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Mobility and Transport Connectivity Series



Developing Urban Rail Corridors in African Cities

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Glossary of Terms

Asset management systems	Systems and processes used to track the state of assets, their quality, and plan maintenance and repair programs
Bi-directional flow	Demand for transport from both the origin and the destination
Bulk infrastructure	Network infrastructure to deliver basic urban services, including water and wastewater reticulation and treatment systems, electricity distribution infrastructure, and local road networks
Counterparty risk	The risk that the other party in a contract may not fulfill its part of the deal and may default on the contractual obligations
Firewall risk	The risk that one party in a contract may not be able to fulfill its part of deal because its performance is dependent on outputs of other contract parties.
Fiscal capacity	The capacity of a government to raise revenue, including both tax and non-tax sources
Feeder services	Public transport services and non-motorized services providing access to and from mass transit stations
Interface risk	The risk of various components of a service not being compatible when a PPP contract is unbundled
Land-based financing	A public financing method triggered by infrastructure investments, which creates value relating to adjacent land that is used to reinvest into transit or other transit-oriented development
Lot coverage ratio	The footprint of the building divided by the lot size
Minibus taxi services	Largely informal services or paratransit services provided by small busses such as the <i>matatus</i> of Nairobi, <i>danfos</i> of Lagos, and the <i>chapas</i> of Maputo
Metrobus	Passenger rail service in Maputo, provided by a private operator
Mixed-use development	Development that includes residential, commercial, and retail properties
Multi-modal connectivity	Transport networks that align various modes of transport to increase accessibility and expand an integrated public transport network, connected through inter-modal transfers

Network integration	Public transport services that seamlessly cover an urban area to increase access to a public transport stop within walking distance for most residents
Peak/off-peak ratio	The ratio between the passenger numbers transported during peak hours and those transported during off-peak times
Poverty line	The 2022 extreme poverty line of \$2.15 per person per day as updated by the World Bank
Public-private partnership	A PPP is defined as a long-term contract between a public party and a private party for the development and management of a public asset and/or the management of a related public service, in which the private party bears significant risk and management responsibility throughout the life of the contract, and remuneration is largely linked to performance
Sub-Saharan Africa	Sub-Saharan Africa includes the African countries south of the Sahara Desert
Subsidies	Contributions towards the cost of rail operations provided by government
Seat renewal	Demand for transport along a route such that newly boarding passengers use the capacity vacated by alighting passenger
Transit-oriented development	Urban development aligned to transport investment to increase densities and diversity of investment along transport corridors to reduce the need for travel and travel times while improving urban efficiency and facilitating urban agglomeration
Travel demand management	Strategies to impact travel demand for certain services, at certain times, or for certain modes of transport
Urban form	Urban form is the physical characteristics that make up built-up areas, including the shape, size, density, and configuration of settlements
Urban rail	Passenger rail connecting urban areas within metropolitan areas

Abbreviations and Acronyms

AMM	Area Metropolitana de Maputo or Maputo Metropolitan Area
AMT	Agência Metropolitana de Transportes (Maputo Metropolitan Mobility Authority)
BRT	Bus Rapid Transit
BRTS	Bus Rapid Transit System
CBD	Central Business District
CFM	Caminhos de Ferro de Moçambique – Mozambique Port and Railway Company
CO ₂ e/pkm	Carbon dioxide equivalent per passenger kilometer
DUAT	Direito do Uso e Aproveitamento da Terra
DMU	Diesel Multiple Units
EMU	Electric Multiple Units
FTC	Transport and Communications Development Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
ILUT	Interdisciplinary Land-Use and Transport
JICA	Japanese Cooperation Agency
KM	Kilometers
KRC	Kenya Railway Corporation
KSh	Kenyan Shilling (Kenyan currency)
LAMATA	Lagos Metropolitan Area Transport Authority
LMA	Lagos Metropolitan Area
LRT	Light Rail Transit
LURN	Lagos Urban Rail Network
LVC	Land Value Capture

