others.

On the other hand, privately-owned and managed vertically-integrated railways are common railways originating from mining infrastructure projects, and thus are usually dedicated to private logistics and freight transport. This model has the advantages of allowing full coordination and requiring little or no costs covered by taxpayers. However, the introduction of passenger operations in this model, usually entails complex and uncomfortable arrangements, with unreliable schedules severely affected by private decision making.

Found mostly in Sub-Saharan Africa, PPP concessions were first introduced in the 90s to mixed results. Despite some successes in improving railway infrastructure, enhancing internal processes and cost structures, many concessions faced financial difficulties, leading to

terminations. Mainstream private operators exhibited limited interest, creating challenges in raising equity and finance, causing stakeholder instability. Factors leading to concession failure included:

- There was limited experience in Public-Private Partnerships (PPPs) and understanding of successful PPP models was lacking

- Political and institutional weaknesses shared by many Sub-Saharan African countries discouraged international investors from engaging in African railway projects. Factors contributing to this perception included the perception of high-risk for infrastructure investment in most Sub-Saharan African countries, with concerns about political, regulatory, partnership, and credit/payment risks

- While some countries had regulatory structures, these frameworks were often poor, lacked independence and transparency

- Concession contracts repeatedly underestimated capital investments leaving private operators with unsustainable infrastructures in the long term

- IFI loans were predominantly utilized by concessionaires to address urgent issues arising from poor maintenance, hindering long-term investment on infrastructure

- Traffic forecasts proved overly optimistic, underestimating the strong competition from road transport, resulting in inadequate cash flows for maintenance and renewal

- Disagreements and disagreements regarding the provision of passenger services, either in PSO formats or under the concessionaire's responsibility

- Lack of involvement of railway users or Governmental Authorities within the SPV, which increase commercial risk perception and political risk

- The profile of concessionaires involved in the first generations of African concessions was of logistics operators that were unfamiliar with the workarounds of civil works and infrastructure management

This first generation of African railway concessions included the obligation of the concessionaire to take full responsibility for infrastructure investment and maintenance on top of railways operations, which usually included public service obligations for passenger services. In others, the allocation of responsibilities and risks in these matters was not properly defined. Given the aforementioned factors, railway operators often failed to fulfill their investment commitments, resulting in an infrastructure cycle of decline that hindered operations and, in turn, doomed the concessions. This was the case of initial concessions in Cameroon, Madagascar, the existing situation of Sitarail (Ivory Coast), and the cancelled concessions of RVR (Kenya) and Transrail (Senegal) concessions. Camrail and Madarail concessions were amended so that the Governments could retake responsibility for infrastructure investment, still leaving the concessionaire with the responsibility of maintenance in regard to infrastructure.

On the other hand, concessions in Tanzania and Zambia were somewhat more evolved and from the beginning gave the Government responsibility for infrastructure development. Nevertheless, the lack of commonly accepted definitions between the private side and the Government regarding the perimeter of investment and maintenance responsibilities resulted in concession instability and are often cited as key reasons explaining their failure. Such issues relate not only to responsibilities, but many African concessions (first generation and amended) also failed to properly allocate risks, generally placing too much risk (commercial in passenger services, infrastructure investment, etc.) on the private side of the business.

Yet, some success cases rose from the Sub-Saharan PPP schemes, with Camrail, Madarail and Sitarail showing good practices for future PPP contracts. The success of these concessions hinged on several key factors. First, the alignment of anchor clients, which served as both the largest customer and majority shareholder, ensured operational efficiency and market responsiveness, reducing the associated risks. On the other hand, Government involvement promotes transparency and accountability while aligning public sector activities with commercial goals. The clarity in these concession agreements regarding the responsibilities for infrastructure development and renewal and securing ongoing funding for maintenance and upgrades proved to be crucial for the sustainability of the railways too. Finally, stable freight markets, which compounded the core activity of all operators, limited road competition, and Government support for passenger services helped enhance overall success by diminishing commercial risks.

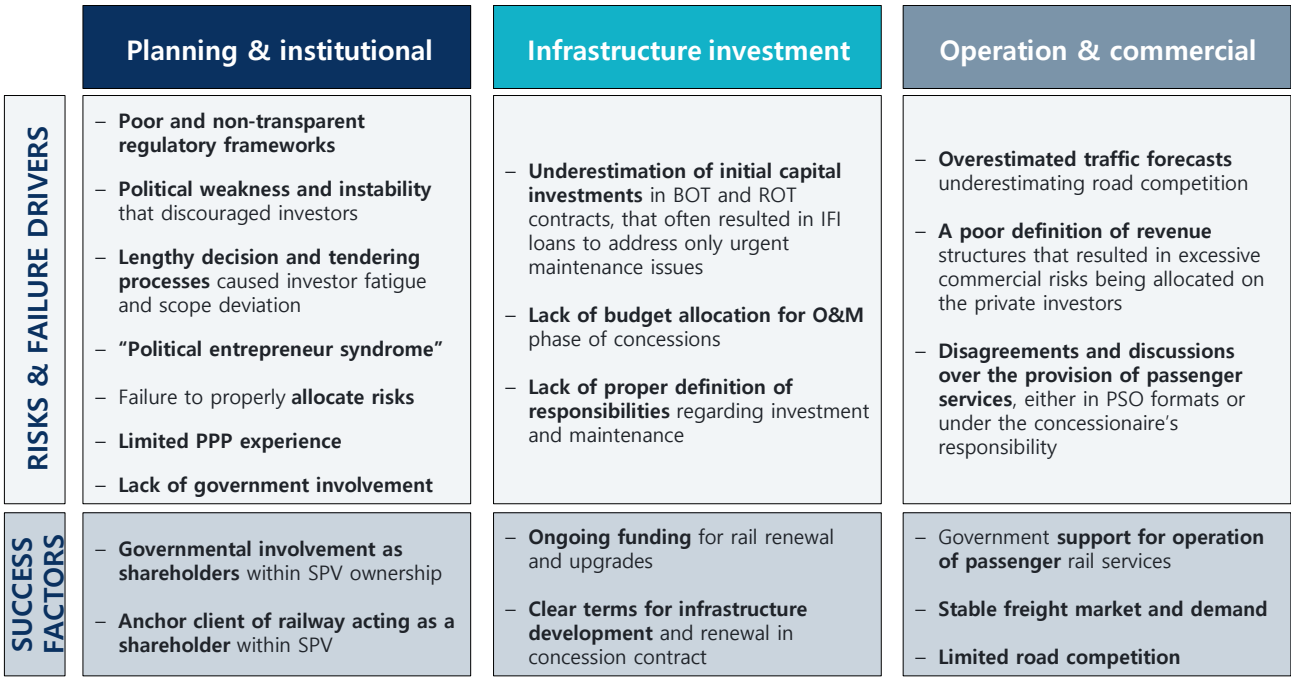


Figure 14: Main risks and issues that caused failures and factors of success in African PPPs

Finally, separation of infrastructure, which is a natural monopoly, and operations, where competition may exist, has been implemented in many countries. In this context, the operator's role entails only the provision of transportation services without any involvement in civil work activities, neither from an infrastructure O&M not construction standpoint. The obligation for infrastructure investment and maintenance is delegated to infrastructure managers, who possess and oversee the infrastructure, providing line capacity to operators in exchange for fees for utilizing their owned railways.

In this context, open access regimes allow multiple operators to utilize a network, thus enticing competition and cross-border interoperability, while franchises generally involve one private operator being awarded exclusive rights to operate within a network, commonly in the grantor's name.

The open access model has been the predominant in Europe for some years, after the Railway Packages 1-4 set the framework for the liberalization of the railway sector. Freight transport was liberalized in the 2000s with mixed results. The liberalization process has generally failed to significantly increase rail transport market share but is slowly increasing competition and lowering prices. Market entry barriers, poor regulatory enforcement and abuse of dominant market position by incumbent public operators has acted as bottlenecks for new railway undertakings and generally deterred increments in competitiveness in some countries such as Spain or France.

Conversely, passenger transport liberalization in Europe is widely considered a success across all of the continent. Opposite to freight transport, Spain's particular case is often referred as a good practice. In order to maintain the incumbent operator, the country opted for a controlled liberalization process in high-speed lines that kept Renfe safe while generating extra revenue and improving the level of service. As a result of liberalization, high speed rail saw a surge in traffic and passenger numbers after market liberalization, while ticket prices decreased around 20-20% in the main national high-speed corridors.

While not an open access model per se, TAZARA's railway (Tanzania – Zambia) is the sole successful example of a third-party access implementation in Africa at the moment. An original 3-year open access PPP arrangement with Calabash Freight Limited resulted in an increment of transported cargo along the line, doubling traffic volumes, and an increment in revenue for the binational company. The agreement's success led to the preservation of the third-party-access regime. Furthermore, additional agreements have been established with more private operators, further solidifying the railway's commitment to this approach. Unfortunately, though, the deteriorated state of the railway line, in severe need for rehabilitation,

and the closure of a bridge in 2021 have halted to rail's success. Other nations having just recently implemented or considering the implementation of 3rd party access PPPs or open access arrangements in their networks include South Africa, Egypt and Tanzania.

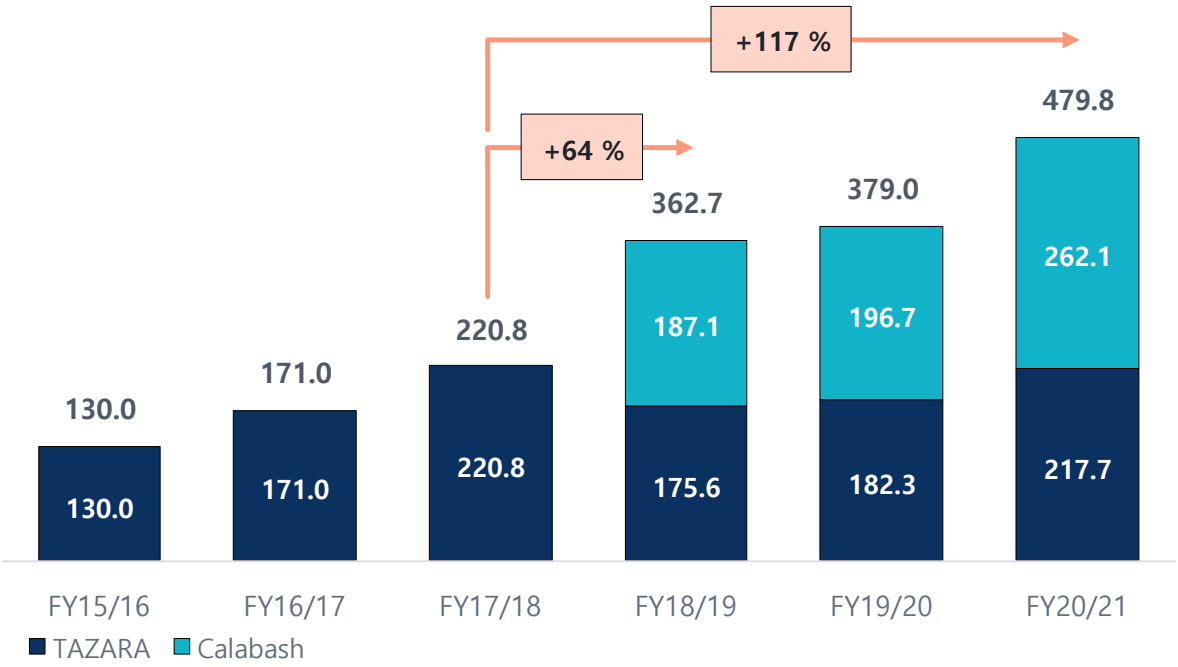


Figure 15: TAZARA total freight transport (Metric Tons, 2015-2021)

Source: TAZARA performance results

Given the generalized opinion that railway concessions failed to deliver results in Africa, other models for infrastructure maintenance and construction have been pursued. Particularly, the Mombasa – Naivasha and Addis-Djibouti projects have been developed under Engineering, Procurement & Construction (EPC) contracts with Chinese contractors and later awarded concessions for only O&M. In this contractual scheme, the Government assumes all risks except for those related to design and construction, particularly commercial risks such as revenue, as the performance of the EPC contractor is distinct from operational performance. These risks were either managed by an operations contractor or borne by the Government, often through the inclusion of "take or pay" clauses in contractual agreements.

However, EPC contract with Chinese contractors have also included significant alternative challenges. These projects were largely tied to financing and contracting arrangements, which resulted in contractors and 3rd parties influencing project implementation and potential conflicts of interest at various project development stages. Particularly, projects were developed mostly from a construction perspective, failing to take into account the particularities of the territory, the private sector, intermodality within logistic chains and interoperability with other lines. The absence of independent feasibility studies or audits further diminished project oversight, exacerbating these shortcomings. Such drawbacks have generally resulted in lower traffic than predicted, thus raising questions about the project's nature and financial sustainability.

Overall, there is no single "fit for all" business model for railways. A large number of railway business models can be found worldwide with various levels of integration/separation of infrastructure and operations, and with more or less private participation. Significantly, the bigger and apparently more efficient railways in Africa (e.g. RSA or Morocco) are public sector undertakings, much like China and Japan, which is not the mainstream pattern in the Americas or in Europe. Yet, many Governments have recently completed projects through different types of PPPs and are beginning to explore open access models as well, reflecting a growing interest in diversifying railway governance structures and financing mechanisms.

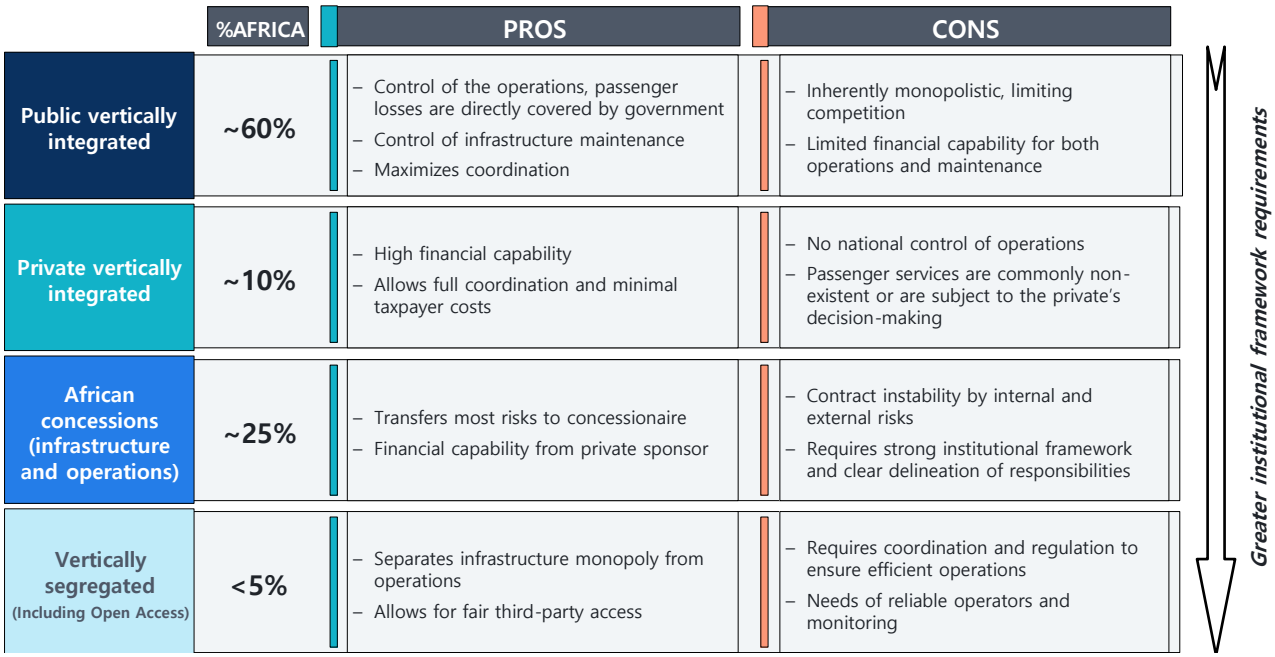


Figure 16: Summary of representativeness of railway operation models and their main benefits and drawbacks

Key takeaways

- Most railways in Africa are owned and operated by governmental entities, with only about 25% functioning under PPPs. Some privately owned railways exist, primarily for mining purposes
- Publicly owned and managed model is predominant in Africa, allowing Governments to maintain control over both ownership and operations in a monopolistic manner
- Initial PPP concessions faced various challenges, including limited experience, political and institutional weaknesses, underestimated capital investments, and disagreements over responsibilities and risks
- Successful PPP models hinged on the alignment of anchor clients, transparent Government involvement, clear concession terms, consistent funding, stable markets and Government support for passenger services, which helped lower risks and ensure long-term sustainability
- While PPPs have shown mixed results and many have failed, they have mostly helped improving railway infrastructure, enhancing internal processes and cost structures
- Very few countries have implemented or are in the process of implementing separation between infrastructure and operations, with infrastructure managers overseeing investment and maintenance while operators provide transportation services
    - Within this separation, open access regimes allow multiple operators to utilize a network, fostering competition, while franchises involve exclusive rights granted to a private operator. TAZARA is a great example of open-access benefits in Africa
    - Segregation of infrastructure and services is the predominant model in Europe, where open access has been introduced in both freight and passenger services
- EPC – O&M contracts have been used in some recent rail projects, especially with Chinese contractors, separating construction risks from operation. However, other problems have arisen in construction and planning phases due to contractor influence and lack of independent monitoring which have later hindered the operation phase

3.2.4 Financing mechanisms and funding sources

3.2.4.1 Financing mechanisms

The challenge of raising funds and financing railway infrastructure projects is the primary impediment to both the development of new rail lines and an efficient maintenance and operation. Despite the intricate complexities of the continent's context, and much like other infrastructure projects internationally, railway projects in Africa are generally financed under three different mechanisms: sovereign financing, corporate financing and project financing. These mechanisms are closely intertwined with the governance models discussed previously.

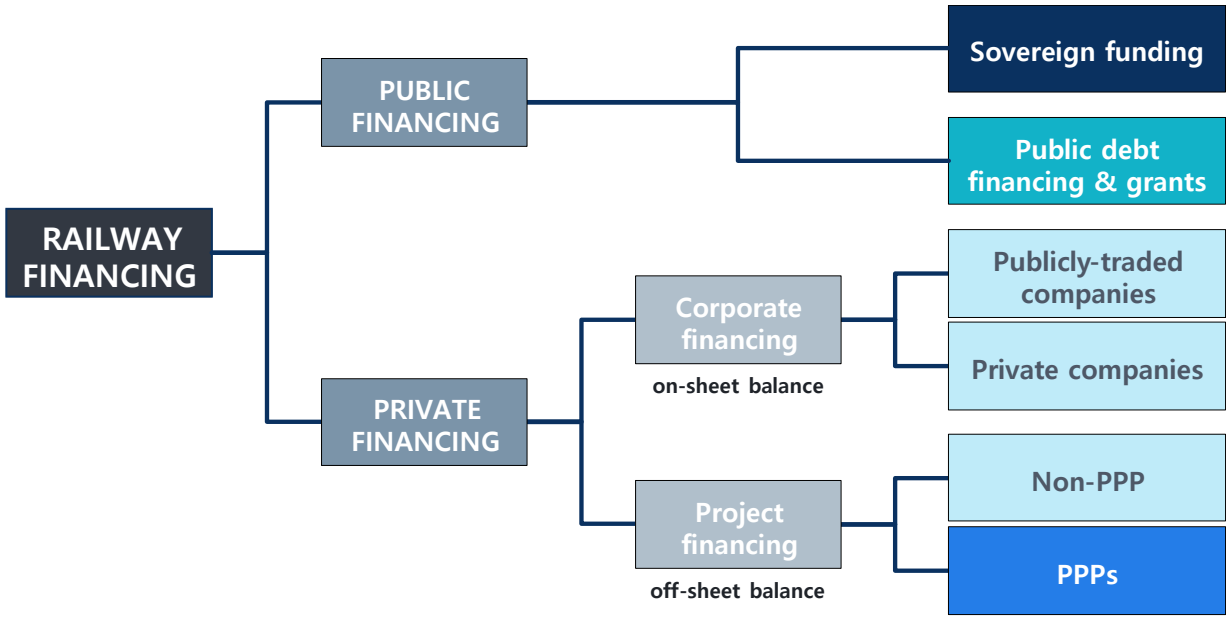


Figure 17: Infrastructure financing mechanisms

Public financing has been historically the most used funding solution for railways in Africa and worldwide. In this scheme, a public sponsor (usually the Ministry of Finance or the Ministry of Transportation) lends/guarantees the required loans for the railway project. Since the project promoter is a public body, the success of the project (or return on investment) is accounted based not only on the internal rate of return of the infrastructure but also on the social welfare generated for the country. Furthermore, sovereign financing in projects allows for asset control, for which the level of administrative influence in African concessions proved to be a key element of project success or failure. However, public funding for railways is hindered by the fact that African Governments have a wide portfolio of sectors needing investment (energy, housing, water supply, agriculture…) that railway infrastructure needs to compete with for funding.

In high-income countries, funds for railways are usually raised directly from the public treasury. However, African countries have limited treasury size and tax revenues compared to higher-income economies, which limit their self-funding potential for new railway lines or upgrades to existing infrastructure. In 2019, the average tax revenue to GDP ratio in Africa was 15%, far below 25% benchmark required to finance development.

In consequence, Africa's nations rely mainly on securing external sources of funding or financing through loans or from capital markets through multiple internal financial products, including railway infrastructure bonds. However, they generally navigate in high levels of public debt that restrict further borrowing, especially considering that railway projects can account for significant proportions of a country's economy. For instance, Tanzania's SGR cost accounted for approximately

5% of its national annual GDP, while the Transkalahari Corridor in Namibia could incur a cost equivalent to the entire nation's economy. Due to such debt ceiling, most railway projects cannot afford bank loans with high interest rates, thus relying on concessional loans from multilateral institutions. On the other hand, Government bonds require consolidated capital markets to provide enough confidence to investors, something only the more macro-economic developed countries have been able to provide.

Through corporate financing, a private sponsor uses its own balance sheet to support the project loan, spreading risk across the firm. Lenders evaluate the firm's overall creditworthiness, generally leading to lower borrowing costs for the project. However, this strategy can expose the private sponsors to heightened risk, potentially increasing future borrowing costs as lenders consider the project's added risk. This is common in fully-private financed projects globally but particularly in Africa, where project risk is compounded by factors like inflation, instability, and market uncertainty.

Industrial sponsors may opt for off-balance sheet financing by establishing special-purpose vehicles (SPVs) for large rail projects. SPVs separate project risks from sponsors' balance sheets, allowing for incorporation of multiple stakeholders who share project risks. In this sense, the creation of SPVs allows for the collaboration between private entities and the public sector to undertake projects together. Furthermore, with a typical 80-20 or 70-30 Debt-Equity ratio, SPVs lower capitalization compared to other mechanisms.

For these reasons, Project Financing is favored for capital-intensive projects like rail infrastructure under Public-Private Partnership (PPP) agreements, as exemplified by railway concessions in Sub-Saharan Africa. Overall, Public-Private Partnerships (PPPs) serve as a means to transfer certain risks to the private sector and gain capital capacity, yet they often entail significant transaction costs and necessitate robust legal and institutional frameworks for support. Effective monitoring by Authorities is also essential.

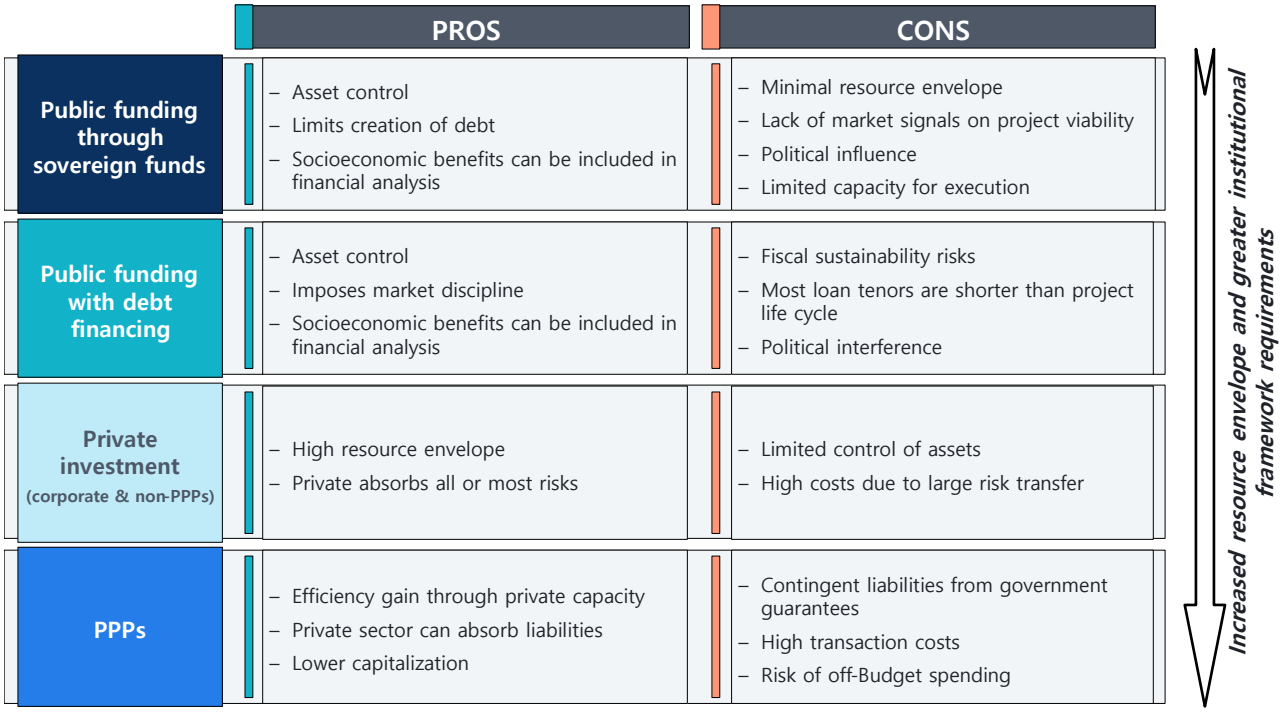


Figure 18: Summary of principal benefits and disadvantages of different financing mechanisms

3.2.4.2 Key considerations on railway financing

Rail projects in Africa also face greater risks in terms of project implementation compared to high-income countries (HICs) or other geographies. First, many African nations lack the institutional and technical capacity that are crucial to conduct appropriate feasibility studies and socioenvironmental assessments and to successfully implement projects.

On the other hand, political instability hinders the development of lengthy projects such as rail infrastructure and also discourage private

investment, especially during the early stages of projects. Additional risks include highly fluctuating inflation rates, market uncertainty, and commodities price variance. The uncertainty inherent in the African context, coupled with the extended investment period necessary for rail projects, amplifies the risks associated with market fluctuations and economic instability.

The lengthy nature of large rail projects can also add to difficulties in securing financing. The lifecycle of rail infrastructure is very long, at 100 years or more. Although shorter, the lifecycle of rolling stock is also relatively long at 30 – 35 years. Given that railways have small profit margins, the return-on-investment periods can be similarly long, especially when there are large infrastructure investments. In contrast, IFIs generally offer loan tenors of around 30 years, while private loans generally have tenors up to 10 years. Furthermore, the current approaches to assess the benefits of rail projects also create barriers for rail investment.

For one, high social discount rates in cost-benefit analysis (CBA) lead to limited or no financial benefits for lengthy infrastructure projects such as railways. Greenfield projects, which require the largest upfront investments for infrastructure and generally have a demand ramp-up period, face the most prominent issues regarding this phenomenon.

Moreover, economic benefits created by rail projects are not only rarely incorporated at full scale in financial models, but they also do not conform with the expected return on investment to the investing entities. Although estimates for avoided carbon emissions can be made, historical prices set for avoided carbon tend to be low, often falling well below assessments of the social cost of carbon. Additional advantages, such as the formal job creation, urban densification influenced by rail-influenced development patterns, and the stimulation of broader economic opportunities and development, prove challenging to quantify and monetize. Rail projects also alleviate externalities that impose significant societal costs, including air pollution, congestion, traffic accidents, noise emissions, and overall health impacts.

Despite being widely acknowledged as public goods, these benefits are typically excluded from financial models. Similarly, the direct or indirect positive effects of rail projects on accessibility and equality are overlooked. Due to these factors, current financial models fail to encompass the positive economic returns of rail projects, concentrating solely on financial return on investment, thereby impeding further investments by Governments and IFIs in rail and contributing to the finance gap for rail in African countries.

3.2.4.3 Alternative funding sources for rail projects

Within this financial framework, several instruments exist and have been developed to help source capital for infrastructure projects. These sources cater to different sovereign and investor preferences and project needs, offering flexibility in financing arrangements.

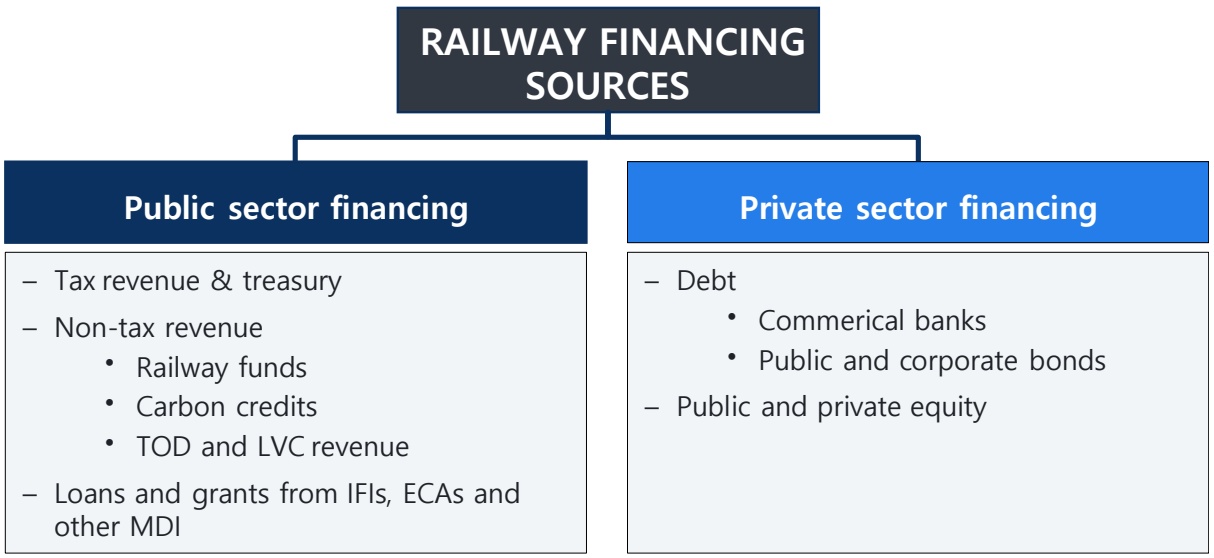


Figure 19: Sources of capital for infrastructure financing (traditional and alternative)

The subsequent overview delineates various sources of funding that stand out for their distinctive characteristics and roles in financing infrastructure projects. Notably, tax revenue, equity investments, and other conventional sources have been omitted from this discussion owing to their widely recognized nature and prior introduction in earlier discussions. This focused examination allows for a more in-depth exploration of alternative and innovative funding sources that are instrumental in driving railway infrastructure development and investment forward.

Railway funds

Regarding sovereign funding, new developments have seen several African countries, including Kenya, Cameroon, and Madagascar, create Railway Funds as a means to finance and support the development and enhancement of their railway infrastructure. In the case of Kenya, the Railway Development Levy Fund was established in 2013 and aims to provide fund for the construction of the SGR as well as for its operation. The Fund was the source of sovereign funding, estimated at 10% of the total cost. In the case of Cameroon and Madagascar, both concessioned railways, the Fonds d'Investissement Ferroviaires (FIF) are examples of funds aimed at securing funding for the improvement of the railway infrastructure. These funds are replenished through a portion of concession fees collected by the Government. In Cameroon, the FIF is anticipated to cover up to 40% of the long-term infrastructure requirements.

At the international level, Poland's Railway Fund was established as a financial mechanism for network expansion, modification, and repair in the National Economy Bank collecting 20% of income from fuel charge and issue bonds in the financial markets. The fund is regulated by the infrastructure manager in collaboration with the Ministry of Transport, and its creation allowed for reductions in infrastructure access fees. In Switzerland, since 2016, operations and maintenance, the renewal of existing rail infrastructure, and further expansion, have been financed exclusively via its Rail Infrastructure Fund (RIF).

As briefly illustrated by the previous examples, funds in various countries have been supported by a variety of mechanisms, demonstrating adaptability to different market conditions and their effectiveness in raising capital. Additionally, funds provide a distinct treasury solely dedicated to railway projects, reducing competition with other sectors for national budget allocation.

Transit-Oriented Development (TOD) and Value Capture

Alternatively, Governments can benefit from transit-oriented development (TOD) through the creation of side businesses or from the changes in value of land close to new rail lines. Rail stations and transit hubs serve as catalysts for mixed-use development, including residential, commercial, and recreational spaces. By leveraging proximity to rail infrastructure, developers can create vibrant, transit-oriented communities that attract investment and enhance property values. Capturing such values can bring substantial benefits to Authorities, as revenue-generation methods are flexible and include taxes, fees, levies, auctions for development rights, or direct sale of land.

In this sense, rail projects typically involve extensive land acquisition for tracks, stations, and associated infrastructure. Yet, surplus land acquired beyond immediate project needs can serve as a valuable asset for future development or resale, providing a revenue stream through land banking and Land Value Capture (LVC). Additionally, land banking harmonizes with the long-term nature of rail projects. These mechanisms are complementary and mutually supportive, mirroring successful examples in Asia, such as Singapore, Tokyo, and Hong Kong, where they have significantly contributed to infrastructure funding and fostered sustainable urban development. Cities in middle-income countries such as Nanchang, Delhi and Hyderabad have also adapted development-based LVC for their metro systems. In Africa, countries such as Ethiopia have expressed their interest in LVC or land banking as an option to finance their rail systems.

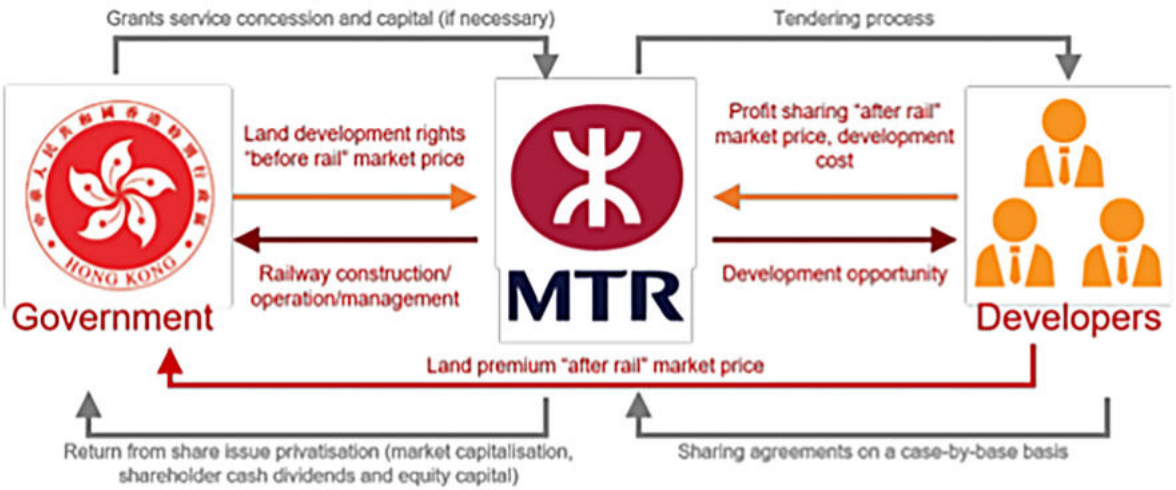


Figure 20: Framework of the Land Value Capture model in Hong Kong MTR project
Source: German Institute of Development and Sustainability (IDOS)

However, LVC projects pose greater complexity compared to standalone rail or real estate projects, primarily due to two factors. Firstly, they entail significant financial investment compared to real estate. However, forecasting profits from real estate development presents a greater challenge due to fluctuations in the market. Secondly, LVC involves intricate political coordination among various agencies, a process that can be susceptible to disruptions during transitions between different administrations.

Alternatively, railway initiatives can collaborate with businesses that capitalize on the connectivity and accessibility provided by rail networks, such as retail outlets, logistics centers, and warehousing facilities. In this context, collaborative ventures between public Rail Authorities and private developers might facilitate the realization of cargo-oriented developments and mixed-use projects, such as intermodal stations or industrial parks. These PPP arrangements could leverage the expertise and resources of different sectors to increase capital raising capacity, optimize land utilization, mitigate commercial risks, and deliver value-added infrastructure and amenities.

Loans, grants and credits from IFIs, ECAs and development agencies

Against a backdrop of limited bank loans and capital market financing, concessional financing from IFIs has been crucial for African railways to date as a development mechanism. Low tax bases and interest rates, together with lengthy concession periods, have allowed African nations to raise the capital required to undertake such projects. This is especially true for the SSA countries and only few of them have investment grade ratings and, hence, capital market debt is unaffordable at a reasonable cost. However, IFIs have traditionally been reluctant to grant large proportions of the loans needed for big infrastructure projects given that their main objective is not to act as a private investor but rather as a catalyst for the development of new initiatives. Consequently, their contribution has been often limited to a certain percentage of the required credit.

While IFIs have helped finance tens of thousands of projects for the transport sector in LICs and LMICs across all continents, there has been a visible predominance of finance for road projects over time, leaving rail infrastructure somewhat overlooked despite its clear green credentials. Furthermore, LICs receive only but a fraction of total funding, which is mostly directed towards emerging economies. In this sense, IFIs are undergoing changes concerning the scale and the prioritization of investments, that will see more of the finance they deploy directed towards projects with positive climate benefits. Many IFIs are progressively moving towards only financing projects that have outcomes that are Paris Agreement-aligned, which will see funding allocations for transport projects flow away from road and airports towards rail and ports.

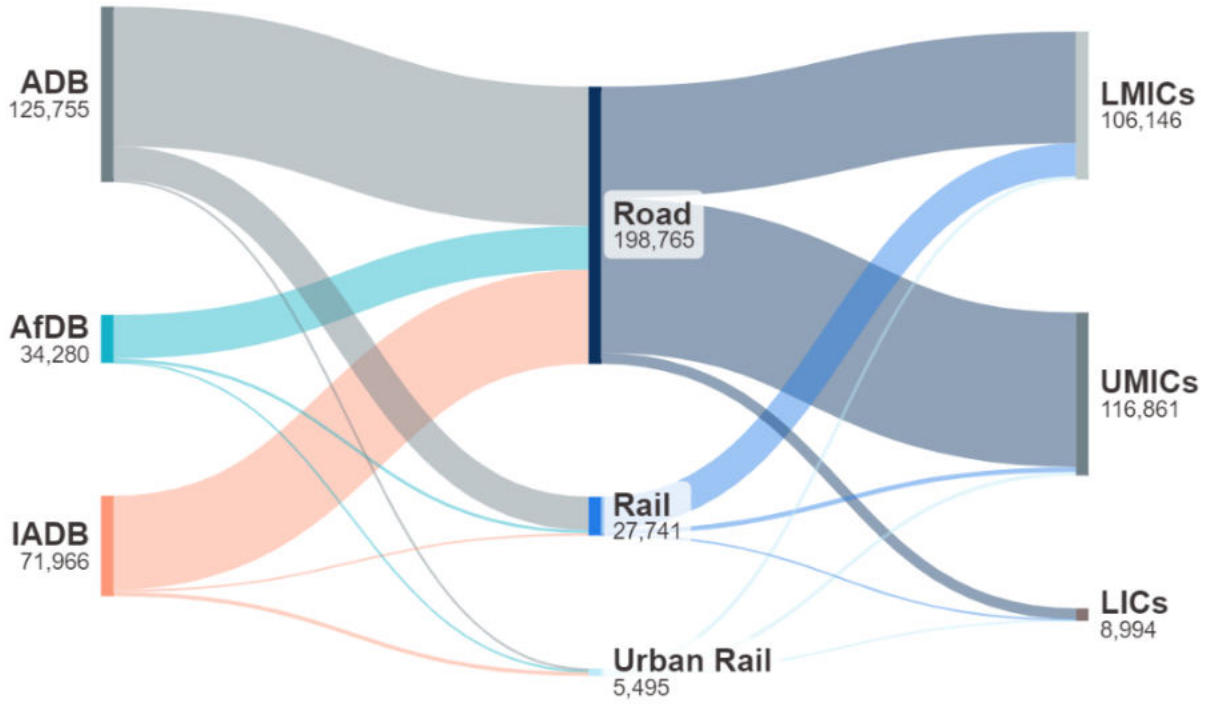


Figure 21: Resource allocation of investments to transport initiatives by IFIs *(Million USD adjusted to inflation)*
Source: UIC, University of Birmingham, ADB (1968-2023), AfDB (1967-2022), IDB (1961-2023)

As previously established, an alternative and so-far efficient financing mechanism to finance rail projects in Africa is through the involvement of Export Credit Agencies (ECAs) from OECD. These entities aim to support private businesses to export to low-income countries according to standardized rules governing the cost of the financings administered by the OECD. This funding mechanism is especially important with regards to financing rail projects that incorporate equipment manufactured in OECD countries (which may include rolling stock and signaling equipment). However, over 60% of the €650 billion mobilized during the last decade for financial support to LICs and LMICs has been directed towards India.

Export Credit Agencies (ECAs) play a crucial role in supporting large-scale projects, particularly in complex endeavors like railway undertakings spanning multiple jurisdictions. Their involvement enhances project success and attracts investment by providing stability, longer tenors, fixed or subsidized interest rates, and insurance against political risks such as non-payment and currency inconvertibility. Additionally, ECAs reduce political risk by leveraging the support of their respective countries, aiding developers in navigating challenges associated with international trade.

Similarly, development agencies form high-income countries, particularly China under the Belt and Road initiative, have recently offered a similar alternative to OECD countries' ECAs to finance rail projects. Recently implemented projects with Chinese funding to date include SGR lines in Ethiopia ($2.5 billion loan by China), Nigeria ($500 million concessionary loan) and Kenya ($4.7 billion loan).

While they have proved to be a powerful tool for infrastructure financing, many Belt and Road projects and ECA loans have been criticized for unsustainably increasing the debt levels of credited countries, as well as lacking sufficient preliminary studies and their inability to meet traffic forecasts.

Climate financing initiatives: Climate funds and Carbon markets

On the other hand, recent developments have seen numerous organizations and investors continuously expressing a desire to endorse environmentally friendly investments, leading to the development of various climate-specific financing instruments and incentive mechanisms designed to facilitate such endeavors in terms of both fund raising and risk-mitigation measures.

Climate funds are multilateral, bilateral, and philanthropic funds that provide grants and concessional financing

specifically to promote investment in climate change mitigation and adaptation measures. The challenge with climate funds is that their resources are relatively limited—in 2020 their total funding was $5 billion—and only a fraction of that went to rail.

Some multilateral funds that African countries can access include the Green Climate Fund (GCF), the Global Environment Facility (GEF), and the Adaptation Fund (AF). These funds were established throughout the years as financial instruments of the United Nations Framework Convention on Climate Change (UNFCCC) to provide resources to developing countries.

On the other hand, stemming from the implementation of regulations and taxes to reduce GHG emissions, carbon finance markets facilitate the trading of carbon credits, representing the reduction of greenhouse gas (GHG) emissions, or allowances, which grant the right to emit a specific quantity of GHG. In voluntary markets, organizations undertaking measures to permanently decrease GHG emissions can sell the corresponding reduction rights to entities seeking to offset their emissions. In compliance markets, regulatory frameworks limit the permissible level of GHG emissions and set emission reduction goals on nations (NDCs). Entities, either Governments, public or private companies, exceeding their allocated emissions or unable to meet their reduction objectives can purchase the right to emit from another entity not utilizing its full allowance. In both scenarios, a third-party verification agency applies standards to ensure that the GHG emissions have genuinely been reduced and are not claimed multiple times.

In 2015, within the framework of the Paris Agreement, each participating country set its own Nationally Determined Contribution (NDC), which define their commitment to reduce GHG emissions and combat climate change. Under Article 6 of the Agreement, countries that cannot meet their NDC goals can purchase carbon credits from other countries or entities that have exceeded their targets or invested in additional emission reduction projects. By purchasing these credits, they can offset their own emissions and fulfill their commitments under the Paris Agreement.

Simultaneously, an increasing number of companies are committing to combat climate change by reducing their greenhouse gas emissions. However, many businesses face challenges in fully eliminating or rapidly reducing their emissions. The challenge is especially tough for organizations that aim to achieve net-zero emissions. For many, it will be necessary to use carbon credits to offset emissions they cannot get rid of through other means. Consequently, the voluntary carbon market (VCM) has continuously grown over the last years. In 2021, the trading volume for voluntary emission reduction exceeded USD 2billion for the first time. The Taskforce on Scaling Voluntary Carbon Markets, sponsored by the Institute of International Finance (IIF), estimates that demand for carbon credits could increase by a factor of 15 or more by 2030 and by a factor of up to 100 by 2050, and that the VCM could be worth upward of $50 billion in 2030.

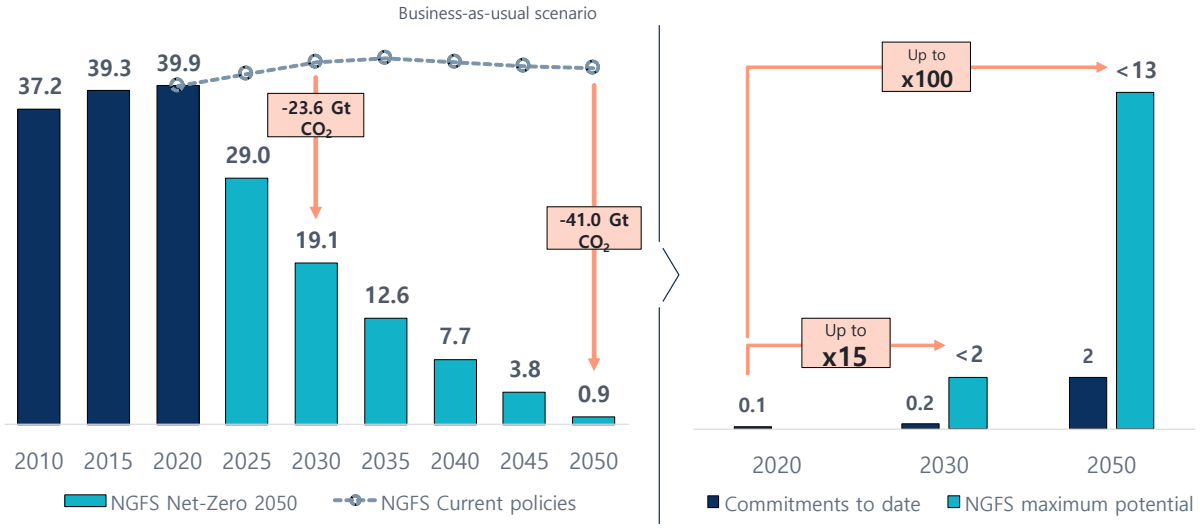


Figure 22: Total CO2 net worldwide emissions scenarios (Gt CO2 per year, 2020-2050) and voluntary demand scenarios in 2030 and 2050 (Gt CO2 per year, 2020-2050)

Source: AR6 Scenario Explorer hosted by IIASA, Network for Greening the Financial System (NGFS), TSVCM

Considering railways' capacity to absorb demand from road transport and thereby mitigate greenhouse gas (GHG) emissions, an opportunity emerges in these markets for generating additional revenue streams to finance railways. However, African railways must contend with the challenge that the validation process for GHG emissions offset are generally unclear and complex.

Debt financing: Commercial Loans and Bonds

Due to a limited sovereign treasury capacity and the natural dynamics of private investments, the greatest part of the financing for developing-country infrastructure projects have historically been provided by loans, often in conjunction with officially-backed export credit agencies (ECAs) or multilateral banks.

Loans are a source of funding with a great resource envelope and cost-effectiveness, for which they are very suitable for large infrastructure projects such as railways. Furthermore, banks offer expertise in managing construction risk and provide gradual disbursement of funds, aligning with project needs. Additionally, banks generally allow for easy renegotiation of debt terms, offering a certain degree of flexibility that can come in handful to address cost overruns or changing financial needs during the construction phase.

However, infrastructure projects necessitate long-term financing to meet their long lifespans and to mitigate refinancing risks. In this sense, bank loans face challenges due to their short-term liabilities versus long-term asset holdings, resulting in maturity mismatches. Furthermore, commercial loans granted by banks generally have high interest rates that hinder project viability and cause debt service burden. Not only that, but single borrower limits within bank loans restrict their capacity to finance large infrastructure projects, while bonds spread credit risks across a diverse pool of investors and are tradable, allowing for the transfer of credit risk before maturity. Additionally, banking regulations like Basel III[3] often make loans more costly, presenting opportunities for bonds to complement loans in infrastructure financing.

In contrast, capital debt markets offer long-term tenors and repayment obligations only upon maturity. Furthermore, they hold significant potential to attract long-term investors such as pension funds, insurance companies, and sovereign wealth funds, investors that are particularly suited for long-term portfolios.

While capital markets appear to be more suited for infrastructure financing through project or corporate bonds, several challenges have impeded an efficient capital disbursement and development of financing through these mechanisms. First, clients generally associated with bonds are more typical of developed financial and economic environments. The absence of such investors in African countries necessitates reliance on international commercial banks and pension funds. Yet, in Africa, associated risks (coin value devaluation, political, environmental, financial, etc.) and small financial markets have deterred international investment.

Only in recent decades has the situation begun to shift, presenting more favorable conditions for capital investments in some regions. However, in the recent past, banks have retreated from developing-country project financing through capital markets, even more so for below investment-grade rated projects.



[3] The Basel III framework is a central element of the Basel Committee's response to the global financial crisis. It addresses a number of shortcomings in the pre-crisis regulatory framework

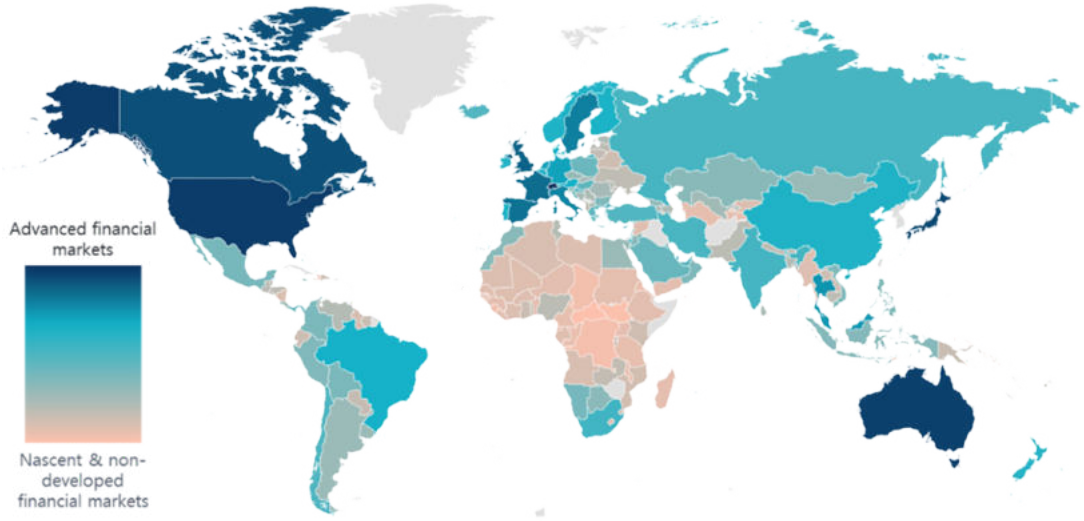


Figure 23: World Map of Financial Development (Financial Market Development Index[4], 2021). **Advanced financial markets are more likely to receive project financing in the form of capital debt markets**

Source: International Monetary Fund

Consequently, there has been limited recent activity in the capital markets for financing developing-country infrastructure projects. While a few successful long-tenor, below investment-grade project financings were launched in the more optimistic mid-1990s market, this approach has largely been abandoned in the current environment. With a renewed interest for infrastructure bonds, there is now a focus on developing new structures applicable to project financing, with the goal of increasing project bankability and achieving investment grade ratings for transactions in developing countries that would otherwise receive below investment-grade ratings.

In this context, the ability of properly-structured transactions to obtain financing in the capital markets has become more important. In order for infrastructure projects in developing countries to regain access to the capital markets, new forms of risk mitigation will be essential. The international capital markets, alongside local capital markets, represent vast sources of financing that can significantly contribute to economic development, provided effective transaction structures are developed.

	PROS	CONS
Railway Funds	– Allows for the integration of multiple and flexible sources of non-tax revenue – Ideal to cover O&M costs – Only for railways, independent of other sectors	– Limited resource envelope for infrastructure investments, specially in the short term
TOD & Value Capture	– Take full advantage of economic benefits of railways in economic development and other sectors – Offer revenue structure flexibility through taxes and wide range of options for private involvement	– Pose greater complexity in financial terms, regulatory frameworks & political coordination – LVC is best suited for urban projects
IFIs, ECAs & other multilateral	– They provide technical assistance and risk mitigation for political risks, non-payment or coin devaluation – Provide financing with low interest rates and long repayment periods that facilitate feasibility	– IFIs are reluctant to grant large loans for big infrastructure projects and have stringent conditions – ECAs and development agencies have caused debt distress in some countries where they invested
Climate financing & carbon market	– Take advantage of global environmental concerns – Carbon markets, either voluntary or compliance, can bring external revenue for railways and are set to grow swiftly in the following years	– Limited resource envelope and risks of market volatility and greenwashing – Emission for carbon credits needs verification that can be challenging, costly and time-consuming
Commercial Loans	– Great resource envelope and possibility of gradual disbursement – Offer aid and expertise in managing risks during construction	– Have maturity mismatches with infrastructure projects – They might cause debt distress & service burden – Single borrower limits and banking regulations
Capital debt markets	– Great resource envelope and long-term maturity – Bonds allow for multiple investors and are tradeable	– Typical of established capital markets – Very susceptible to risks present in African infrastructure (political, coin devaluation, market...)

Figure 24: Main benefits and drawbacks or risks of alternative funding sources in the African context

[4] Index conceived by the International Monetary Fund (IMF), which comprises the following indicators: stock market capitalization to GDP; stock market total value traded to GDP; international debt securities of Government to GDP; total debt securities of financial corporation to GDP; and total debt securities of non-financial corporation to GDP

Key takeaways

- The challenge of raising funds and financing railway infrastructure projects is the **primary impediment** to both the development of new rail lines and an efficient O&M.
- Sovereign financing, historically the most common, relies on public funds but faces constraints due to **limited tax revenues and competing investment sectors.** The low **sovereign debt limits** hinder the ability of nation's to take loans to fund rail projects
- Complete reliance on private funding directly under the sponsor's balance sheet is almost exclusive of mining projects. Instead, project financing through **Special Purpose Vehicles (SPVs) is a prevalent approach to incorporate private funding in PPPs.**
- Attracting private investment during the early project stages and construction phase is challenging due to the higher associated risks
- Some countries have set up **innovative mechanisms** to increase the **sovereign capacity** to undertake railway developments and increase rail revenue, such as **Rail Funds or TOD/LVC**
- **Loans suffer maturity mismatches** with long-term railway projects. **Capital debt markets** fit infrastructure project financing needs but they **require an economic environment** most African nations are deficient in. **Risk mitigation strategies** and efficient transaction structures c**ould help unlock** this source of financing, as well as other kinds of private investment.
- African railways **rely mostly on loans and concessional financing** from International Financial Institutions (IFIs), Export Credit Agencies (ECAs), and development agencies
- Railways could benefit from their lower external costs to acquire **financing through a number of new methods recently developed (carbon credits, climate funds)** and by exploiting public interest in greener transport

3.2.5 Operation and safety

Africa's railway operations are significantly limited compared to global norms, managing only a small fraction of the world's freight and passenger rail traffic. Railways, renowned for their efficiency in handling large volumes of traffic, outperform other modes of transportation in this regard. However, Africa contributes merely 2% to the total volume of freight and less than 1% of passenger rail traffic worldwide, according to UIC. This illustrates the reduced size of the railway market in Africa, especially sub-Saharan Africa, appearing as one of the main reasons for the financial struggles of railways in the region.

Most African railways offer both passenger and freight services, despite freight being the most prominent type of traffic. Particularly, freight traffic in Africa is dominated by bulk and semibulk commodities, mostly being carried to and from seaports. In this sense, South Africa's Transnet is responsible for most freight traffic, mainly due to the transport of coal, iron and other mining products. In the latter years, South Africa's railway network has suffered intensely from maintenance issues and vandalism, hindering capacity and severely diminishing Transnet's freight volumes. Given Transnet's magnitude at a continental level, and despite other countries maintaining or increasing their freight volumes, Africa's overall freight traffic has decreased by about 35% from Jan-19 to May-23 and 20% with respect the first half of 2022, according to UIC reports.

On the other hand, passenger transport in Africa is spearheaded by the Northern states of Morocco, Algeria and Egypt, which account for over 80% of passenger services in Africa. South Africa's PRASA has historically been an important passenger mover

in the southernmost part of the country, but has suffered the same fate than its freight counterpart. Conversely, other networks around the continent have opened or increased their passenger traffic volumes, contributing to an apparent overall growth of passenger volumes at the continental level. Notably, new rail developments such as Nigeria's SGR, TER Dakar or Morocco's High-Speed line are bolstering passenger transport within and between large urban areas.

Other than track maintenance discussed in previous sections, most railway lines currently operate significantly below capacity levels due to rolling stock shortage. For instance, a study in Ghana in 2012 showed that only 7 locomotives were available out of the 39 available in the fleet. Maintenance issues and aging rolling stock compound the challenges posed by financing issues, resulting in small operational fleets. Such drawbacks are evidenced by the low traffic densities in African railways, especially in Sub-Saharan Africa.

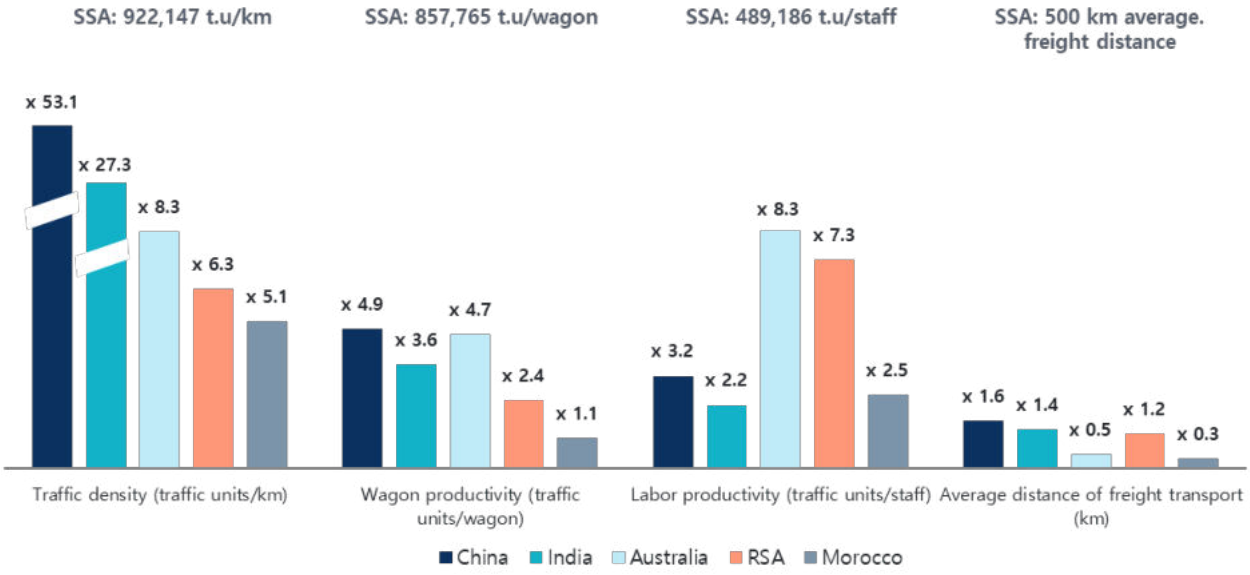


Figure 25: Main performance indicators of Sub-Saharan African railways compared to other countries (2010)
Source: SSATP

The Maghreb railway systems in Morocco, Algeria, and Tunisia exhibit traffic densities similar to numerous European systems (2-4 million traffic units/km). South Africa has historically displayed similar levels to North Africa and Europe, but recent deterioration of its railway system has seen traffic density decline. In contrast, only three railways in Sub-Saharan Africa boasted traffic densities exceeding a million, with many averaging less than 500,000. In other terms, African railways are generally lightly loaded and lack critical mass compared to global standards. This represents a huge constraint for the development of African railways since high volumes and frequencies are the foundations of the operational sustainability of any railway system. Moreover, other historic performance indicators also evidence room for efficiency improvement and resource optimization in African railways.

Yet, details regarding Africa's freight transport are indicative that there is a great potential for further development given its average freight transport distance at approximately 500 km. This is an excellent haulage for railways to maximize the railway's operative and gain a competitive advantage respect to other modes, which may not be as efficient in such distances.

Such lack of maintenance stands not only from the lack of investment but also from a lack of capacity. There are almost no maintenance facilities at a continent level with South Africa (Transnet) being the only nation with a great distribution of maintenance depots across its territory. Not only that, but South African facilities are explicitly for narrow gauge rolling stock. In consequence, while some African countries have set up parts manufacturing facilities and are able to perform

minor repairs, most major maintenance interventions have to be carried out abroad (especially SGR rolling stock). Manufacturing and maintenance in-house are further complicated due to a lack of technical expertise.

In addition to these underlying issues, the railway market's development has been impeded by Governments' prioritization of a thriving road transport sector. Policy support for trucking, as the dominant mode for freight movement, coupled with economic growth, has bolstered the market position of road transport. The presence of large logistics operators, exemplified by ESLSE in Ethiopia, contributes to a market environment favoring truck transportation. Moreover, the well-established road sector often provides competitive door-to-door service and has been seen to rapidly adjust pricing to maintain market share, thereby presenting a challenge to rail. In addition, the lack of regulation and control of road transport has impeded fair competition between the two means of transport.

However, road transport's dominance has also resulted in significant drawbacks for the trucking sector and society overall. First, the transport of large bulks on roads has generally resulted in damaged roads with insurmountable infrastructure maintenance costs. The unproper condition of roads, in turn, coupled with a poor regulatory framework, brings high accidentality rate and truck maintenance need. Furthermore, road congestion and other external costs are beginning to be outlined as significant challenges.

Some Governments have attempted to promote modal shift from road to rail through policies of varying rigidity. For instance, Kenya mandates compulsory containerized movement by rail from Mombasa inland, though outbound traffic primarily relies on trucks due to competitiveness. Similarly, countries like Cameroon and Tanzania have implemented axle load controls to encourage rail usage for heavy bulk freight transport. However, achieving modal share targets for rail, typically around 30%, necessitates collaboration with truck transport companies in consonance of the implementation of such road-to-rail incentives and policies to ensure a smooth transition.

Furthermore, as established before, many African railways, excluding those in South Africa and North Africa and new developments, continue to operate at their original construction standards. These railways are typically only capable of accommodating lightweight and slow-moving trains, with prolonged poor maintenance leading to severe track deterioration in some areas, impacting competitiveness and rolling-stock productivity. While this situation may be acceptable for low-volume feeder lines, it poses a major disadvantage when compared to the modern roads being developed in key transportation corridors.

On the other hand, safety is a widely recognized essential precondition for successful rail businesses. Internationally, railways typically operate in a highly regulated environment that sets standards for safety. The degree, structure and organization of safety regulation varies widely between nations. In contrast, most railways in Africa have very weak regulatory bodies or are self-regulated. This means that operators set their own standards, investigate their own incidents and are accountable to no one in particular for safety performance. RSR is the most established regulator, working in South Africa and also operating in some neighboring countries (Botswana, Swaziland). While it is very efficient and is the closest to European regulators, its autonomy from service providers, which are both public corporations, may be perceived as insufficient, being quite susceptible to the interests of the operators and the Department of Transport.

South Africa's regulator is tasked with both overseeing railway safety and conducting investigations into rail accidents. In contrast, most benchmark countries utilize independent boards to carry out investigations into rail accidents. According to the Railway Safety Act Review Secretariat (Transport Canada), it is crucial for the investigating agency to operate independently and be devoid of any conflicts of interest while scrutinizing accidents to foster public confidence in the transportation accident investigation process.

The RSR is mainly funded from Government grants and permit fees. However, in the coming years there is a drive to ensure that the RSR gets funded only from permit fees as opposed to relying more on Government funding. This is in-line with the Government's user-pay principle and the prospects for open access in the near future. This can also help to ensure that the regulator is more independent from the Government and that it delivers value for money to the operators responsible for funding it.

Even with a somewhat sound regulatory body, South Africa has an accident rate far above those of developed countries. Conversely, Morocco, lacking a regulatory agency, maintains a lower accident rate, although it still surpasses international benchmarks. Overall, this comes to show that the implementation of regulations and regulatory agencies is only but a component of rail safety. The condition of tracks, proper signaling, state of rolling stock, active safety protocols, staff training, and regulation are equally important pieces of the rail safety puzzle. If any of these components falls short, the entire system suffers. In the case of Africa, work is being carried out to address challenges across all of these topics.



Figure 26: Accidentality (derailments, collisions, damage to persons, level crossing and others) in African countries compared to benchmark European and Japanese railway systems (accidents/ million train-km, data has been obtained from the last 5 years of operation of the different infrastructure managers)
Source: UIC Railista, RSR & Transnet Annual Results

With derailments being the most prominent type of accident across Africa, most efforts for safety improvements are being placed on infrastructure enhancements and rolling stock maintenance and renovation. Its key relationship to operational performance also sets infrastructure as the priority for most railway infrastructure managers. Other initiatives to bolster safety across the sector include staff training and the implementation of safety protocols. In Egypt, the World Bank is also supporting the creation of a database for safety incidents, which will help ENR monitor and analyze incidents in a more systematic way to prevent reoccurrence.

Key takeaways

- African railways have a very **reduced market size** and operate with **very small traffic densities**, contributing to the **financial unsustainability** of the sector
- Freight traffic in Africa, primarily bulk and semibulk commodities, is dominated by South Africa's Transnet. Despite positive developments elsewhere, issues within Transnet's network have causes global freight traffic levels to decrease in recent years.
- Passenger transport is led by Northern African states and is growing at a continent level and specially thanks to new lines connecting and within urban metropolises
- African railways generally **operate well below their original design capacity** due to poor track condition, lack of locomotive and wagon availability (due to financial challenges and lack of capacity to manufacture rolling stock locally) and low operating capital.
- Governments' **historic prioritization of road transport**, coupled with policy support and economic growth, has bolstered **road transport's dominance over rail**, despite drawbacks such as high accident rates and road infrastructure maintenance costs arising
- Some Governments have started promoting **modal shift from road to rail** through different policies, but are generally insufficient and not supported by an efficient railway alternative
- Weak regulatory bodies and self-regulation among operators raise **safety concerns,** with derailments being the most common type of accident. Efforts are underway to improve safety through infrastructure enhancements, rolling stock maintenance, and staff training

3.2.6 Key lessons learnt from the sector diagnosis

- Africa's railway infrastructure grapples with a number of challenges including a lack of common technical standards, fragmented networks with low densities, poor intermodal connectivity, and significant deterioration, compounded by issues of funding, monitoring, and security

- The African rail sector faces institutional challenges including the absence of continental and regional coordination bodies, blurred lines between policy formulation and service provision, and insufficient regulatory oversight, all of which hinder safety, competitiveness, and sustainable development efforts

- Governmental entities predominantly own and manage railways in Africa, with limited private sector participation. While some PPPs have been attempted and contributed to infrastructure improvements, they faced many challenges like institutional weakness, insufficient infrastructure investment and improper risk allocation. Effective separation of infrastructure and operations and third-party access, models seen in Europe, are beginning to gain relevance in Africa but remain exceptions

- The primary challenge in financing railway infrastructure projects in Africa stems from limited public funds, debt ceilings and difficulties in attracting private investment, necessitating innovative approaches and leveraging external concessional financing sources such as ECAs, IFIs and climate funds

- African railways face significant challenges including infrastructure and rolling stock maintenance issues and small fleets that result in a reduced market size and densities, contrary to the economies of scale needed in railways; fierce competition from a policy-favoured road sector; and safety concerns

3.3 New rail developments and initiatives

In order to reverse the sharp decline in rail use in Africa observed in recent decades and meet environmental targets, the continent has several initiatives planned in the rail sector for the coming years. This includes extensions of existing networks and planned new rail lines at a regional, national, and metropolitan level, in some stage of planning or under construction. The following are some of these examples of relevant rail projects for the African continent:

- **Regional** (74,000 km):

  - AIHSRN (African Integrated High-Speed Railway Network), a continental initiative to link all political and economic capitals through a standard-gauge HSR network by 2063, at a design speed of 240 km/h. In 2033, the first phase of the project will include 19 covering a total length of 16,970 km, while 62 more connections will follow by 2063, for a total HSR network of almost 74,000 km
  - ARN (African Railway Network), a continental freight rail backbone linking different regions of the African continent and providing landlocked countries with rail connectivity to major seaports. This will be a freight focus sub-network of AIHSRN

- **National** (~15,000 km):

  - **Namibia and Botswana:** Trans-Kalahari Railway (TKR), spanning 2,000 km to connect Walvis Bay in Namibia and Gaborone in Botswana via Windhoek. The project is currently at an EOI stage, inviting potential investors that are interested in the design, build, finance, operate, maintain, and transfer the project to Member States
  - **Tanzania and Rwanda:** Dar es Salaam-Kigali Railway, including a 1,500-km SGR line to link the two cities via Isaka. The project is partially completed, while some sections are under construction or planning process.
  - **Kenya and Uganda:** Mombasa-Nairobi-Kampala Railway, including a 490-km extension of the SGR from Nairobi to Malaba (on the Kenya-Uganda border) and the Malaba-Kampala section, currently under planning stages

- **Ethiopia, Djibouti, and Sudan:** including a 1,500-km SGR line between Ethiopia and Port Sudan, planning to finalize the feasibility stage by December 2025
- **Cameroon and Chad**: Cameroon-Chad Railway, encompassing a 700-km line between Ngaoundere and N'Djamena (under feasibility assessment, to be finalized in Dec '23), and a 500-km line between Mbalam and the Atlantic coast, to be funded by Chinese investors to facilitate iron ore export
- **Nigeria**, with several SGR projects spanning 2,700km in total
- I**vory Coast, Ghana, Togo, Benin and Nigeria,** with the West Coast High-Speed Rail Project
- **Morocco, Algeria and Tunis,** mainly focused on high-speed developments, with the HSR lines in Morocco (the first high-speed rail line inaugurated in the country) and the Trans-Maghreb lines (connecting Morocco, Algeria and Tunisia over a distance of more than 900 km, potentially extended to reach Libya's planned rail network as well.
- **Egypt,** aiming to build a 500-km SGR from Alexandria to Aswan at a high speed, recently awarded recently to NGE for the construction

- **Metropolitan** (<1,000 km):

  - **Nigeria:** Lagos Rail Mass Transit is to inaugurate its second line (Red Line) in early 2024
  - **Senegal:** The second phase of the Regional Express Train (TER) will connect the capital of the country to its airport through with a double-track SGR line for passenger trains and a single-track 1,000 mm gauge freight line. The 19-km extension is currently under construction.
  - **Ivory Coast:** The Abidjan Metro (Rapid Transit) project encompasses the construction of a 37.5km of double-track rail line connecting the suburbs with Abidjan and is set to open in 2025
  - **South Africa:** Gautrain Rapid Rail Integrated Network extension will span over various areas, with feasibility studies predicting almost 150km of new rail, and will be developed in several phases under a PPP model
  - **Ghana's** Accra SkyTrain (Rapid Transit) project is in feasibility stages and will have a total track length of 194km, expected to be implemented in three phases

In summary, based on the projects planned/ undergoing on the African continent and taking as a reference the development observed in comparable regions such as South America, it is estimated that the growth potential of railroads in Africa for the next 10-15 years can reach 40%, including more than 37,000 km-lines of new construction. This would mean that the continent could reach 125,000 km of railways by 2035.

Such growth would be driven in part by the development of high-speed rail, with the AIHSRN (African Integrated High-Speed Railway Network) project. The project includes a first phase with a development of 16,970 km of high-speed tracks over the next 10 years (2033). Investment requirements during this initial stage are estimated at $400 Bn, assuming unit costs similar to those of the Agadir-Casablanca high-speed project (the only high-speed line in the entire continent).

As for the remaining rail growth potential (55%; more than 20,000 km; out of which more than 15,000km are already planned or under construction), this would be driven by the development of conventional tracks for freight and passenger transport, at metropolitan, national and regional level. This would involve an investment of more than $150 Bn in design and construction of rail infrastructure (assuming a unit cost per km based on comparable rail projects in the region), plus all the investment derived in rolling stock (which could exceed $30 Bn).

While the development of the AIHSRN project and most large railway initiatives has been carried out mostly from an infrastructure point of view, it is crucial to consider the symbiotic relationship between rolling stock and infrastructure in all railway projects. With more than 170k wagons expected to be needed in the African continent for the following years (20%-30% of infrastructure cost), the supply, maintenance and operation of mobile equipment is going to be a pillar for the development of the sector in Africa.

There is a generalized trend of developing SGR greenfield projects as a means to attain a harmonized, interoperable network. However, such SGR projects come with high associated costs and could involve interoperability issues with the existing narrow-gauge networks, as seen in recent

developments. Furthermore, past SGR projects parallel to existing lines have generally had mixed results, with questions raised regarding the return on investment on their huge costs. Particularly, it was determined that upgrading existing lines could cost only around 25% of the investment of building a parallel SGR. In this context, Africa needs to address its next steps regarding the development of its continental network, the degree of cost-effectiveness in new greenfield projects and the issue of interoperability.

All this paints an exciting landscape of rail development in Africa, which will require organized and harmonized planning across the continent, to ensure network interoperability, sustainability and optimal performance.

3.4 Summary of the main challenges faced by the sector

Except for some lines in southern and northern Africa, most lines are outdated, inefficient and below international standards. This can be mainly explained by the following systematic factors:

- **Poor regulatory and institutional framework:** The African rail sector lacks of effective regional and continental coordination institutions and regulations, an insufficient regulatory oversight and a lack of transparency and accountability that hinders the separation between policy-making and services; and a lack of efficient management models; all which hinder competitiveness, safety, and sustainable development.

- **Infrastructure fragmentation:** In most of Africa, railway lines were built by private or military entities to connect interior cities and production facilities to seaports, thus resulting in a series of individual lines stretching inland from the coast that are not connected to each other. Other than Southern and North Africa, which have developed extensive networks, most countries continue to possess only independent railways, disjointed from other neighboring's countries railway systems.

- **Low railway network density:** Africa accounts for only 8% of the world's total railway length, despite encompassing 23% of



the world's surface area and approximately 18% of the global population.

- **Lack of harmonization** regarding regulations, safety requirements, operational procedures, track gauges, and other technical parameters. The varying standards across both national railway lines and in cross-border settings often result in increased costs and capacity limitations.

- **Limited electrification, and majority of single-track lines,** which limit the network's operational efficiency, capacity, reliability and competitiveness. The worrisome aspect of the electrification issue is further exacerbated by the fact that not only does electrification currently stand at only 15%, but the constrained energy supply capacity in most African countries also significantly hinders the feasibility of operating electrified networks.

- **Limited financial resources:** Due to weak internal revenue generation and challenges in tax collection of most African countries, infrastructure development has historically relied on concessional financing and IFIs. Additionally, several African nations face difficulties raising capital from capital markets at an affordable cost, resulting in limited access to private financing schemes for infrastructure. This financial constraint has historically hampered Africa's ability to undertake new railway projects and adequately maintain existing systems.

- **Inadequate maintenance of infrastructure and rolling stock:** The limited financial resources involved in railway maintenance, as well as limited knowledge, have led to structural underinvestment in infrastructure (extreme wear of the track, insufficient ballast, deteriorating earthworks; poor condition of most structures such as bridges, tunnels and stations; obsolete signaling and telecommunications; bottlenecks and high accident rates) and rolling stock (poor technical state of the fleet, sometimes extremely aged and too heavy to operate on the existing structures).

- **Low handled volumes compared to road transport:** Governments have long prioritized road transportation over rail, while economic growth has fueled increased motorization, reinforcing the dominance of the road transport market, which is responsible for about 80% of total freight and 90% of passenger transportation in Africa. Furthermore, road transport's competitiveness and lack of policies benefiting rail transport translate to rail demand issues and the inability to generate sufficient revenue, further complicating the financial sustainability of railways in Africa.

- **Limited interoperability with other modes** and last-mile challenges for rail lines, resulting in high associated costs, can be attributed to the absence of comprehensive intermodal infrastructure planning that fails to incorporate, among others, the operational considerations from the private sector.

- **Limited availability of expertise:** There is a shortage of solid railway expertise that is not being solved through specific training. This issue affects all types of positions, from the most operational positions to top management, and to both the public and private sectors. The lack of local experts results in reliance on external operators, with the search for competent operators proving to be a challenge




OFF

4 Pillars for railway development in Africa.

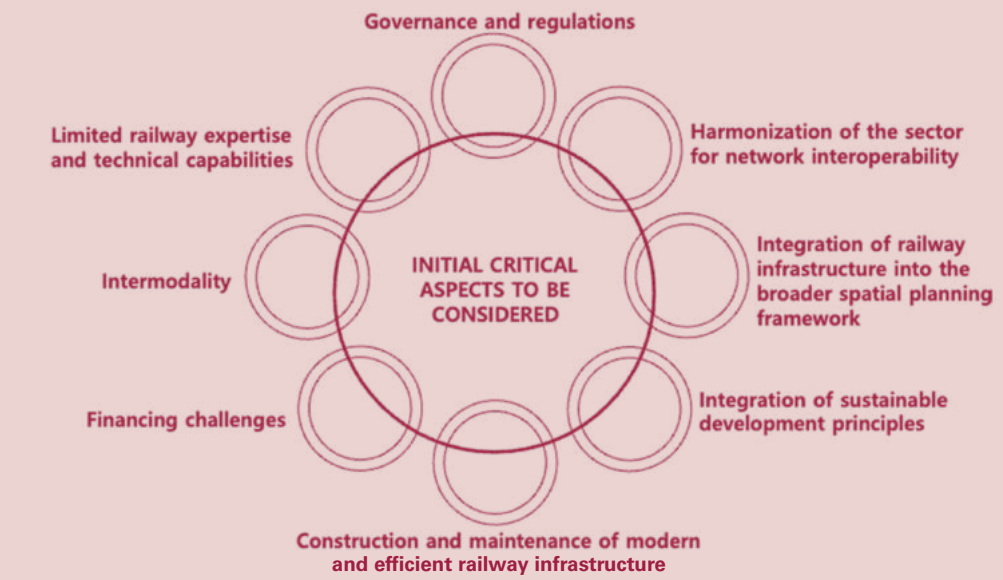


Figure 27: Building blocks for the development of railways in Africa

- **Governance and regulations,** supported by the coordination at all levels and a solid regulatory environment

    - Effective national institutional framework, management models (with a clear allocation of risks between parties) and market access regimes for the railway sector in African countries
    - Regional rules and regulations applicable to the railway sector in Africa, including specific legal frameworks and policies to support a modal shift to rail
    - Railway regulatory agencies or bodies for monitoring compliance with continental regulations, procedures and updates

- **Harmonization of the sector for network interoperability,** to ultimately secure interoperability between lines in African countries and put an end to disjointed sub-networks of varying gauges and operating standards across regions and countries. This block shall address:

    - Harmonized technical standards: track, structure and loading gauge; traction power; signaling, control and telecommunication systems; rolling stock, couplers and breaks; safety specifications; operating standards (design speed, train length, maximum axle load…)
    - Domestication strategy, to effectively implement these continental technical standards and procedures at the national level, building on the specific strengths and weaknesses of each country in Africa. Also, regional organisms to oversee

compliance with these continental technical standards and procedures, enforcing the interoperability and safety of the African railway network
- Common cross border procedures, to minimize delays at border crossings points, which can help reduce overall transport costs and increase the attractiveness of the rail alternative

- **Integration of railway infrastructure into the broader spatial planning framework,** including all modes of transport at different levels

  - Master planning to integrate all transport modes (land, sea and air) and levels, i.e. regional, national and metropolitan, with a clear project evaluation and prioritization framework, to effectively prioritize those investments (identified in the Master Plan) that generate the greatest impact on the continent, economically, socially and environmentally
  - Coordination of the different stakeholders involved along the complete transport chain, including Government agencies at different levels and private sector partners (focusing on truck transport companies), for an integrated planning at a continental level and coordinated executive of future infrastructure investments
  - Project preparation and readiness assesment, to ensure that sufficient planning is undertaken prior to construction, both in terms of design and resource mobilization

- **Integration of sustainable development principles,** leveraging climate/environmental, social and financial aspects

  - Climate and environmental considerations: implementation of eco-friendly and energy-efficient technologies and strategies for transport decarbonization, network electrification plans, climate adaptation and resilient design…
  - Social aspects: boosting local employment and economic trade coupled with gender inclusion, development of new railway related manufacturing industries, reduction of health risks to people by improving air quality and reducing accident rates… Monetizing the economic benefits of railways for a comprehensive business case
  - Financial sustainability over the entire useful life of the railway asset

- **Construction and maintenance of modern and efficient railway infrastructure,** to ensure an efficient and cost-effective development and operation of the rail network in future years, addressing:

  - Address the key challenges faced in rail infrastructure construction projects across the continent, implementation of clear standards, thorough feasibility studies, consideration of previous infrastructure (brownfield vs. greenfield), robust procurement guarantees, and the adoption of new technologies and best practices in construction management
  - Tackle the critical challenges faced in rail infrastructure operation & maintenance (O&M) in African countries: stringent and costly periodic maintenance activities vs. budgetary constraints (especially for high-speed lines), aging infrastructure increasing O&M costs, high replacement costs of spare parts, demanding safety standards, implementation of innovative technologies for monitoring network maintenance and operation (predictive maintenance, smart tracks, automated inspections…), etc. This requires to accurately estimate future operating and capital expenditure requirements (OpEx & CapEx), for an effective budget allocation to meet maintenance needs
  - Face the main challenges around the procurement of rolling stock in Africa and how the Luxemburg Protocol and other treaties can help in this regard:

debt credit risk perceived as being too high, outstanding demand for rolling stock in future years, lack of a common procurement strategy, lack of local manufacturing industries…

- **Financing challenges,** to bridge the funding gap of the sector both during construction and operation stages, which is one of the main bottlenecks for the development of the railway network in Africa
    - Sound financing mechanisms for new railway developments, to face the huge investment costs of the sector: Public leverage on levies during construction and debt return, such as specific Railway Development Fees; Multilateral financing, concessional loans, grants, guarantee to credit enhancement; Commercial financing, capital debt markets; Structuring of private investment and participation; seeking for alternative PPP options; Climate funds; Alternative sources: Tax Increment Financing, Railway Funds, Land banking or Land development charges, etc.
    - Secure financing for the O&M of the existing and future railway network, to bridge the gap between operational revenues and operational cost, studying the need of Government subsidies (specially for passenger services). Railway Funds can help in this regard, by earmarking different revenue sources
    - Railway agencies for the oversight of Construction and O&M funds
- **Intermodality,** for a seamless multimodality in end-to-end transportation of people and goods
    - Policies to promote intermodality to ultimately mitigate its high associated costs and address the last-mile challenge
    - Intermodal infrastructure planning, incorporating private sector operational considerations already in early planning stages
    - Harmonized Design & Construction specification for intermodal stations, to address overheads and operational bottlenecks, and establishment of a monitoring performance framework at intermodal stations, addressing operational times, costs, quality of infrastructure, layout configuration
- **Limited railway expertise and technical capabilities,** to address the urgent call for a well-sound capacity building of staff and institutions involved in the African railway sector
    - Capacity building enhancement initiatives to increase railway expertise at all levels: managerial, design and construction, O&M, safety, railway-related manufacturing industries, sustainable infrastructure, innovative technologies, etc.
    - Skill transfer programs with international and local experts, for knowledge and lessons-learn sharing between African countries
    - Harmonized training programs and certifications, consistent with international standards and global best practices. Regional certification agencies or institutions, with regional Centers of Excellence for the railway sector in Africa to act as knowledge hubs and R&D facilities

4.1 Governance and regulations

4.1.1 Institutional framework, management models and market access

The future of railways in Africa holds immense potential for driving economic growth, fostering regional integration, and enhancing connectivity across the continent. The success of railway development in Africa is intricately tied to the establishment of a sound institutional framework capable of effectively managing railway policy-making, regulation, infrastructure planning, implementation, operation and regulation.

Institutional framework. Continental and regional level

First, the development of a unified African network necessitates significant volumes of technical work,

coordination and continent- and regional-wide policies led by specialized and industry-focused bodies. While the African Union holds an important role in infrastructure planning and development at the continental level, the institution has a significantly broad spectrum and does not have a specialized railways arm. Parallelly, AUDA-NEPAD's attributions focus mainly on the technical work to support the implementation of projects. None of these institutions serve that necessary purpose.

Realizing this gap, the AUC initiated efforts to revitalize the Union of African Railways (UAR), a process that should be accelerated in the following years to establish a strong continental agency for railway development and promotion. Much alike SARA's part in SADC, UAR could act as the railways arm of the AUC.

To lead continental efforts effectively, a revitalized UAR should undertake several responsibilities:

- Firstly, it should help integrate railways continentally and develop common strategies to optimize network efficiency and connectivity, coordinating efforts for railway development
- On the other hand, UAR should spearhead the development of viable common standards and safety requirements to ensure uniformity and reliability across the continent's railway systems
- Thirdly, the agency should take the lead in reporting on rail safety to enhance transparency and accountability, encouraging member states to set up regulators, publish performance and financial reports and undergo external auditing
- Additionally, UAR could also lead alternative efforts to create unified standards for other aspects of rail operations, such as procurement processes and project prioritization frameworks

The Union of African Railways should take a leading role in the development of the sector mirroring the part the European Union Railways Agency (ERA) has played in railway development in the European continent. However, it is important to acknowledge that directly emulating the ERA's strategy in the short term may not be feasible, given the large workforce, coordination efforts and resources required. This challenge is magnified by the fact that Africa is significantly larger than Europe. Nonetheless, the European model could serve as a valuable long-term goal for a reinvigorated UAR.

To address the scale and complexity of Africa's railway development needs, UAR should adopt an approach that recognizes the work carried out and importance of regional associations. Particularly, the Southern African Railway Association (SARA) demonstrates a successful example of a regional cooperation agency in the railway sector, showcasing the effectiveness of collaboration on a smaller scale. Similarly, other regional bodies like the Comité des Transports Ferroviaires Magrébin (CTFM) and some regional corridor authorities (For instance, CCTTFA) have been instrumental in guiding railway development within their respective areas, despite the different institutional nature of the latter.

By closely collaborating with regional agencies like SARA and CTFM and drawing lessons from their achievements in guiding new developments and promoting regional collaboration, UAR can enhance its effectiveness in revitalizing the African railway sector and achieving continental integration and development goals. Additionally, there's an opportunity to explore the creation of similar regional bodies in other parts of Africa to address the specific needs and challenges of different regions. Just as UAR aims to be the technical arm for continental railway policies for the African Union, regional associations could help guide RECs on the development of regional policies.

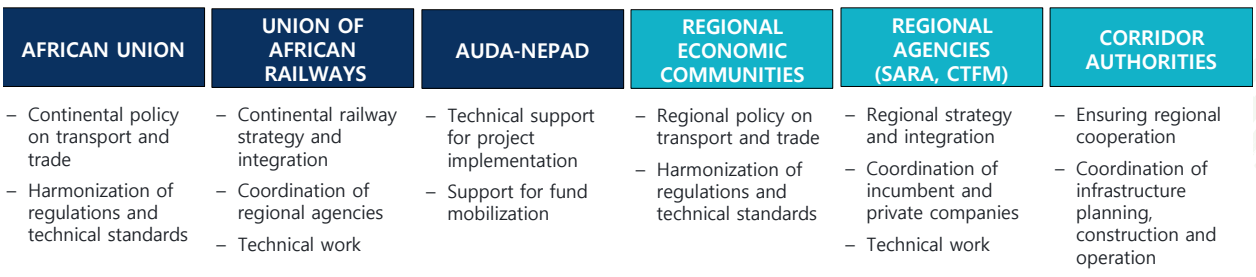


Figure 28: Main stakeholders within the suggested institutional framework at the continental and regional level

Institutional framework. National level

At the highest level of national railway governance, most African countries consolidate their transportation oversight under a unified Ministry of Transport encompassing all modes (**joint-up governance**). This is considered as the best-case scenario, as it aids in formulating integrated legislation and policies for an efficient development. However, many ministries may lack a dedicated directorate for railways, which could result in a shortage of expertise for specialized policymaking and planning.

A slight review of the institutional framework of railways should be conducted to ensure the independence of railway companies, either infrastructure managers or public operators, from their respective Ministry of Transport. This is crucial to promote clarity, accountability, flexibility and adaptation to changing circumstances, as well as efficiency from both the government and operation.

Railway public sector bodies should be corporatized and allowed a high level of autonomy in their decision-making, with management made accountable for meeting government policy objectives. Corporatization is commonly a prerequisite to accessing the financial markets, as lenders and investors would like to assess the borrower's financial performance and its ability to generate revenue before any deal is closed. Moreover, any public railways wishing to access international financial markets should be prepared to be audited by international credit rating agencies. Railway companies elsewhere and railway associations such as UIC can provide valuable examples and know-how regarding the organizational structure of such commercial entities.

While many African states uphold the **separation between policymaking and service delivery,** and most public railway companies have already adopted a corporate structure, only a handful meet the rigorous criteria expected in the private sector. These criteria include the publication of independently audited annual reports and financial statements, which are essential for transparency and accountability.

When it comes to the delineation of ministerial responsibilities and operations, one of the most prominent challenges in Africa is that an important share of railways (mainly publicly owned) are self-regulated. Even where regulatory bodies exist, these have appeared to lack independency, efficiency and enforcement capability. Such absence of independent regulation and inadequate monitoring tools pose challenges for ensuring an appropriate separation of responsibilities, as well as safety, competitiveness, and sustainable development in the African railway sector.

Thus, the establishment or comprehensive review of independent regulators and/or monitoring agencies is suggested in order to provide a sound institutional framework that ensures fair competition, safety and quality of services.

Transparent regulatory bodies also enable both capital markets and privates to increase their confidence in railways investment in Africa. In concessions, monitoring bodies or regulators play a crucial role in ensuring adherence to agreements, PSOs (Public Service Obligations) and investment and maintenance plans, thereby boosting investor confidence. Furthermore, regulatory bodies are essential for a potential evolution towards a vertically segregated framework to monitor policy compliance, supervise capacity allocation, monitor the financial framework of the industry and act as appellate body for legal disputes.

In cases of countries that choose to maintain vertically-integrated railways, smaller dedicated monitoring bodies or commercial arrangements could also serve as independent regulators to ensure the proper performance of public railway companies. These bodies would reassure clients and suppliers that railway services adhere to agreed quality standards. The rationale and legal nature of regulatory agencies or monitoring bodies and their responsibilities is further developed in Section 4.1.2.

Finally, it is also important to remark the importance of an autonomous accident investigation agency, independent from both the regulatory body and national railway company. An independent accident investigation agency in railways ensures thorough, unbiased investigations, fostering greater accountability for all stakeholders in the event of an accident.

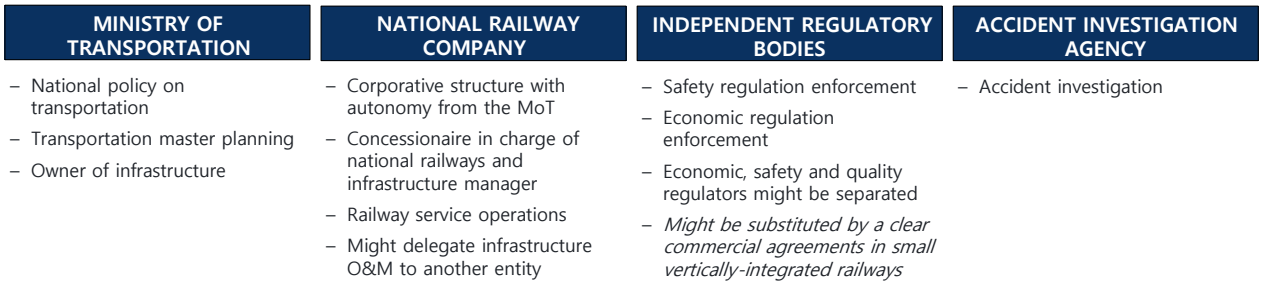


Figure 29: Main stakeholders within the suggested institutional framework at the national level

Management models

Currently, most countries consolidate railway infrastructure ownership and operation within a single authority, facing problems in terms of the financial sustainability of the business model. Furthermore, most railways integrate all services within a single business unit. On the other hand, despite the mixed results of concessions, some have persisted over time and continue to operate nowadays under rather successful models.

Full integration of infrastructure and operations has seemed only to work where demand is concentrated by a single customer (in high-density freight corridors) and in particular in private lines. These dedicated railways have a different type of business model and require different finance solutions from other medium-to-low density railways. Despite some public monopolies have managed to operate a reliable and quality service, most do so at a considerable loss and with significant inefficiencies. In the case of medium-to-low density railways, it is recommended that railway concessions are structured in such a way that rail transport companies performed operations with few additionally-added complexities. Therefore, civil works specialists should manage infrastructure maintenance and repairs. Therefore, according to the type of railways and market size, different business and management models involving should be encouraged.

High-density freight railways are often owned by mining projects that serve a single customer. In such cases, vertical integration of private management, whether through concession (preferably, under a DBFOMT model) or private ownership, is considered appropriate because the anchor customer can be directly involved in operations. This model is common in resource-rich countries like Australia and the USA, as well as in some successful concessions in Africa.

An interesting challenge arises when trying to extend this model to serve a group of mines within a mining basin, especially if they are owned and operated by different companies, and sometimes even located in different countries. In such scenarios, the most suitable option would be for the infrastructure and operations to be provided by the leading mining company or by an independent private operator.

In **general lines** and **medium- to low-density railways,** mostly under public monopolies, the transition to a vertically segregated business model (i.e., separating the ownership and management of the infrastructure from the service operator) could be the key to a more robust and efficient management model as well as to increase the competitiveness of the sector. Vertical segregation can be achieved through different subsidiaries within a single corporation (holding model), similar to France's SNCF, or through completely separate companies (separation model), as seen in Spain with Adif and Renfe. Such vertical segregation enhances transparency and accountability while promoting efficiency in railway operations. Moreover, the separation of infrastructure management and operations has other benefits such as allowing for multiple operators within the market, thus increasing competitiveness and the level of service.

Why separate railways vertically?	– To **promote competition** in or for the rail transport market – To **encourage private sector participation** in rail transport operations while maintaining state ownership and control of the network – To **increase transparency** in use of government subsidies
What are the most favorable conditions?	– **Larger railways** that can operate as viable separate entities – Networks within **large enough markets** as to be competitive – Countries with **strong implementation, administrative and regulatory capacity**
When not to segregate railways vertically?	– **Small national rail markets** unable to support competition and for which increased costs would overcome benefits of separation – Vertical segregation can still be useful to segregate accounts, risks and increase the efficiency at each end of railways

Figure 30: Motivation and conditions for vertical segregation of African railways

Source: World Bank, 2011

Countries with well-established rail markets should also consider implementing horizontal segregation between freight and passenger transport. Horizontal separation is most effective when there are distinct business units with different operational requirements or geographical focuses. For instance, in regions with multiple railway markets such as heavy-haul freight in mining areas, commuter trains in major urban centers, and regional networks, each segment can be owned, managed, and funded separately. This way, each company can focus or compete over different routes within the country or potentially access tracks in other regions in a liberalized market.

This approach leads to more efficient operations for both passenger and freight transport, as they have distinct operational needs. Additionally, separating services allows for account segregation, as demonstrated by Cameroon's railway system, where financially sustainable services (such as freight) can be separated from those requiring subsidies (like passenger services). PRASA and Transnet have also been noteworthy examples of the benefits such separation in Africa.

Why separate railways horizontally?	What are the most favorable conditions?	When not to segregate railways horizontally?
– To **create more manageable business units and sharpen market focus** – To **increase subsidy and financial transparency** by segregation of accounts – To **divest selected units** to the private sector by sale or concession – To **assess efficiency** by comparing through available benchmark	– **Larger railways with separable regional freight and passenger services** – **Regional passenger networks** separable from long distance operations – **Specialized freight operations** (general cargo vs ores)	– **Small national railways,** because they lack offsetting benefits from devolution or divestment – Segregated units can still be useful to segregate accounts

Figure 31: Motivation and conditions for horizontal segregation of African railways

Source: World Bank, 2011

Clear delineation of responsibilities in both the vertical and horizontal directions enhances accountability and efficiency within the railway sector. Separation of responsibilities also allows to delegate tasks to the private sector in a more efficient way, separating risks and targeting specialized companies. Hence, concession agreements should also prioritize the separation of responsibilities between private and public entities for operation and infrastructure maintenance. This division ensures that each party focuses on its core competencies, leading to improved service delivery and infrastructure management.

The recommendations outlined in this sub-section

draw upon best practices from more developed markets, particularly the European Union. However, simply replicating these models may not produce optimal results for all railways. Each railway system operates within a unique context, and what works well in one region may not be suitable in another due to differing economic, social, and infrastructural conditions.

Particularly, small railways with low densities might not be suitable for segregation of responsibilities, as the increased costs of such separation might overcome its benefits. Similarly, railways in countries with limited administrative and regulatory capacity might not be suitable for vertical separation.

Therefore, it is essential that reforms targeting the institutional and operational frameworks of national railways be tailored to the specific circumstances of each case and that the segregation of responsibilities is not rushed. This means conducting thorough analyses to understand the local environment, including the current state of the railway infrastructure, existing governance structures, financial health, market size and demands.

Market access

The suggested changes for the institutional framework of railways in Africa are not only directed towards increased efficiency but they also pave the way towards the introduction of competition and liberalization of the market, drawing parallels with the European development of the industry in the 1990s. Their introduction holds the promise of transformative changes, presenting a dynamic and competitive market driven by private investment and innovation that should, in turn accelerate the industry's development.

Promoting open access policies that allow incumbent railway operators to access and operate on any line is crucial for fostering competition and innovation. By encouraging market access and competition, third-party and open access policies empower customers with a wide range of competing transportation options, which stimulates industry growth and drives improvements in service quality and efficiency.

Moreover, by permitting additional operators to utilize tracks, these policies can address capacity gaps left unmet by public national operators, something that TAZARA showed during its years of successful open-access regime (see Figure 15). Several African nations have already detected such needs and started acting accordingly, with South Africa, Tanzania and many others introducing open-access regulations or planning to do so in the near-term.

However, the process of liberalization also poses several challenges and requires of a sound regulatory and institutional framework. One major concern is ensuring fair competition and preventing monopolistic practices. Regulatory frameworks and Regulators must be established to safeguard against anti-competitive behavior and ensure a level playing field for all operators. Additionally, issues such as proper infrastructure maintenance and safety standards must be addressed to guarantee the continued reliability and safety of rail services, as well as private investment in railway operations. For instance, TAZARA's open access regime was halted by infrastructure issues (bridge collapse and poor track condition).

Furthermore, it is crucial to implement the liberalization of the railway sector in phased approaches. A blanket, fully open liberalization process may pose challenges, particularly in the context of the relatively small markets in most African states. Such a sudden shift could potentially lead to economic issues and undermine financial viability, ultimately hindering service provision and escalating costs over the long term.

To navigate this, a gradual approach to liberalization is recommended. This involves strategically opening up the market while also considering the unique economic and operational circumstances of each country. By carefully phasing in liberalization measures, policymakers can mitigate risks and ensure a smoother transition towards a more competitive and efficient railway sector. This approach allows for adjustments to be made based on market dynamics and enables stakeholders to adapt gradually, thus minimizing disruptions and maximizing the benefits of liberalization.

In a phased development of a liberalized market, valuable insights can be gained by exploring markets like Spain's mixed model, which combines competition for the market and competition within the market through limited tenders for participation in the open market. By adopting a balanced approach to regulatory oversight and market competition, African countries can enhance efficiency and customer satisfaction within their railway networks.

Core insights and suggestions

1. Establishment of a robust institutional framework is crucial for effective management and coordination of infrastructure planning, implementation, operation, and regulation. Revitalizing the Union of African Railways (UAR) can spearhead continental efforts, integrating railways and developing common standards and safety measures. Learning from successful regional cooperation models like the SARA can further bolster UAR's effectiveness in driving African railway sector revitalization and continental integration

2. Most African countries centralize transportation oversight under a unified MoT, facilitating integrated policies that encompass all modes, but the absence of dedicated railway directorates within these ministries may lead to a lack of specialized expertise for sector planning

3. A slight review of the institutional framework should be conducted to ensure the independence of railway companies from their respective MoT. Although numerous African states maintain the division between policymaking and service delivery and most public railway companies have shifted to a corporate structure, only a few meet the stringent criteria typical of the private sector for transparency and accountability

4. High-density freight railways, typically linked to mining projects, are suitable for private vertically-integrated management, either through concessions (DBFOMT) or with private ownership

5. Vertical and horizontal segregation of railways management not only enhances accountability and efficiency within the railway sector, but it also allows to delegate tasks to the private sector separating risks and targeting specialized companies

    - Vertical segregation of railway infrastructure ownership from service operation enhances transparency, accountability, and efficiency in operations. Furthermore, vertical segregation allows for competition, enhancing the level of service provided

    - Horizontal segregation between freight and passenger transport, exemplified by countries like RSA or Cameroon, enables distinct operational focuses, leading to more efficient operations and allowing for better management of subsidies

    - Segregated models are most suited for large markets in nations with strong administrative capacity, but can also be applied in smaller markets if the additional costs are balanced

    - In smaller markets, countries might retain the public vertically-integrated model until conditions are optimal for an institutional reform. The transition into segregated models should be assessed case by case

6. EPC – O&M contracts have been used in some recent rail projects, especially with Chinese contractors, separating construction risks from operation. However, other problems have arisen in construction and planning phases due to contractor influence and lack of independent monitoring which have later hindered the operation phase

    - African railways should consider establishing open access policies allowing railway operators to access the market and foster competition, innovation, and service quality improvements, addressing capacity gaps and stimulating industry growth

    - Liberalization should be gradual and carefully managed to avoid economic challenges and ensure sustained benefits, needing robust regulatory framework. A phased implementation is recommended, introducing services as done in Spain's HSR or in TAZARA

4.1.2 Regional rules and regulations

The regulatory framework of Africa's railway networks is characterized by a patchwork of regulations at the national level. While these regulations serve specific purposes within individual countries, they often lack harmonization, hindering the seamless operation of cross-border rail networks. Furthermore, despite the AU, corridor authorities and RECs have implemented policies and treaties, most are not specific for railways and the agencies lack enforcement capabilities.

Adding to the obstacles to railway development, inadequate regulation and a deficiency in enforcement capabilities have been unable to counter road transport's dominance over railways. Moreover, policies have generally favored road transport, with a lack of regulations promoting modal change towards rail.

On the other hand, certain existing regulatory frameworks have fostered a restricted investment environment, leading to diminished service quality and competitiveness in rail transport. Compounding these financial issues, numerous African concessions did not meet expectations or were terminated due to instability stemming from the absence of robust and transparent regulatory frameworks, coupled with the lack of an independent regulatory agency to enforce such regulations.

These three challenges have severely impeded the development and effective management of railway systems across the continent, becoming increasingly apparent as railways evolve in Africa. In this context, it becomes imperative to examine the regulatory landscape governing the railway sector at the national, regional and continental level.

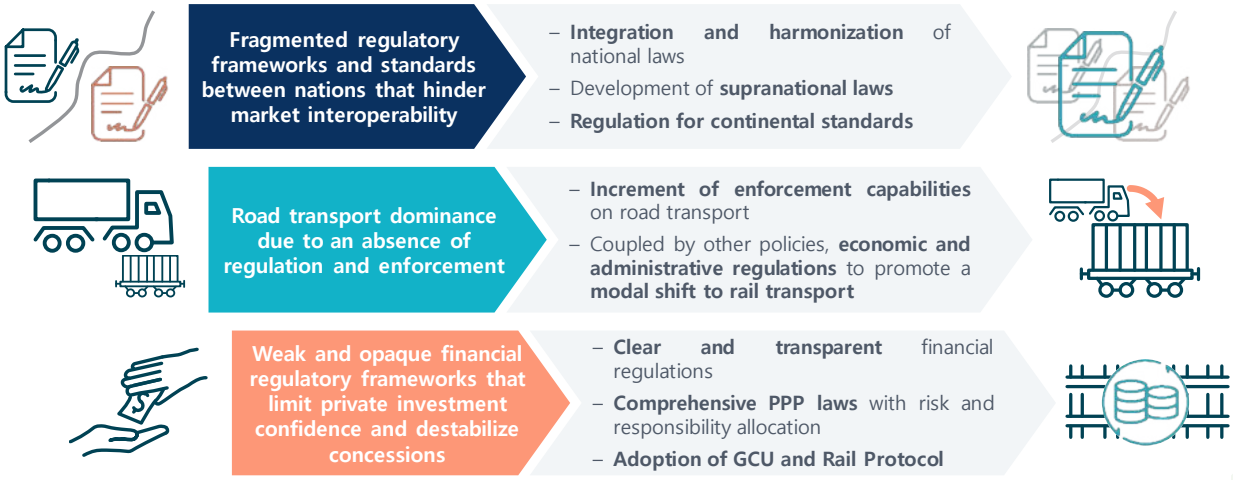


Figure 32: Identified challenges in regulatory frameworks impacting African railways and proposed solutions to address them and work towards the development of the sector

Integration of fragmented regulations and standards to improve interoperability

Currently, disparate regulations at the national level impede the seamless operation of cross-border rail networks, presenting significant challenges to intracontinental trade and regional and continental integration efforts. To realize the full potential of African railway initiatives, such as the creation of dedicated corridors or the integration of the AIRN and AIHSRN networks, harmonization of regulations and standards becomes paramount.

Particularly, it is paramount that regulations are aligned across the market level. As railways join together within corridors and regional networks, and eventually across the entire continent, it becomes imperative that the regulations governing them are aligned and consistent across all member states involved in these markets. This alignment ensures that there are no discrepancies or conflicting requirements that could hinder the smooth operation and interoperability of railway systems, as well as no barriers to trade between different Member States. Furthermore, alignment

of national laws with regional and continental standards and policies is essential to promote interoperability and facilitate the movement of goods and passengers across borders. Key areas of alignment include technical regulations (interoperability, safety, rolling stock, operational procedures, staff certification…), market access policies, management models and trade regulations, all of which contribute to streamlining operations and fostering regional cooperation.

Moreover, in parallel to the development of more robust and aligned regulations, enforcement capabilities must be strengthened and coordinated across nations to ensure compliance and effective implementation of standardized regulations, thereby promoting a cohesive and efficient railway network that drives economic growth and development across the continent.

In this sense, in order to bolster the integration of the African continent, increasing REC and AUC's enforcement capabilities and its legislative jurisdiction though supranational laws could prove a key pillar, as exemplified by the development of the European Union in parallel with European Law. Recognizing this, the AUC is actively pursuing institutional reforms to bolster its management and enforcement capacities, potentially evolving into a supranational entity akin to the EU, with greater emphasis on legal supremacy over Member States and enhanced enforcement authority. However, it remains uncertain whether the AU will be granted such authority, let alone when.

This does not entail a top-down enforcement of rules and standards. Instead, this aims to provide the AUC with increased enforcement capabilities as to manage harmonization efforts more effectively. The development of common rules, however, should always stand from the

The current regulatory framework at both the regional and continental level is based on multinational treaties and general policies, as these entities do not have legal authority to develop and enforce law under their jurisdiction. Treaties offer a global framework for addressing cross-border issues and promoting international cooperation, yet they face challenges in enforcement and can be time-consuming to negotiate due to the need for consensus among multiple parties.

In anticipation of imminent developments in the sector (including unification of networks, liberalization, vertical segregation, new PPPs and other new financing methods, among others) and the correspondent requirements for changes to railway regulations, the African Union and RECs could explore alternative instruments to promote regulatory adjustments within its Member States, avoiding the complexities associated with multinational treaty ratification processes. Soft laws or non-legally binding protocols could serve as an efficient alternative, facilitating streamlined policy implementation. These protocols, once published by the multinational Authority, could be efficiently adopted into national law, tailored to the specific needs of each Member State, without necessitating multiple amendments.

On top of African-developed regulations and standards, signing international treaties for the implementation of tools such as GCU could provide African States and railway undertakings with a standardized, internationally recognized framework for the utilization of railway wagons. By adhering to GCU, African railway operators and wagon owners can establish clear rules and obligations for the use of wagons in international rail traffic. This streamlines processes and reduces the need for negotiating individual bilateral agreements between national railway operators in cross-border transport, thus promoting interoperability and facilitating cross-border transportation, which are essential for regional integration and trade facilitation.

Finally, establishing independent and effective enforcement mechanisms is crucial for the implementation of extensive regulatory frameworks. In this regard, the introduction of Rail Regulators and monitoring bodies is essential. These specialized entities are tasked with overseeing compliance with regulations of all levels (continental, regional and national) within the rail transport sector in an impartial manner, free from influence from both public and private sector stakeholders. This independence is crucial for fair application of the law and to instill confidence among investors.

Regulatory changes to support a modal shift

In Africa, the deregulation of road transport and the ineffective application of the limited

existing regulations bolstered the dominance of road transport over railways, compounded by other factors such as road transport's flexibility, Government support and greater private involvement. However, recognizing the negative societal and environmental impacts of road transport, African states are now seeking to transition towards more sustainable modes of transportation, particularly rail.

While the modal shift from road to rail is primarily driven by market competitiveness, national Governments need to play a proactive role in creating conducive conditions for this transition. To such extent, the following regulatory and policy initiatives should be considered:

- Increment enforcement capabilities on road transportation: introducing stronger legal frameworks, eliminating loopholes, implementing technologic solutions and providing training

- Economic regulations, such as taxation incentives and grants for rail infrastructure development, can incentivize businesses and individuals to opt for rail transportation. In this sense, particular emphasis should be placed on the development of regulatory measures to internalize the social and environmental costs of road transport

- Administrative measures, such as implementing axle load limitations on roads, can discourage the use of road transport and promote the utilization of rail networks for freight and passenger services

- Prioritization of rail infrastructure investment and strategic planning considering railways as the pillar of the logistics chain

Regulatory review to entice private financing

On the other hand, a robust and transparent regulatory framework is also essential for fostering private investment in Africa's railway sector, as well as facilitating innovative financing and procurement strategies for both infrastructure and rolling stock. For doing business, it is important that stable, predictable, transparent and decent working conditions are established by the legislation and international – global and/or regional – regulations in force. Such conditions decrease operational risks and disruptions. Particularly, establishing a strong and transparent framework plays a crucial role in mitigating risks associated with Public-Private Partnerships (PPPs) and attracting investors to engage in railway projects.

In this sense, comprehensive PPP laws are foundational, delineating the rights, responsibilities, and obligations of public and private partners. These laws should cover risk allocation, revenue structuration, performance standards, and dispute resolution procedures to provide clarity and confidence to investors. Standardized contract templates further facilitate private investment by simplifying negotiations and implementation processes. These templates, integrating best practices and risk allocation mechanisms, establish a consistent framework for structuring agreements, reducing transaction costs for investors.

Furthermore, adhering into international treaties such as the General Contract for Use of Wagons (GCU) and the Luxembourg Rail Protocol could hold significant benefits for African countries in the development and modernization of their railway sectors, particularly for the provision of rolling stock.

- The General Contract for Use of Wagons (GCU) offers a standardized contractual framework for the use of wagons in international rail traffic. By defining the rights and obligations of wagon owners and railway undertakings, the GCU simplifies bureaucratic processes associated with rolling stock procurement, especially for leasing agreements. This standardization eliminates the need for complex and time-consuming negotiations, making it easier for operators to access rolling stock

- The Luxembourg Rail Protocol aims to facilitate financing and leasing of railway rolling stock by providing a legal framework for asset-based financing and security interests in movable assets. This protocol enables investors to secure their investments through internationally recognized mechanisms, thereby reducing risks associated with asset financing in the African railway sector.

Core insights and suggestion

1. The regulatory framework of Africa's railway networks is fragmented at the national level, lacking harmonization and enforcement capabilities at a regional and continental level. Combined with inadequate regulation in both railway and road sector, these challenges have hindered railway development and led to road transport dominance, destabilized concessions and discouraged investment, highlighting the need for examination of regulations at national, regional, and continental levels

2. Alignment of regulations across markets is essential to prevent discrepancies and barriers to trade between member states, promoting interoperability and facilitating movement of goods and passengers

    - Strengthening and coordinating enforcement capabilities across nations is crucial for ensuring compliance and effective implementation of standardized regulations in African railway networks. The use of supranational laws could help in this matter, but the AUC does not currently have the jurisdiction for so
    - In multi-national initiatives, instruments such as soft laws or non-legally binding protocols could streamline regulatory adjustments within member states, avoiding complexities associated with multinational treaty ratification processes
    - Signing international treaties like the GCU could provide standardized frameworks for cross-border transportation, promoting interoperability and facilitating regional integration

3.. To facilitate a transition from road to rail, governments should focus on increasing enforcement capabilities on road transportation, implementing economic regulations like taxation on road or incentives for rail infrastructure, introducing administrative measures such as axle load limitations on roads to encourage rail use, and prioritizing rail infrastructure investment with railways at the center

4.. A robust regulatory framework is crucial for attracting private investment and enabling innovative financing strategies, which needs of stable, predictable, and transparent working conditions that decrease risks

    - Comprehensive PPP laws are essential, outlining rights, responsibilities, risk allocation, revenue structuring, and dispute resolution procedures to provide clarity to investors
    - Standardized contract templates could simplify negotiations and implementation processes, reducing transaction costs for investors and facilitating private investment
    - Adhering to international treaties like the General Contract for Use of Wagons (GCU) and the Luxembourg Rail Protocol can benefit African countries by standardizing contractual frameworks and facilitating financing and leasing of railway rolling stock

4.1.3 Railway regulatory agencies or monitoring bodies

One of the key challenges of the enabling environment of African railways is the lack of effective monitoring and regulation enforcement, particularly in cases where railways are publicly owned. Even where regulatory bodies exist, they often lack independence, efficiency, and enforcement capability. This absence of independent oversight and insufficient monitoring tools hampers the appropriate delineation of responsibilities, compromises safety, undermines competitiveness, and impedes sustainable development in the African railway sector.

In concessions, the inadequate adherence to off-take agreements, public service obligations, investment and maintenance plans, coupled with poor communication among railway stakeholders, has consistently impeded the proper development of numerous railway concessions. Consequently, this failure has heightened the risk for private sector involvement in African railways, leading to increased capital costs for governments and concessionaires.

In response to these challenges, several countries, notably South Africa, Cameroon, Madagascar, Kenya, and Tanzania, have established regulators, monitoring bodies or commissions to enhance

oversight of railway performance. However, the effectiveness of these entities has been inconsistent. In many instances, they have either failed to become operational or their actions have not been acknowledged by concessionaires. South Africa's RSR is the only notable exception to this trend and, despite also showcasing some disparities with respect to best practices, is equitable to European regulators.

Thus, the establishment or in-depth review of regulators and/or monitoring bodies is necessary in order to increase the safety and efficiency of railway systems and provide a better institutional framework that enables both capital markets and privates to increase their confidence in the railways investment environment in the given country.

The regulatory bodies should be a body autonomous from the Ministry of Transport and independent from any infrastructure manager, charging body, or applicant. Furthermore, following the guidelines of EU legislation:

- It should be independent in its organization, legal structure, funding and in its decision making

- Decisions taken by the Regulatory Body shall be subject to judicial review by a higher authority or specialized court. These higher authorities typically include an Appeals Court that specializes in disputes involving public agencies decisions or, at a higher level, a Supreme Court. The structure of such appellation bodies might vary from country to country depending on its judiciary structure

- Regulators should have the necessary powers to make enforcement decisions or issue directions under their domestic legislation

- Regulatory bodies should be able to enforce their decisions with the appropriate penalties including fines and restrictions

Since political background and laws regarding railways, public companies and PPPs differ substantially from country to country, the particular composition and competences of regulating/monitoring bodies may have to be defined according to the context of each country. Notwithstanding, some recommendations for the attributions of these bodies are presented:

- **Regulate and enforce safety standards** to be provided by infrastructure managers and operators according to continental or regional standards

- Require ongoing **publication of financial and operational reports** by administrators and operators

- **Set and assess KPIs** for both administrators and operators in terms of service and safety, as well as investments or financial performance among others

- **Monitor cash flows** between the Government and concessionaires or public railways undertakings

- **Monitor and ensure contract compliance** by all parties involved and establish sanctions for breaches. This includes the compliance of concessions, public service obligations (including ticket pricing, frequencies, level of service, etc.), investment obligations, maintenance, payment of grants, off-take agreements, among other contract specificities

- **Regulate market entry, slot allocation and infrastructure access fees,** especially in the case of open markets, to ensure fair competition

    - Slots should be accessible in an equitable way by all potential operators, with allocation procedures being transparent and just

    - The establishment of access fees will depend on case-by-case evaluation, but should reflect the true economic costs of infrastructure use and aim for full cost recovery while also providing clear and accessible tariffs. The regulator's role should involve making sure that the established fees are fair to all the operators while ensuring railways' competitiveness with respect to other modes

- Regulate specific services offered by public operators to ensure fair competition with services offered by private firms

- **Supervise the payment of levies and fees by operators**

- Establish an improved communication framework for all stakeholders to address concerns and arbitrate disputes between different parties, serving as an appeal body in relation to decisions taken by an infrastructure manager or a railway undertaking regarding discriminatory access conditions

Moreover, many regulators are also tasked with the provision, suspension and renewal of licenses

for operators to enter the market and run on the national infrastructure. Regulators should implement clear, objective criteria for licensing, and make these publicly available to guarantee all applicants understand the requirements.

In larger and more complex markets, especially in those where competition is encouraged, regulatory responsibilities can be integrated within one sole agency or separated between economic and safety rail regulators.

On the other hand, the economic and safety regulators should play a key role in not only regulating railway transport subsector but also in appealing to political decisions and regulations to ensure that wider transport policies are fair and reasonable for the railway sector. Additionally, regulatory bodies should also be tasked with overseeing compliance with continental, regional, or national technical standards in construction projects, railway operation and rolling stock procurement.

While it is recommended to establish regulators, emphasis should not be placed on the automatic creation of bodies which elsewhere have guaranteed the success, but on their staggered establishment depending on the development stages of a particular system. This implies that a railway regulator may not be strictly required until the market has reached a certain level of maturity or if competition is not encouraged.

Hence, in smaller networks or railways operating under the monopoly of a public railway operator, simplified dedicated monitoring bodies or contractual arrangements could be instituted to oversee the operations of public railway companies, effectively replacing the role of an independent regulator. These entities would ensure that railway services meet agreed-upon safety and quality standards for both clients and suppliers while requiring of less skilled personnel and funds.

The implementation of commercial agreements, such as the Contrat-Programmes seen in Morocco, could serve as a model for other public railways across Africa. Under this approach, governments and public railway companies collaborate to define shared goals, expected outcomes, and managerial responsibilities. Additionally, these commercial arrangements may establish mutual obligations to prevent funding shortages from the Government or underperformance from the public railway company. In countries without regulators, commercial agreements should also include specifications for compliance with technical standards.

	MANAGEMENT MODEL	VERTICALLY-INTEGRATED RAILWAYS	RAILWAY CONCESSIONS	VERTICALLY-SEGREGATED RAILWAYS
	SUGGESTED REGULATORY INSTRUMENT	CONTRACT PROGRAMMES	RAIL REGULATORY AGENCIES	
REQUIRED RESPONSABILITIES	Regulate and enforce safety standards provided by infrastructure managers and operators	✕	✕	✕
	Require ongoing publication of financial and operational reports by administrators and operators	✕	✕	✕
	Set and assess Key Performance Indicators for both administrators and operators	✕	✕	✕
	Monitor cash flows between the Government and concessionaires or public railways undertakings	✕	✕	✕
	Establish a communication framework for stakeholders to address concerns and arbitrate disputes		✕	✕
	Ensure compliance with concession contracts by all parties involved and establish sanctions for breaches		✕	
	Regulate slot allocation and ensure fair competition in open markets			✕
	Regulate infrastructure fees to prevent monopolistic practices			✕
	Regulate specific services offered by public operators to ensure fair competition with private services			✕

Figure 33: Suggested monitoring and regulatory tools for management models in African railway

As to ensure overseeing, guidance and collaboration between such regulatory agencies or monitoring bodies, these should work under the umbrella of a pan-African or regional agency akin to Europe's ERA.

The revitalization of the Union of African Railways (UAR) presents a valuable opportunity to serve as this overarching entity. With its existing infrastructure and experience, the UAR can potentially evolve into a robust pan-African agency dedicated to advancing the railway sector. Building upon initiatives like the Southern African Railway Association (SARA), which has already demonstrated success in promoting regional cooperation, the UAR could expand its scope to encompass the entire continent.

Furthermore, if railway undertakings are to expand their services beyond national networks and established corridors under a liberalized market, UAR can play a key role in coordinating continental transit by coordinating or absorbing the issuance of safety permits, slot allocation and regulating competition in international services.

In addition to overseeing regulatory activities, the UAR can provide guidance and opportunities for collaboration among member countries. This includes sharing best practices, facilitating knowledge exchange, and coordinating joint initiatives to address common challenges and capitalize on emerging opportunities in the railway sector.

Core insights and suggestion

1. Inadequate regulation enforcement, particularly in publicly owned railways, poses a significant challenge to African railway systems, compromising safety, competitiveness, and sustainable development. Despite efforts in some countries to establish monitoring bodies, their effectiveness has been inconsistent, necessitating an in-depth review

2. Regulators play a crucial role in ensuring fair competition, policy compliance, capacity allocation, dispute resolution, and increasing investor confidence, especially in the proposed framework of segregated railways

3. Conducting a thorough review of regulatory bodies is essential to enhance railway system efficiency and build confidence among investors. Given their different regulatory frameworks, the nature of regulating/ monitoring bodies may have to be defined according to the context of each country

    - The regulatory bodies should be a body autonomous from the MoT and independent from any infrastructure manager, charging body, or applicant. The regulator shall have the authority to issue regulations and enforce penalties, and he decisions of the regulator might be subject to judiciary review by a higher court
    - Recommendations for improving regulatory bodies include enforcing safety standards, requiring financial and operational reporting, setting and assessing KPIs, monitoring cash flows, facilitating communication among stakeholders, ensuring contract compliance, and regulating slot allocation and infrastructure fees
    - In large markets, regulatory responsibilities can be consolidated under a single agency or divided between economic and safety regulators
    - In smaller, vertically integrated railways, simplified monitoring bodies or contract arrangements could serve as regulatory instruments without the need for complex administration and additional funds, overseeing operations, ensuring safety and maintaining quality standards

4. Regulatory bodies should also ensure compliance with technical standards in construction projects and rolling stock

5. The UAR has the potential to evolve into a robust entity dedicated to advancing the railway sector, coordinating and regulating international transit, and facilitating collaboration among Member States

4.2 Harmonization of the sector for network interoperability

Africa's railway network has developed largely as a subset of isolated sub-networks, built using different gauges, technical systems, and adhering to different operating and maintenance standards and practices. Furthermore, regulatory, customs and market barriers exist that define imaginary barriers that stack upon those created by different technical standards.

While some parts of the continent have seen some levels of standardization and integration, the rest of the continent remains largely non-standardized, thus creating physical and non-physical barriers that hinder interoperability between different networks and deter railway's efficiency and sustainability. Following the general objective to ultimately secure network integration between lines in all African countries, the requirement to set continental standards arises from the need to overcome the current fragmented nature of the continent's rail.

In the EU, standards have been developed hierarchically. First, the EC outlines the need for standardization and identifies domains for it. ERA then develops specific Technical Specifications for Interoperability (TSIs). Each TSI is developed by ERA with participation from member railways, regulators and industry members. TSIs must be adopted by national rules within a certain period by individual Member States. TSIs are adopted by states as enforceable standards, which are then monitored by national enforcement bodies.

The European or Australian standardization processes serve as a valuable model. Their examples showcase that it is essential to acknowledge that in large markets with considerable variability, harmonization typically arises not from a top-down imposition of standards and policies but rather from the recognition of shared needs, preferences, and resources within the community. Furthermore, interoperability levels targeted by the EU or the mechanisms to achieve it may not fit other regions as a "copy-paste" approach.

Hence, achieving rail harmonization in Africa requires a continent-wide approach addressing the desired developmental trajectory that each of the nations and RECs want to pursue, as well as a comprehensive domestication strategy that adapts to each country's scenario. In this context, it is imperative that any standardization process for African railways is built upon a thorough examination of the following factors:

- **WHY:** Pursuit for interconnection of African railways and the desire to diminish continental trade barriers. These objectives should stem from the identification of common continental needs among Member States, yielding comprehensive motives for the standardization of railways
- **WHAT:** Definition of aspects to be standardized for network interoperability, mainly physical standards for infrastructure, data exchange systems, rolling stock commonalities and cross-border procedures
- **WHO:** Identification of entities responsible for setting the general standards (AUC, UAR, RECs)
- **HOW:** Delineation of a sound standardization strategy at a regional and national level, including monitoring bodies to verify the implementation of such standards

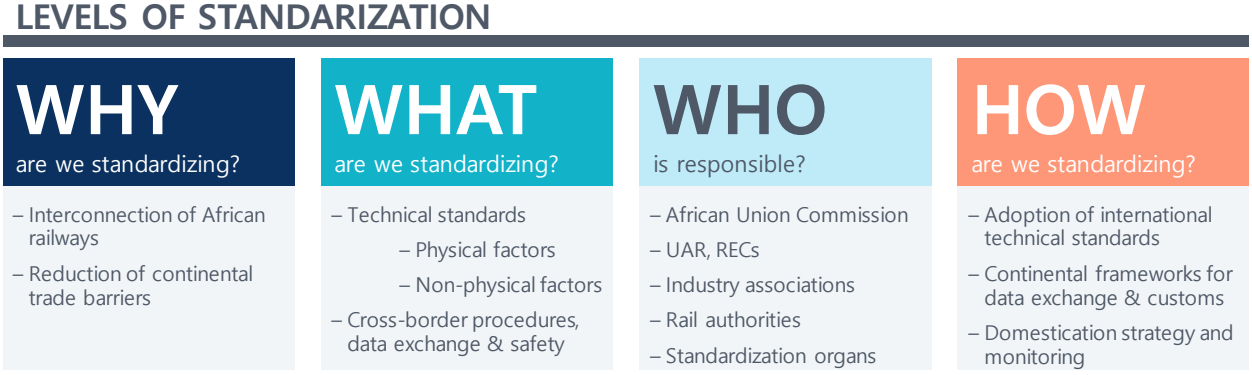


Figure 34: Suggested standardization framework for African railways

4.2.1 Continental rail technical standards and norms

Throughout the African continent, there is a generalized lack of technical standards and harmonization regarding track gauge, electrification, axle load, coupling systems, ICT and other technical design standards. Given the fact that these physical elements are rigid and cannot be easily replaced, harmonization in this sense requires of greater consideration to the existing landscape and the prospects for future adaptation.

In technical terms, one of the most evident and critical parameters for interoperability is track gauge. At the moment, SGR emerges as the envisioned continental standard for future network expansion, in accordance with the decision made by the First African Union Conference of Ministers Responsible for Transport (Algeria, April 2008), and having been used to new developments in Nigeria, Kenya and Tanzania, among others. However, the prevalence of cape gauge in SADC underscores the need to take both gauges into account, at least in the short term.

In this sense, the general consensus is that SGR should be used for all new developments and rehabilitations except those where cape gauge is justified by connections to existing cape gauge railways. In those cases, cape gauge could be used with provisions made for the future adaptation of SGR (right of way, substructure, curvature radius, etc.). On the other hand, the dwindling presence and poor condition of meter-gauge and other narrow-gauge railways evidence the inevitability of their replacement by SGR. This strategic approach would balance the imperative for standardization into SGR with the practical considerations of legacy infrastructure and regional connectivity in SADC.

Given that narrow- and standard-gauge railways are expected to persist and coexist despite efforts towards harmonization, gauge interoperability is poised to remain a pressing concern for Africa's rail infrastructure.

In this context, variable gauge technology emerges as a practical solution to this challenge. Systems such as the Spanish TALGO and CAF (1,435mm – 1,668mm) demonstrate the efficacy of variable gauge technology in facilitating seamless transitions between different gauge systems, thereby reducing the need for costly and time-consuming gauge change operations.

Although implementing narrow to standard gauge changes presents certain challenges, recent innovations like the PROSE EV09-EV18 (1,000mm-1,435mm) in Switzerland offer promising solutions. Despite initial operational issues, such as wheelset deterioration[5], the advantages of this variable gauge technology, including reduced transfer times and enhanced efficiency, outweigh the challenges.

While NGR-SGR variable gauge technology entails greater technological complexity and costs, it holds immense value for the unique demands of the African market. By embracing this technology and investing in its development, Africa could effectively reduce the expenses derived from interoperability issues, avoiding line duplication and the need for gauge change stations where loads and passengers need to switch from one train to another. A sound business case should be developed to study the possibility of implementing variable gauge technology in Africa, or whether it would be more economical to progressively switch towards a unified SGR network.

While the variation in track gauge emerges as a the most evident hurdle to interoperability, it is imperative to recognize the collective significance of all factors in fostering a cohesive and efficient railway network. Physical considerations such as general design standards, structure and loading gauge, maximum axle loads, or design speeds are among some of the most pivotal considerations and come with tangible effects. Conversely, non-physical considerations such as signaling and control or telecommunications systems are equally crucial for facilitating interoperable operations, even if the limitations they impose are not as evident.

For instance, the aforementioned frontrunners in SGR conversion (Tanzania, Kenya, Ethiopia, Nigeria…) demonstrate a considerable disparity between their railway infrastructures despite all being built recently in a standard gauge, having been built under the specifications of the contractors or financers. Despite having the same gauge, the disparities in other parameters actually hinder the interoperability between these networks. There is great risk if countries copying and pasting specifications used by countries which may be providing financing or contracting as this will be a reincarnation of the

[5] Swiss gauge-changing GPX trains back in service

problem the Africa colonizers brought to Africa, with each colony adopting standards and specifications of its colonizers or, in this case, collaborators.

For this reason, it is crucial to emphasize the urgency of harmonizing technical standards across the continent. Furthermore, it is of the upmost importance that any definition of African standards takes into account all aspects of rail infrastructure and operation for an interoperable network. Technical specifications should be defined by African regulations, not imposed by contractors or financiers. Figure 35 displays the main technical parameters that should be considered for African railways harmonization. Additionally, such process should also consider the particularities regarding each aspect within the current African rail infrastructure context to ensure proper interoperability of the network at all levels:

- Many railway lines focus on freight transport and aim to transport double-stack containers, thus probably requiring large structure gauges such as AAR plate-H

- Most SGR lines have been build with UIC or AREMA standards (Chinese standards are based on UIC)

- A number of networks will accommodate high levels of bulk traffic and trains with great loads, for which axle load standards should set minimums for general lines (generally 30 tonnes per axle) and offer guidelines for incrementing axle load requirements in lines with high levels of bulk traffic

- Due to the fact that electrification is not going to be continentally widespread and that diesel locomotives are likely to remain predominant in the short to medium term, standards for traction mode will not have a great impact on network interoperability. However, African railways should pursue the electrification of the network with common standards for power (most likely 25 kV 50Hz AC), catenary height, overhead contact systems and pantographs

Additionally, non-technical factors, albeit less critical, can also impede interoperability among different systems. Varied operating languages may restrict staff's mobility across borders and their ability to operate rolling stock in different countries. Moreover, staff may lack familiarity with diverse operating norms and procedures in neighboring countries, even when utilizing the same technical systems.

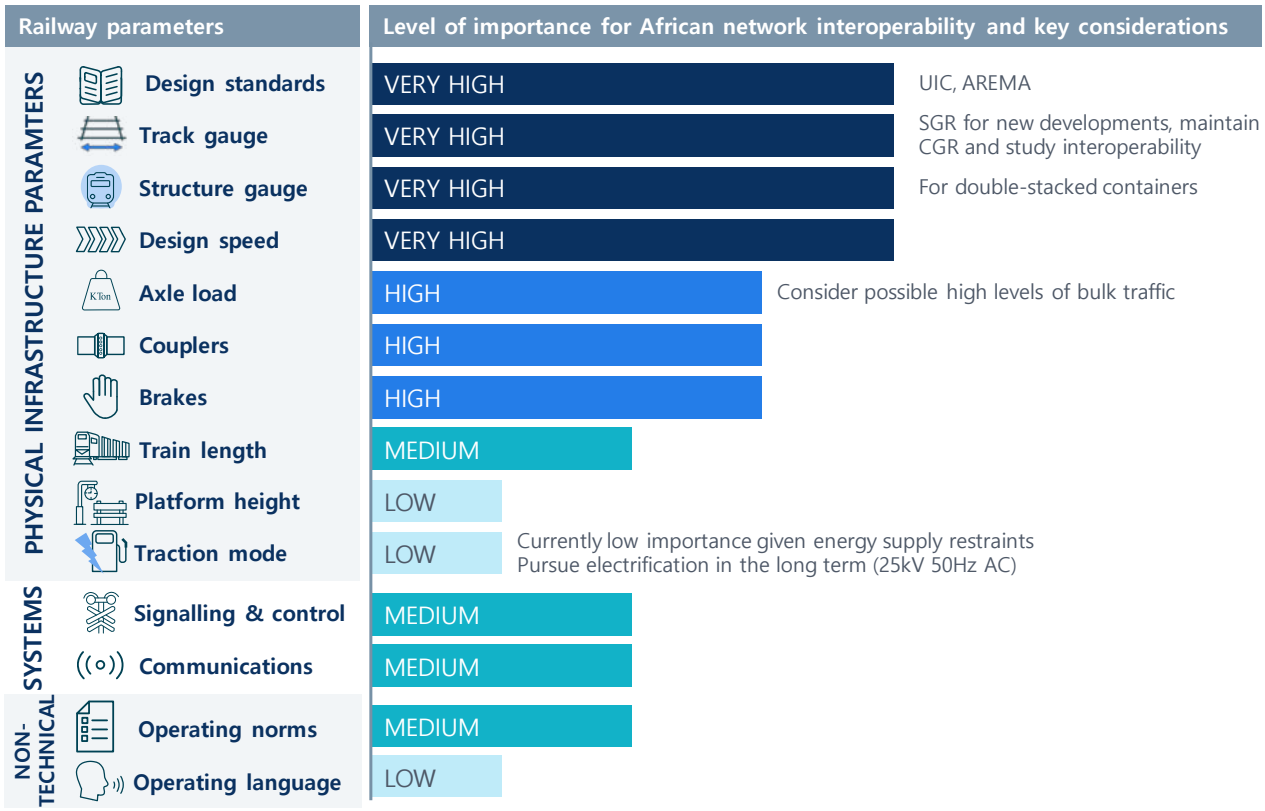


Figure 35: Main standardization parameters to include in African standards or TSIs, their importance for network interoperability and key considerations for the African continent (adapted from CPCS-AU report)

A working group should be set up by the AUC and UAR to define and agree on a set of minimum technical standards. By consolidating agreed technical standards into a comprehensive technical documentation, akin to the European TSIs, AUC and UAR can set the framework for African nations to adopt clear common standards that pave the way for network interoperability. In this sense, the African Union report Definition of Norms and Standards for the African Railway Network sets a proper basis framework on which to base African standards, providing a list of TSIs for the African Railway Network (ARN), and a draft intergovernmental agreement for AU Member States for adopting the TSIs for the construction of ARN projects. These technical specifications should be broadened to encompass continental standards applicable to all primary railways in Africa, transcending the scope of AIRN and AIHSRN. Given AU's current limited legislative enforcement capabilities, the enforcement of such TSIs could be based on treaties or its adoption into national law.

It is essential to recognize that continental standards should bridge disparities among different networks by balancing uniformity and flexibility, facilitating their adoption across all African states. While TSIs should provide a robust framework for interoperability, they should not delve too deeply into specifics, allowing for adjustments to suit each country's unique technical requirements and local conditions. For example, European Technical Specifications for Interoperability (TSIs) offer specific guidelines for most physical infrastructure but allow certain flexibility in signaling, control systems, and electrification methods to accommodate diverse Member States' needs.

While specific standards adopted by railway companies may vary across regions, adherence to minimum TSI requirements guarantees compatibility and facilitates efficient network operation and development across the continent. This approach guarantees common critical interoperability components for network compatibility while allowing for necessary customization.

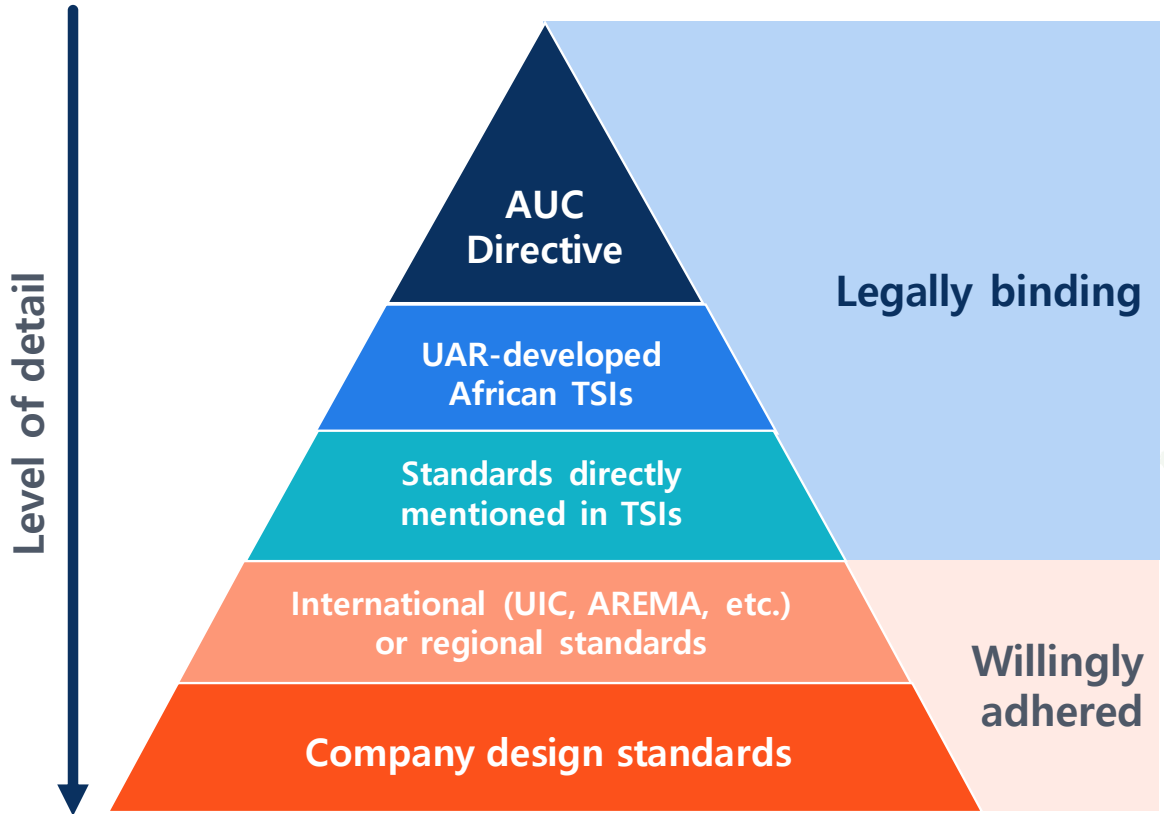


Figure 36: Proposed layers of standardization by detail and conditions of adherence, based on European standardization practices

States for adopting the TSIs for the construction of ARN projects. These technical specifications should be broadened to encompass continental standards applicable to all primary railways in Africa, transcending the scope of AIRN and AIHSRN. Given AU's current limited legislative enforcement capabilities, the enforcement of such TSIs could be based on treaties or its adoption into national law.

Core insights and suggestion

1. African standards, in the form of Technical Specifications for Interoperability (TSIs), should be developed by an AUC and UAR working group as a framework for continental harmonization
    - The African Union's report Definition of Norms and Standards for the African Railway Network that sets standards for the AIR can serve as a basis for setting continental standards applicable to all African networks
    - African standards should include some specifications for all technical parameters of railways, recognizing their individual importance in ensuring network interoperability
    - African TSIs need to be living documents that adapt to new developments in the rail industry and consider the particularities of the African context
    - Continental standards should balance uniformity and flexibility to accommodate diverse technical requirements and local conditions
2. While all parameters are crucial for interoperability, track gauge is the most obvious impediment
    - SGR is envisioned as the continental harmonized gauge for future expansion, but the prevalence of cape gauge in SADC requires considering maintaining such gauge
    - Variable gauge technology, despite costly and technologically complex, offers a practical solution to interoperability issues between cape gauge and standard gauge railways.
3. Standards for intermodal stations should also be developed to accommodate for prospects of more international trade and ensure consistent cargo management across the continent

4.2.2 Domestication strategy for standards & monitoring organisms

The African continent boasts a diverse array of railway systems, each with its own unique set of challenges and requirements. Therefore, it is crucial to develop strategies that can adapt to these diverse contexts while still working towards common regional objectives for harmonization. A comprehensive action plan for railway harmonization across the continent is required to define the necessary steps and timelines to gradually increase the interoperability between networks across the continent.

First, the simultaneous pursuit of the goals of railway interoperability and safety requires substantial technical work led by a specialized body. That is why it is deemed necessary, as the Second Railway Package of European rail identified in 2004, to create within the existing institutional framework, and with respect for the balance of power in the African Union Commission, an African agency dealing with railway development, safety and interoperability.

In Africa, such entity already exists in the form of the Union of African Railways (UAR) but needs of review and revitalization. SARA performs a similar function at a regional level in SADC. Like its European counterpart, a revitalized version of UAR should be responsible for setting common standards and interoperability procedures in the form of TSIs, as well as setting domestication strategies and promoting their enforcement across the various African states.

Recognizing the long-term nature of the domestication process in Africa is essential for ensuring its success. Consequently, strong and long-term commitment is required from all stakeholders. In this sense, setting a comprehensive temporal strategy involves setting compromises with realistic timelines, milestones, and phased approaches to implementation. Each country with railways on the continent should be part of an accord that commits to long-term rail standardization across the continent and a minimum set of TSIs and mandatory standards implemented over a multi-decade transition period.

Furthermore, African railways operate within diverse socio-economic, financial and political contexts, which can impact the pace and direction of harmonization efforts. Therefore, a tailored

comprehensive temporal strategy is necessary to accommodate varying levels of readiness among stakeholders and navigate complex challenges that the current situation may impose.

By collectively establishing clear paths towards harmonization, including thorough financial planning, setting realistic timelines and establishing achievable milestones, African countries can progress towards harmonization goals while addressing local needs and priorities.

Adopting a phased approach allows for gradual implementation of standards, starting with priority areas where the impact will be most significant. This approach minimizes disruptions and allows stakeholders to adapt gradually to the new standards. Phasing also enables stakeholders to learn from early implementation experiences and adjust as needed before expanding to other areas.

In this context, it is again paramount to evaluate the clear differences between the current networks and the direction adopted by the African Union towards an integrated network.

- In Northern Africa, not only do most railway lines already comply with gauge standards and most of the AU standards proposed in *Definition of Norms and Standards for the African Railway Network*, but stronger economic and financial capabilities make changes to their networks feasible in the short term.

- In East, West and Central Africa, where many nations have already started transforming their railway networks. Most new developments have been carried out with standard gauge and similar design standards, but present minor differences in other design parameters that could hinder interoperability and need to be addressed. In these regions, the major complications to harmonize all the network come from financial difficulties in undertaking large infrastructure projects to transform their generally obsolete narrow-gauge railways.

- In Southern Africa, mainly South Africa, the standardization process is significantly complicated by the extensive presence of cape-gauge track and generally standardized designs that deviate from the AU direction. Here, performing usual gauge and standards transformations is significantly complicated as the implementation of continental standards would exchange continental interoperability for a loss of connection with the existing SADC network.

In this context, a strategy with significant potential involves introducing provisions for future transformation and implementing multiple gauge railways in a transition phase. This strategy entails providing SADC railways with some of the characteristics of the continental standards (such as increased structure gauge, wider substructures to accommodate SGR in the future, larger curvature radii, etc.) while maintaining their current functionality of their railway network. A comprehensive business case should be developed to assess the potential options of SADC towards interoperability and determine the best progression strategy for the region.

To ensure adherence to the agreed standards, harmonization objectives and implementation timelines defined by UAR, Governments ought to contemplate setting up dedicated bodies within each nation, ideally within the structure of the regulatory agencies. These entities should function under the umbrella of a unified pan-African association (UAR) that coordinates effective enforcement of standards across all Member States. Their primary responsibility would be to uphold established standards within their respective jurisdictions. Endowed with the authority to enforce railway legislation and regulations, these bodies would play a pivotal role in maintaining industry standards and ensuring compliance.

Furthermore, to effectively implement such harmonization strategy, it is crucial for UAR and Railway Authorities to understand and define the maturity level of the railway industry throughout all of the process. This involves assessing the current state of harmonization of infrastructure, operational practices, technology adoption, and regulatory frameworks. By developing and adopting a consistent assessment methodology, UAR and relevant stakeholders can gauge the readiness and identify areas requiring further attention. This assessment could also help in setting realistic goals, prioritizing initiatives, and measuring progress over time. The following criteria should be considered and consolidated into efficient KPIs that allow for a thorough examination of harmonization efforts:

- Degree of standardization in rail gauges, track alignments, and key **infrastructure components** across networks. In SADC, evaluate whether

networks are adapted to potential gauge conversion projects in the future, assessing the presence of multiple gauge sleepers, SGR right of way, structure gauge, etc.

- Interoperability of **rolling stock** across networks, evaluating the extent to which common standards have been adhered for brakes, couplers, and electrical interfaces, among others

- Evaluate the integration and compatibility of **communication and control systems**

- Assess the extent to which **operating rules** have been harmonized, allowing for seamless movement of trains and efficient staff utilization across network boundaries

In addition to the aforementioned strategies, it is imperative to emphasize the pivotal role of capacity building and training in ensuring the success of standardization efforts. Investing in comprehensive training programs and capacity-building initiatives is paramount to equip stakeholders with the requisite skills and expertise necessary to drive harmonization endeavors effectively. This entails providing targeted training for various stakeholders within the railway sector, including operators, maintenance personnel, regulatory bodies, and other relevant parties, to familiarize them with new standards, technologies, and procedures.

Moreover, harmonization can serve as a catalyst for facilitating skill transfer and knowledge exchange among African countries. By harmonizing standards and procedures across borders, opportunities emerge for collaborative capacity-building initiatives and mutual learning between Member States and Railway Authorities. This cooperation fosters the sharing of expertise and resources, ultimately bolstering the collective capacity of African states to implement and adhere to harmonized standards effectively.

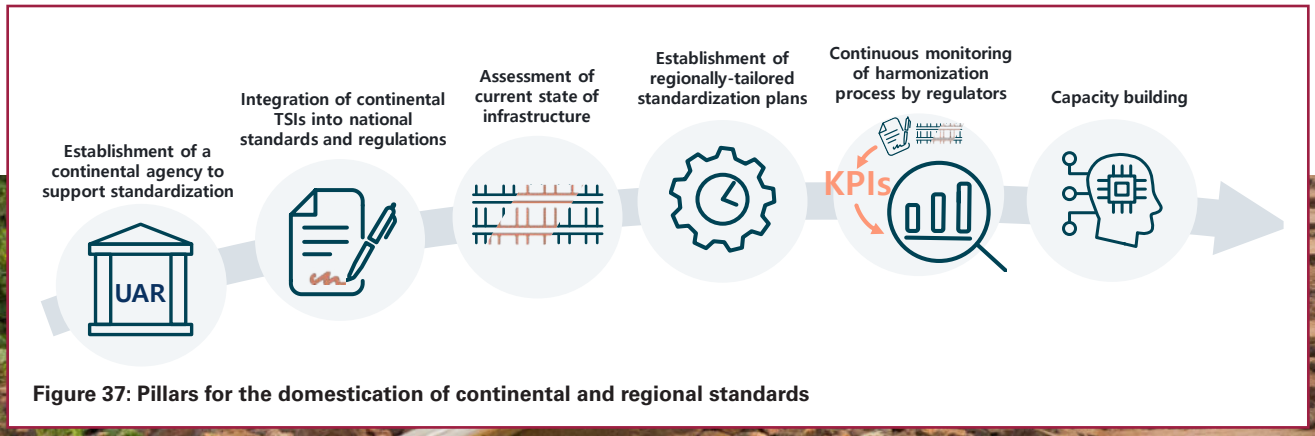


Figure 37: Pillars for the domestication of continental and regional standards

Core insights and suggestion

1. Developing a country-specific comprehensive action plan for railway harmonization across Africa is crucial for addressing diverse challenges and working towards common regional objectives

2. Establishing a specialized body, such as a revitalized Union of African Railways (UAR), is essential for leading technical work on railway safety and interoperability

3. Understanding the long-term nature of harmonization and accommodating stakeholder readiness levels are crucial requirements for a comprehensive temporal strategy, which would encompass realistic timelines, milestones, and phased approaches, considering diverse infrastructure and socio-economic contexts in Africa

    - Northern Africa and most SSA states have already embarked on a harmonization path aligned with the potential standards of UAC, but the latter might struggle to effectively adopt these standards due to financial liabilities
    - Implementing a strategy with provisions for future transformation into continental standards and multiple gauge railways, could facilitate harmonization in SADC while maintaining functionality of the extensive narrow-gauge network

4. Establishing dedicated bodies within each nation, under the umbrella of UAR, ensures effective enforcement of standards and compliance

5. Capacity building and training are essential for empowering stakeholders to lead harmonization efforts effectively. Moreover, harmonization fosters skill transfer and knowledge exchange among African countries, encouraging collaborative capacity-building initiatives and mutual learning



4.2.3 Common cross-border procedures

TIn the pursuit of an African network, the challenge of physical interoperability is significant, as varying technical specifications and infrastructure standards impede smooth connectivity between varying railway networks. Parallelly, the existence of closed markets with monopolized operations adds layers of complexity by requiring convoys and locomotives to be changed at borders in cross-border transport.

However, several stakeholders have highlighted that some of the most critical operational issues at the borders between different networks and countries are related with the procedures for border crossings executed by various African states along an international route, rather than proper interoperability. These inefficient procedures, executed by various African states along international routes, significantly contribute to prolonged transit times, escalated expenses, and diminished efficiency in railway operations.

The significant challenges faced by railway operations at international borders in Africa include lengthy and inefficient customs processes, controls at both sides of borders, and complex bureaucratic processes and regulations. Moreover, the paperwork required varies from country to country, further increasing the administrative costs.

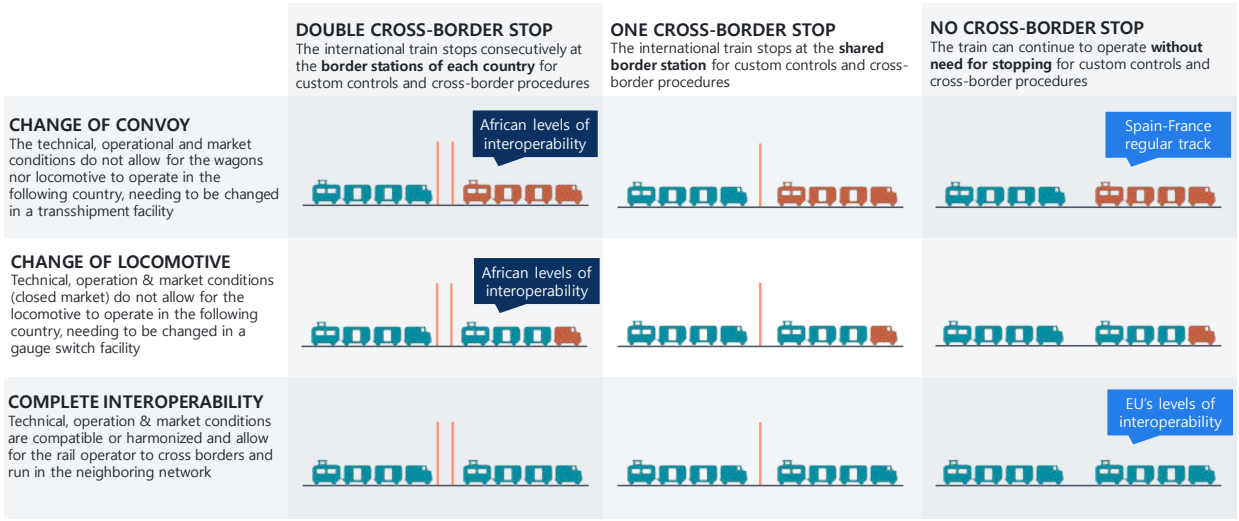
The AfCFTA agreement, endorsed by 54 countries in Africa, aims to establish a pan-African single market for goods and services, facilitating the free movement of people and enhancing trade between African countries. This agreement signifies Africa's progression toward a continental customs union, a common market, free movement of goods, and eventually the removal of borders. However, the transition to a full customs union will require a lengthy process with strong political will and commitment, necessitating a long-term transitional approach to facilitate efficient cross-border customs procedures and enhance trade and network interoperability.

The Revised Kyoto Convention (RKC), developed by the World Customs Organization (WCO), emphasizes joint control at neighboring border posts, along with the creation of juxtaposed customs offices to streamline joint control processes. Furthermore, WTO-TFA mandates member states to ensure coordination among authorities and agencies responsible for border controls and procedures, including the establishment of One-Step Border Posts (OSBP) to facilitate trade border operations.

Since the 1920s, single-stop inspection facilities were developed between various European countries before the formation of the European Union, which ultimately led to the disappearance of border controls across Europe. OSBPs have also been developed in Asia and, more recently, in some African borders. However, most African OSBP operate in cross-border roads, with very limited presence in African railways, which most often require inspections on both sides of a border. Furthermore, political sensitivities and divergent procedures among countries contribute to excessive and lengthy customs controls, resulting in delays and increased costs for cross-border trade.

The challenges and inefficiencies in cross-border operations highlighted above add significant layers of complexity, exacerbating the issues arising from potential interoperability concerns. While technical interoperability is crucial for seamless integration and efficient operations at border crossings, the procedural hurdles and lack of harmonization in border crossing procedures present substantial obstacles. These challenges often result in delays, increased costs, and administrative burdens for businesses and stakeholders involved in cross-border trade.





Efficient joint border posts reduce clearance time at border crossings and, in consequence Figure 38: Levels of interoperability at border crossings

According to the AU, to achieve the goal of trade and transport facilitation, which involves reducing the time and costs of border crossing while ensuring security and requiring only one stop, OSBPs are established based on four key pillars:

- **Legal and institutional framework**: OSBPs rely on coordinated efforts among various Governments, necessitating the development of a supportive legal and institutional framework, including application of laws extraterritorially, interagency cooperation, and integrated border management practices.

- **Streamlined procedures:** Implementing an OSBP without simplifying and standardizing border procedures renders it ineffective, necessitating review of procedures for greater effectiveness, which could include joint control, trusted trader schemes, single bonds or AEOs, among others.

- **ICT and data exchange systems:** While OSBPs can be implemented in a manual environment, the use of modern ICT equipment and application of electronic platforms significantly expedites border and transit operations, allowing for "single windows" for document presentation and risk management for more efficient operation, as well as the automation of lengthy inspection processes

- **Hard infrastructure:** In addition to the soft components, the construction of appropriate border facilities and the availability of appropriate operational tools create a suitable environment for efficient and effective border operations

In this sense, the AU and the WCO offer valuable guidance for the implementation of joint border posts, harmonized procedures, and agile and efficient procedures. While the African Union's *OSBP Sourcebook* includes towards road transport, reflecting its predominant role in Africa, its principles and guidelines remain relevant for rail operations, as it provides valuable insight into establishing the institutional framework, regulatory environment, and procedural guidelines necessary for effective customs controls and cross-border procedures. The WCO's *Railway Guidance* document also provides a specific tool for improving customs procedures in railways, focusing on effective documentation procedures through electronic platforms, agile controls through non-intrusive inspections (NII) and coordination between stakeholders.

Core insights and suggestion

1. Some critical operational issues at African borders are often related to border crossing procedures rather than interoperability challenges, with the main issues being inefficient and lengthy customs procedures, controls at both sides of a border and
2. Efficient joint border posts reduce clearance time, lowering transportation costs and increasing competitiveness
3. OSBPs have been widely developed across the world, but their presence in Africa railways is limited. Furthermore, procedures might be lengthy and different between various countries leading to delays and increased costs, especially in multi-national corridors
4. Effective implementation of OSBPs relies on four key pillars: common legal and institutional frameworks, streamlined and harmonized procedures, ICT and data exchange systems to expedite procedures, and hard infrastructure
5. Both the AU's OSBP Sourcebook and WCO's Railway Guidance document offer valuable insights for effective customs controls and cross-border procedures in Africa, with an emphasis on electronic customs procedures, risk management, non-intrusive inspections and cooperation between different agencies

4.3 Integration of railway infrastructure into the broader spatial planning framework

4.3.1 Master planning, project assessment and prioritization framework

In the anticipated rapid development of railway infrastructure across the African continent, African States must consider a comprehensive approach that considers its role within the wider transportation policy at the national level and the part railways need to play in fostering economic growth and trade at the regional and continental levels. This involves developing Master Plans that encompass all modes of transport and other industries across various administrative levels, including continental, regional, national, and metropolitan scales.

Effective master planning for railway infrastructure relies on integrating railways within broader transportation policies and strategies, encompassing all modes. This approach grounds railway planning in comprehensive transport-sector objectives, integrating multi-modal strategies and considering downstream operational efficiency. By aligning railway development with national transport agendas, infrastructure investments are optimized to serve specific objectives within broader development strategies. Moreover, close coordination between transportation authorities and other relevant government departments ensures seamless integration of transportation master planning into economic and social development frameworks.

In the seamless integration of master planning across all transport modes, prioritizing sustainable transport within a broader policy framework enhances the benefits of railways. In this context, railways should be viewed as the primary backbone of national logistics and mobility systems. Particularly, railway transport is almost always a link in broader logistics chains that involve other transport modes, notably maritime and road. In many cases road transport is an essential complement of railways-based logistics chains to ensure the delivery of freight to its final destination. In other cases, rail and road compete for the cargo along a single corridor. In all scenarios, efficient master planning needs to assess the interrelation between all the transport modes, assessing competitive balance and the existence of effective points for intermodal exchange, critical for rail performance.

In this sense, centralizing the governance of all transport modes within a single Ministry of Transport or Infrastructure facilitates the creation of cohesive transportation frameworks that consider all modes of transport, rather than developing independent policies for each mode. This consolidation, generally present in African nations, enhances efficiency and coherence in transportation planning, fostering synergies among different transport systems and supporting a holistic development of transportation infrastructure.

For the evaluation of concise railway projects developed in Master Plans, an assessment framework should be established which considers both the financial and economic aspects of projects to enable them to be accurately assessed. A key component of this should be accurate demand studies as they are paramount to ensuring that projects generate enough demand to justify rail as the most suitable mode of transportation. Subjecting such demand studies to independent review should also be considered.

Beyond the transportation realm, it is also imperative for railway planning to consider the interface between railways and other industries such as manufacturing, energy and ICT. For instance, in the landscape of limited electricity supply in Africa, railways must adapt accordingly and consider that electrification might not be feasible for certain projects. Conversely, during planning stages, the energy sector needs to consider the potential electricity demand railways might require in the future.

In this context, not only is it essential to include considerations regarding other sectors within railway planning, but collaboration should also be fostered between the railway sector and other key industries such as energy, ICT, mining, and manufacturing. This requires incorporating railways into the policies of these sectors, thereby raising awareness of the importance of railways and promoting their integration into broader development agendas. Sensitizing stakeholders across various sectors to the benefits of railways is crucial for garnering support and ensuring the success of railway projects.

Master planning should adopt a bottom-up approach, commencing either at the national level or even on a metropolitan scale where applicable. Similarly to harmonization efforts, the formulation of broader continental Master Plans should stem from the integration of strategic projects and objectives from each participating Member State. While the strategic objectives and policies of particular African States will be inevitably affected by wider continental policies, this approach ensures that infrastructure networks are tailored to meet the specific requirements of individual African States, rather than imposing solutions that may not align with their unique needs.

With clear national transportation strategies defined for transportation schemes and railways, African nations should then collaborate closely with neighboring States though RECs to develop unified regional Master Plans. This also needs to be developed as a wider transportation plan that integrates transport modes seamlessly, encompassing the prioritized infrastructure projects of each Member State and also other projects of regional interest. In this sense, these Master Plans should be guided by long-term national and regional strategic objectives aimed at enhancing connectivity, promoting trade, and fostering sustainable development.

Similarly, continental Master Plans should stem from the integration of regional Master Plans, encompassing the most crucial projects proposed by RECs and the participating countries. By aligning continental priorities with regional and national objectives, African countries can leverage synergies and maximize the benefits of integrated transport networks.



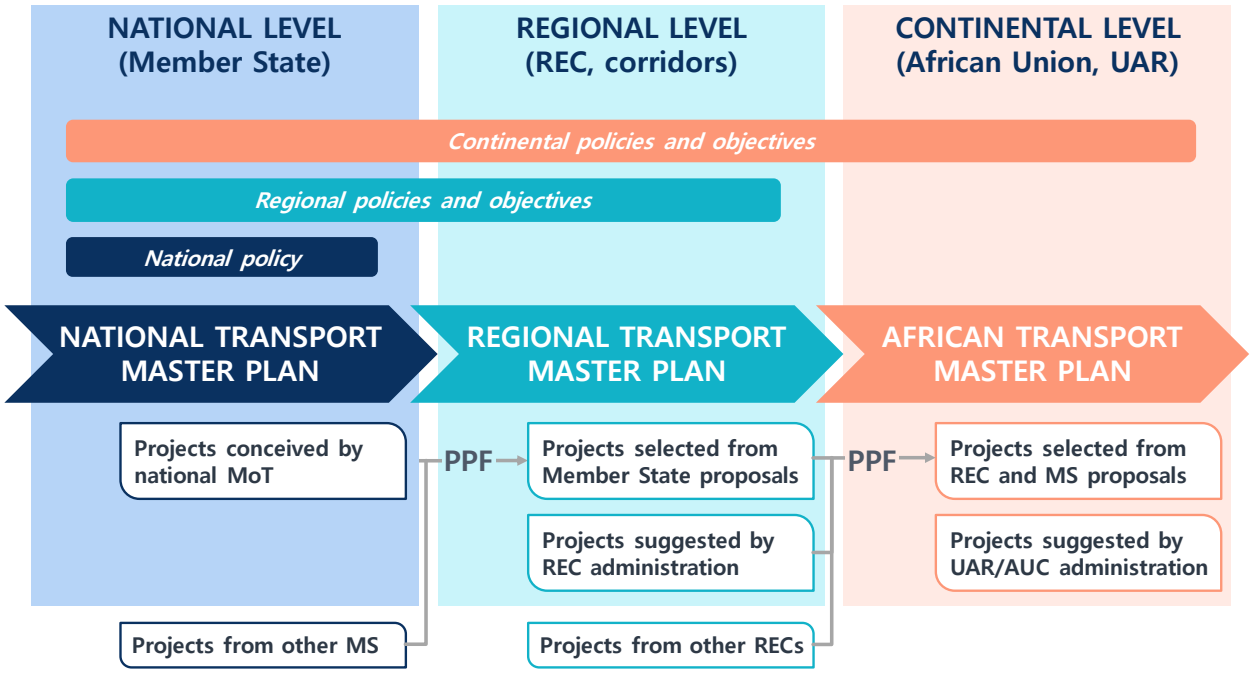


Figure 39: Framework for the integration of national, regional and continental transport Master Plans

In order to select the projects that are chosen as part of national, regional and continental Master Plans and given priority for development, continental and regional agencies need to evaluate and assign an order of priority to all projects suggested by Member States. Recently, the prioritization of projects within PIDA has been carried out based on a selection criterion previously defined by the stakeholders involved in the program. Conversely, pilot project selection for the AIHSRN Master Plan was carried out using a Project Prioritization Framework (PPF) criterion of the consultancy firm employed. The PPFs employed on these programs are specific for each decision and consist of multi-criteria analysis that failed to incorporate cohesive analysis of the economic benefits these infrastructure initiatives could bring.

In this sense, African rail infrastructure could benefit from the creation of harmonized and comprehensive tools for decision-making regarding the implementation priority of projects via the creation of a sound continental Project Prioritization Framework. Drawing from insights provided by reports such as *Prioritizing Infrastructure Investment: A Framework for Government Decision Making* by the World Bank, African policymakers and stakeholders should develop a broader and more robust methodology for assessing and ranking infrastructure projects in Africa based on their potential contributions to sustainable development and economic growth. By systematically evaluating various factors such as environmental sustainability, social inclusivity, cost-effectiveness, and broader economic impacts, decision-makers can identify and prioritize rail projects that offer the highest returns on investment while addressing critical infrastructure gaps across the continent.

In this sense, through commitment to green transport and rail infrastructure development and by including the socioeconomic benefits of rail in this evaluation framework, rail projects can be underscored as pivotal initiatives to public stakeholders. This not only expedites their development but also ensures that they are viewed favorably within broader infrastructure investment priorities. Through collaborative efforts and strategic planning informed by such a framework, Africa can optimize its rail infrastructure investments to drive socio-economic progress and regional integration effectively.

Other than providing a prioritization order for projects, the creation of such framework should also encourage transparency from public stakeholders regarding project development and transport policy. After the prioritization analysis is performed and projects are prosed for selection,

decision-makers should also publish the results of the PPF, reporting deviations from project selection guidelines with supporting justification. In this sense, the creation of a continentally standardized framework could increase the transparency of infrastructure initiatives and support the rail's role as a driver for growth.

Regarding the implementation of Master Plans, it is imperative to understand that master planning demands a long-term commitment and recognition that defined projects will most likely not materialize in the short term but rather be developed and implemented progressively, especially in the context of Africa's limited financial capabilities.

Furthermore, authorities must grasp that the true benefits of individual projects often materialize not in isolation but through the interconnected implementation of various infrastructure endeavors. For instance, the construction of a railway corridor may not yield substantial advantages unless complemented by the development of supporting infrastructure like seaport terminals, dry ports, and mining projects.

African States must adopt development plans linked to policy frameworks, ideally insulated from the transient nature of administrative changes. Defining independent structures that sponsor projects and ensure coherent development is needed as to maintain commitment to such long-term development strategies. For instance, land use should be defined in alignment with Master Plans to ensure coherent urban development and reserve the space for future infrastructures. This comprehensive approach not only ensures the longevity of infrastructure projects but also positions them to effectively navigate and thrive amidst changing socio-economic landscapes, ultimately fostering long-term growth and development across the continent.



Core insights and suggestion

1. African States need to adopt a comprehensive approach to railway infrastructure development, considering its role within national transportation policies and its contribution to regional and continental economic growth and trade

2. Railway infrastructure planning should stem from cross-sectorial Master Plans that encompass all modes of transport and are aligned with transport development policies across metropolitan, national, regional and continental administrative levels. Furthermore, Master Plans and railway infrastructure planning should consider the interface of railways with other sectors beyond transportation, such as manufacturing, energy and ICT

3. The joined-up governance of all transport modes within a single Ministry or Department of Transport enhances efficiency and coherence in transportation master planning

4. Accurate demand studies are essential to justify rail as a sustainably viable alternative to meet the strategic objectives of Master Plans

5. Master planning should adopt a bottom-up approach, starting at national or metropolitan level

    - African nations should collaborate on regional Master Plans that seamlessly integrate various transport modes, aligned with long-term strategic goals for connectivity, trade promotion, and sustainable development. These plans should stem from the integration of projects from multiple national Master Plans to ensure coherence and effectiveness
    - Continental Master Plans should integrate crucial projects from regional plans, aligning priorities to maximize the benefits of integrated transport networks across Africa

6. Continental and regional agencies should develop a standardized Project Prioritization Framework to assess and prioritize projects across national, regional, and continental Master Plans

    - This framework should consider factors such as environmental sustainability, social inclusivity, cost-effectiveness, and broader economic impacts to ensure optimal investment in rail projects that contribute to sustainable development and economic growth
    - The implementation of this framework should promote transparency and accountability while supporting rail's role as a driver of growth

7. Long-term commitment to master planning is crucial as infrastructure projects take time to materialize and require interconnected implementation for maximum benefits. African States should link development plans to policy frameworks and establish administration-independent structures to sponsor projects, ensuring coherent long-term development aligned with Master Plans and promoting sustainable growth

4.3.2 Cross-sector stakeholder

First, insufficient consultation with the logistics private sector during operational planning stages has led to a lack of understanding of their needs, resulting in downstream service integration issues. Key market players such as trucking and logistics operators could benefit from integrating with rail operations to offer comprehensive services. For instance, logistics operators like Bolloré face obstacles in moving outbound containers by rail due to the absence of dedicated slots, impacting their ability to set competitive prices.

Furthermore, with certain recent projects primarily driven from a construction perspective, there have been significant missed opportunities for connectivity with major origin and destinations of cargo. This includes port terminals, dry ports and connections to mining and industrial hubs. The absence of these vital connections restricts accessibility for numerous private entities to

utilize rail services effectively, thereby dampening demand and ultimately posing challenges to the financial sustainability of the infrastructure.

Moreover, infrastructure developments from different sectors often occur independently of railways, indicating a lack of coordination among public and private stakeholders. This disjointed approach hinders the integration of rail infrastructure with other transportation networks and related industries, leading to inefficiencies and missed opportunities for synergies.

In order to assess these issues, early engagement with cross-sector public and private sector stakeholders is paramount, including truck owners and logistics operators. This can be achieved, for instance, through the creation of formal channels of communication, such as regular meetings and meetings, where representatives from the rail industry, private sector, road transport, and maritime transport can exchange ideas, share concerns, and coordinate activities. For particular projects, working groups should be formed as such communication channels.

The inclusion private sector insights in transparent planning processes ensures alignment with operational needs and also facilitates buy-in from key industry players. In this sense, securing anchor customers that ensure a substantial demand for transport is a key element in the success of railway projects and can also reduce commercial risks for resource mobilization in later stages of the project.

Moreover, private sector entities offer valuable expertise and perspectives that can significantly enhance the planning process of railway and intermodal projects. By engaging with these stakeholders and seeking input and feedback, planners can gain a comprehensive understanding of market dynamics, operational needs, and also possible avenues for investment. This collaboration ensures that planning efforts are well-informed, responsive to market demands, and conducive to sustainable transportation development.

In order to meet the operational needs of the private sector, proactive consideration of first and last-mile challenges in planning is imperative for rail to provide a cost-effective alternative to road transport. This generally entails the provision of strategically-located intermodal terminals for an effective transfer onto road transport for the last-mile delivery, as well as the implementation of digitalization and other improvements to the cargo handling procedures. Additionally, even if many railway projects in Africa are already conceived from a mining point of view, it is important to remark that specific rail links and cargo terminals should be developed to cater to significant sources of bulk traffic like mines or industrial hubs.

In this sense, integrating railway infrastructure with production facilities, seaports, and other essential intermodal transport facilities, such as dry ports, also demands a coordinated approach from different parts of the public sector. This coordination encompasses design, operation, and investment strategies to ensure seamless connectivity and efficient logistical operations that drive demand.

This involves aligning the design and implementation timelines of railway lines with those of port terminals and logistics parks. Moreover, it is essential to consider potential projects in other sectors like mining or energy to ensure comprehensive integration and maximize the benefits of interconnected infrastructure networks.

Various partnership models exist to coordinate efforts for railway projects involving multiple stakeholders. These models can be tailored to different levels of stakeholder coordination depending on the project's complexity and sectoral intricacies. In simpler and independent projects involving small sets of partners, joint projects or programs can be useful to coordinate efforts in particular defined projects without the need for defining complex governance structures. Collective impact partnerships, conversely, are more suited for wider agendas without particularly defined projects.

On the other hand, to ensure successful implementation of larger-scale railway projects along transit corridors, especially in multinational, adopting a multi-stakeholder initiative approach could prove crucial to increase stakeholder coordination, mirroring current corridor development approaches. This involves establishing multi-stakeholder partnerships where

representatives from various sectors can collaborate to develop integrated transportation solutions. These partnerships include stakeholders from the rail industry, road transport, maritime transport, and government agencies, but should also introduce further tools to introduce private stakeholder insight.

Furthermore, multi-stakeholder initiatives make most sense when there is a need to coordinate multiple organizations and companies working on the issue and especially when partners have or are ready to commit large amounts of funding. Moreover, multi-stakeholder initiatives can unlick pooling of funding and procurement processes (rolling stock, construction materials, etc.), which could then enable economies of scale and better results than if partners acted on their own.

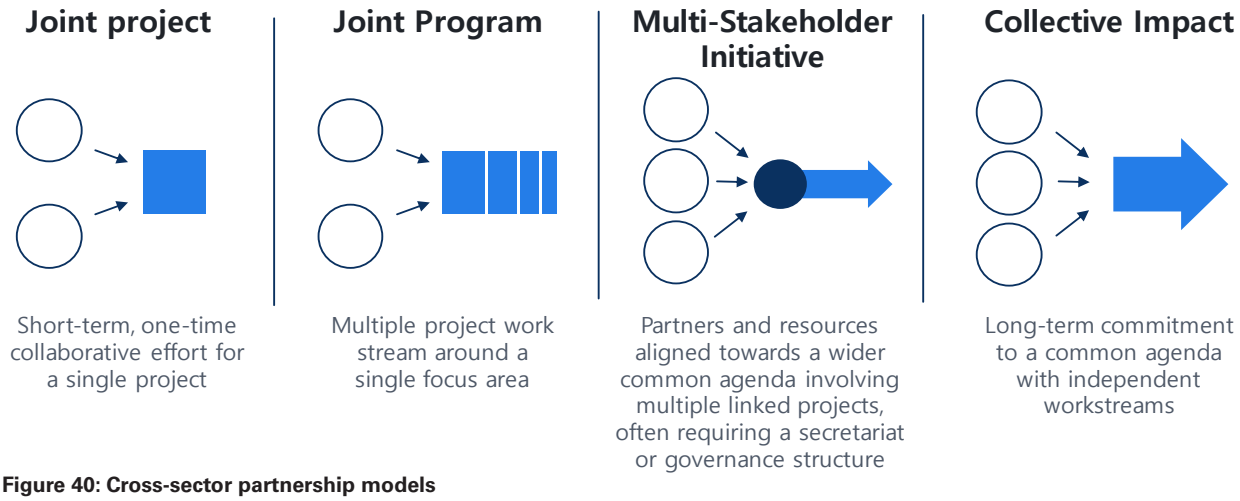


Figure 40: Cross-sector partnership models

By fostering improved cross-sector collaboration and addressing connectivity hurdles through synchronized planning and investment endeavors, the integration of railway infrastructure into broader spatial planning frameworks can be significantly enhanced. Such efforts promise to not only bolster rail operations and increase cargo volumes but also offer compelling value propositions to shippers and logistics operators, thereby fostering sustainable transportation efficiency and economic growth.

Core insights and suggestion

1. Inadequate consultation with the logistics sector during planning has led to integration issues in recent projects, hindering rail service and sustainability. Missed connectivity opportunities exacerbate this, reflecting a broader lack of coordination across sectors

    - Early engagement with private and cross-sector stakeholders, including truckers and logistics operators, is crucial for a planning process that incorporates private sector insights and ensures alignment with their operational needs and facilitates buy-in from industry players
    - Proactive consideration of first and last-mile challenges in planning is imperative to provide a cost-effective intermodal alternative to road transport. In turn. seamless integration of railway infrastructure with ports and other intermodal facilities requires coordinated design, operation, and investments between cross-sector stakeholders

2. Various partnership models can be adopted to coordinate efforts in multisectoral or multinational projects, tailored to project complexity and sectoral intricacies. Joint projects and programs offer simple coordination structures that require no coordinating agencies, while multi-stakeholder initiatives are crucial for larger-scale railway projects, enhancing stakeholder coordination and facilitating integrated transportation solutions

4.3.3 Project readiness plans

A robust planning and preparation including extensive feasibility studies, detailed designs and stakeholder coordination and engagement, is crucial for laying the foundation of successful rail infrastructure, ensuring its long-term operational viability and financial sustainability.

However, in recent years, various infrastructure projects across different regions have been initiated without sufficient comprehensive feasibility studies nor established planning and designs. This has been particularly worrisome in Chinese-developed EPC contracts, which have been developed from a construction point of view. Consequently, many of these projects have failed to meet their strategic objectives or were developed without giving much consideration to such. This lack of thorough planning and preparation has led to inefficiencies in resource allocation and, in most cases, suboptimal project outcomes.

On the other hand, projects involving multiple countries or sectors have suffered from uneven timelines and coordination in resource mobilization and implementation efforts. This, in turn, has results in partial projects that also fail to yield the complete benefits the complete infrastructure might offer.

To address these challenges and ensure successful infrastructure development, it is first crucial to emphasize the importance of **comprehensive project planning** and an **extensive preparation** to ensure that all stakeholders are ready for implementation and construction of the project.

Comprehensive feasibility studies are imperative during the **planning phase.** Initially, the project must align with overarching policies and present clear strategic justifications for its development. Subsequently, these studies should assess various aspects of the project such as technical feasibility, economic viability, environmental impact, and social implications, meticulously examining factors like terrain orography, population density, traffic demand, placement of intermodal stations, economic analysis, financial viability, and environmental impact, among others. Moreover, feasibility studies should carefully evaluate the existing infrastructure, determining whether greenfield or brownfield projects are more appropriate to attain the strategic objectives that the project aims to address within the existing financial capabilities. Properly supported by thorough feasibility studies, decision-makers can make informed choices and mitigate potential risks associated with infrastructure projects such as cost overruns and delays.

Ultimately, successful planning for railway infrastructure projects relies in a sound feasibility analysis that answers the key components in **strategic, economic, financial, commercial, and managerial analyses** to ensure that the chosen project is sensible, economically and financially viable, affordable and achievable.

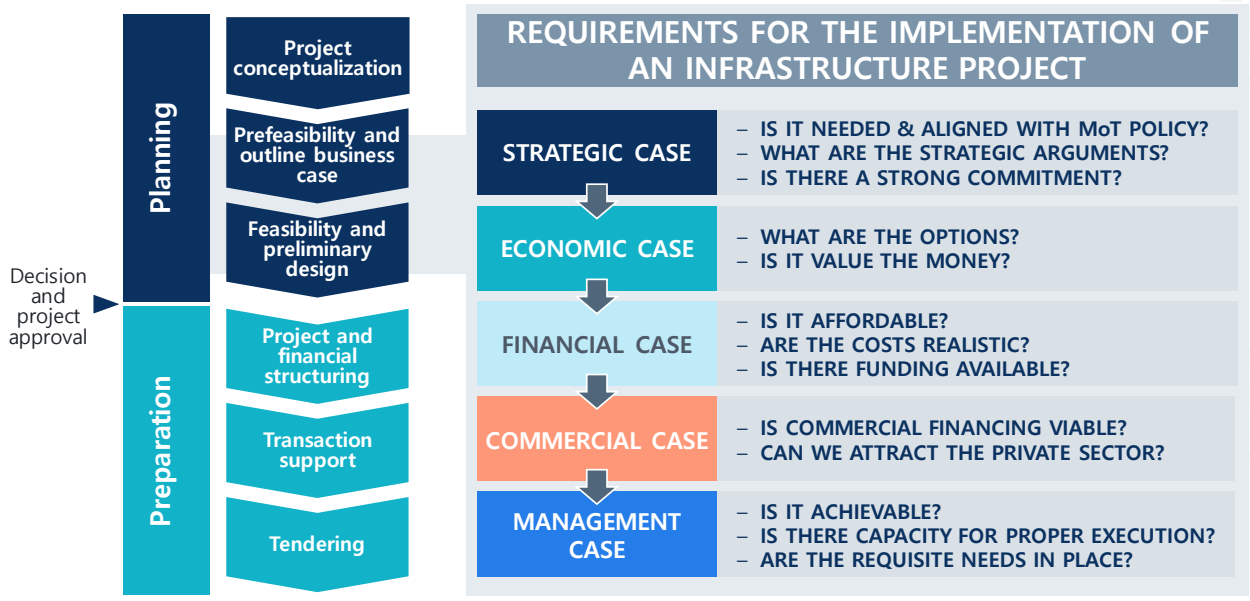


Figure 41: Project implementation requires of 5 specific case analyses for success

- Before initiating a rail project, a **strategic case analysis** is necessary to assess its alignment with broader economic and development goals. This involves evaluating the project's motivation, strategic importance, and alignment with national transportation policies and objectives

- An **economic case analysis** is crucial for assessing the project's contribution to societal and strategic objectives. This entails evaluating the project's costs, benefits, and potential economic returns over its lifespan, ultimately identifying the most suitable and profitable implementation design alternatives

- The **financial case analysis** is a critical component of railway project implementation, assessing affordability within available funding resources. It scrutinizes projected costs' realism, considering costs throughout the project lifecycle and balancing them against expected revenues, as well as considering different financing options (public and private)

- A **commercial case analysis** should be conducted to determine the likelihood of attracting private sector investment and commercial financing for the project through PPPs, revenue-sharing models, and risk mitigation mechanisms. This approach not only enhances financial sustainability and efficiency but also allows public stakeholders to potentially allocate public funds towards other rail projects

- The **management case analysis** evaluates execution capacity and operational readiness by assessing governance structures, regulatory frameworks, project management systems, material availability, and workforce readiness. Prioritizing robust management practices and organizational capacity mitigates execution risks, enhancing the project's potential for success and self-sustainability

These feasibility studies should undergo rigorous auditing and verification by independent agencies to ensure transparency and accuracy. This process is vital for preventing the initiation of projects based on unrealistic feasibility studies, as observed in recent EPC collaborations. Independent agencies or contractors can provide unbiased assessments, identify potential discrepancies or inflated projections, and ensure that projects are founded on reliable data and analysis. By subjecting feasibility studies to external scrutiny, stakeholders can mitigate risks and uphold the integrity of infrastructure development initiatives.

On the other hand, after the approval of a project and the decision to implement it, it is necessary for project sponsors to conduct an **extensive preparation** the project's development before venturing into its implementation or construction, including detailed designs, effective resource mobilization and institutional and regulatory coordination.

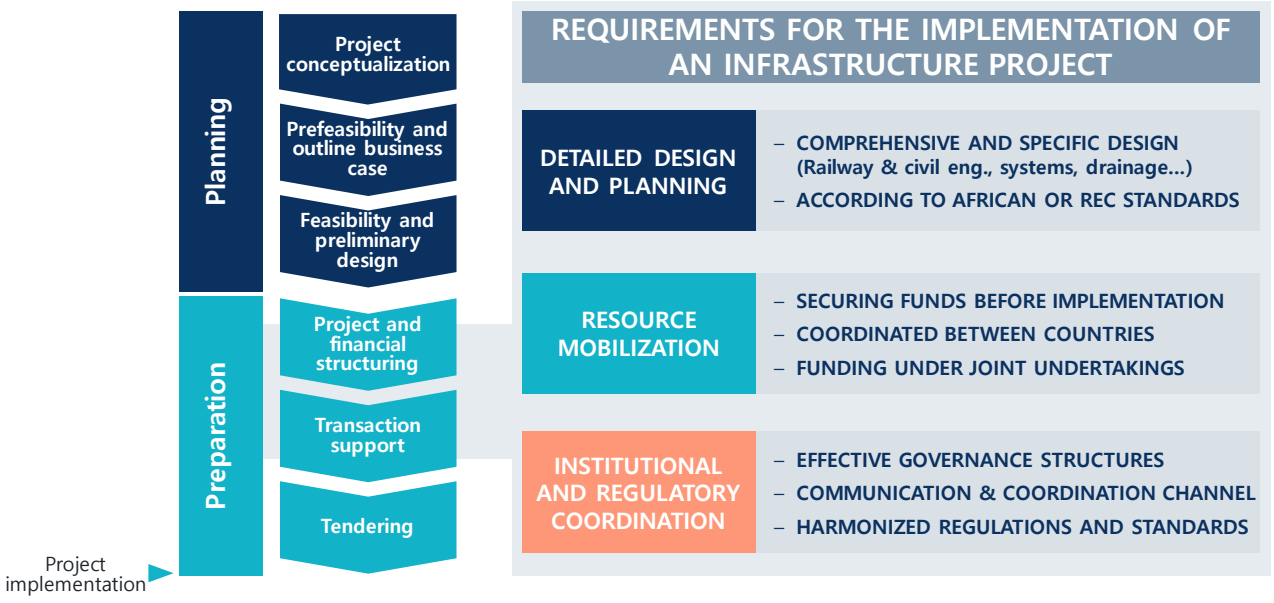


Figure 42: Extensive preparation is necessary before implementation of a project, to avoid costly changes and delays during the such implementation process

First, d**etailed designs** are crucial before beginning construction. Civil and railway engineering and architecture experts, as well as other relevant professionals, should be engaged to develop detailed designs for the infrastructure project. These designs should be comprehensive and include all necessary technical specifications (track, earthworks, structural design of bridges, ICT systems, etc.), materials, and construction methods, all according to the specifications of pan-African or regional technical standards. Furthermore, detailed designs should come with detailed budgets for the tendering process.

By incorporating a balance of African expertise and foreign engineering know-how during the detailed design stages, railway projects can not only meet the international quality standards but also offer better adaptation to the African context. Furthermore, this collaborative approach should foster technical capacity building on the continent and introduce best practices in infrastructure design.

On the other hand, **effective resource mobilization** is vital to the project's success. This entails financial structuring and transaction support, for which financial experts play a crucial role in structuring the project's financing, determining balance between debt and equity, developing mechanisms to attract private investment, and securing funding from investors or lenders. Given Africa's difficulties in raising capital, innovative mechanisms such as guarantees, debt subordination or new funding sources could prove crucial in sourcing the necessary funds for capital intensive infrastructure projects. It is essential to ensure that all necessary financial resources are secured and available before construction begins.

Furthermore, in multinational infrastructure projects involving multiple countries, the independent mobilization of resources (especially financial) is a huge problem that hinders project viability and success. There is a need to set common strategies and efforts at a corridor level. Therefore, it is essential to synchronize timelines and strategies to facilitate effective **coordination in project execution and resource mobilization.** This coordination ensures that all participating countries are aligned in their efforts and commitments, minimizing delays and optimizing resource utilization.

To facilitate efficient and coordinated resource mobilization across multiple participating countries, multinational projects could consider the establishment of common funding frameworks as a guideline outlining how financial resources will be mobilized, allocated, and managed. This should be aimed at clarifying the contribution responsibilities of each country and providing guidelines for accessing and utilizing common funds. Furthermore, exploring opportunities for pooling resources and expertise among participating countries can enhance the effectiveness of resource mobilization efforts.

Other than in resource mobilization, a clear governance structure needs to be established a for projects. This includes defining the roles, responsibilities and assumed risks for key stakeholders such as project owners, sponsors, managers, contractors and oversight committees. Furthermore, stakeholders should define decision-making processes and communication channels to ensure effective coordination and accountability among all participating stakeholders. Clear channels of communication should be established to address any issues or concerns that may arise promptly, involving regular meetings, information sharing, and joint decision-making processes to ensure that all stakeholders are aligned with the project's implementation timelines. This could also entail defining multinational and multisectoral agencies specific for the project or facilitation agencies (as seen in corridor projects).

Additionally, standardized procedures and protocols should be implemented to streamline project management across borders. This includes harmonizing regulatory frameworks, standardizing technical specifications, and facilitating cross-border trade and logistics, all critical to the success of cross-border rail projects.

As to assess project readiness, especially in projects belonging to AIHSRN and AIRN projects that should serve as the backbone of Africa's

trade and logistics infrastructure, independent monitoring by a continental agency (AUR). This monitoring should be established as a prerequisite for assessing project readiness, particularly in the case of railway projects, before giving the green light for construction. By conducting thorough assessments and evaluations, the pan-African agency can ensure that these projects meet predefined criteria before advancing to the construction phase. This process involves scrutinizing aspects like feasibility studies, financial viability, resource mobilization and technical specifications.

Furthermore, AUR's independent monitoring helps identify potential challenges, risks, and deficiencies early on, allowing stakeholders to address them proactively and avoid challenges further down the line in during the construction phase.

The implementation of independent monitoring, either by AUR or external entities, should foster a culture of diligence and responsibility in infrastructure development across Africa. This factors, in turn, can increase project transparency and increase investor confidence for African projects, therefore unlocking potential capital sources. Furthermore, it not only ensures that projects meet the necessary requirements before construction but also safeguards against mismanagement, delays, and cost overruns.

Core insights and suggestion

1. Comprehensive planning and preparation are essential for successful rail infrastructure projects, including extensive feasibility studies, detailed designs, and stakeholder engagement, to ensure long-term operational viability and financial sustainability

2. A robust planning process should include comprehensive feasibility studies that assess technical, economic, environmental, and social aspects of the project to accurately guide decision-making

    - A thorough feasibility study that green-lights the implementation of a project should include a strategic case analysis to align the project with broader development goals, an economic case to evaluate costs and benefits, a financial case to assess affordability and potential financing sources, a commercial case to evaluate the likelihood of attracting private investment, and a management case to ensure effective execution
    - Feasibility studies should undergo rigorous auditing by independent agencies to ensure transparency and accuracy, preventing the initiation of projects based on unrealistic forecasts

3. Before construction begins, thorough preparation is necessary, including detailed designs developed by civil and railway engineering experts that meet technical specifications and regional standards. Collaboration between African and foreign experts during the design stage could enhance quality and adaptation to African contexts while fostering technical capacity building

4. Effective resource mobilization is crucial for project success, ensuring that all necessary financial resources are secured and available before construction begins

5. Multinational infrastructure projects demand synchronized timelines and strategies to ensure effective coordination in project execution and resource mobilization, minimizing delays and optimizing resource utilization

    - Common funding frameworks can facilitate coordinated resource mobilization across participating countries, clarifying contribution responsibilities and enabling collaborative financing mechanisms for maximum impact
    - Clear communication channels are essential for stakeholder cooperation, involving regular meetings, information sharing, and joint decision-making
    - Harmonized regulatory frameworks and technical specifications are critical for facilitating cross-border transportation and logistics for the success of cross-border rail projects

6. Independent monitoring by a continental agency, such as AUC or AUR, should assess project readiness and ensure compliance with predefined criteria and standards before advancing to construction phases, fostering diligence and responsibility in infrastructure development

4.4 Integration of sustainable development principless

As global concerns about sustainability continue to escalate, there is a growing recognition of the pivotal role that transportation plays in achieving sustainable development goals. In this context, railways play an important part, contributing to 7 of the 17 Sustainable Development Goals defined by the United Nations. Furthermore, railways present significant benefits with respect to other transport modes, mainly their reduced environmental impact and their social implications. The recognition of such contributions has further bolstered global advocacy for railways, as many international organizations and regional groupings have set up their supporting schemes for railways under broader sustainable transport strategies.



Figure 43: Railways actively contribute to 7 of the 17 UN Sustainable Development Goals

Despite their inherent sustainable nature when compared to other modes, there remains a pressing need for railway companies to enhance their sustainability performance. This entails fully integrating sustainability principles into all fundamental processes of railway projects, starting from project conception. The incorporation of sustainability criteria into railway projects is essential for ensuring that they maximize their positive contributions to environmental preservation and social equity while also maintaining their own financial sustainability. Moreover, the nature of these pillars within a sustainability framework underscores the interconnectedness between.



Figure 44: Sustainable development of rail relies equally on environmental, social and financial considerations

4.4.1 Climate & Environmental considerations

Transport decarbonization is critical for mitigating climate change through near-term actions and long-term transitions. Within the classic *avoid-shift-improve* framework for sustainability, rail plays a crucial role in this effort. Because rail is relatively energy efficient, its primary contribution toward mitigating climate change comes from shifting transport from less energy efficient modes, such as road and air, to railways.

To incentivize such shift, Governments have various measures, policies, and regulations available. However, it is crucial to recognize that these policy interventions are most effective when implemented in tandem. Pricing and taxation measures alone may not effectively encourage the shift from road to rail without a reliable rail service alternative nor without efficient options for the last-mile delivery. Creating an appealing alternative requires investment in infrastructure, rolling stock, digitalization, and customer-oriented railway management. Successful investment also necessitates coordinated planning and land use to ensure seamless connectivity between rail and other transportation modes.

In summary, supporting rail's role in transport decarbonization requires a comprehensive framework encompassing policies, market conditions, and infrastructure investments that work together to create an environment conducive to rail's success in attracting traffic from less energy-efficient modes. Section 4.7.1. *Policies to promote intermodality* includes a wide array of policy options to encourage a modal shift from road to railway transport.



Figure 45: Policy Process and Key Questions for determining Rail's role in transport decarbonization

Source: World Bank Group: The Role of Rail in Decarbonizing Transport in Developing Countries

Within this framework, rail's contribution to decarbonization can be amplified by maximizing its efficiency and using clean energy. To enhance railway's sustainable potential and their role in decarbonization, GHG emission reduction through network electrification is the main objective of most stakeholders involved in the sector, as identified during the stakeholder consultation process carried out by the consultant. However, the prospect of electrifying rail networks across Africa presents significant challenges. The primary constraint is the lack of reliable access to electricity in many regions of the continent, which raises questions about the feasibility of meeting the substantial energy demand that electrified railways would entail. Not only does Africa have an energy deficit in terms of power, but power cuts and outages are

not uncommon where energy is available. In this context, network electrification in Africa in the short/medium term poses major challenges.

Moreover, in the pursuit of network electrification, it is crucial to quantify the specific energy requirements of rail operations and assess the associated costs, taking into account the diverse geographic and economic landscapes across Africa. With a clear estimate in hand, realistic cross-sector considerations are essential to address these challenges effectively, ensuring that network electrification efforts align with the continent's energy capabilities and infrastructure development priorities.

In pursuing sustainable development, African stakeholders must closely scrutinize their energy mix, particularly focusing on electricity generation methods. While transitioning to electric railways can mitigate emissions, reliance on coal for electricity production can minimize such environmental gains. Thus, to align development goals with sustainability objectives, African nations must evaluate energy sources and prioritize diversification. While coal reserves offer developmental opportunities and should be used to drive such development, investing in renewables and energy-efficient technologies is crucial to reduce carbon footprints as Africa progresses. Furthermore, a cleaner energy mix for railways will be an essential requisite to access potential sources of climate financing.

While aspiring towards electrification in the mid/long-term, African Rail Authorities should consider exploring alternative traction modes to diminish emissions in the short term. In this sense, research and development efforts should be directed towards alternative tractive power mechanisms, collaborating with other transport sectors, industries and regions. Potential alternative green traction sources that could be pragmatically introduced in the short term include:

- **Hydrogen fuel:** The introduction of hydrogen trains in commercial services in Germany in 2018 and R&D initiatives like FCH2Rail in Spain are showing positive results for the feasibility of green hydrogen as a viable alternative fuel. Furthermore, green hydrogen fuel has also been already implemented in other transportation modes, being a wide-spread fuel in urban buses. However, while green hydrogen shows promise as a green alternative, its introduction could also present other kinds of challenges, mainly logistic and operation-wise, and new risks in safety terms.
- **Electric batteries** are an alternative green electric power source that requires no catenary and that have already been implemented in many short railway lines around the globe. Despite higher purchase costs, battery trains are economically viable on certain railway lines as the high investment and maintenance needs for full line electrification are eliminated. Furthermore, battery technology has greatly improved over the past 20 years, broadening the scope of use of battery trains. Vivarail in the UK claim their trains have a range of 160 km on only battery power, with a 10-minute charging time. Overall, electric batteries already hold significant potential for regional and metropolitan passenger railways, with reference implementations in France, Japan, Austria and the United Kingdom, but further development could unlock new applications for long-distance passenger and freight transport in Africa.
- **Liquified natural gas:** While natural gas has been explored as a potential alternative fuel for trains due to its lower emissions compared to diesel, its adoption in the railway industry has been limited. The first LNG-powered railway locomotive was put into operation in Russia in November 2015.
- **Biofuels:** Biodiesel is technologically feasible for blending in diesel traction systems, but there is relatively little experience with using biodiesel in railways as compared to other sectors.

Apart from their intrinsic role in decarbonizing transport, rail projects must now also account for the effects of climate change on infrastructure resilience. Africa, in this sense, faces unique vulnerabilities to these effects, given its exposure to some of the highest temperatures globally and the growing incidence of natural disasters resulting from shifts in climate patterns.

Recognizing this imperative, some sector stakeholders have begun introducing climate-resilient designs onto their greenfield projects and in their renovations of existing infrastructure. The United Kingdom, for instance, is developing a comprehensive Weather Resilience and Climate Change Adaptation Strategy (WRCCA) to identify and manage risks and vulnerabilities across its rail network. Moreover, UIC is working on a comprehensive set of guidelines tailored to the construction of climate-resilient railways. Such guidelines are already being applied on some cases of rail infrastructure design in Europe. The available reports of UIC RailAdapt project, as well as MOVE-IT guidelines, provide some examples of

risk mitigation measures to prevent damage to infrastructure from the effects of climate change, shown in the figure below.

To effectively bolster the resilience of railway infrastructure against the effects climate change, it is crucial to integrate climate-resilient design into continental standards, ensuring a unified approach to climate adaptation across railway networks. Additionally, proactive monitoring of infrastructure for temperature variations and prompt intervention during extreme weather events could be essential measures ultimately safeguarding the integrity and safety of railway infrastructure and operations.

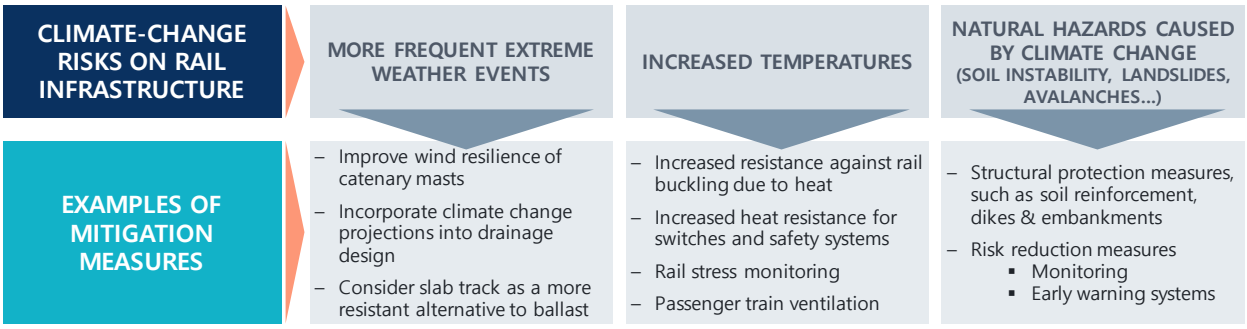


Figure 46: Examples of mitigation measures for risks associated with climate change on rail infrastructure

Core insights and suggestion

1. Facilitating rail's contribution to transport decarbonization demands a holistic framework integrating policies, market conditions, and infrastructure investments. This approach fosters an environment supportive to rail's effectiveness in drawing traffic away from less efficient modes.

2. Rail projects mainly aim to enhance their environmental sustainability and reduce GHG emissions through electrification, but electrifying African networks faces issues due to unreliable electricity access, for which widespread network electrification is difficult in the short term

    - Precisely quantifying energy requirements while considering energy sector developments and diverse landscapes is crucial for a realistic rail electrification planning in Africa
    - While aspiring towards electrification in the long-term, African authorities should investigate alternative traction modes like hydrogen fuel, electric batteries, natural liquified gas and biofuels as viable short-term options by collaborating on R&D with other sectors and regions to enhance their efficiency and suitability for different types of projects

3. Railway projects must account for climate change impacts on infrastructure resilience, particularly in vulnerable regions like Africa facing extreme temperature and natural disasters. Incorporating climate-resilient design into continental standards and implementing proactive infrastructure monitoring are vital for ensuring the safety and effectiveness of railway operations. The UIC guidelines for the construction of climate-resistant railroads can help in this regard

4.4.2 Social aspects

Social sustainability in the context of transport infrastructure, particularly railways, involves fostering communities capable of supporting present and future generations' well-being. Railways play a vital role in this by providing equitable access to transportation services, creating jobs, and enhancing community well-being. However, quantifying the social benefits of railways has been challenging, hampering their recognition and project viability. To address this, a framework for social sustainability in African railways should focus on enhancing and monetizing these benefits across three pillars: economic growth and job creation, equal opportunities and gender inclusion, and societal well-being.

Economic growth and job creation

By enabling the seamless movement of goods and people, railways stimulate economic activity along their routes, spurring investment, trade, and commerce. Moreover, railway infrastructure projects themselves generate employment opportunities, from construction to operation and maintenance, contributing to job creation and skill development in local communities.

Additionally, railways serve as catalysts for the emergence of economic hubs, attracting businesses, industries, and logistics operations to areas served by rail networks. For instance, the introduction of HSR to St. Pancras Station in London brought £10Billion in private investment into the local station area. These hubs become focal points for economic activity, creating further jobs, driving innovation, productivity, and competitiveness in surrounding regions. For example, Madrid to Valencia HSR line generated over 100,000 direct jobs and an additional 135,000 permanent positions within five years. Similarly, economic activity increased by 2.7% around Frankfurt and Cologne stations compared to the rest of the region.

To further enhance economic development, effective regulatory frameworks and proactive measures are needed to entice businesses to establish operations near rail corridors, benefiting Governments and Railway Authorities through transit-oriented development mechanisms.

However, assessing the exact impact of large infrastructure projects is often challenging during planning and design phases, particularly in the African context. Large-scale macroeconomic studies to determine the effects of railway initiatives on economic activity and job creation can be lengthy, imprecise, and costly. Moreover, uncertain conditions in Africa further complicate accurate quantification

To solve this, African states and continental agencies should research and develop simplified models to identify impact of railway lines on national and continental economies, including factors such as job creation and changes in GDP. Drawing from benchmarking techniques and historical data, various models exist to provide quantifiable results for the impact of railways. Integrating such models into project viability assessments under a standardized model would not only enhance project feasibility but also underscore the significant economic contributions of railway projects at national and regional levels.

Equal opportunities and gender inclusion

By connecting urban centers, rural areas, and communities in between, railways ensure that individuals have access to essential services, education, employment opportunities, and social amenities. This accessibility can be particularly vital for marginalized and underserved populations, including women, persons with disabilities, and low-income individuals, who may face barriers to mobility and inclusion. Moreover, railways foster social cohesion by facilitating interactions and connections between people from different backgrounds and regions, thus contributing to a more integrated and inclusive society.

Not only in Africa but at a world-wide level, infrastructure design has traditionally failed to account for the distinct needs of men and women who often have different use patterns of infrastructure, leading to a widening gender gap that current projections suggest will take years to close. Gender inequalities in infrastructure design have broader economic implications, with the potential to increase economic activity significantly by addressing them.

Safe, comfortable, convenient, and economical transport can help meet women's practical requirements, such as getting to school and the market, as well as contribute to their strategic empowerment by facilitating access to social and economic possibilities.

In this context, it is necessary to implement and reinforce legal and institutional arrangements on gender equality, as well as define best practices for gender-inclusive designs, requiring political will and multi-stakeholder engagement. However, even simple actions can yield significant impacts in promoting gender inclusiveness in transportation. For instance, in El Salvador, the design of bus stops and vehicle interiors was improved to create safe spaces for women. Other initiatives such as regular gender training of all public transport staff, implementing surveillance systems, and provision of supporting infrastructure such as separate public toilets, lactation booths and creches for children at transport hubs could encourage women to use public transport.

Another key area to address is mainstreaming women's participation in the transport sector, as they are underrepresented in infrastructure planning, design, and implementation, accounting for only 18% of staff in infrastructure ministries worldwide. Women's voices and leadership are also vital for transparent and evidence-based

decision-making processes to avoid inadvertently maintaining existing power imbalances. Many steps need to be taken to incentivize opportunities for leadership and entrepreneurship at all levels. For instance, Malawi implements innovative methods to enhance women's public participation by organizing community and virtual events near residential areas.

To incorporate social integration and gender considerations into infrastructure design and operation, stakeholders should prioritize monetizing the benefits of such initiatives in terms of gender equality and social inclusion. While accessibility can generally be addressed through demand forecasts, measuring gender equality poses challenges. Nevertheless, developing industry-specific KPIs to assess gender inclusiveness could serve as an initial step towards monetizing the impact of railways on addressing gender inequalities in Africa.

Societal well-being

Railways serve as a fundamental element of transportation infrastructure, facilitating swift and cheap connectivity not only between diverse cities but also linking production facilities, ports, and urban hubs. This efficient network enables rapid movement of both people and goods across regions. Moreover, the accessibility and speed offered by railways play a pivotal role in shaping urban growth dynamics. By extending transportation options to the outskirts of major cities, railways contribute to decentralization and spread economic opportunities beyond city centers. This expansion encourages the development of peripheral areas, fostering more balanced urban growth and alleviating congestion pressures in densely populated city cores. With Africa experiencing significant growth in current and future megacities, railways could serve as a vital tool in sustainably managing urban expansion and preventing overcrowding.

However, it is also essential to recognize that some large infrastructure projects require the involuntary displacement of large masses of population. While the main priority should always be for no individual to be resettled, project promoters and stakeholders should adhere to the following principles:

- It is imperative that all individuals impacted by resettlement receive fair compensation for their losses

- Involuntary resettlement should be viewed as a chance to enhance the livelihoods of those affected

- All individuals impacted by involuntary resettlement should be consulted for the resettlement planning to ensure that measures to mitigate the effects of displacement are appropriate and sustainable

Following this principles, Tailored approaches to resettlement and livelihood restoration should be developed to address specific needs and conditions of affected communities, outlined in a Resettlement Action Plan integral to any project involving displacement. In this sense, the *IFC Handbook for Preparing a Resettlement Action Plan* provides a comprehensive guide to managing involuntary resettlements.

On the other hand, the prioritization of road sector development over rail has overlooked the significant externalities associated with road transportation. This includes the alarming mortality rate on African roads, which raises profound social concerns. Additionally, environmental and health issues such as high emissions of GHG, particles, and noise pollution are contributing to the escalating total external costs of the road industry. In contrast, railways contribute to societal wellbeing by reducing such external costs.

To address these shortcomings and fully monetize the societal benefits of railways, improvements in the quantification of external costs are necessary. This could be achieved through the development of standardized manuals akin to those used for CBA by the EU Commission (*Handbook of External Costs of Transport*), which standardize the values to be used in CBA analyses in each European Member State. While many CBA in Africa already use adaptations of the values contained within such EU Handbook, the development of a specified Handbook for African costs would provide standardized monetization technique for external costs of transport in Africa and more accurate to the African reality

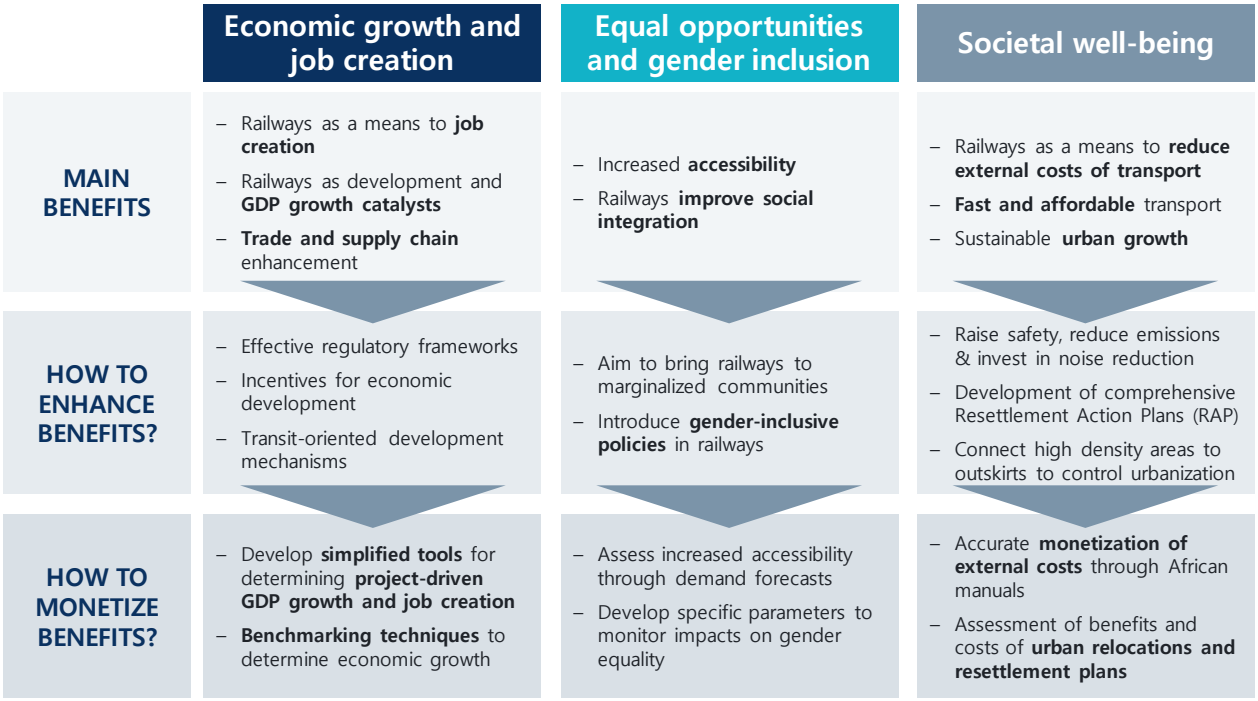


Figure 47: Social sustainability framework for African railways

Core insights and suggestion

1. Railways promote economic growth and job creation, with successful rail projects acting as key GDP-growth catalysts by enhancing trade and movement of people

    - It is challenging to properly quantify the macroeconomic benefits of railway projects, for which unified models based on benchmarking techniques and historical data could serve as powerful tools to monetize the macroeconomic benefits of rail infrastructure projects
    - Regulatory frameworks and policies that incentivize economic development, as well as TOD mechanisms, can boost the effectiveness of railways' impact on the economy

2. Given that a proper framework is provided, railways can help bring equal opportunities and gender inclusion and equality to the African society

    - By connecting different areas within the continent, railways can help breach social barriers and improve accessibility
    - Infrastructure design overlooks gender-specific needs, widening the gender gap and even impacting economies. Gender-inclusive policies in transport and promoting women's participation in transportation projects are essential for achieving gender equality in society

3. Railways contribute to societal well-being by reducing the external costs of transport and increasing accessibility in different areas, which helps structure sustainable urban growth

    - Railways have the potential to be pivotal in addressing the rapid expansion of African megacities by promoting decentralized urban growth and easing congestion
    - Large infrastructure projects that involve displacement of collectives should develop Resettlement Action Plans that prioritize fair compensation, enhancing affected livelihoods, and thorough consultation during sustainable resettlement planning
    - Standardized manuals for quantifying external costs, similar to those used by the EU Commission, could help to accurately monetize the societal benefits of railways in Africa

4.4.3 Financial sustainability

Rail financial sustainability refers to the ability of railway systems to maintain their economic viability and operational efficiency over the long term. This encompasses effectively managing various financial aspects, including revenue generation, infrastructure construction costs and debt, maintenance expenditures, and procurement, operation, and maintenance of rolling stock.

However, for most railway projects, achieving financial sustainability poses significant challenges. The balance between revenue generation and the costs associated with constructing, maintaining, and operating railway infrastructure often tilts negatively, with construction costs often not recovered. Moreover, the journey to self-sustainability for such projects is typically prolonged. Therefore, successful railway initiatives necessitate a robust commitment from railway promoters and Governments to preserve their socioeconomic benefits and strive for eventual financial self-sufficiency.

The development of financially sustainable infrastructure begins with meticulous project conceptualization and planning. As previously discussed in previous sections, sustainable infrastructure is intricately linked with the project's overall development phase, which encompasses multiple stages and analyses before reaching the construction and implementation phase with guarantees of success. Particularly, the **five key case analyses** within the strategic plan play a vital role in ensuring an infrastructure project's financial sustainability (see Figure 41).

Taking a holistic approach to achieving financial sustainability in railway projects necessitates a thorough examination of all pertinent factors outlined in each of the strategic, economic, financial, commercial, and management analyses. The comprehensive execution of these analysis should, if properly conducted, yield the framework for a financially sustainable project. Particularly, the analyses should cover the **essential requirements** for any railway project to be successful and financially sustainable in the long term:

- **Political commitment**, evidenced through **policy and regulatory support** as well as **subsidies for O&M financing** in those projects that are not self-sustained
- **High-quality technical design** according to established standards, to avoid cost overruns (related to major maintenance works) during the operational phase
- **Comprehensive feasibility studies** with reliable and realistic demand forecasts that can be met during operation, to avoid a substantial shortfall in operating income during the O&M phase
- **Budget availability and technical capacity for construction of infrastructure** according to high-quality design specifications, which in its absence could again lead to again cost overruns in O&M
- **Necessary funds for infrastructure maintenance and operation throughout all of its lifecycle**
- **Necessary funds and technical capacity** for operation of rolling stock

Initially, subsidies for the operation and maintenance of infrastructure and rolling stock are indispensable, especially for passenger services. However, financially sustainable railways should aim to decrease their reliance on Government subsidies over time as they mature. This progression towards self-sustainability is crucial for the long-term viability of railway in the context of a limited pool of governmental funds.

While planning stages are most critical, it is paramount to acknowledge that misconceptions, lack of commitment or oversights at any stage of the project lifecycle can lead to significant challenges in achieving financial sustainability. Furthermore, most deviations from the path for financial sustainability result in the need for bigger commitments or cycles of decline. For instance, inadequate construction and a low-quality end product generally convert to higher maintenance costs for both infrastructure and rolling stock, which then hinder other aspects of the project's financial sustainability. Alternatively, inadequate infrastructure maintenance can result in increased operational costs and decreased service reliability

and safety, negatively impacting revenue streams. Limited income, in turn, hinder funds for infrastructure maintenance, thus leading into a cycle of decline such as seen in African railways during the last 100 years.

The flowchart presented below outlines the critical path to financial sustainability and the potential pitfalls during each of the various stages of project development and management. Each phase should highlight key considerations and potential risks related to financial sustainability, emphasizing the importance of robust planning, effective resource allocation, and continuous commitment to railway initiatives in their financial sustainability.

By adhering to a comprehensive approach that integrates strategic, economic, commercial, and financial analyses throughout the project lifecycle, stakeholders can enhance the likelihood of achieving sustainable outcomes. This proactive approach not only mitigates risks associated with the infrastructure's financial unsustainability but also fosters a culture of resilience and adaptability, enabling railway projects to thrive and deliver lasting benefits to communities and economies alike.

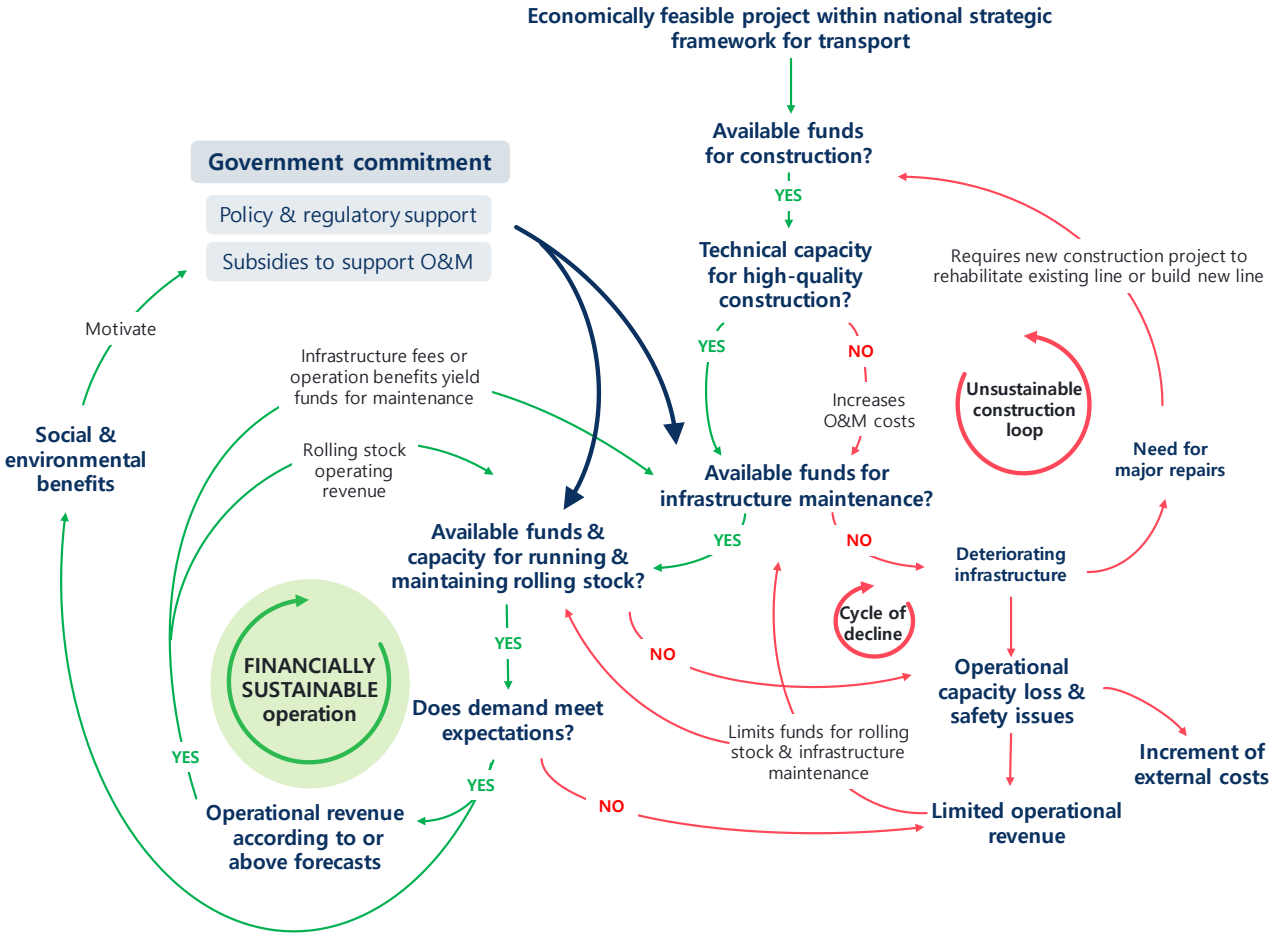


Figure 48: Flowchart of a financially sustainable operation and challenges to infrastructure sustainability

Core insights and suggestion

1. Government commitment is crucial for sustaining rail initiatives due to their typically non-self-sustaining nature. This commitment involves implementing necessary policies, regulations, and potential subsidies to support these initiatives, ensuring they yield socioeconomic benefits or achieve self-sustainability

2. A comprehensive approach integrating strategic, economic, financial, commercial, and management analyses from project conceptualization and through the entire lifecycle of a project enhances the likelihood of achieving self-sustainable outcomes for rail projects

3. Initially, subsidies are crucial for maintenance and operation, but financially sustainable railways should gradually decrease reliance on Government funding towards a self-sustained operation

4. Design and feasibility misconceptions, lack of continuous Government commitment and technical capacity, or poor budgetary oversights at any stage of the project lifecycle can pose significant challenges to financial sustainability. Continuous commitment and robust planning are essential to mitigate risks and ensure sustainable outcomes

4.5 Design, procurement, construction, maintenance, and operation of modern and efficient railway infrastructure

4.5.1 Rail infrastructure design, procurement and construction

A A robust design and construction process with high-quality results is crucial for laying the foundation of successful rail infrastructure, ensuring its long-term operational viability and financial sustainability. However, recent experiences with EPC contracts in Africa have highlighted significant challenges in this regard. These include inadequate monitoring, insufficient quality assessment, and the absence of procurement guarantees, which have had ramifications on the final outcomes and the subsequent operational phase of rail projects, especially in sub-Saharan Africa.

The execution of a railway project entails a series of intricate tasks, from the initial planning stages to the final implementation. Each phase demands meticulous attention to the initial design, stringent quality control measures during the procurement and construction phase, and effective project management to guarantee that the infrastructure meets desired standards and specifications.

First and foremost, designing railway lines requires adherence to the established African standards to ensure safety, efficiency, and compatibility with existing infrastructure. While African standards are not yet properly defined, the agency responsible for infrastructure should define a clear guideline of the standards to be used for the engineering process and monitor compliance with such standards in the final design of the infrastructure.

Comprehensive feasibility studies are imperative during the planning and design phase, meticulously examining factors like terrain orography, population density, traffic demand, placement of intermodal stations, economic analysis, financial viability, and environmental impact, among others. These studies must be audited and verified by independent agencies to ensure transparency and accuracy, avoiding projects with unrealistic feasibility studies as seen by recent Chinese EPC collaborations. Moreover, feasibility studies should carefully evaluate the existing infrastructure, determining whether greenfield or brownfield projects are more appropriate based on cost-effectiveness, financial viability, environmental impact, and logistical considerations such as the involvement of the private sector.

In terms of procurement, it is essential to prioritize the implementation of guarantees that span the entire lifespan of the infrastructure. These warranties should encompass the quality of materials, construction processes, and ongoing maintenance to mitigate the risks of premature deterioration or operational issues. Enforcing

penalties for procurement errors and failures serves as a powerful incentive for contractors and suppliers to uphold their contractual obligations and maintain high-quality standards.

Furthermore, contractors should be required to maintain comprehensive records of the projects, including plans, bid evaluations, contracts, certifications and correspondence with suppliers and other relevant information. Reporting on procurement activities to other relevant stakeholders should also be encouraged to ensure transparency and accountability.

Material and execution quality control processes should be implemented during construction to verify the integrity of components and structures, thereby minimizing the likelihood of defects or structural weaknesses. Construction activities must comply with established technical regulations and best practices to mitigate risks and ensure the durability and reliability of the infrastructure. Furthermore, adherence to rigorous safety standards is also paramount.

Accountability and transparency of all contractors involved in the development of a railway project should be a pivotal cornerstone in future railway projects, as lapses in quality during either design, procurement or construction can escalate costs during the operational and maintenance phases for railway management agencies. In this context, carrying out specific measures to secure the quality of infrastructure after construction are essential for ensuring the long-term sustainability and efficiency of railway projects.

To enhance project oversight and accountability in projects that are deemed of regional and continental importance, supranational independent monitoring mechanisms should be established by continental agencies such as UAR. These agencies can play a crucial role in monitoring the progress of infrastructure projects, ensuring adherence to established plans and designs, and identifying any deviations or challenges early on.



Figure 49: Main considerations to take into account and contractually define throughout rail infrastructure projects

The definition and consolidation of these aspects onto a manual for construction management would help to define construction procurement and construction techniques for a better control of the end product. This is mainly significant in light of the management of EPC contracts, which have evidenced issues in these three pillars and resulted in infrastructures with dysfunctional designs and infrastructure quality issues. Furthermore, standardizing and consolidating best practices into rail infrastructure construction manuals could help build capacity for better contractor contract management and project implementation.

As an example, the Indian Railways Construction Manual (December 2023) offers a comprehensive manual covering all aspects of rail construction activities, from planning to commissioning, that aims to enhance the strengths and capabilities of the National Rail Authority for the efficient

implementation of infrastructure projects. Similarly, many European Rail Authorities, including Adif, offer technical manuals on the construction and maintenance of rail infrastructure, such as ET and NAV Spanish manuals.

On the other hand, the potential to leverage new technologies and advancements in rail infrastructure construction presents an exciting opportunity. Emerging technologies such as (BIM, lean project management, digital twins) offer innovative solutions to streamline project planning, design, and execution processes. Additionally, advancements in materials science (auto-repairable concrete, smart materials) and new construction techniques (modern prefabricated structures, artificial intelligence, drones, robotics) and automation offer opportunities to build faster, more cost-effectively and with greater resilience and environmental sustainability.

In this sense, embracing new technologies and investing in research and development (R&D) for cost-efficient railway construction techniques and new technologies can enhance project efficiency, reduce construction timelines, and optimize resource utilization, ultimately contributing to the overall success of rail infrastructure projects. For instance, integrating artificial intelligence in tunnel engineering holds immense potential for advancing the state-of-the-art in construction efficiency, safety and cost reduction.

TECHNOLOGICAL INNOVATIONS	DESCRIPTION AND MAIN BENEFITS
BIM	Collaborative platform for efficient design, construction, and operation of buildings and infrastructure projects in a digital representation or model
Lean construction	Project methodology aimed at maximizing value and minimizing waste and costs in the construction process by emphasizing collaboration, efficiency, and continuous improvement
Digital twins	Virtual representations of physical objects or infrastructure projects that allow real-time monitoring, analysis, and simulation for an enhanced understanding
Autorepairable concrete	A concrete that has the ability to autonomously repair cracks and fissures through the use of embedded healing agents and to regain mechanical properties
Smart materials	Materials engineered to respond to external stimuli, such as changes in temperature or stress, enabling them to adapt or perform specific functions, such as serving as sensors for monitoring
Prefabricated structures	Pre-built components or modules manufactured off-site that offer faster construction times, reduced labour costs, improved quality control, and minimized environmental impact
Artificial intelligence	AI enables predictive analytics, automation of repetitive tasks, and real-time decision-making, leading to improved efficiency, cost savings, and enhanced safety on construction sites
Drones	Drones in construction are used for mapping, monitoring progress, inspecting structures, providing real-time data and enabling better decision-making throughout construction
Robotics	Robots are used in construction to perform tasks that can be heavily automated, such as brick-laying, or tasks with high risks like demolitions or excavations, enhancing productivity and safety

Figure 50: Non-exhaustive list of technological developments in project management and construction field



Core insights and suggestion

1. Robust construction processes and high-quality results are crucial for ensuring the long-term success of rail infrastructure. Recent experiences with EPC contracts involving Chinese contractors have highlighted challenges like inadequate monitoring and lack of quality assessment that have later hindered the operation of the railway lines and endangered its financial sustainability

2. Accountability and transparency of all contractors involved are pivotal during all phases of a construction project, with specific measures to ensure infrastructure quality after construction.

    - Comprehensive feasibility studies, audited by independent agencies, are necessary for accurate project planning
    - Regarding procurement contracts, African nations should implement guarantees throughout the infrastructure's lifespan to mitigate risks and enforce the maintenance of comprehensive records and transparent reporting ensure accountability in procurement, with penalties for failures in case of noncompliance with contract terms
    - Material and execution quality control processes must be implemented during construction to minimize defects or structural weaknesses, complying with technical regulations and safety standards

3. Defining standards for design, procurement, and construction in rail infrastructure projects in the form of construction manuals could improve contract management capacity, accountability and project implementation. India's Railways Construction Manual 2023 or European Rail Authority's regulations and manuals could serve as examples for such

4. Embracing new technologies and investing in R&D for construction processes and materials can enhance project efficiency, reduce construction costs and increase sustainability of railways

4.5.2 Rail infrastructure operation and maintenance

The operation and maintenance of railway infrastructure encompasses a broad spectrum of activities, including the management of train services, track monitoring and maintenance, and the operation of signaling systems. Overall, a well-managed and properly maintained railway infrastructure is fundamental for supporting traffic growth and promoting sustainable operation. However, in Africa, the operation and maintenance of rail infrastructure have been plagued by numerous challenges, resulting in deteriorating conditions and persistent safety issues.

The most prominent among these challenges include insufficient funding, **inefficiency of tools to monitor the maintenance condition of the infrastructure, and lack of technical expertise,** leading to neglect and poor maintenance of railway infrastructure across the continent. This neglect has caused severe track wear, inadequate ballast, deteriorating earthworks, poor bridge and tunnel conditions, outdated signaling systems, persistent bottlenecks, and frequent accidents. Additionally, theft and vandalism further exacerbate these issues, particularly evident in countries like South Africa, where railway lines have been significantly affected by looting episodes.

Ensuring the financial sustainability and resource availability for railway infrastructure operation and maintenance (O&M) is paramount for maintaining efficient and reliable services. Comprehensive financial planning should consider both operational and capital expenditures, prioritizing periodic maintenance to prevent costly repairs on aging infrastructure. Independent audits of investment demand projections could assist in obtaining more accurate estimations of the required OpEx & CapEx expenditure. Furthermore, it is imperative to balance the calculated investment demands with budgetary constraints to optimize resource allocation.

To address such budget limitations, mechanisms such as **railway funds or ring-fenced financing**

can be instrumental in raising capital for O&M activities. These funds facilitate the annual budget allocation process, ensuring efficient operation and maintenance of the railway infrastructure. Moreover, fostering a critical mass to generate revenue for infrastructure managers is essential for financial sustainability. Exploring alternative management models, such as total open access or engaging third-party stakeholders, offers promising strategies to optimize revenue streams and enhance operational efficiency. Yet, the implementation of these models must be supported by high-quality infrastructure.

Parallelly, policymakers and railway companies should invest in R&D to develop and implement **Predictive Maintenance** into the maintenance schemes of its railway infrastructure. Predictive Maintenance (PdM) is an approach that allows service activities to be carried out only for vulnerable components of equipment or structures before the probability of their failure reaches a limit. This method is based on the processing of actual, real-time data of specific equipment, as opposed to scheduled maintenance based on statistics.

The predictive maintenance process begins with the collection of data using sensors installed on railway components. This data is then transmitted to the cloud, where it is processed using AI-based predictive models. These models analyze the data in real-time to identify patterns that indicate potential failures. When an anomaly is detected, the system alerts technicians, allowing for proactive intervention before a breakdown occurs. This technology-driven approach ensures timely and efficient maintenance actions, reducing downtime and enhancing the overall reliability of the railway system.

Leveraging PdM, railway companies can streamline maintenance processes, identify potential issues before they escalate, and optimize resource utilization. Ultimately, these result in significant long-term cost savings, an extended lifespan of infrastructure components, a mitigation of safety risks, and improved reliability of services, which is key to make railway services appealing to the market.

Recognizing such benefits, many companies are already implementing predictive maintenance in railways. For instance, DB in Germany has begun integrating predictive maintenance solutions in the Rhein-Ruhr-Express RRX in Dortmund (implemented by Siemens) and other railroads. In Spain, Renfe has signed an agreement with Microsoft to investigate AI and internet of things (IoT) technologies that support predictive maintenance, digitalization and optimization[6].

Several companies provide predictive maintenance solutions, including Siemens, GE Transportation, and Alstom. Furthermore, being a pressing matter within the railway sector at the moment, several companies are also emerging, including MPEC[7], KinetiX Inspection Technologies, RailPod, DelphiSonic and IVM Tech, among others. These companies offer a wide range of products and services that can be tailored to the specific needs and financial capabilities of each railway operator and nation.

However, there are also risks associated with implementing predictive maintenance. The initial investment can be high, both in terms of equipment and personnel training. Moreover, the technology is not yet fully mature and can be challenging to integrate with existing systems. Furthermore, it is imperative to consider that the large-scale integration of technology onto O&M of railways can raise cybersecurity concerns, necessitating robust cybersecurity measures to safeguard railway operations.

Together with continental technical standards, RECs, AUC and UAR should consider establishing comprehensive **maintenance and operational manuals** that outline standards for signaling and control. These manuals could serve as a central reference point for railway personnel, providing detailed guidelines and protocols for conducting maintenance tasks, operating signaling systems, and managing control procedures. Additionally, consistent adherence to established protocols promotes interoperability among different railway systems and facilitates seamless integration of new technologies and equipment. Like the suggested continental standards, such manuals should be living documents. Regular updates and revisions to

[6] Microsoft Introduces Mixed Reality Tech to Renfe's Maintenance Processes | Railway-News

[7] MPEC; Kinetix Inspection Technologies; RailRod; DelphiSonic; IVM Tech

these manuals are necessary to accommodate evolving industry standards, technological advancements, and regulatory requirements.

The development of standardized manuals should serve also as one of the cornerstones for formal staff training and skill transfer, which is also an essential requirement for incrementing Africa's technical capabilities for the operation and maintenance of its infrastructure. Additionally, standardized protocols facilitate the transfer of skills between various nations, promoting continuous improvement and skill development across the continent.

On the other hand, addressing security issues related to **vandalism and theft** requires implementing effective security measures and collaborating with law enforcement agencies to protect railway assets and ensure uninterrupted operations.

Serving as the best example in African grounds, Senegal has implemented sound security protocols on the TER Dakar, which work together with the rest of operating systems of the railway (GSM-R, ETCS Level 2, SCADA), to continuously monitor infrastructure condition. Outside the continent, more developed countries can also boast examples of efficient theft and vandalism prevention. For instance, Poland's PKP have recently developed an anti-theft device for the railway catenary system, which allows to detect irregularities in wires, sends signals to railway staff and the police in case of an incident, and has its own power supply thanks to solar panels.

Additionally, Government bodies should consider launching public awareness campaigns to educate the population on the consequences of theft and vandalism on railway operations and safety. By fostering a culture of respect for railways, instilling a sense of ownership, and promoting collective responsibility for safeguarding railway assets, these campaigns could serve as deterrents to criminality.

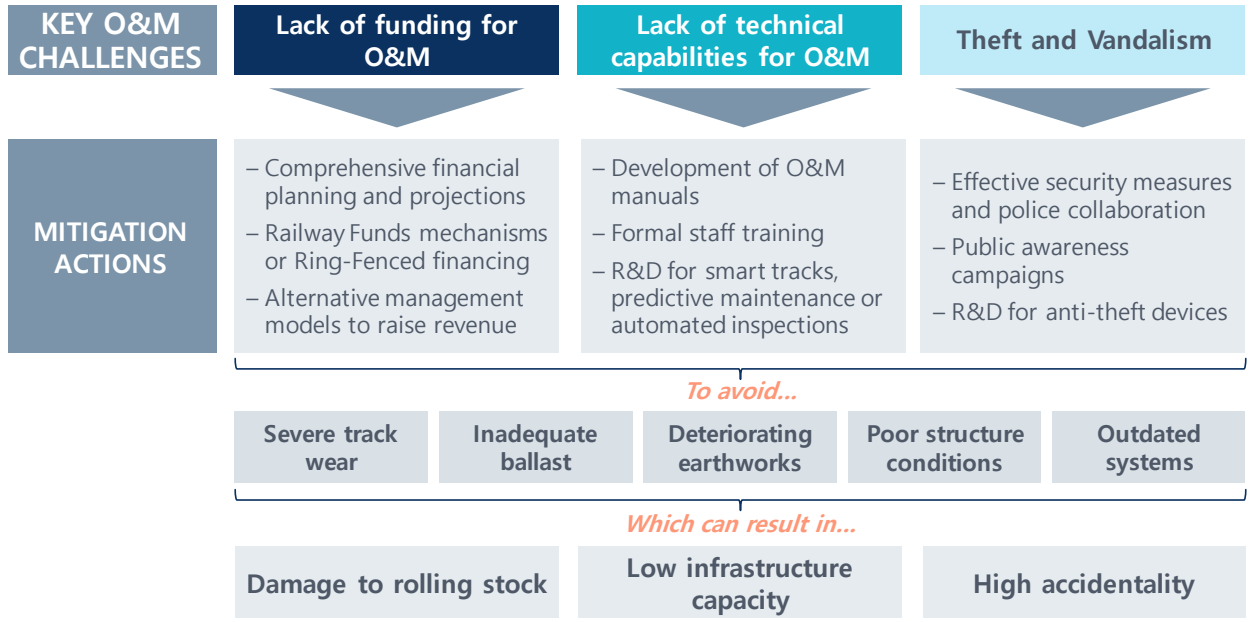


Figure 51: Challenges for operation and maintenance of infrastructure in Africa and mitigation actions



Core insights and suggestions

1. Financial sustainability and resource availability for operation and maintenance of railways are paramount:Accountability and transparency of all contractors involved are pivotal during all phases of a construction project, with specific measures to ensure infrastructure quality after construction.

    - Comprehensive financial planning, including forecasting operational and capital expenditures, is necessary, considering the higher maintenance costs of aging infrastructure. In this sense, railway managers should prioritize periodic and preventive maintenance to avoid costly interventions on deteriorated infrastructure
    - Mechanisms like railway funds or ring-fenced financing can help raise capital for O&M
    - Exploring alternative management models, like open access or engaging third-party stakeholders, can enhance revenue streams but requires of proper infrastructure condition

2. Policymakers and railway companies should invest in R&D to integrate Predictive Maintenance (PdM) into railway infrastructure, leveraging real-time data and AI-based predictive models to preemptively address equipment vulnerabilitiesEmbracing new technologies and investing in R&D for construction processes and materials can enhance project efficiency, reduce construction costs and increase sustainability of railways

    - PdM optimizes maintenance processes, extends component lifespan, mitigates safety risks, and improves service reliability, leading to long-term cost savings
    - High initial investment, technological integration challenges, and cybersecurity concerns must be addressed to ensure successful PdM adoption

3. Establishing comprehensive maintenance and operational manuals, aligned with continental standards and in the form of living documents, could promote capacity building, interoperability, and the integration of new technological advancements

4. Implementing effective monitoring systems and security measures, collaborating with law enforcement, and launching public awareness campaigns are crucial to address vandalism and theft, with examples from Senegal or Poland highlighting successful implementations

4.5.3 Procurement and maintenance of rolling stock

The availability of rolling stock has been often overlooked in the planning stages of railway initiatives in the continent, but it is as crucial as the construction of large-capacity infrastructures. In fact, the development of efficient railway networks requires of both symbiotic elements. The availability of high-capacity infrastructures is senseless without sufficient rolling stock to maintain a financially sustainable operation, while the provision of rolling stock is useless without an appropriate infrastructure to run through. Furthermore, inefficient or not properly maintained mobile equipment can damage infrastructure, and vice-versa.

Within the landscape of rapid growth of the railway sector in the following years, there is a substantial anticipated demand for rolling stock in Africa, both in the short and long-term, to accommodate the capacity demands of both the current infrastructure and upcoming pipeline projects. Particularly, more than 170k rolling stock units are expected to be required for African railways over the next decade. Therefore, it is essential to develop a framework for an effective procurement of both locomotives and wagons, addressing the financial and risk allocation challenges, standardizing protocols, and increasing Africa's capacity to maintain its rolling stock fleets.

First and foremost, rolling stock procurement has been usually left out of initial financials during project developments, leading to costs overruns and inefficiencies. This is especially worrisome considering that rolling stock acquisition can account for a 20-30% of infrastructure costs. Furthermore, the acquisition of rolling stock is often carried out after infrastructure investment, which typically absorb a significant portion of available funding, leaving limited funds and capacity for additional debt (due to a low debt ceiling) and

posing considerable challenges in financing rolling stock. An insufficient allocation of budget for mobile equipment and the financial burden related to them has led, in the longer term, to small fleets that do not exploit the infrastructure capacity, thus creating unsustainability contexts in the vertically integrated framework of African railways.

Addressing rolling stock considerations earlier in project planning can significantly alleviate financial complexities associated with procurement. It allows for a more efficient allocation of resources and helps in avoiding the pitfalls of insufficient budgeting for mobile equipment. Recognizing rolling stock costs and potential debt-related challenges during the earlier stages, especially for public entities with restricted debt ceilings and high risks for private stakeholders, underscores the need for a proactive financial strategy.

Leasing rolling stock assets can offer several advantages for operators, especially in terms of flexibility, cost-efficiency, and risk reduction. By leasing, operators can access the latest technology and equipment without having to commit to large upfront capital expenditures. They can also adjust their fleet size and composition according to the changing demand and market conditions and avoid the depreciation and obsolescence of their assets. Leasing can also reduce the operational and maintenance costs, as well as the regulatory and environmental compliance risks, as these are usually borne by the lessor.

However, leasing is capital intensive for the leasing company and requires of proper maintenance and transparency from the operators, as they need to provide guarantees that debt will be repaid, and that the asset can be returned in proper condition at the end of the lease. They must guarantee debt repayment and ensure the asset's return in good condition at the lease end. So far, only South Africa, with its favorable macroeconomic conditions and robust railway network, has successfully established leasing companies. In the rest of Africa, the primary impediment to leasing remains ensuring the deal's financial bankability and enabling leasing companies to secure funding for rolling stock manufacturing or acquisition from investors on behalf of clients.

In this context, the Luxembourg Protocol to the Cape Town Convention on International Interests in Mobile Equipment is expected to become a game-changing treaty for an efficient and cost-effective acquisition of rolling stock. The Luxembourg Rail Protocol grants holders of international interests in rolling stock clear rights as creditors, including rights of repossession on debtor default or insolvency, the overriding concern of every secured creditor. This is extremely significant for the development of African railways, as the perception of debt credit as excessively risky is mitigated by the Luxembourg protocol, which diminishes this risk and offers enhanced security to creditors. Therefore, adopting the Rail Protocol will free operators from the need to obtain state finance or state guarantees for rolling stock procurement (and relieve Governments of the burden) as they work to transform rail transport of passengers and freight into a competitive, cost-effective and environmentally sustainable service.

In parallel, the General Contract of Use of Wagons (GCU) establishes a standardized contract outlining the responsibilities between owners of rolling stock and railway undertakings or operators. Implementation of this multilateral contract can simplify bureaucratic processes associated with rolling stock procurement, eliminating the requirement to draft multiple bespoke contracts for the use of each wagon.

Furthermore, the adoption of international treaties might not only facilitate the procurement of rolling stock in the financial side, but it can also serve as a framework entice the standardization of procurement protocols across the continent. Both the GCU and the Luxembourg protocol could play roles in this.

Benefits extend further, as the Luxembourg Protocol is to be implemented with the URVIS identification number which allows to uniquely identify each unit of rolling stock. When coupled with other technologies, it can also help locate and monitor every single unit of rolling stock on track in a standardized manner. Moreover, through the monitoring of rolling stock and its vibrations, such can in turn be used to detect track damage and lack of maintenance.

On the other hand, it is essential for the African continent to address the urgent need for capacity building in local rolling stock manufacturing and maintenance. First, with SGR rolling stock manufacturing currently only available outside Africa, building infrastructure for rolling stock without local production capabilities creates a significant dependency on external sources. To address this, Africa is slowly working to build capacity for manufacturing of SGR rolling stock,

but there is a need to bolster such development to meet the anticipated development of the sector. On the other hand, manufacturing and maintenance capacity for narrow-gauge rolling stock is mostly present in South Africa, with limited capacity elsewhere.

First, establishing platforms for knowledge transfer within Africa, particularly from countries with existing capacity like South Africa, can be instrumental. This can be complemented with international aid to further enhance technical expertise in critical aspects of rolling stock manufacturing and maintenance, addressing gaps in knowledge. Using the industrial hubs throughout the continent and synergies with other sectors, such as the automotive sector, presents a valuable opportunity to further enhance capacity.

Alternatively, African Railway Authorities and Governments can negotiate the transfer of manufacturing capacity to African grounds. In this sense, leveraging the high anticipated demand for rolling stock can be a powerful tool in negotiations with international manufacturers. Recognizing the unparalleled opportunity that such demand brings, rolling stock manufacturers can be incentivized to establish manufacturing posts in Africa, contributing to job creation and the transfer of skills and knowledge to local factories. This strategic approach not only might address the demand for rolling stock but could also lay the foundation for sustainable, self-reliant manufacturing capabilities in the continent.

Core insights and suggestion

1. Rolling stock has a symbiotic relationship with infrastructure and should play an important part during planning stages and in the financials, including the consideration of future O&M and CapEx related to rolling stock.

2. Leasing rolling stock assets offers operators flexibility, cost-efficiency, and risk reduction by accessing the latest technology without large upfront costs, yet it requires proper maintenance and transparency from the operator's side, as well as a sound business case, for investors to participate in rolling stock procurement

3. The international Luxembourg Protocol to the Cape Town Convention on International Interests in Mobile Equipment (Luxembourg Rail Protocol) can be used to mitigate debt risk for investors and facilitate crediting for rolling stock acquisition, especially in leasing. Alternatively, the GCU can reduce bureaucratic processes for rolling stock leasing and procurement.

4. The adoption of international treaties such as GCU and Luxembourg Protocol will set the framework for the standardization of procurement protocols and other regulations

5. The inclusion of the URVIS number in rolling stock can be combined with new technologies to efficiently monitor rolling stock and infrastructure condition in order to reduce costs

6. Africa needs to build capacity for in-house manufacturing of rolling stock and rolling stock parts. Several strategies can be pursued in order to attain this objective:

    - Use the high anticipated demand for rolling stock as leverage with international manufacturers to negotiate the transfer of knowledge and capacity to African grounds
    - Investigate the possibility of exploiting synergies with other industrial hubs such as the automotive sector (South Africa, Egypt…)
    - Set up platforms for knowledge transfer from African countries with capacity (for instance, South Africa) to other regions of the continent and complement such knowledge with international aid to gain technical expertise in other aspects (SGR rolling stock manufacturing and maintenance, per example

4.6 Financing challenges

4.6.1 Financing mechanisms for new railway developments

In the realm of financing new railway developments in Africa, a significant challenge looms over the ambitious expansion of rail infrastructure set in the short and long-term. The magnitude of financial obstacles and dependence on external aid, coupled with the historical complexities of failed PPPs and the constricting debt ceilings of African nations, underscores the pressing need for innovative financing mechanisms and changes to the current fund-raising schemes.

In the upcoming years, public investment is anticipated to maintain a predominant role in infrastructure investment across many African countries, primarily funded through internal resources and complemented by concessional borrowing and grants from multilateral agencies. However, novel methods for rail financing should also be directed towards building more favorable commercial cases and facilitating the considerable potential that resides in attracting private investors to participate in collaborative public-private initiatives.

In this context, a proactive consideration of key challenges related to resource mobilization during the outlining of project business plans can pinpoint critical areas for focused efforts in the financial structuring phase. This approach, considering all potential implications for the financial structure of the project, can yield in a more effective mobilization of both private and public resources, ultimately leading to the successful implementation of railway projects and the financial sustainability of both projects and all involved stakeholders.

1. Do the socioeconomic analyses highlight project benefits to incentivize disbursement of public funds, both from national authorities and multilateral agencies?

2. How can African states under debt distress and limited tax revenue increase their sovereign capacity, balancing initial disbursement and debt management?

3. What PPP structures and contractual arrangements can maximize financial returns and minimize risks for the private sector, thereby stimulating their participation?

4. In the context of commercial considerations, what types of debt financing packages are most suitable at various stages of the project lifecycle to meet the demands of rail projects?

5. How can risks of investment in African rail infrastructure be mitigated to make projects bankable?

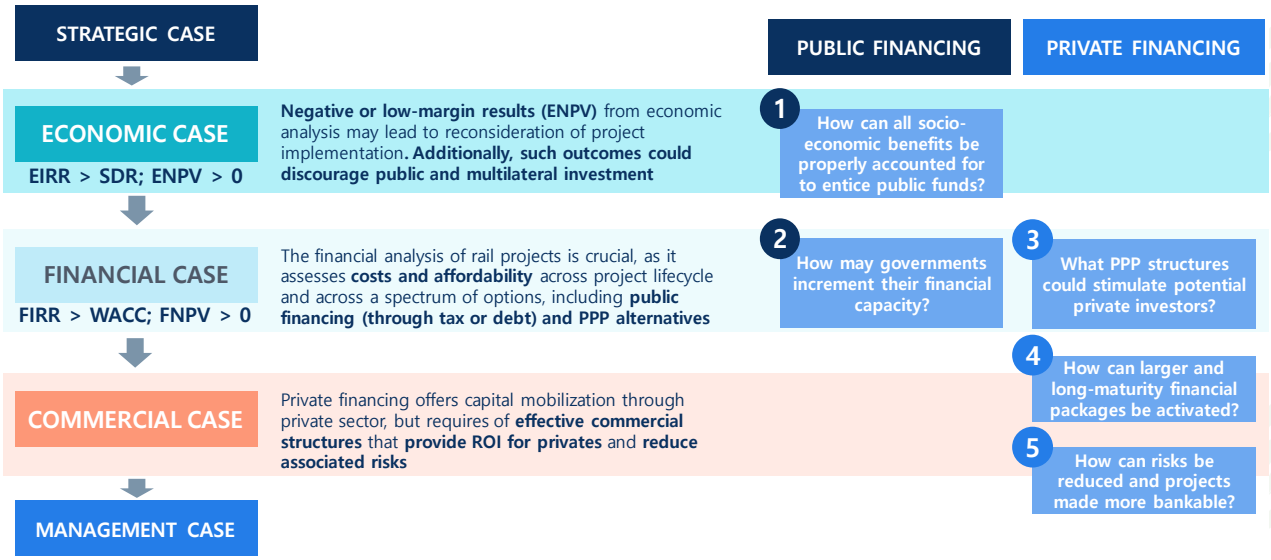


Figure 52: Main considerations for rail infrastructure financing to be addressed during project business plan for an effective resource mobilization in the financial structuring phase

1. Enhancing project attractiveness to public sources and multilaterals by effective monetization of socioeconomic benefits

In general terms, many current economic appraisal methods of cost-benefit analysis used by nations and IFIs often fail to fully capture the comprehensive and long-term benefits derived from rail projects. These methods, due to their standard social discount rates, typically emphasize short-term financial gains in the early stages of infrastructure development, which may not fully reflect the substantial societal and economic advantages that emerge over the lifespan of rail projects.

Lower discount rates for rail projects, coupled with longer time horizons, could increase the monetized benefits of rail projects in the middle and latter periods of rail infrastructure life. Furthermore, these later phases often yield higher benefits as demand matures over time. Aided by increased monetization of broader socioeconomic benefits that rail projects can bring in Africa (GDP growth, job creation, social inclusion, gender equality, reduced external costs, etc.), such changes could result in significantly more positive results (higher ENPVs and EIRRs). This, in turn, may increase the socioeconomic attractiveness of such projects and demonstrate the alignment of such projects with the objectives of multilateral agencies, ultimately encouraging more support and resource mobilization from public entities, especially IFIs, ECAs and Climate Funds who favor investments in projects that align with sustainable development goals.

2. Mechanisms to increase sovereign capacity for financing and manage debt responsibilities

As a first step to bridge the finance gap, Governments need to build up their financial capacity to undertake rail projects with sovereign funds. As African economies continue to grow, this funding source should gain prominence and increased availability. However, current circumstances of limited tax revenue and debt distress highlight the necessity for careful mechanisms to enhance national funding capacity for railway projects. This is especially significant for rail infrastructure projects with lower financial performance, in which private sector funding is limited. The railway sector can implement a range of mechanisms to expedite the accumulation of funds for sovereign railway infrastructure investment:

- As a first step to obtain more financial resources from **tax revenue**, some African countries could consider implementing tax and regulatory reforms to, among other things, eliminate loopholes for tax avoidance, especially by multinationals, and improve efficiency of their tax administrations. Not only does this expand budget for undertaking new projects, but higher tax revenue-to-GDP ratios might also help alleviate debt distress and offer guarantees for the ability to repay their public debt financial obligations when due

- To secure **concessional loans and grants** for rail projects **from IFIs**, emphasize developmental impacts, demonstrate commitment to reforms and sustainability, highlight regional benefits, and ensure political stability. Engage with IFIs in early stages of projects to seek technical assistance, negotiate favorable terms.

- To effectively and sustainably utilize **ECA funding**, prioritize negotiations for favorable terms, diversify funding sources, and evaluate the debt sustainability of projects and borrowing states. ECAs are also Furthermore, maximize the potential benefits offered by ECAs for directly financing infrastructure and rolling stock. This includes negotiating discounts or preferential terms for rolling stock financing, akin to strategies employed in aviation financing.

- Despite the promising alternative of favorable terms provided by concessional loans from IFIs and ECAs, many African states still grapple with limited borrowing capacity due to **limited public debt ceilings.** The deterioration of debt sustainability, evident in the increase from 9 to 23 countries at high risk of debt distress between 2012 and 2022, underscores the need for effective debt governance and management. Key policies to address these challenges, as proposed by AU and FES AU in *Debt Management and Governance in Africa,* include revising public debt management legal frameworks, integrating sanctions, strengthening Public Debt Management Offices, improving self-assessment and debt oversight, and rationalizing or privatizing some state-owned enterprises, among others.

- African States should also exploit the advantages that railways can bring to the

national economy with a comprehensive **Value Capture framework.** Railway projects can act as catalysts for economic growth and tax collection, indirectly generating revenue through fees and taxes from developments in transit-oriented communities and cargo corridors. This additional future revenue can be leveraged in negotiations for debt financing with either commercial banks or ECAs to secure better terms

- An emerging opportunity in climate financing is for buyers to engage directly with project developers providing upfront financing in exchange for future **carbon credit** allocations. While it has not been applied in railway financing before, this arrangement can be particularly beneficial for large-scale projects requiring significant initial investment, in which a share of the project capital expenditure financing could be traded against future carbon credit issuances

- While **Rail Funds** (addressed in the following section) are mostly directed towards sourcing funds for operation and maintenance costs, such mechanisms also hold certain potential for funding railway infrastructure. In Kenya, the Rail Fund was used to finance 10% of Mombasa – Naivasha line, while in Switzerland, way more advanced, the Rail Infrastructure Fund covers all infrastructure repairs and expansion projects

3. Types of PPPs and contract arrangements to minimize risks and stimulate private participation

The initial concessions' conventional model proved unstable for the private sector, burdening them with excessive financial risks and complexities. Although some have since been reorganized, challenges persist in passenger services, maintenance, and rolling stock management. Recognizing this, recently implemented projects in Africa have been developed under sovereign capacity and other kinds of contracts, generally avoiding PPPs for rail infrastructure projects.

However, rather than PPPs in general, these failures and ongoing challenges indicate that those particular PPP models might not have been the most suitable alternatives. In this context, African Governments should explore alternative PPP structures that can enhance profitability and attractiveness for private sector investment, balancing risk allocation and return on investment.

Furthermore, given the fact that many concessions failed due to the allocation of excessive risks and responsibilities, it is advisable to structure PPPs to minimize operational complexities for rail transport companies. If private involvement in infrastructure and maintenance is required, it is recommended to engage civil works experts to oversee these aspects. In this sense, African Governments should explore alternative PPP approaches including separation of infrastructure and operations such as the listed below:

- **Turnkey + maintenance contracts:** Government procures infrastructure works with an obligation of maintenance for a determined period of time, after which the infrastructure is transferred back to the Government. The Government pays the private contractor for maintenance costs throughout the period under agreed terms

- **Availability-based concessions:** Construction, renewal or upgrade works are awarded to a company that takes full responsibility for the infrastructure and ensures that it will be available under pre-set performance conditions for a period of time. The Government, in turn, pays remuneration

- **Build, Operate, Transfer (BOT) infrastructure concession:** In this setup, revenue for the infrastructure concessionaire comes from users through railway operators paying capacity and access fees. Under BOT concessions, the concessionaire bears commercial risks, but Governments often guarantee minimum revenue levels, which would be essential in African contexts

Meanwhile, if the provision of services is to be undertaken by the private sector, franchises and service contracts offer a viable alternative. Alternatively, open access regimes could allow for services to be offered by various operators, thus fostering competition and improving service quality. For passenger services, Passenger Service Contracts outlining operator obligations and state compensations are essential.

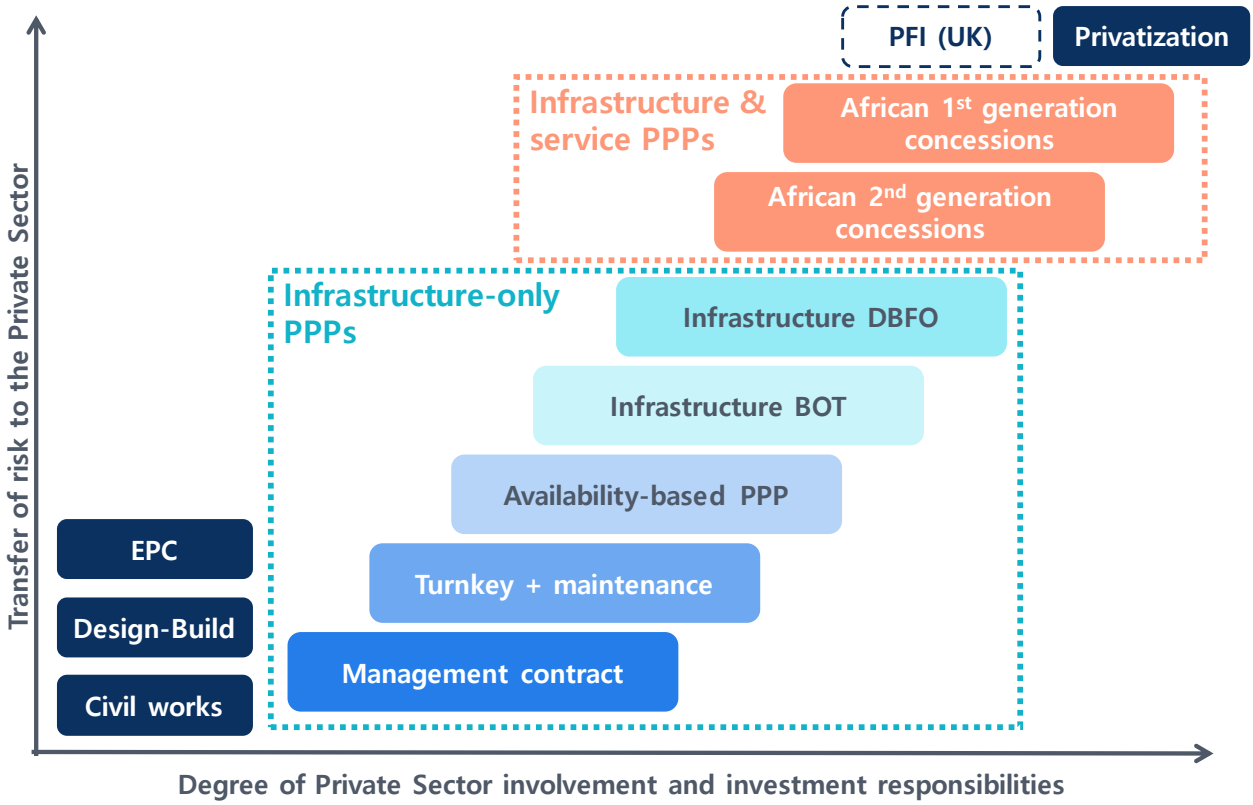


Figure 53: Types of contracts for rail infrastructure development projects

4. Exploiting the benefits of different financial packages for long-term investments through bonds

Currently, most private investment in the form of debt is carried out through loans. However, while they provide significant benefits in early stages of projects, these have maturity mismatches with length rail infrastructure projects and have generally high-interest rates.

On the other hand, bonds present the benefit of extended maturity periods and the advantage of reduced interest rates. Additionally, they enable diversification of funding sources by tapping into capital markets, where successful bond issuance can elevate the borrower's standing and prominence, resulting in better terms for subsequent bond offerings.

However, in railways, the market of infrastructure bonds is almost non-existent and extremely limited to the macro-economically developed countries. Still, it represents a real potential for development of the host countries financial environment, and a solid source of financing for railways, if risk mitigation and guarantees are provided. Furthermore, railways can exploit more specific financing mechanisms as **green bonds**, which specifically cater to investors interested in developing green infrastructure.

African countries can tap into bond markets by implementing credible economic policies, strengthening legal and regulatory frameworks, and ensuring debt sustainability. Furthermore, a functioning bond market – not just for project bonds but also for Government bonds – requires a significant amount of financial infrastructure, including, at a minimum, adequate disclosure and reporting rules. Engaging with IFIs is recommended, as they can provide valuable technical assistance, capacity building for bond issuance programs, as well as enhance investor confidence.

In Brazil, dedicated infrastructure 'debentures' (dedicated infrastructure bonds) have had significant success and in particular those that were issued as green bonds. A great example is the green bond issued by an electricity transmission company for the construction of transmission lines. Conversely, an example of a railway accessing sustainable

commercial financing in Africa is Moroccan Railways' Green Bond. The World Bank supported the Government of Morocco and the railway to restructure its balance sheet, shedding certain debt, to pave the way for issuing a Green Bond for approximately USD 95 million.

While capital debt markets and bond financing are expected to become increasingly important, loan financing is expected to remain crucial, especially in the initial stages of infrastructure projects when risks are higher. Banks offer expertise in managing construction risk and provide gradual disbursement of funds, aligning with project needs and avoiding negative carry forward. Additionally, during the design and construction phase, banks allow for easier renegotiation of debt terms compared to bond financing, which involves complexities with multiple bondholders. Leveraging the advantages of each mechanism, a common strategy for infrastructure financing involves initially financing projects through loans and later refinancing them with bonds after the construction phase, carried out through methods like securitization. For instance, Indonesian power producer Paiton Energy issued a $2 billion project bond to replace existing project debt, freeing up capital for new ventures.

5. Financial structures to reduce risks, improve conditions and increase bankability of projects

On the other hand, Africa needs to address the bankability of its rail projects. Achieving the threshold investment grade for African's infrastructure debt has historically been challenging, as rating agencies tend to cap the rating of project finance transactions in developing countries at the level of the domestic sovereign's rating unless there are some risk-mitigating factors. Similarly, loans by commercial banks for African countries usually entail high interest rates to counteract the increased risks involved, skyrocketing the cost of capital for African infrastructure developments.

In this context, railway projects should include innovative finance structures to make investing in infrastructure projects through loans and bonds more attractive to commercial banks and investors. These structures include increasing equity share, subordinated debt (debt credit enhancement, blending of funding sources and guarantees) and other contractual safeguards, among others.

- **Investment-enhancing regulatory frameworks** that reduce the cost of capital

- The development of a set of **standardized criteria for project eligibility** could provide guidance and increase visibility in foreign markets. In this sense, proper documentation and due diligence are essential for project bankability, which should include the establishment project's governance, guarantee for the provision of permits (land, construction, etc.) and comprehensive feasibility studies and risk assessments by independent agencies

- Minimum targets of **equity/debt ratios above the standard 20/80** should be encouraged since African railway projects may require a higher percentage of equity as proof of long-term sponsor commitment

- **Credit enhancement** techniques like tranching offer a means to restructure debt obligations, improving credit quality by diversifying risks among involved parties and creating securities with varied risk-return profiles, thus aiding in attracting different types of investors. Through subordinated tranches of debt, IFIs, ECAs and other multilaterals can reduce the risks associated with investment in rail projects

- Despite their paper as fund raisers and loan grantors can be crucial, IFIs and ECAs can also be used efficiently to minimize risks for private investors and commercial banks as **partial credit guarantee** (PCG) providers. By covering part of debt services, these PCGs improve the terms of debt by extending maturity, lowering interest rates and enabling access to financial markets

- **IFI and ECA participation in the early stages** of project development or construction phase is an effective tool to reduce investor's construction risk concerns. Participation of **IFIs in equity** can strengthen their involvement in the long-term and reassure that adequate internal monitoring is kept

- While their contribution to financing large projects is generally limited, climate funds could have a real impact if African Governments can use then to de-risk investments through

the previously discussed mechanisms. An example of this leveraging mechanism is the construction of a light rail transit system in Costa Rica that will be powered by more than 90% renewable energy. The Global Climate Fund is financing $250 million of debt and providing a $21 million grant, with other financing coming from the Central American Bank for Economic Integration and private equity from a PPP element

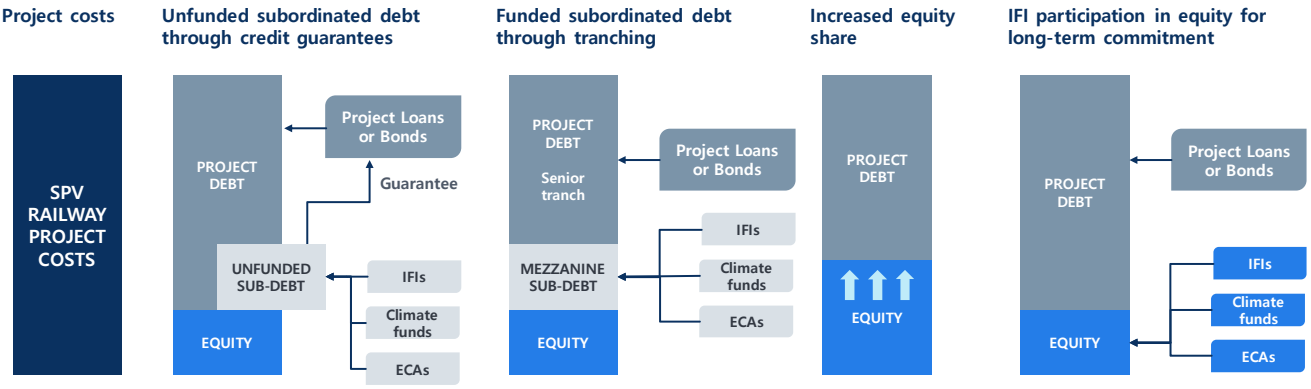


Figure 54: Illustrative list of financial structures to reduce investment risks and increase bankability



Core insights and suggestion

1. Proactive consideration of resource mobilization challenges during project planning can facilitate financial structuring in posterior stages and enhance mobilization of both private and public resources. Key considerations include incentivizing public fund disbursement, enhancing sovereign financial capacity for debt-distressed African states, maximizing private sector participation through alternative PPP structures, identifying suitable debt financing packages for each project phase, and mitigating investment risks for bankable rail projects

2. Adjusting discount rates, extending time horizons and monetizing all socioeconomic benefits in CBAs can better outline the environmental, societal and economic advantages of rail projects, attracting more support from multilaterals and Governments alike

3. With private financing commonly unavailable for African railway projects, African governments must find mechanisms to overcome their limited tax revenue and debt distress to ultimately strengthen their financial capacity for rail projects using sovereign funds

    - Implement tax reforms to increase revenue for railway projects and alleviate debt distress
    - Engage with IFIs and ECAs for concessional loans, grants and favorable financing terms, emphasizing developmental impacts, regional benefits, and political stability
    - Develop comprehensive Value Capture frameworks to leverage the economic benefits of railway projects during debt financing negotiations (ability to pay through tax revenue)
    - African Governments should exploit climate financing through green bonds, blended green finance solutions and upfront financing against future carbon credit issuance

4. African governments should explore alternative PPP structures for railway projects to address past failures and ongoing challenges, including availability-based concessions, turnkey & maintenance contracts, BOT infrastructure concessions, franchises, and service contracts to enhance profitability and attractiveness for private sector investment while minimizing operational complexities

5. Rail infrastructure investment currently relies on loans as the predominant financing method, but the underdeveloped bond market for railways (infrastructure bonds, green bonds, corporate bonds, etc.) holds potential for more sustainable financing due to their longer maturity, contingent on sound economic policies, transparent legal frameworks, and engagement with international financial institutions

6. Addressing the bankability of rail projects in Africa requires a transparent regulatory framework, support from multilateral institutions and changes in financial structures of projects to attract commercial banks and investors

    - Investment-enhancing regulatory frameworks can reduce the cost of capital, while standardized project eligibility criteria and comprehensive feasibility studies are crucial for due diligence and boosting investor trust
    - Minimum targets of equity/debt ratios above the standard 20/80 should be encouraged as proof of long-term sponsor commitment
    - Early involvement of IFIs and ECAs during project development, particularly when in the form of equity, can effectively mitigate investor construction risk concerns and strengthen long-term engagement, ensuring adequate internal monitoring
    - Credit enhancement techniques like tranching, partial credit guarantees from IFIs, ECAs and climate funds can mitigate risks for investors and improve the terms of private financing for African rail projects

4.6.2 Mechanisms to secure financing for the O&M of the railway networke

As discussed in previous sections, a key requirement for the financial sustainability of railway operations is the availability of sufficient funds as to cover the necessary CapEx and OpEx that both infrastructure and rolling stock might require. Yet, a significant challenge faced by numerous African railways lies in their limited capacity to consistently raise this capital. This predicament is primarily attributed mainly to their constrained revenue returns, compounded by difficulties in accurately forecasting such expenditures. As a result, railways struggle to balance financial viability and operational requirements, outlining the need for innovative strategies to address such funding gaps and enhance financial sustainability in the long-term.

In order to create greater pools of capital for railway O&M financing, international (mainly European) and African examples have shown the benefits of creating Railway Infrastructure Funds. These funds create a separate treasury specifically allocated to railways, eliminating competition with other infrastructure sectors for national budget allocation. This, in turn, also allows for rapid budget allocation for urgent repairs without need of complex financing approvals or procedures.

Moreover, the funds can be sustained by various financing schemes that can be adjusted according to market conditions and that have shown minimal impact on the market, as surplus costs or taxes constitute only a fraction of overall expenditure for users. Furthermore, the creation of national funds for infrastructure would not be a novelty for most countries in Africa, as many nations have already set up road maintenance funds, commonly funded though fuel taxes. Yet, it must be noted that a possible drawback of this type of fund is that the plurality of sources of revenue, unlike typical road funds, may make its management somehow more complex.

In order to feed such Rail Funds, taxation, levies and subsidies are the most common mechanisms:

- **Cross-sector subsidies from road to rail,** commonly through added taxes or levies on fuel prices, can be an easy-to-implement and powerful tool for both railway financing and to trigger a modal change. However, cross-sector policies might not be well-received by the private road sector and are thus a delicate challenge, especially if road funds are not able to cover for road maintenance

- **Taxes paid by operators** for locomotive fuel; portions of **infrastructure access fees**, also paid by operators; or **penalties** on operators for **regulatory infringements**

- **Monetization of socioenvironmental benefits of railway infrastructure**

    - In this context, the cross-subsidization of rail infrastructure financing from road transport earns a stronger justification, as fuel taxes on road users could be applied **proportional to the road repair costs** reduced by railways use or **part of the external costs mitigated**
    - Overloading **fines** from road transport, which would also serve to limit heavy trucks on roads
    - P**ortion of the Government budget** calculated as a percentage of the external costs mitigated or as part of the returned socioeconomic benefits brought upon by railways

In the context of external costs and climate financing, the emissions that can be avoided by the development of rail projects in Africa should be considered by Governments as climate mitigation under **Article 6 of the Paris Agreement**, allowing to sell this carbon savings in the form of **carbon credits** to other countries that are not able to meet their NDC goals. This mechanism under Art. 6.2 is already operational, and buyer countries such as Switzerland and Japan have reached first bilateral agreements with several host countries. Alternatively, carbon credits might be sold to the voluntary market, where a growing number of companies will be looking to buy credits to meet their emission allowances. In this context, Railway Funds could be an effective instrument to channel these additional benefits onto railways.

However, the carbon market standards and regulations that qualify rail carbon savings are unclear at the moment. For this reason, African

railways and Governments should work in collaboration with rating agencies on methods to certify their carbon savings to trigger the possibility of sell carbon credits to generate additional income and financing for new projects. In Section 4.6.4, a methodology for the issuance of carbon credits is suggested.

On the other hand, rail projects in urban areas or close to urban sprawls (commuter railways, light rails, regional) and cargo corridors could benefit from **Value Capture mechanisms**. Examples such as urban rail development in Delhi, Hong Kong, Singapore and Japan can serve as clear references for such undertakings, taking into account the recommendations within The World Bank Group's *Financing Transit-Oriented Development with Land Values*. Not only have these projects shown positive results in terms of added revenue, but the projects have also shown great operative efficiency and have helped entice and structure urban development.

It is important to emphasize that the benefits of value capture on railways do not depend solely on Government-owned land (60m on the wayside of infrastructure), as privately-owned land can also provide significant benefits. Notwithstanding, the main potential financing or revenue instruments in the African context include:

- **Tax- or fee-based Value Capture**

  - *Property and land tax:* Tax levied on the estimated value of land or/and buildings, which should raise after the construction of infrastructure, collected from both public and private property owners
  - *Betterment charges and special assessment:* Surtaxes imposed by Governments on estimated benefits created by public investments, requiring property owners who benefit directly from public investments to pay for their costs

- **Development-based Value Capture**

  - *Land banking:* Governments or transit authorities can generate revenue by selling or leasing land that has increased in value due to nearby railway infrastructure projects
  - Air rights sale: Governments sell development rights extended beyond the limits specified in land use regulations

Similar to the case of carbon credit revenues, Railway Funds emerge as a perfect tool to channel these benefits directly towards railways. Within this framework, increased tax revenues or revenues from Government property sale proceeds, proportionate to the impact of rail infrastructure, could serve as potent sources to contribute to railway performance and development in such environments.

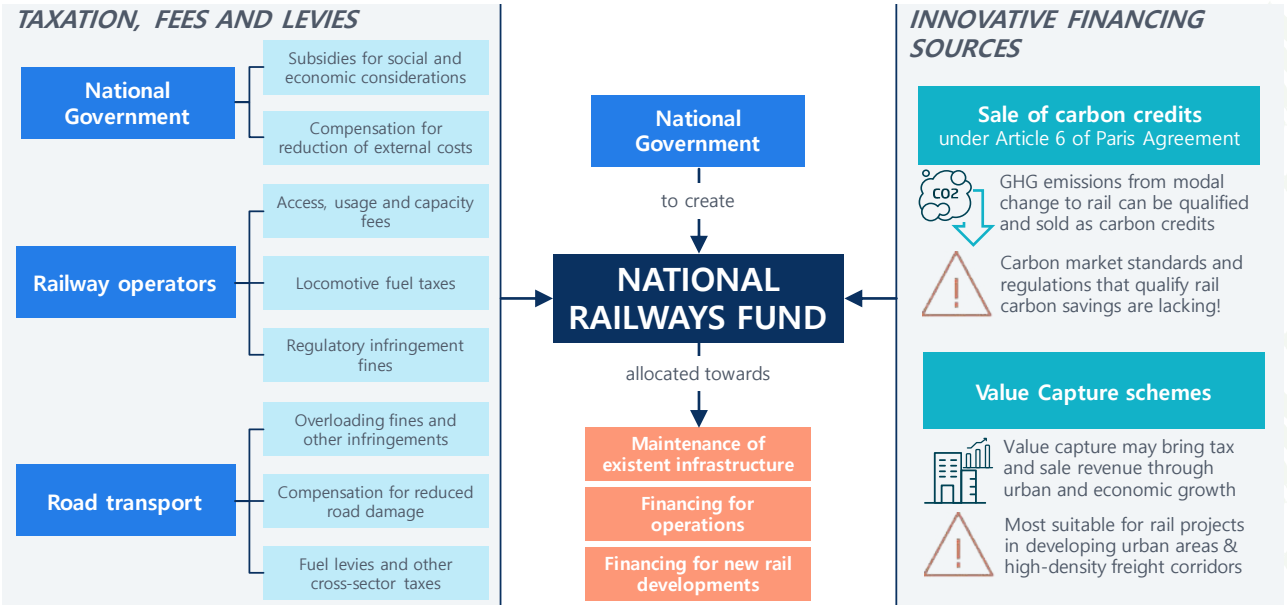


Figure 55: Suggested O&M financing mechanism under a Railway Fund and potential revenue sources

While their main objective should be to secure financing for O&M, such funds could also be of use to fund new rail infrastructure projects (to a lower extent). In the short term, not only can O&M surpluses be directly allocated towards this goal, but present and future revenue may be capitalized or used as collateral for borrowing. Looking ahead, railway funds may eventually accumulate sufficient resources to maintain O&M and exclusively finance new infrastructure projects, as demonstrated in the case of Switzerland.

Overall, establishing dedicated funds can significantly augment capabilities for O&M financing in public-owned railways. These funds provide a reliable and sustainable source of capital, ensuring ongoing upkeep and improvement of infrastructure crucial for efficient rail operations. Similarly, for public-operated railways, such funds can bolster O&M capabilities for rolling stock.

In the case of concessions and service contracts involving private entities, CapEx and OpEx responsibilities (either for infrastructure and rolling stock or rolling stock only) usually fall on the private sector and are covered by their revenues, as per included in the private's business case. However, when it comes to providing passenger services, private operators may be reluctant, as these services often yield limited financial returns that are unable to provide coverage for the operating expenses.

Specifically, medium and long-distance passenger train services in Africa often face significant challenges in achieving economic sustainability, particularly outside high-density corridors between certain city pairs. While there is potential for passenger rail services to serve as a viable mass transit option in some African megacities, factors such as competition from alternative modes of transportation, lengthy demand ramp-up periods, and limited internal revenue can impede the financial viability of rail infrastructure in both the short/medium term, even under more favorable circumstances.

In this context, the decision to provide passenger services is usually part of the overall transport policy of any country, necessitating strong commitment through political and financial support. Particularly, in many African countries, passenger services are designed to be affordable for the poor 40% of the population. In this sense, it is important to acknowledge that such operations are likely to operate at a loss and **will require subsidies.**

However, the definition of such subsidies can be challenging. Often, the costs associated with service-delivery are not transparent, leading to Authorities not knowing the level of deficit to expect and service providers being uncertain about how much they will receive for their annual budget. This uncertainty may be exacerbated in environments marked by regulatory instability and corruption.

To address these challenges, establishing a framework that facilitates the understanding and assessment of the socioeconomic impact and financial requirements of passenger services is essential. Such framework would enable Governments and the private sector to make well-informed decisions regarding their obligations, allowing for the implementation of effective commercial agreements that ensure the sustainability of passenger operations. It is noteworthy that while the recommendations primarily focus on private sector involvement in passenger railway operations, they are equally applicable to public sector railways, as effectively demonstrated in countries like South Africa and Morocco.

- Robust evaluation framework: The evaluation of mobility schemes should include financial, economic and environmental impacts, so that the subsidy required can be assessed against the broader economic, environmental and social benefits to society, thus enabling a true understanding of railway's importance within the transportation policy

- Account segregation and transparency of railway business: In order to implement a Passenger Service Contract it is necessary to understand the true commercial/financial status of both passenger and freight railways. They should be separated into different business units (infrastructure, freight and passenger) and have a transparent accounting system that allows direct cost calculation and evaluation, enabling separation of accounts for infrastructure maintenance, passenger and freight services

- Operations performance framework under Public Service Obligation: The introduction of commercial agreements similar to the Public

Service Obligation within the EU is a useful tool, as it enables the Government to understand the costs of the services it purchases with its subsidy and provides incentives so that passenger services are provided efficiently. It should also clearly set out the contractual risks and responsibilities of both the Government and the private sector, with the regulator supervising the compliance of such contractual terms

In the current predominant management model, a major reason behind the integration of freight and passenger business units in Africa is that it enables seamless cross-subsidization for passenger services. The suggested PSO framework is not only compatible with cross-subsidization, but it provides a clearer framework for such. Within this framework. the passenger subsidy of the PSO can be covered by the greater revenues or additional charges (levies, fees, taxes...) obtained from the freight side of the business, which can be channeled either through a railway fund or directly through Government treasury.

Through this approach, Governments can not only maintain cross-subsidization necessary to maintain passenger services, but they can also increase the transparency of each business unit and identify progress opportunities in each branch. In this framework, the regulator is essential to ensure that the flow of subsidies between the two different companies is seamless and clear, avoiding misallocation and corruption.

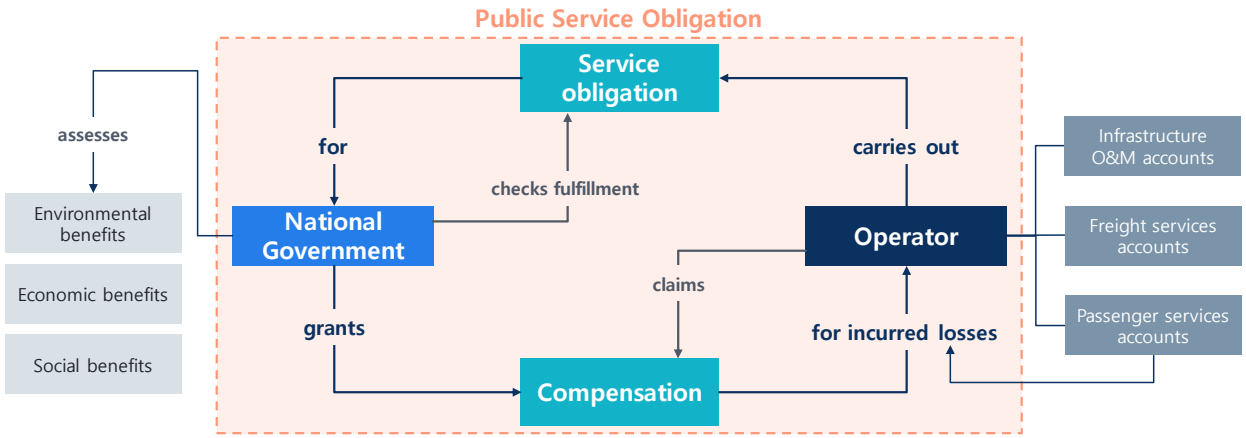


Figure 56: Basic framework for implementation and scheme of a Public Service Obligation



Core insights and suggestion

1. Limited capacity to raise capital due to constrained revenue returns and CapEx and OpEx forecasting challenges poses a significant obstacle for African railways, necessitating innovative strategies to bridge funding gaps for O&M and ensure long-term sustainability

2. To increment sovereign funding capacity for operations and maintenance of both infrastructure (in publicly-owned railways) and rolling stock (in publicly-operated railways), nations should consider establishing Railway Infrastructure Funds

    - Rail Funds allow for an efficient budget allocation segregating funds for rail projects from other sectors and ensures financial sustainability through various financing schemes
    - Railway funds could be primarily funded by taxation and levies on operators, subsidies from Government for the reduction of external costs of transport, and also by some cross-subsidization from the road sector when properly justified under a broader transport policy
    - New financing schemes feeding Railway Infrastructure Funds could include carbon credit sales and benefits form Value Capture in transit-oriented development (TOD) initiatives. TOD could even bring benefits in the form of private finance, given effective structures are provided

3. Private operators handling CapEx and OpEx responsibilities in concessions or service contracts may be hesitant to provide passenger services due to limited financial returns, necessitating subsidies and strong political support to cover operating costs for a sustainable operation

    - Challenges in defining subsidies arise from opaque cost structures and uncertainties, especially in environments marked by regulatory instability and corruption
    - Implementing an effective framework for evaluating the socioeconomic impact and financial requirements of passenger services enables informed decision-making and facilitates the implementation of commercial agreements under Public Service Obligation, applicable to both public and private sector railways

4.6.3 Railway Agencies for the oversight of construction and O&M funds

As nations embark on ambitious railway projects, there arises a critical need to address the complexities inherent in managing vast financial resources. The sheer magnitude of funds circulating for these projects might raise concerns regarding the risk of misallocation, inefficiency, and susceptibility to corruption. Moreover, the intricate nature of infrastructure development, coupled with the involvement of multiple stakeholders and varying interests, adds layers of complexity to financial oversight. Without robust mechanisms in place, the potential for mismanagement and malfeasance looms large, threatening the success and sustainability of railway initiatives.

Given these challenges, effective oversight of construction and O&M funds is crucial. Responsible entities must be defined to ensure efficient allocation of funds throughout the project lifecycle. Transparency, accountability, and management expertise are vital to prevent mismanagement and corruption, as well as to build trust among investors, Governments, and the public.

Regarding construction funds, which encompass the most significant financial packages, efficient oversight of fund allocation in construction projects hinges on several key factors: robust procurement procedures, transparency, rigorous cost tracking, and external audits. Transparent procurement procedures are vital, ensuring fairness through competitive bidding processes and clear vendor selection criteria. Moreover, procurement contracts should include guarantees and mechanisms for maintaining comprehensive records and transparent reporting, mitigating risks and ensuring the value for investments. The implementation of transparent financial systems in construction projects would facilitate real-time

tracking of project expenses, enabling comparison with budgeted amounts and generating regular reports for stakeholders. Finally, external audits conducted by independent auditors add another layer of accountability, ensuring compliance with financial regulations, project agreements, and best practices.

On the other hand, establishing effective governance and management structures will be crucial for the proposed Railway Infrastructure Funds designated for O&M. In this sense, it is prudent to draw upon Africa's experience with Road Funds, which can offer valuable insights. The key characteristics of successful Road Funds, often referred as the second generation of Road Funds, include:

- Sound legal basis, separating the road fund from the administration, similar to the governance of regulatory agencies, and setting clear regulations for its management and fund disbursement
- The Road Agency (equivalent of Railways Agency) is independent from the Road Fund and acts as a purchaser, not as the provider of road maintenance services
- Strong oversight, with a wide-based private/public board
- Revenues generated from charges related to road usage are transferred directly to the Road Fund
- Sound financial management systems and efficient administrative structure under corporative structures with transparency and accountability, including public financial reports
- Regular technical and financial audits by independent entities and regulatory agencies

Moreover, the experiences of countries that have established rail infrastructure funds, such as Kenya, Cameroon, or Madagascar, offer valuable insights into the unique complexities that rail funds may entail compared to their road counterparts.

In the realm of Public Service Obligations, ensuring the transparent and accountable distribution of State compensations is paramount. Generally, the responsibility for monitoring financial packages rests with the contract issuer, typically entities like the Ministry of Transport or Railways Agency. However, the potential for conflicts arises when these packages lack clear definitions, necessitating the intervention of external authorities. In this sense, an independent rail regulator should hold responsibilities in monitoring the contract on behalf of both parties to decide on compensation sums, potential bonuses and penalties.

Core insights and suggestion

1. Effective oversight of railway projects' financial resources is essential to prevent misallocation, inefficiency, and corruption, requiring responsible entities to be assigned with ensuring transparent and accountable fund allocation throughout the project lifecycle
2. Efficient oversight of fund allocation in construction projects relies on robust procurement procedures, transparency, rigorous cost tracking, and external audits to maintain accountability and prevent mismanagement
3. Drawing upon Africa's experience with Road Funds, the effective governance of proposed Railway Infrastructure Funds for O&M should encompass clear legal foundations, independent oversight, transparent financial management systems, and regular audits to ensure accountability and efficiency
4. State compensations in Public Service Obligations in benchmark countries are usually carried out and overseen by contract issuers like the Ministry of Transport or Railways Agency, with potential intervention from rail regulators to resolve conflicts and ensure fairness

4.6.4 Climate finance mechanisms

Along the document, three new climate-related mechanisms have been identified as nascent opportunities to bridge the finance gap of railway development and maintenance in Africa: carbon credit financing, green bonds, and climate funds. The following section provides more details and recommendations on how to leverage these mechanisms to obtain funds for railway projects.

Carbon credit financing

Carbon credits are generated by projects that have avoided or removed greenhouse gas emissions. Each credit represents one less ton of carbon dioxide, or another greenhouse gas equivalent, (CO2e) in the atmosphere. There are three major types of carbon credits, based on the type of projects:

- *Removals*: Direct physical removal of CO2 from the atmosphere, e.g., through reforestation or carbon capture and storage (CCS) technologies.
- *Avoidance:* Projects that prevent emissions that would otherwise occur, such as renewable energy installations displacing fossil fuels.
- *Reductions:* Projects that reduce emissions compared to a business-as-usual scenario. Railway projects in Africa could generate reduction carbon credits by shifting traffic from road transport.

In order to be traded, each credit from the categories above requires distinct methodologies for quantification, verification, and certification, underpinned by robust scientific principles to ensure the integrity and credibility of the credits.

Only after being verified under a certified standard can credits then be traded for an economic gain in the carbon finance market, which entities can access directly through exchanges or through the use brokers. Furthermore, it is crucial to emphasize that the market is bifurcated into two main segments:

- **The compliance market**, legally-binding and government-mandated, requires businesses and countries to offset emissions to meet targets set by international agreements or national policies, such as the EU ETS and California Cap-and-Trade Program. As of May 2024, no similar compliance market exists in Africa. However, Article 6 of the Paris Agreement enables African countries to trade carbon credits in the international compliance market, trading carbon credits as ITMOs to countries that cannot meet their NDC goals.
- **The voluntary market** (VCM) allows entities not to bound by regulation to purchase carbon credits voluntarily, often driven by corporate social responsibility (CSR) goals, customer demand, or pre-emptive compliance strategies. The voluntary market is global and not bound by geographies.

Over the last decade, the carbon credit market has witnessed significant growth, driven by increasing awareness of climate change and regulatory pressures. This growth has been accompanied by the proliferation of trading platforms and financial instruments, allowing for liquidity and price discovery in the carbon market. The development of derivative products, such as futures and options, further enhances market depth and hedging capabilities.

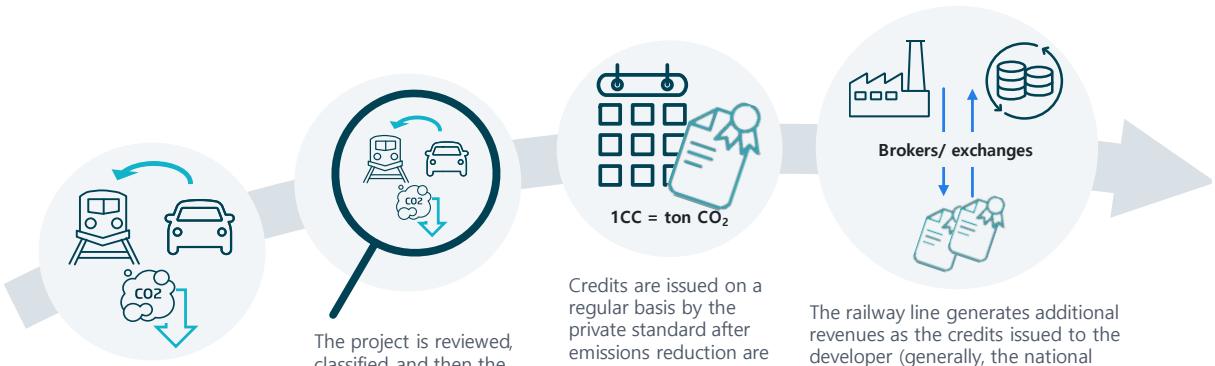


Figure 57: Overview of the lifecycle of a carbon credit and issuance and monetization processes

Market prices for carbon credits have been found to be significantly volatile to market dynamics, regulatory changes and market sentiment. However, recent years have seen a gradual increase in prices, driven by tighter supply and growing demand. Furthermore, the market is seemingly shifting towards more structured and long-term agreements that stabilize the market. Not only that, but there is a growing interest in regional projects that not only offer carbon offsetting benefits but also socioeconomic improvements, for which railways are in an advantageous position.

Within this context, standards and registries play a crucial role in the carbon market by tracking the issuance, transfer, and retirement of carbon credits, ensuring each credit is unique and only counted once towards a climate commitment. Each registry has its own specific focus, methodology and target outcomes. The main standards in the carbon credit market currently include the Clean Development Mechanism, the Verified Carbon Standard and the Gold Standard.

The methodology AM0090, "Modal shift in transportation of cargo from road transportation to water or rail transportation," is structured to facilitate Clean Development Mechanism (CDM) projects that aim to reduce greenhouse gas (GHG) emissions by shifting cargo from road to less carbon-intensive modes of transport like water or rail. While the methodology cannot be used any longer under the CDM standard, as this has been discontinued, it is also supported by Verra and project proponents who are interested in using AM0090 can send a request for reactivation of the methodology under the Verra registry.

The AM0090 methodology, with its emphasis on clear boundaries, specific applicability conditions, and detailed monitoring requirements, provides a robust framework for railway projects to quantify and claim carbon credits for the emission reductions it achieves. Figure 58 proposes a methodology for project financing through carbon credit issuance in railway projects based on the approved baseline and monitoring methodology AM0090. The expected timeline of AM0090 from Step 1-5 is expected to be around 1 year.

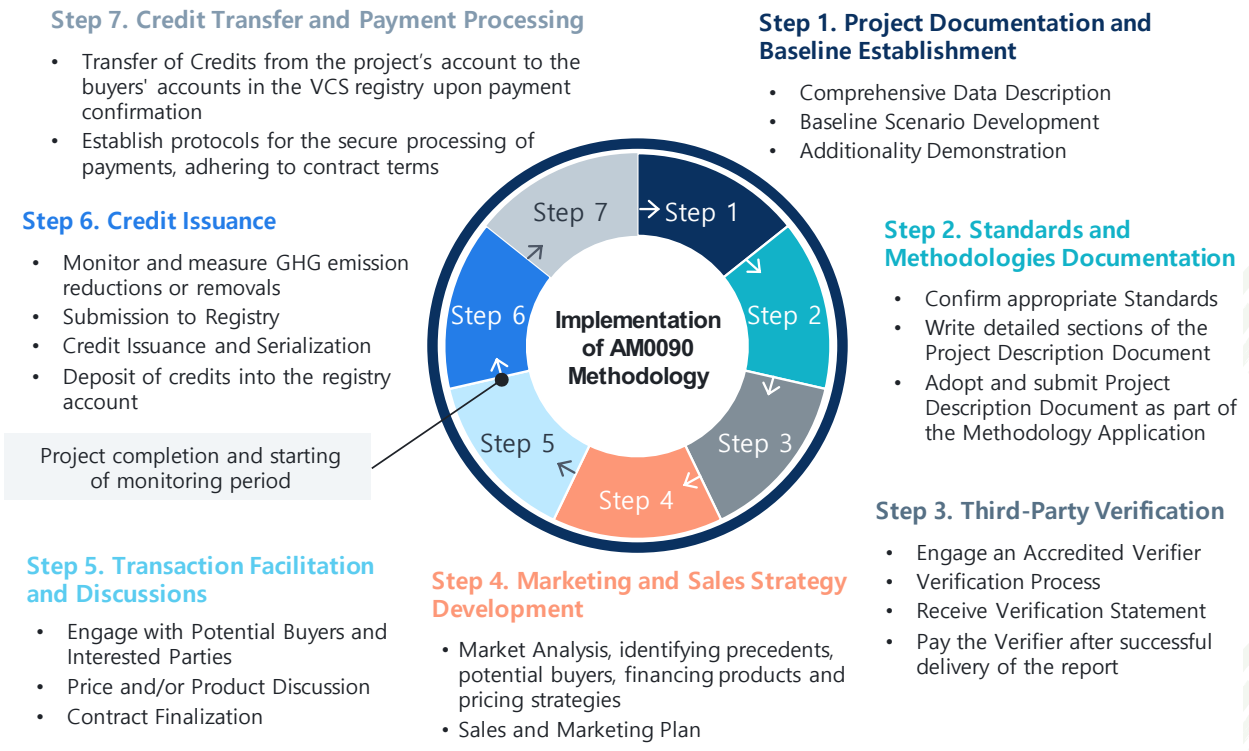


Figure 58: Detailed process to conduct a DD and analysis as per AM0090, the issuance, verification, and sale of carbon credits in a railway infrastructure project

Under this mechanism, policy-makers and railway sponsors in Africa can tap into carbon finance markets to help bridge the finance gap in infrastructure development and maintenance. Particularly, some noteworthy opportunities presented by carbon credit financing are:

- The yearly revenue from carbon credit issuance could help cover for O&M expenditure and bridge the financing gap during the operational phase. According to a preliminary estimation by ALG, the revenue stream generated from a single-track electrified railway section could be a crucial to partially finance maintenance (estimated -20-40% of maintenance costs across a 30-year period) and improve the financial performance of the infrastructure.

- An emerging opportunity is for buyers to engage directly with project developers, **providing upfront financing** in exchange for future credit allocations. This arrangement can be particularly beneficial for large-scale or innovative projects requiring significant initial investment, such as railway projects, where institutional partners and/or multilateral development banks could play a substantial role in the design and financing of the project. In that role, a share of the project capital expenditure financing could be traded against future credit allocations.

However, it also important to understand that upfront funds for carbon credits **will only cover but a small portion of a project's budget.** Therefore, it is paramount to emphasize that these funds should be coupled with other mechanisms to co-finance infrastructure investments and specially to unlock other financing options.

- Collaboration under Article 6 of the Paris Agreement can facilitate the trade of carbon credits in Africa, transfer of green technologies and build local capacity for climate change-mitigation strategies.

Despite the great potential of this instrument, experience with carbon markets in the transport sector is limited and the potential for railway carbon finance is still developing. Without any particular instruments for compliance markets in Africa, countries currently rely solely on Article 6, and the prospect of selling in voluntary markets only adds more layers of complexity to the situation.

Additionally, being still a nascent market, ensuring the integrity and additionality of carbon credits remains a challenge, affecting market confidence and prices. Furthermore, it is significantly challenging to measure GHG emissions from the railway sector as the projects are difficult to ring fence and it is difficult to collect data, especially in the context of African railways. In consequence, further research is necessary to enable African railways to tap into the carbon finance market and effectively monetize emission savings.

Green bonds

Green bonds are commercial bonds that finance green investments and are labelled accordingly. To access this financing, the investment financed must be certified as sufficiently "green" by a qualified third-party and the bond issuer/borrower must be creditworthy, similar to any other private sector loan or bond. As such, green bonds can finance railway investments and can also be used for refinancing projects and assets post-implementation.

Although evidence on the costs of green financing compared to traditional commercial sources is inconclusive, these **debt instruments tap into a growing pool of investors interested in enhancing the climate impact of their portfolios.** After a decade of increasing interest, green bond issuances reached $487 billion in 2022.

In order to qualify for green bonds, projects must be eligible under the criteria issued by standards agencies. For example, Climate Bonds Initiative's (CBI) Climate Bonds Standard and Certification Scheme is a labeling scheme for bonds for which many railway investments would qualify under the low-carbon transport eligibility criteria.

Despite appealing to a particular pool of investors and the "green" tag, green bonds are no different from normal bonds in that they also require the railway to be creditworthy to access private capital markets. While many railways in Africa, especially passenger railways, involve excessive risks or will not generate enough revenue from sales to cover their operating and capital costs, governments can

still enable their railways to be creditworthy through provision of predictable support and collateral for loss-making public services and exercising effective governance of their railway SOEs. In this sense, collaboration from IFIs and other multilaterals is essential to provide risk mitigation mechanisms that make investing in green bonds creditworthy, as previously discussed during Section 4.6.1.

An increasing number of railways in developing countries are benefitting from green bond financing. Georgia railways and Moroccan railways (ONCF) were able to establish themselves as creditworthy borrowers with green investments.

Climate funds

Climate funds are multilateral, bilateral, and philanthropic funds that provide grants and concessional financing specifically to promote investment in climate change mitigation and adaptation measures.

Some multilateral funds that African countries can access include the Green Climate Fund (GCF), the Global Environment Facility (GEF), and the Adaptation Fund (AF). The two first funds were established throughout the years as financial instruments of the United Nations Framework Convention on Climate Change (UNFCCC) to provide resources to developing countries and are supported by the World Bank. Other noteworthy Climate Funds include the Clean Technology Fund, the Global Environment Facility, the Green Climate Fund, the Least Developed Countries Fund, the Pilot Program for Climate Resilience, the Scaling Up Renewable Energy Program, and the Special Climate Change Fund.

The challenge with climate funds is that their resources are relatively limited—in 2020 their total funding was $5 billion—and only a fraction of that went to rail, as transport is a small beneficiary of such funds. Due to such small financial capabilities, Climate Funds act better in co-financing schemes and to provide guarantees or risk mitigation measures that can mobilize funding by private capital.

For example, the construction of a light rail transit system in Costa Rica, which will be powered by over 90% renewable energy, demonstrates this leveraging mechanism. The Green Climate Fund (GCF) is providing $250 million in debt financing and a $21 million grant. Additional funding came from the Central American Bank for Economic Integration and private equity through a PPP.

Core insights and suggestion

1. The AM0090 methodology, supported by Verra, provides a framework for railway projects to quantify and monetize emission reductions through carbon credit issuanceEfficient oversight of fund allocation in construction projects relies on robust procurement procedures, transparency, rigorous cost tracking, and external audits to maintain accountability and prevent mismanagement
    - Railways can benefit by generating carbon credits through emission reductions, potentially covering 20-40% of maintenance costs over the infrastructure's lifetime
    - Upfront financing from future credit allocations is also an emerging opportunity, but could only cover smaller portions of budget and should be rather used for co-financing and to mobilize private capital
    - At the moment, there is no compliance market in Africa, but countries can access carbon credit financing through the sale of ITMOs in the framework of Art. 6 of the Paris Agreement
2. Ensuring the integrity and additionality of carbon credits remains a challenge, as does measuring GHG emissions from railway projects, particularly in Africa. Further research and collaboration are needed to effectively tap into carbon finance markets and monetize emission savings for railway development
3. Green bonds finance certified green investments and attract climate-focused investors, but require creditworthiness just as other debt instruments. Hence, government support and risk mitigation measures should be encouraged from IFIs, as shown by the successful examples in Georgia and Morocco
4. The limited resources of Climate Funds are better suited for co-financing and risk mitigation to mobilize private capital, as demonstrated by Costa Rica's light rail project which combined Climate Fund funding with private and multilateral investments

4.7 Intermodality

4.7.1 Policies to promote rail intermodality

In Africa, trucking has been favored by both the private sector and Authorities over the decades as the primary mode of goods and passenger transport. This is due to lower investment requirements, strong private sector involvement and government support. Furthermore, road transport is the most flexible mode for transporting goods, as it allows for door-to-door delivery.

However, road transport is susceptible to congestion, especially in dense corridors; heavy trucks cause damage to asphalt and increase maintenance costs; accidents or breakdowns often happen due to exposure to poor road pavement; and trucking has limited load capacity for business operations that require the displacement of great volumes over long distances. In the African context, given the importance of bulk transport from mining and other commodities, such negative externalities are underscored.

Conversely, railways demonstrate exceptional efficiency in transporting great volumes of goods and passengers over long distances and through densely populated areas. Moreover, they are generally safe and reliable when properly maintained and operated. Yet, railways face limitations in flexibility due to their fixed infrastructure, making it challenging to reach various locations, and adherence to schedules.

Furthermore, to fully harness the advantages of railways, it is crucial to integrate their development into comprehensive intermodal schemes. This involves optimizing intermodal solutions by leveraging the unique strengths of various transport modes within a unified logistics network rather than treating them as separate and competing entities. This includes seamlessly connecting sea, rail, and road transportation to maximize the efficiency and effectiveness of each mode within the overall transportation chain, with railways assuming a central role as the backbone infrastructure for inland transport.

The burgeoning trade landscape in Africa has led to a significant increase in freight transportation, both domestically and internationally, that is expected to continuously increase over the next decades. This surge in trade activity has not only amplified the volume of goods transported but has also exacerbated the adverse effects associated with transport by road. Moreover, the negative effects of road transport are starting to impact other trade infrastructure, such as seaports, which frequently face capacity constraints due to the high influx of trucks. Additionally, road transport efficiency is being compromised by heightened congestion, leading to longer travel times and increased accident rates.

In this context, a modal shift from road to rail is being pursued by national Governments and multinationals as it can help reduce some of the negative costs of transport and mitigate capacity constraints of current African trade infrastructure. **The desired modal shift will only take place due to deliberate decisions made by the market operators, which are mostly performed on a price competitiveness basis.** Safety and the reliability of travel time are also crucial factors that may determine modal choice.

However, currently, road transport is often the fastest and most cost-effective way to deliver goods. According to a study by the European Comission and the European Court of Auditors, intermodal transport in Europe is on average 56% more expensive than exclusive road transport, when not considering supportive actions. This cost disparity primarily stems from expensive transshipment procedures and other inefficiencies associated to modal change (increased time, delays, reduced loading capacity, transaction and legal costs…). Not only that, but increasingly cost-effective road transport also limits the benefits of economies of scale and capacity rail has to offer. While rail undertakings can work towards better cost-effectiveness to promote intermodality, the shift to intermodality is a challenge too big for railway companies and that it requires the support of governments in the framework of trade logistics schemes.

Hence, at both the national and regional levels, the modal change **requires of a combination of regulatory measures, financing, and other operative actions that motivate a market-based**

modal shift. In this sense, a strong dedication is required to overcome the current challenges and unleash the full potential of railways within a broader intermodal transportation policy framework.

Building upon the identified challenges and opportunities, implementing targeted policy measures is essential to promote the market-based modal shift towards intermodality in Africa.

- **Logistics and trade strategy based on the integration of intermodal infrastructure**

Governments should establish a logistics strategy centered on integrated intermodal infrastructure, including strategically located hubs and terminals along dedicated transport corridors. These hubs serve as centralized points for transferring cargo between different modes, optimizing operations and reducing costs. In this context, railway transport should play a vital role as the backbone of these corridors, connecting strategic hubs like seaports, inland intermodal stations, production facilities and industrial hubs. It is essential to recognize the complementary nature of rail and road in logistics chains, as road is strictly necessary to reach the last mile, and to consider the competitive transportation environment between different modes when planning railway projects.

This strategic approach forms the foundation of transportation Master Plans and investment strategies, guiding the development of integrated networks with railways positioned as the primary backbone. The focus of such strategy should be on minimizing reliance on road transport for long-haul journeys and shortening road legs in multimodal transport. Additionally, it should include thorough assessments of terminal demand and capacity alongside proactive measures to ease congestion at key nodes like seaports and urban areas. These efforts should prioritize the relocation of cargo movement away from the most critical nodes, ensuring smoother logistics operations and enhanced efficiency.

- **Improvement of rail efficiency and reliability**

    - Improvement of rail performance in terms of speed and capacity throughput
    - Increment in rail safety and reliability, for which modern infrastructure and rolling stock are necessary, accompanied of due maintenance
    - Simplification, digitalization and standardization of customs procedures across borders to reduce delays and costs associated with international rail transport, particularly in multi-national corridors

- **Digitalization of multimodal transportation**

    - Implementation of ICT systems to streamline data transfer and improve operational agility. Particularly, African stakeholders should work on the development of integrated cargo tracking systems. For instance, FERRMED[8] contemplate an integrated rail-road freight flow control system (in the ERTMS framework) supported by a real time rolling planning concept (RTRP) as one of the cornerstones for its +FIRRST program for the EU
    - Integration of multimodal transportation in metropolitan areas, including integrated ticketing systems, transport hub development, synchronization of modes, information provision, etc.

- **Revision of the regulatory framework and financial incentives**

    - Promotion for the use of containers and other standardized Intermodal Load Units (ILUs)
    - Marked-based instruments to internalize the external costs of road transport (Pigouvian taxation), such as road pricing schemes, congestion charges or tolls. As an example, in 1999, the EU issued the Directive 1999/62/EC[9] on the charging of heavy goods vehicles
    - Reduction of taxes or subsidies on shippers participating of intermodal transport, especially road carriers

[8] FERRMED Studies – FERRMED

[9] Internalisation of transport external costs - European Commission (europa.eu)

performing portions of an intermodal journey. This has been a strategy widely used in Europe, with programs such as the Mode Shift Revenue Support (MSRS)[10] in the United Kingdom or the "eco-incentivo ferroviario[11]" in Spain. The European Union's policies stemming from the Combined Transport Directive[12], despite their mixed results, also offer a valuable example of possible structures for such subsidies.

- Load, activity or speed limitations for road carriers, such as the axle load limitations already imposed in many different countries in Africa. The obligation to ship containers inland by rail transport in Mombasa could also be taken as an example for shifting traffic to rail, but extreme actions such as this should generally be discouraged as they oppose market forces and might undermine the competitiveness of the logistics sector in the region
- Integration and liberalization of the African rail market, to promote more efficient use of railways on multi-national corridors. This has been applied within the European Union with limited success in many product markets, given that many other requirements for the private were not addressed

While regulatory measures are the most straightforward policy to implement, it is important to underline that a modal shift should not solely rely on them, as they are generally restrictive to market forces. Ideally, the modal shift should be completely market-based and through a combination of the successful integration of infrastructure, digitalization and an efficient rail network. In this sense, it is essential to coordinate efforts in all fronts to trigger a modal shift from road to rail.

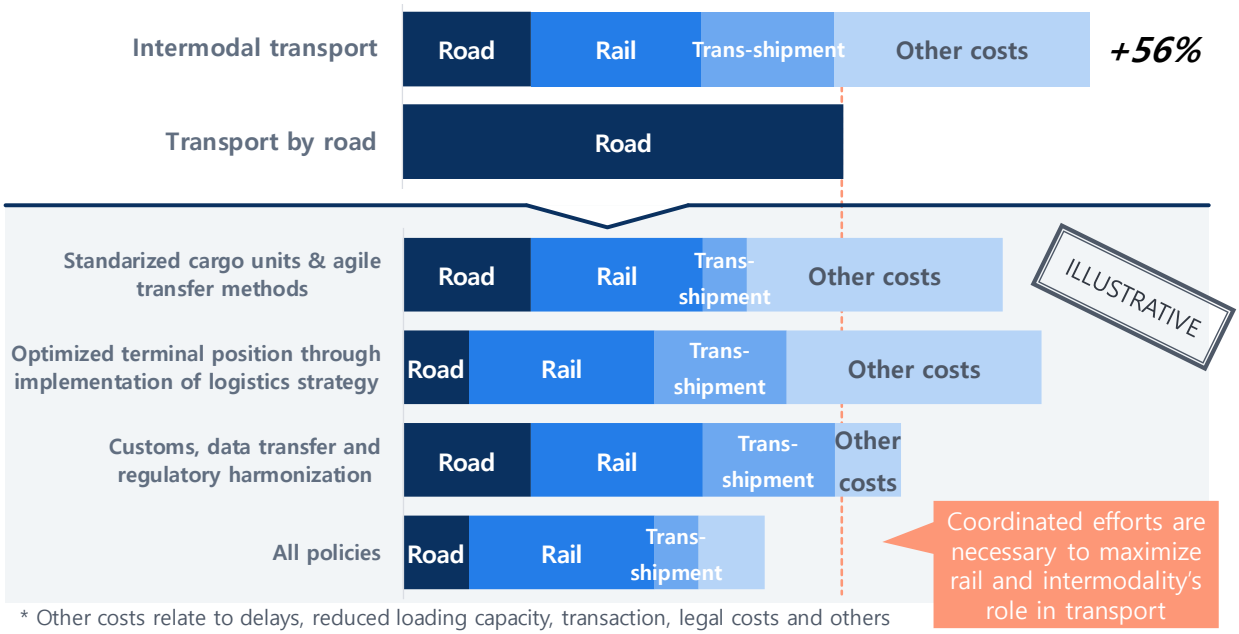


Figure 59: Comparison of the average cost of freight transport (Europe, 2017) without policies to support intermodal transport; and an illustrative representation of the effect of individual and coordinated policies

Finally, policymakers need to recognize that imposing restrictive policies on road transport will likely lead to conflict with powerful trucking lobbies, which have gained significant influence due to long-standing favorable policies. Therefore, it is crucial to communicate that promoting rail and intermodal transport is not intended to undermine road transport. Instead, the goal is to reframe road transport's role as an integral part of a more efficient and sustainable logistics chain, particularly for the first and last mile of transportation.

In this sense, collaborating with trucking associations is indispensable to avoid direct confrontation. Furthermore, it is essential to recognize that only through joint efforts can stakeholders facilitate the adoption of intermodal solutions, optimize transportation networks and effectively tackle logistical hurdles.

[10] Mode Shift Revenue Support - GOV-UK Find a grant (find-government-grants.service.gov.uk)

[11] Programa de apoyo para un transporte sostenible y digital: eco-incentivo ferroviario

[12] Directive - 92/106 - EN - EUR-Lex (europa.eu)

Some potential arguments to encourage trucking stakeholders to collaborate in intermodal solutions include:

- Thanks to the stimulus provided by railways, truck transportation can benefit even if it loses market share. For instance, if a port becomes more competitive compared to others due to a good railway connection, the port's traffic can grow, benefiting truck transportation both at the port and in the hinterland (last-mile delivery)

- Outline potential benefits to trucking operations due to shorter routes stemming from intermodal transport: shorter turn-around times, avoidance of congestion, increased safety, lack of lengthy customs procedures in border crossings, driver comfort…

- Short-haul routing typical from last-mile delivery if rail transport generally results in more predictable schedules and dedicated routes

- Emphasize the safety and climate nature of Pigouvian taxes on road transport, underscoring the societal externalities of long-haul transport of heavy goods

The suggested approach tries to foster a symbiotic relationship between different modes of transport, maximizing the benefits of each mode and enhancing overall efficiency and sustainability in the transportation sector.

However, it is imperative to acknowledge that the support of the road transport sector will be challenging to obtain despite diplomatic efforts and the outlined benefits. Resistance may arise from concerns over potential revenue loss, changes in operational practices, and skepticism about the actual advantages of intermodal transport. If support from the road sector is not achieved, policy-makers must not bend to truckers antagonism and continue to commit to rail transport by applying the necessary policies. Only by maintaining a firm stance, governments can ensure the advancement of a more efficient, sustainable, and balanced transportation system, even if it means confronting opposition from powerful trucking lobbies.

Core insights and suggestion

1. Trucking has been the primary mode of transport in Africa due to lower investment requirements, flexibility, and strong private sector involvement. However, road transport has limited load capacity for long-distance bulk transport and brings sever external costs that are being exacerbated in the rise of trade within Africa

2. Railways demonstrate efficiency in transporting large volumes over long distances and densely populated areas, with higher safety and reliability when properly maintained. The main challenge for railways is their inability to perform the last-mile delivery, for which the promotion of railways must be accompanied by wider intermodality schemes

3. The desired transition to rail or intermodal transport relies heavily on market forces. However, the private sector prioritizes cost-effectiveness, where road transport often emerges as the most economical choice. Challenges such as costly transshipment procedures and inefficiencies in modal changes hinder the adoption of intermodal transport

4. Modal change requires strong dedication at national and regional level and comprehensive policy frameworks advocating for rail transport and intermodality to incentivize market-based shift, including: 1) An integrated transport strategy with intermodality at its core, 2) The improvement of rail's efficiency and reliability 3) Digital integration of multimodal transportation 4) A revision of the regulatory framework, coupled with market-based and financial incentives for intermodal transport

5. Advocating for rail and intermodal transport should aim to enhance efficiency and sustainability through a symbiotic relationship between transport modes. Therefore, trucking companies must understand that, despite losing market share, the promotion of railways will also bring benefits to their sector. If the collaboration of the trucking sector is not possible, policymakers must maintain a firm stand and continue to pursue a modal shift towards rail

4.7.2 Intermodal infrastructure planning

In freight transport in Africa, the high costs associated with limited interoperability with other transportation modes and last-mile challenges for rail lines stem from the lack of comprehensive intermodal infrastructure planning. Furthermore, recent railway infrastructure planning has neglected to incorporate crucial operational considerations from the private sector, as well as the particular needs that intermodal transport requires to be competitive against road-only transport.

Playing a key role in master planning of transportation, intermodal infrastructure planning involves the strategic coordination and development of transportation networks that effectively integrate various modes of transport, including rail, road, inland waterways, and sea routes. This comprehensive approach aims to optimize the movement of goods and passengers by leveraging the unique strengths of each mode while ensuring seamless connectivity between all links of the transportation system.

In this sense, depending on the specific legs and interface between modes of intermodal transport that are to be addressed, several considerations can be addressed to maximize the benefits of intermodal transport in Africa:

Rail-sea transport

Sea transport serves as the backbone of international trade, lauded for its efficiency in managing large cargo volumes and offering economical solutions for long-haul shipments. In Africa, it plays a pivotal role as the primary mode for importing and exporting goods, initiating the inland transportation journey. At port terminals, goods are unloaded from ships and readied for further transit on land and vice versa. However, Africa's inclination towards trucking means that most inland transport from and to ports relies on trucks, introducing logistical complexities and strategic considerations.

- Deep-sea shipping, the predominant method for importing and exporting goods at African ports, often involves large volumes of containers arriving simultaneously. However, stringent customs procedures for both exit and entry in many African countries can lead to extended stays for containers in ports until clearance is obtained, causing congestion in already limited container terminals

- Seaport terminals often experience long queues of trucks awaiting cargo pickup, leading to congestion on access roads and within terminal premises. This congestion is compounded by the presence of parked trucks along nearby roads, further impeding the efficient flow of traffic. Consequently, these challenges extend turnaround times and hinder the timely movement of cargo out of the port

- Although RoRo ferries are less common in many of Africa's major ports, they also encounter delays due to congestion caused by customs procedures, contributing to longer turnaround times

Railways offer a compelling solution to address the challenges associated with congestion and inefficiencies at seaports in Africa. By leveraging their larger capacity, improved cargo traceability, and economies of scale, railways can significantly enhance the efficiency of inland transport from ports.

In particular, African States should consider the development of a network of intermodal platforms and "dry ports" along transit corridors in the hinterlands of major ports where containers can be transported immediately after reaching a port terminal. At these larger intermodal terminals, custom controls may be performed more efficiently and later continue with the shipment of goods through rail or, alternatively, finish their road transport.

On the other hand, while maritime transport is usually the most cost-effective for long distances and large volumes, it is strictly limited to the available sea routes that circumvent the world's geography. Particularly, the African continent currently stands in the middle of sea routes between most of the Atlantic seaports and the Indic or Pacific seaports, forcing ships to circumvent the continent through the South (Good Hope Cape) or the Mediterranean Sea (Suez Canal).

In this sense, due to its geography, Africa presents promising opportunities for the establishment of land bridges, particularly in the west-to-east and vice versa directions. These land bridges could significantly enhance connectivity, reducing transit times from West Africa to Asia or East Africa to the United States, for instance. Moreover, they could serve as efficient alternatives for USA East Coast-Asia shipments, circumventing the lengthy routes around the Cape of Good Hope and the Suez Canal. This is especially pertinent in light of recent crises that have disrupted shipping through the Suez Canal, underscoring the importance of diversified transportation routes for uninterrupted trade flows.

Serving as an example of successful implementation, land bridges in North America have been instrumental in advancing intermodal freight transport through rail, notably by substantially reducing transportation times. For instance, a container shipped from Singapore to New York via the Panama Canal typically took 36 days, whereas utilizing the land bridge shortened the journey to just 19 days. Moreover, these land bridges have competed effectively for market share traffic between Asia and Europe, reducing shipping time from Rotterdam to Tokyo by almost 3 weeks.

Road-rail transport

For rail-road transport, planning of infrastructure should be aimed at maximizing the length of rail transport while minimizing the length and cost of road transport for all stakeholders. Furthermore, ensuring smooth transfer between the two modes is essential for intermodal transport to be competitive.

As modal shift is primarily driven by market forces, incorporating insights from private stakeholders during the design and location optimization phase is paramount. By involving the private sector, planners can gain valuable insights into the specific needs and requirements of businesses involved in freight transportation and the logistics chain. This collaboration enables the development of intermodal solutions that not only cater to the objectives of larger policy frameworks but also to the private sector, thus motivating a modal change towards more sustainable logistics.

In order to effectively meet the operational requirements of private entities, a proactive strategy is essential for tackling first and last-mile challenges. Engagement with the private sector should first focus on understanding the anticipated demand volumes and cargo characteristics to determine if specialized rail links catering to specific industries are feasible. This scenario is often observed in industries like mining, where high volumes of bulk cargo may justify the development of dedicated railway lines.

Most often, however, general cargo does not comply with the necessary requirements to motivate the construction of such lines. This is often because the demand is dispersed across wide areas, making it challenging for railways to reach all delivery or origin points efficiently. It is in this scenario where intermodal solutions and the input of the private sector are essential as to establish:

- Optimal terminal position and characteristics, balancing small catchment areas and large demand volumes. This involves careful consideration of factors such as proximity to major transportation routes, industrial centers, and population hubs to ensure accessibility and minimize last-mile transit times.

- Design and layout of intermodal terminals, as to accommodate different types of cargo and cargo handling procedures that the private sector requires, to meet storage demand, facilitate transfer between different modes of transport and facilitate other potential procedures that might be required such as customs or cargo consolidation.

Transshipment costs within intermodal terminals constitute a significant portion of the expenses associated with intermodal transport. To enhance the cost-effectiveness of combined freight transport via road and rail, the promotion of Intermodal Loading Units (ILUs) is essential for facilitating swift and efficient transfers between these modes. Among the most common ILUs utilized for rail-road combined transport are swap bodies and containers, which are mounted on flat wagons and base plates. These ILUs enable seamless transitions between trucks and wagons at intermodal terminals, facilitated by a range of machinery catering to various load sizes. However, efficiency hinges on the effectiveness of these transfers, which, despite ILU use, can still suffer delays and inefficiencies in some terminals.

The rolling road or rolling highway concept presents an attractive option for shippers and freight forwarders in Africa, offering combined transport services without the need for significant investments in transshipment facilities and coordination among multiple shippers. In this transport mode, lorries are transported on wagons, operating as a Roll-on Roll-off system. However, lorries must meet specific requirements to conform to the category and clearance gauge of the railway.

In Europe, the technical standards include a smaller loading gauge, for which carrying trucks directly on flat wagons is not possible and require of purpose-built low-floor wagons. Conversely, the African network is generally being developed with a loading gauge for double-stacked containers, so placing trucks on flat wagons should not be a problem to interoperability for most railways. The Konkan Railway in India offers an example successful implementation of RoRo operations in rail-road intermodal transport. In railways with smaller loading gauges, operators and shippers could explore European options for truck carrying like Modalhor, CargoBeamer, Helrom or RoLa, which employ purpose-built low-floor wagons but require quite specific terminals and large investments on this particular technology.

On the other hand, to address the first/last-mile challenge in rail infrastructure planning of passenger services, a holistic approach to planning is also indispensable. In passenger services, intermodal planning entails not only strategic positioning intermodal terminals, but also providing parking spaces and introducing feeder services like shuttle buses. These measures serve to connect rail stations with end destinations, improving accessibility for passengers. Furthermore, they contribute to boosting demand, thereby enhancing the network's sustainability through increased utilization and economies of scale.

Core insights and suggestion

1. Many ports in Africa face terminal and road congestion due to lengthy and inefficient administrative procedures (customs) and reliance on trucking for inland transport. Railways can alleviate congestion by facilitating efficient cargo movement inland and establishing intermodal platforms and dry ports in hinterlands where customs procedures can be carried out

2. Africa's geographical positioning with respect to major shipping routes offers opportunities for land bridges, particularly in the east-to-west direction, reducing transit times and providing efficient alternatives to lengthy and congested sea routes (Suez Canal, Good Faith)

3. Private sector engagement in initial infrastructure planning is essential to address operational requirements and overcome first and last-mile challenges efficiently, encouraging private preference for intermodal transport

    - Proactive strategies are necessary to tackle first and last-mile challenges, focusing on understanding demand volumes and cargo characteristics
    - Optimal terminal position and layout, accommodating various cargo types and handling procedures, are essential for efficient intermodal transport

4. Intermodal Loading Units (ILUs) like swap bodies and containers facilitate swift and efficient transfers between trucks and wagons at intermodal terminals, reducing transshipment costs

5. The rolling road concept, where lorries are transported on wagons, offers combined transport services without significant investments in transshipment, especially considering the fact that most African railways allow trucks on flat wagons due to their large loading gauge

6. Intermodality is crucial in passenger services, involving strategic terminal placement, parking provision, and feeder service introduction to improve rail accessibility and stimulate demand

4.7.3 Design, Construction & Monitoring specifications for intermodal terminals

Intermodal terminals are critical nodes to ensure efficient and cost-effective intermodal transportation, facilitating the transfer of cargo between different modes of transport. As with any other infrastructure, their operational efficiency is intricately linked with its design, which should take several key factors into account:

- The terminal layout should prioritize modal connectivity and accessibility, facilitating seamless transfers between transportation modes such as rail, road, and sea. Furthermore, design considerations should focus on enabling efficient cargo movements within the terminal's cargo handling facilities, which may include container yards, warehouses, loading and unloading areas, etc.

- Efficient traffic flow within the terminal is essential to prevent congestion and minimize delays. Design elements such as well-defined traffic lanes, clear signage, and designated vehicle parking areas should be incorporated to facilitate smooth movement of vehicles and cargo within the terminal

- Safety and security measures should be integrated into the terminal design to protect personnel, cargo, and infrastructure. This may include perimeter fencing, surveillance cameras, access control systems, and emergency response protocols to mitigate risks and ensure a secure operation

- Sustainable design principles should be incorporated to minimize the environmental impact of terminal operations

- Terminal design should allow for future expansion and adaptation to accommodate changing operational requirements and evolving market demands. Flexible layouts, modular infrastructure, and scalable facilities can facilitate seamless growth and optimization of terminal operations over time

In general terms, the design of intermodal terminals is generally tailored to address the specific needs and objectives of each station. This customization requires close collaboration with the private sector to understand their operational requirements and goals. By engaging with the private sector, terminal designers can ensure that the layout, features, and functionalities of the facility align closely with the needs of businesses and industries they serve. This collaboration allows for the incorporation of specialized infrastructure and processes that optimize efficiency and support seamless operations. However, the fact that intermodal terminals might require certain level of customization depending on their needs also means that design specifications might significantly vary from terminal to terminal.

In this context, regional or continental standards for intermodal stations should also be developed to ensure seamless transit through intermodal terminals, as well as agile and consistent cargo management, which are key to decrease transshipment costs and increase the competitiveness of intermodal transport. This entails integrating terminal-specific aspects such as traffic lane and loading lane dimensions, track centerline distances, crane facilities, loading roads, parking spaces, gate area design, safety measures, security systems, and environmental considerations into a comprehensive standard. On top of that, cargo handling procedures, including consolidation and movement, should be standardized to ensure handling consistency across all the continent.

Many countries worldwide have established norms and standards govern the design and construction of seaports, which consequently extends to sea-land intermodal stations. Conversely, design standards for road-rail intermodal terminals are generally non-existent at a worldwide level. No international (ISO) nor European standards (CEN) exist covering this area. At the national level, Austria has relatively comprehensive standards, but these date back to the 1980s and are generally out of date. In many other countries, guidelines for inland intermodal terminals are used rather than standards. In others, inland intermodal station design is project specific or uses regulations and standards from seaport design.

In this sense, rather than extensive prescriptive standards, which are mostly inexistent elsewhere and might limit the flexibility of intermodal

terminals to cater market dynamics and the needs of the private sector, performance-based standards could prove a more viable alternative. Thus, it is suggested for African standards for intermodal stations to be developed taking into account a mix of prescriptive and performance-based standards.

Other than setting standards for intermodal terminal characteristics, the AUC should also study the viability of creating a detailed Standard Operational Procedures (SOPs) framework for cargo handling to ensure consistency across Member States. This framework should cover critical areas such as cargo acceptance, storage, handling, documentation, security checks and connection processes. Such a common framework would streamline operations in international trade and facilitate efficient and consistent cargo handling practices throughout the region.

Finally, monitoring operational efficiency is crucial for the sustained success of intermodal terminals. Together with logistics partners and other key stakeholders, the AUC and African States should set harmonized KPIs to measure the efficiency of terminals and evaluate performance across terminals. KPIs can be related to performance-based design standards, operational procedures, or include other considerations that either public or private stakeholders might consider of importance, encompassing metrics such as throughput capacity, turnaround times, equipment utilization rates, and safety records. Comparing operational efficiency metrics among African terminals and international benchmarks serves as a roadmap for improvement initiatives, ultimately driving ongoing enhancement efforts and ensuring sustained competitiveness.

Moreover, monitoring operational efficiency is imperative for intermodal terminals as it not only enables cost management but also provides avenues to enhance the effectiveness transshipment activities and bolster customer satisfaction. Additionally, it plays a pivotal role in maintaining competitiveness in the market and fostering continuous improvement by pinpointing areas for enhancement and adaptation to changing demands.

Core insights and suggestion

1. Intermodal terminal design considerations include modal connectivity prioritization, efficient traffic flow management, safety and security integration, sustainability principles incorporation, and future adaptability planning

2. Collaboration with the private sector is essential for tailoring terminal designs to meet specific operational needs and objectives

3. With intermodal design being generally tailored to meet the needs of the private sector, the development of regional or continental standards for intermodal stations could prove crucial to ensure seamless transit through terminals and promote consistent cargo management

    - Design standards for road-rail intermodal terminals are generally lacking at a worldwide level, unlike the more extensive regulations and standards available for seaports
    - A mix of prescriptive and performance-based standards could offer flexibility to cater to market dynamics and private sector needs while setting standards for compatibility
    - African authorities (possibly AUC) should consider developing a Standard Operational Procedures (SOPs) framework for cargo handling to promote consistency across Member States, covering areas such as cargo acceptance, storage, handling, documentation, security checks, and connections

4. Establishing harmonized KPIs for intermodal terminals is crucial for monitoring efficiency, ensuring competitiveness, and driving continuous improvement. These KPIs should cover metrics like throughput capacity, turnaround times, equipment utilization, safety, and customer satisfaction, enabling effective comparison and improvement initiatives

4.8 Limited railway expertise and technical capabilities

4.8.1 Capacity building

As showcased throughout the other chapters of this document, Africa faces a significant shortage of railway expertise that spans all positions, from operational roles to top management, across both public and private sectors. First, a lack of railways expertise at the top level can negatively impact decision-making processes, project planning, and the overall development of the railway sector. Moreover, due to the shortage of local experts, African railways often rely on external engineers and operators, further complicating the search for competent operators amidst the systemic flaws within the railway systems on the continent. The main reason for this has been the absence of sustained railway programs across many countries over the past 40 years. This has resulted in constrained hiring policies, insufficient technical preparedness, and, in some instances, the closure of existing railway training centers. Consequently, both public and private railway entities have grappled with a dearth of qualified personnel, impeding efforts to enhance productivity and bolster project planning and execution capabilities.

Therefore, for the railways in Africa to become more competitive, capitalizing on human resources and a skilled workforce is indispensable. Know-how and human factor expertise must be boosted through holistic training and transfer skills plans to enhance professionalism and adapt the companies to rapidly changing railway technology. Additionally, there's an urgent requirement to attract and train new employees, given the aging workforce (as raised during the interview campaign), particularly in crucial technical positions, and the absence of attractive incentives for both existing and prospective workers.

Railway technical capacity building efforts should address a range of critical areas across railway companies and management to ensure a successful implementation of railway infrastructure projects and the continuous development of the sector:

- There is a need for specialized technical training programs to equip personnel with skills in railway engineering, rolling stock and infrastructure maintenance, operations, signalling, safety regulations... These programs should cater to various levels of expertise, from entry-level employees to experienced professionals within the operational and maintenance levels.

- There is a shortage of skilled engineers in technical direction with expertise in railway design, construction, and project management. This includes civil and mechanical engineers who are essential for the design and planning stages of projects. In consequence, most design and planning projects are outsourced to international engineering firms or to the contractors, resulting in projects that might fail to incorporate insights from the African players or the particularities of the African context.

Additionally, due to a lack of expertise and workforce, Africa has very few domestic construction companies. As a consequence, international players (French, Turkish and Chinese) dominate a construction market with very little competition. The African construction market shows growth potential for the following period, which is expected to drive competition in the market.

- Many African nations lack the institutional and technical capacity that are crucial to conduct appropriate feasibility studies and socioenvironmental assessments necessary to successfully implement projects. Furthermore, stakeholders have raised awareness of their limited ability to deal with financial negotiations and management of contracts. This includes, among others, challenges such as negotiating interest rates and allocating risks in financing arrangements, defining project clauses with private or external entities, and ensuring control over various processes within contracts that could impact the quality of the final products. These issues that were mainly exposed during EPC contracts for greenfield SGRs with Chinese companies.

Experiences such as the Rail Nikas Vigam (RVNL) and Indian Rail Finance Corporation (IRFC) show that it can be useful to create specialised units to deal with negotiations railway financing, PPPs,

procurement, construction and maintenance. These units are run on a professional basis, are ring-fenced from day-to-day politics, and have become credible and creditworthy interfaces with the private sector. Most of the Asian Development Bank's funds for rail infrastructure in India are channelled through the RVNL. The AU could also encourage the emergence of such units in some countries, although the national scale may be too small in most of Africa and therefore the units could be envisaged at the regional or corridor level.

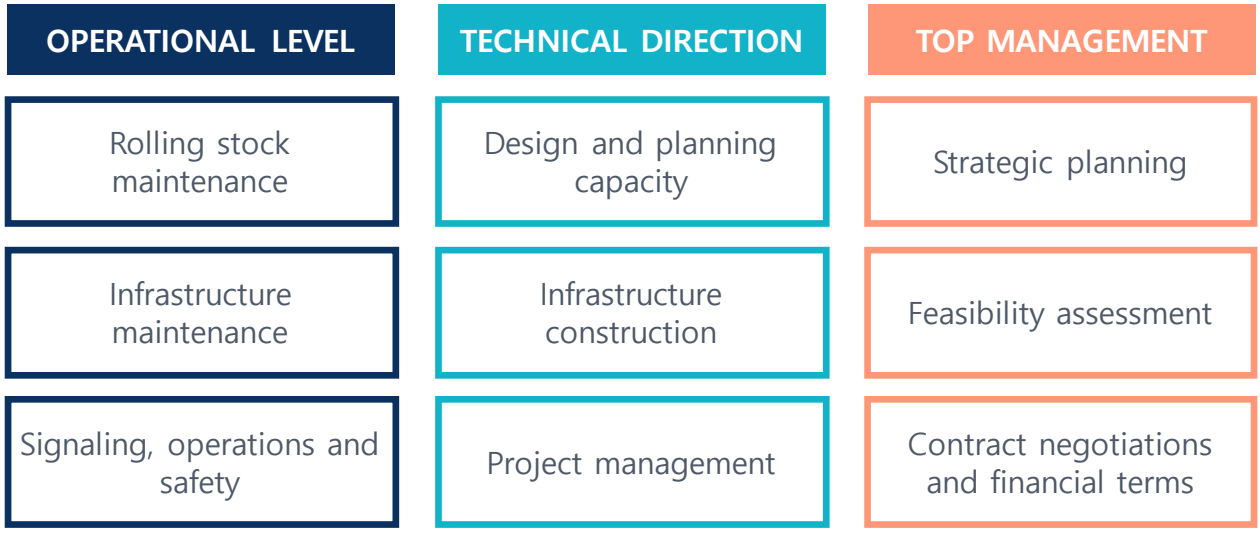


Figure 60: Main gaps in technical expertise in railway companies (Public and private) and management

As a consequence of this lack of investment in railways and lack of technical skills, no railway-related industry has developed in Africa. This shortfall means that essential facilities for producing rolling stock, locomotives, and conducting maintenance are largely non-existent or underdeveloped. For instance, there is no technical capacity to manufacture SGR equipment within all of the continent. Alternatively, manufacturing and maintenance facilities for narrow-gauge rolling stock are mostly present in South Africa, with limited capacity elsewhere. Although some progress has been made in building capacity for maintenance, many African countries are currently only capable of undertaking minor repairs. However, the majority of major repairs still necessitate outsourcing outside of the continent, leading to the transportation of locomotives overseas for servicing.

Consequently, Africa relies heavily on international collaboration for these critical components, leading to heightened costs and dependency on foreign suppliers. Moreover, without domestic manufacturing and maintenance capabilities, countries face challenges in executing large-scale railway infrastructure projects efficiently and sustainably. Therefore, addressing this deficiency and fostering the development of a robust railway-related industry should be a priority for African governments and stakeholders for their railway networks to operate in the most efficient manner. Particularly, the following key topics should be developed:

- Development of effective maintenance facilities in all railway networks across the continent that can fix both minor and major repairs
- Establishment of manufacturing industry for railway wagons and locomotives to reduce dependency on imports and stimulate economic growth
- Encouragement of innovation and development of R&D facilities to drive technological advancements and enhance the competitiveness of the sector

Overall, capacity building in African railways is crucial for the development and sustainability of the continent's transportation infrastructure. With the potential to stimulate the sector's growth, enhance connectivity and trade, and ultimately boosting the economy, investing in railway capacity across all levels is paramount. This includes managerial roles, design and construction teams, operations and maintenance (O&M) staff, safety specialists,

maintenance and manufacturing industries, and innovators in sustainable infrastructure and technology. The main initiatives for capacity building for the railways sector should be based on:

- Skill transfer plans from international and local experts in the sector, including training programs with international experts; collaboration with IFIs and other multilateral development banks; leveraging relationships with international engineering firms, manufacturers, and construction companies to absorb capacity; and setting knowledge pool platforms within the African continent

- Establishing training programs in Africa, academic institutions, R&D centers and certification agencies

Efforts to enhance railway capacity are already underway in several African countries such as Ethiopia, South Africa, Tanzania, and Morocco, among others. For instance, regarding technical expertise, the ERC - Railway Academy in Ethiopia has been working since 2012 with national entities (Addis Ababa Institute of Technology - AAIT) and the international community (American, English, Russian and Chinese partners) in trainings in railway engineering and Master's degree. Moreover, recognizing the need for further specialized training, the Academy has launched the project for the construction of a physical site for long-term formal education of railway engineers and short-term trainings of technician staff in the operation and maintenance services of railways. However, the project requires large investments (+$60M) that are currently not being met.

The case of the Ethiopian Railway Academy underscores the imperative need for institutional support and fund commitment towards capacity building. Hence, it is necessary for financial institutions and policy-makers to understand that promoting capacity building should be considered as a key cornerstone for developing a sustainable railway network in Africa. Accordingly, the necessary institutional arrangements and resource mobilization should be prioritized to ensure the success of capacity building efforts.

This involves establishing partnerships between governments, educational institutions, industry stakeholders, and international organizations to design and implement comprehensive programs tailored to the specific needs of the railway sector. Additionally, sustainable funding mechanisms must be put in place to sustain long-term training initiatives and ensure ongoing development for railway professionals.

Core insights and suggestion

1. Africa faces a major shortage of railway expertise that spans all positions, from operational roles to top management, across both public and private sectors, which negatively impacts decision-making processes, project planning, and the overall development of the railway sector

2. As a consequence, Africa relies heavily on international collaboration for these critical components, leading to heightened costs and dependency on foreign suppliers

3. Experiences such as the Rail Nikas Vigam (RVNL) and Indian Rail Finance Corporation (IRFC) show that it can be useful to create specialized units to deal with negotiations railway financing, PPPs, procurement, construction and maintenance

4. Overall, capacity building in African railways is crucial for the development and sustainability of the continent's railway infrastructure, mainly by means of: (i) Skill transfer plans with international and local experts in the sector; (ii) Training programs in Africa, academic institutions, R&D centers and certification agencies

5. Efforts to enhance railway capacity are already underway in several African countries such as Ethiopia, South Africa, Tanzania, and Morocco, among others, but face challenges that underscore the imperative need for institutional support and fund commitment towards capacity building

4.8.2 Skill transfer plans with international and local experts in the sector

The limited technical expertise within African nations poses a considerable challenge to the sustainable development and maintenance of rail infrastructure. Recognizing this, efforts to enhance capacity must extend beyond national borders. Collaborative partnerships with neighboring countries and international stakeholders offer opportunities for importing skills, knowledge exchange and shared learning. By leveraging transfer skill plans with both local and international experts in the sector, African nations can enhance their capacity and pave the way for a more robust and sustainable railway industry.

Different international institutions already work in collaboration with African railway companies in training programs and courses. For instance, the Franco-Moroccan collaboration Institut de Formation Ferroviaire (IFF) has served as a gateway of knowledge into the African continent for French-speaking countries since 2015[13], with important implications in the development of the Moroccan High-Speed Line from Casablanca to Tangier. Alternatively, the World Bank initiative East Africa Skills for Transformation and Regional Integration Project (EASTRIP) also provides support for the development of quality training in the railways sector in Africa, most specifically in Ethiopia.

While collaborations with international institutions have proven to be a valuable and effective avenue for knowledge transfer and should be expanded upon, knowledge donors have generally applied approaches in capacity development based on conventional instruments and methods (such as technical assistance, training, scholarships and research), despite their often modest long-term effects. It is also troublesome that approaches and measures for capacity development from the side of donors are frequently very fragmented and are being implemented in isolation from other initiatives and experiences.

Therefore, African States should also look to complement conventional skill training programs with additional opportunities of engagement with international experts that might bring more continued capacity building to the African continent. By tapping into various interactions with experts from around the world, African countries can facilitate skill transfer and import much-needed capacity onto the continent.

- Considering the financial challenges in most African railway projects, the support of IFIs and ECAs is expected to continue being crucial for the development of projects. **Multilateral development banks** and other international financial institutions are **knowledge banks** that should be exploited for transferring knowledge onto African grounds, especially regarding project planning, management, financial structuring, among others. By tapping into the wealth of knowledge offered by these institutions, African nations can bolster their capabilities and navigate the complexities inherent in railway project development with greater confidence and efficiency.

  Furthermore, IFIs and other multilaterals are extremely well positioned to spearhead efforts for fostering collaborations between training institutions and railway companies in Africa, given their experience in granting this type of education and in hiring services to develop them when necessary. Furthermore, they might benefit from economies of scale that nations might not be able to access, promoting capacity building at a regional or continental level.

- **Design collaborations, EPC contracts, concessions and other projects with international contractors, especially SGR greenfield projects,** can be an avenue for knowledge transfer and building up local expertise during various project stages by utilizing international experience and best practices. At the moment, most contracts with foreign operators (either concessions or EPC contracts) have failed to perform this transfer, either by a lack of collaboration, knowledge transfer not being defined in the contractual terms or by an unproper monitoring or supervision of such skill transfer. Conversely, Gautrain Agency is a good example of skill transfer from a contract with a foreign contractor, as the Gautrain Agency has successfully adopted the operation of the regional railway after a concession with a

[13] Launch of the "TREMPLIN" training program in Gabon. - IFF | IFF (iff-ma.com); Eiffage Rail - Dakar in training at the IFF! - IFF | IFF (iff-ma.com)

Chinese contractor linked with construction.

Using insights gained by experiences like Gautrain and successful experiences elsewhere, railway developers should establish strategies for skill transfer in projects with the collaboration of international contractors or experts. This entails enhancing design and planning expertise through close collaboration between African engineers and international experts in joint projects; and increasing operation and maintenance technical skills through the inclusion of skill transfer plans in concession contracts with mentoring programs and on-the-job training.

- Leveraging the unprecedented opportunity presented by rolling stock demand in the African continent (+170k units by 2030), manufacturers of rolling stock can be encouraged to **establish more manufacturing facilities in Africa,** especially for SGR wagons and rolling stock. Under a coordinated strategy, stakeholders should establish incentives and build a strong business case for the creation of key manufacturing facilities in African grounds, targeting international manufacturers such as Bombardier, already present in RSA, Alstom, Siemens, CRRC…

This move would not only address the high demand for rolling stock but also foster job creation and the transfer of skills and knowledge to local factories. Furthermore, such a strategic approach has the potential to lay the groundwork for sustainable, self-reliant manufacturing capabilities on the continent.

- Expanding beyond formal partnerships, African States can continue to benefit from engagements such as expert consultations, technical exchanges, and participation in **international conferences and workshops**

On the other hand, despite the existing challenges, a notable volume of knowledge exists within the continent that can be tapped into. In this sense, national collaboration between African stakeholders emerges as a pivotal instrument for capacity building.

Establishing **platforms for knowledge transfer within Africa**, particularly from countries with existing capacity like South Africa or Morocco, can be instrumental. These platforms could facilitate the exchange of best practices, technical expertise, and lessons learned in railway development and management. Also, countries that have undertaken successful or failed concessions can share their lessons learnt, thus providing valuable insights that should aid in building more successful concessions in the future. These can be complemented with international aid to further enhance technical expertise in critical aspects where local knowledge falls short.

In this sense, pan-African railway institutions, like the proposed UAR, can spearhead the efforts for the enhancement of these skill transfer initiatives across the sector. Alternatively, the AU's agency for capacity development - African Capacity Building Foundation (ACBF) - is also very well positioned for that task.

Additionally, regional collaboration frameworks, such as the African Union's Agenda 2063 and the Regional Economic Communities (RECs), play a crucial role in fostering cooperation and coordination among African countries. These frameworks provide platforms for joint initiatives, policy harmonization, and resource mobilization to support railway capacity building efforts across the continent.

In the broader context outlined above, harmonization stands out as a potential catalyst for enabling the transfer of skills and fostering knowledge exchange among African countries. By aligning standards and procedures across borders, the harmonization process creates fertile ground for collaborative capacity-building initiatives and facilitates mutual learning between Member States and Railway Authorities. Moreover, the establishment of common objectives inherent in the harmonization process lays a solid foundation for collaborative endeavors, nurturing an environment conducive to extensive knowledge sharing and synergistic efforts in the railway sector's development across the continent.

Crossing borders into other sectors, particularly leveraging the industrial hubs scattered across the continent, offers a promising avenue to bolster

capacity in the railway sector. By fostering synergies with adjacent industries like the automotive sector, African nations can tap into existing infrastructure, expertise, and resources to amplify their railway development efforts. For example, established automotive manufacturing facilities can be repurposed or expanded to produce components for railway rolling stock, capitalizing on existing production capabilities and supply chains. Moreover, collaboration with the automotive sector can facilitate knowledge transfer and technology adoption, particularly in areas such as manufacturing processes, quality control, and innovation.

Core insights and suggestion

1. Different international institutions already work in collaboration with African railway companies in training programs and courses (IFIs, MDBs, IFF, EASTRIP, etc.)
2. However, conventional approaches in capacity development exhibit modest long-term effects and fragmentation, necessitating additional engagement opportunities with international experts.
3. African States should also look to complement conventional skill training programs with additional opportunities of engagement with international experts, focusing mainly on: (i) skill transfer terms in EPC and PPP contracts with foreign constructors/operators, while (ii) leveraging the unprecedented opportunity presented by rolling stock demand in the African, which can encourage to establish more manufacturing facilities in Africa
4. In this sense, pan-African railway institutions, like the proposed UAR, can spearhead the efforts for the enhancement of these initiatives in the railway sector throughout the continent
5. Harmonization stands out as a major catalyst for enabling the transfer of skills and fostering knowledge sharing among African countries, by aligning standards and procedures across borders
6. Leveraging the industrial hubs scattered across the continent (especially for the automotive industry), offers a promising avenue to bolster capacity in the railway sector for manufacturing rolling stock locally

4.8.3 Training programs, academic institutions and certification agencies

In addition to importing knowledge from abroad, it is crucial for African governments to spearhead initiatives aimed at fostering the domestic development of capacity, all under a recognized quality seal endorsed by global stakeholders.

First, African policy-makers should develop standardized framework of training programs specific to railways that are consistent with continental standards and global best practices. These programs should cover various aspects of railway operations, maintenance, engineering, and management to ensure a comprehensive skill set among railway professionals for each of the varying levels of railway companies, from top management to rolling stock operation and maintenance. Education in railway matters across the continent should be based on these standards.

For the application of these programs and training of the workforce, policy-makers must prioritize investment in training centers and universities capable of implementing these programs effectively. By mobilizing resources and investing in the development of training centers and universities that teach railway-specific programs, policymakers can ensure that railway professionals have access to quality education and training opportunities that are tailored to the specific needs of the industry, thus ensuring that their railway systems can be developed in-house while continuing to meet the international standards. This investment is crucial for nurturing a skilled workforce equipped to address the unique challenges and requirements of the railway sector in Africa. Moreover, by

establishing partnerships with industry stakeholders and leveraging international expertise, these training centers and universities can enhance their capacity to deliver cutting-edge education and training programs that not only strength the capabilities of the African railway workforce but also contribute to the sustainable development of the continent's railway infrastructure.

The concentration of knowledge within the largest of these institutions, coupled with the development of the railway sector and industrial hubs, presents a unique opportunity to expand them and create regional knowledge hubs and specialized research centers dedicated to advancing railway technology.

For instance, Ethiopia, with support from the EAC and the WBG, is looking to expand part of its Railway Academy into a Center of Excellence for railways, seeking to enhance capacity building efforts and foster technological advancements within the Ethiopian and East-African railway sectors. Similarly, SARA is actively working towards establishing another Center of Excellence. This center aims to serve as a focal point for railway expertise and innovation in SADC, driving research and development initiatives across both the region and the whole continent.

Moreover, following the examples of SARA and Ethiopia, these Centers of Excellence could be viewed as regional hubs aimed at addressing the diverse challenges present in different regions of Africa. Therefore, it would be beneficial to consider the establishment of similar centers in other regions, such as Northern Africa (e.g., Morocco or Egypt), Central Africa, and Western Africa. These additional centers would not only cater to the specific needs and priorities of their respective regions but also foster collaboration and knowledge-sharing across the continent.

In shaping the future development of these centers, policymakers and stakeholders should draw inspiration from international best practices, such as the Global Centre of Rail Excellence in Wales. This leading facility in Europe serves as a premier site for research, testing, and certification of rolling stock, infrastructure, and cutting-edge rail technologies. By emulating successful models like this, African Centers of Excellence could even aspire to become globally recognized hubs for railway innovation and expertise, ultimately encouraging more collaboration with international experts and other Centers of Excellence.

The establishment of these continental and regional hubs of knowledge should serve to condensate both academic and industry knowledge in one sole place within the continent or region, therefore acting as leading facilities for conducting research, developing new technologies, and disseminating knowledge within the African railway industry. By fostering innovation and research, African countries can stay abreast of advancements in the railway sector and address the specific challenges unique to the continent, such as the enhanced impact of climate change adverse effects, the need for more cost-effective solutions and the issue of interoperability.

Furthermore, there is a widespread absence of certification agencies catering to operators and technical staff within the railway sector. This deficiency poses a significant risk to the perceived quality and reliability of railway services offered by companies across the continent. Without proper certification processes in place, there is a lack of assurance regarding the competence and proficiency of operators and technical personnel, which can deter potential customers and investors from engaging with railway projects. Furthermore, the absence of certification agencies hampers efforts to standardize and regulate the quality of railway services across different regions and countries. This lack of uniformity can lead to inconsistencies in service delivery and operational practices, further undermining the efficiency and reliability of railway systems under an integrated network. Moreover, if Africa is to develop a rolling stock manufacturing industry, proper certification is necessary to assure the safety and quality of the manufactured products.

To address this issue, stakeholders in the railway sector should consider the establishment of certification agencies or institutions tasked with accrediting railway professionals and ensuring compliance of both professionals and manufactured rolling stock with industry standards. The established Centers of Excellence could be in a promising position to act also as these certification agencies, mirroring the functions of European Centers of Excellence such as the aforementioned Global Centre of Rail Excellence in Wales or ApplusIDIADA in Spain, which serves as a homologation and R&D center for the automotive industry.

If established, agencies could collaborate with existing railway academies and training centers to develop standardized certification programs tailored to regional needs. For instance, the Ethiopian Railway Academy has worked with the Ethiopian Federal Technical and Vocational Education and Training Agency to define the Occupational Standards of Railway middle level professional (Levels I to V), thus defining standardized levels for the operational capabilities of railway professionals in their country.

Core insights and suggestion

1. African governments must enhance domestic capacity development alongside importing knowledge from abroad, establishing training programs and quality certifications that are recognized at the global level

2. Development of standardized training programs tailored to railways is crucial, covering aspects from management down to operation and maintenance

3. An effective implementation of these programs in training centers and universities across the continent is crucial to ensure that the developed training programs result in the maximum quality education for the workforce, necessitating of strong institutional commitment and investments

4. Establishing regional Centers of Excellence in railway technology across Africa, following examples like Ethiopia and SARA, can enhance collaboration between different stakeholders to foster knowledge-sharing and R&D

    - Centers of Excellence should be research and knowledge hubs connected to both the industry and academia, driving development of new technologies in Africa
    - These centers should draw inspiration from international best practices to become continentally and globally recognized hubs for railway innovation and expertise
    - By condensing knowledge and fostering innovation, these regional hubs can help African countries stay abreast of advancements, address specific challenges, and enhance interoperability in the continent's railway sector.

5. Establishing certification agencies or institutions, possibly through existing Centers of Excellence, can ensure compliance of training programs and manufacturing with industry standards and enhance the competence of railway professionals

6. These agencies can develop standardized certification programs tailored to regional needs, similar to initiatives undertaken by the Ethiopian Railway Academy, to improve operational capabilities and service quality across the continent



5 Way forward

This Source Book seeks to lay the foundations for harmonized and sustainable railway development across the African continent, through informed and grounded considerations and recommendations for each of the building blocks identified:

- Governance and regulations
- Harmonization of the sector for network interoperability
- Integration of railway infrastructure into the broader spatial planning framework
- Integration of sustainable development principles
- Construction, maintenance, and operation of modern and efficient railway infrastructure
- Financing challenges
- Intermodality
- Limited railway expertise and technical capabilities

From this forward, a high level of commitment and effort is demanded from all stakeholders involved in the development and operation of railroads in Africa (namely, Government bodies and policy makers, Ministries, infrastructure owners, private operators…), to ensure a sustainable development of the sector in all regards: Technical, Commercial and E&S.

In turn, it is necessary on the part of these stakeholders to deepen each of these basic pillars, by means of more specific studies and research on each of these building blocks, in order to land in greater detail each of the recommendations raised throughout this document.



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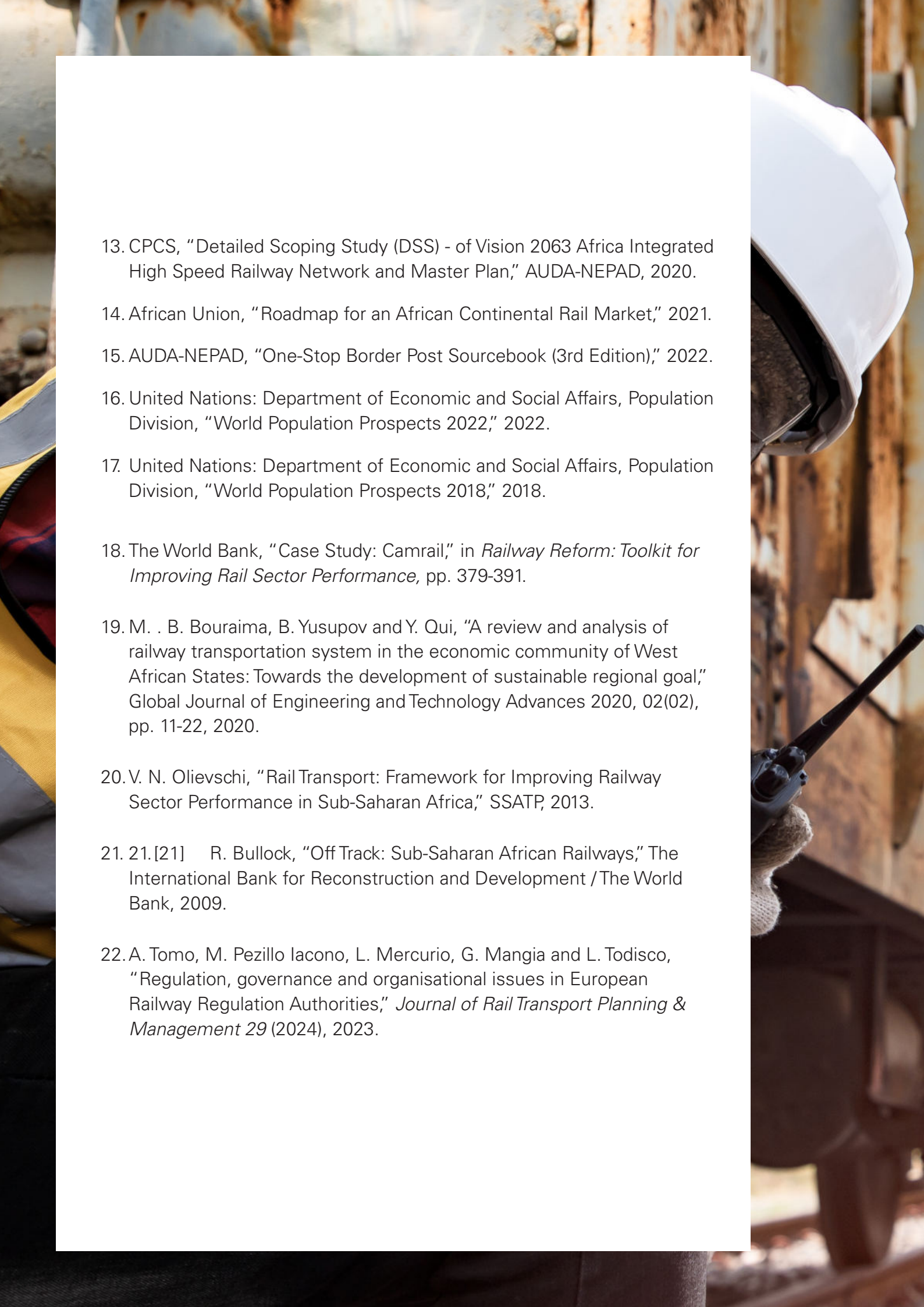
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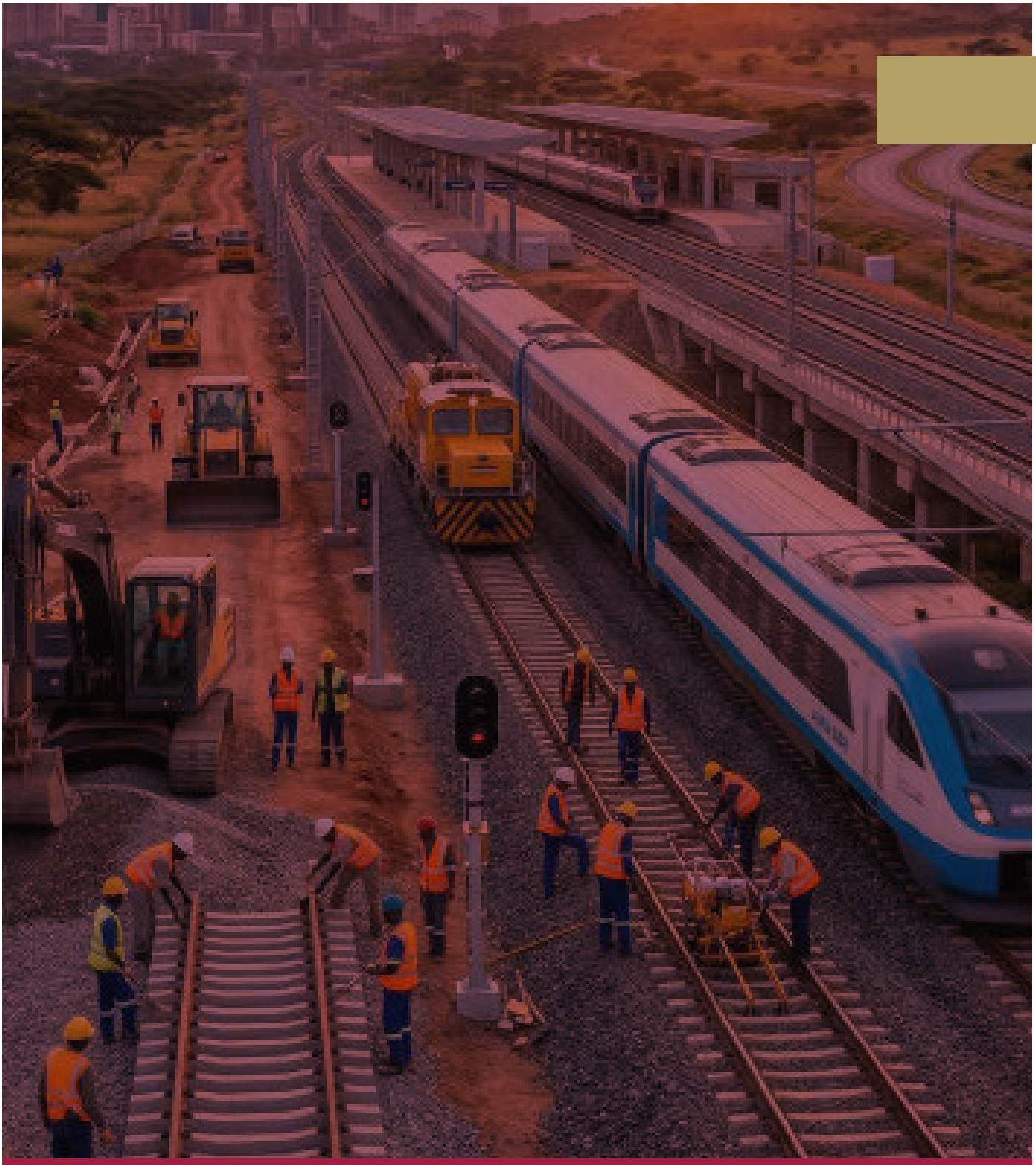
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