MGR	Meter Gauge Railway
MMA	Metropolitan Mobility Authority
MRTS	Mass Rapid Transit System
MoT	Ministry of Transport
MT	Metical/Meticais (Mozambique currency)
MTC	Ministry of Transport and Communications
N	Naira (Nigerian currency)
NaMATA	Nairobi Metropolitan Area Transport Authority
NCC	Nairobi City County
NCR	Nairobi Commuter Rail, division of Kenya Railway Corporation
NMA/R	Nairobi Metropolitan Area/Region
NMT	Non-motorized Transport
NRC	Nigerian Railway Corporation
PDTU	Transport and Mobility Master Plan
PEU	Plano de Estrutura Urbana – Maputo Urban Masterplan
PPP	Public-Private Partnership
RVR	Rift Valley Railways
SACCO	Savings and Credit Co-operative Society
SADC	Southern African Development Community
SOE	State-owned Enterprise
SGR	Standard Gauge Railway
STMP	Strategic Transport Master Plan
TETRA	Terrestrial Trunked Radio
TOD	Transit-oriented Development
WB	World Bank

Executive Summary

Africa contains 11 of the world's most populous cities (Geoba.se, 2011) and urban areas throughout the continent are growing rapidly (World Population Review, 2023). Demand for urban transport is rising. Traffic congestion, road accidents, and urban sprawl making daily commutes long and costly. Introducing rail-based public transport can help meet this demand as well as enable affordable mobility and greater accessibility, reduce pollution and greenhouse gas (GHG) emissions, and help reshape African cities into compact, livable, urban environments.

Many cities in Africa have underused railway lines. While the lines may be operated primarily for freight, the railway right-of-way has potential value for urban passenger rail. This study explores how such railway lines can be repurposed for passenger transport and paired with transit-oriented development (TOD) to create development corridors. Case studies of urban rail in Lagos, Maputo, and Nairobi provide the practical foundation for the findings of the report, summarized below.

Transformational asset/investment. In congested cities, the existing railway right-of-way is a unique and valuable asset that municipalities can leverage to deliver improved mobility. However, the existing rail lines were not designed for urban passenger service and a step change in the level of service offered is often needed. The lines require comprehensive investments in upgraded tracks, train control systems, and rolling stock to deliver a competitive and attractive service.

Multimodal connectivity. Suburban rail can serve as the backbone of a transit system; however, it needs to be integrated with lower-density transport that connects passengers to the rail station. This requires:

- Complementary investment in feeder infrastructure, encompassing sidewalks, bikeways, and roads. In most cities, multiple national and local government authorities are responsible for such infrastructure, meaning that active coordination is needed among responsible agencies.
- Complementary bus and minibus services. A new model of collaborating with bus and minibus operators in feeder networks is needed, as the private sector operators of these services see the railway as a competitor.

Funding. Financial support for operations as well as investments is vital to provide affordable commuter rail services to lower-income residents. This will represent a departure from the current practice of the government providing only the road infrastructure, and private bus and minibus operators recouping the service costs through passenger fares. The discussion should be based on a well-supported analysis of the costs of providing rail service and the revenues available to cover them. A realistic examination of the typical sources of funding, such as ticket revenue, commercial revenues at stations, subsidies from local or national government, and land value capture (LVC), is essential to ensure the suburban railway service is financially viable. Ultimately, the government—not the railway—is responsible for ensuring the service is financially sustainable.

Resolving Urban Mobility Challenges in Africa with Rail Solutions

1

Transformational Asset/Investment

- ▶ Improve service levels
- ▶ Upgrade tracks, control systems, rolling stock

2

Multimodal Connectivity

- ▶ Integrate with lower-density transport system
- ▶ Enhance feeder infrastructure (sidewalks, bikeways, roads)
- ▶ Develop new operation model to collaborate with bus and minibus operators

3

Funding

- ▶ Shift away from road-centric funding
- ▶ Analyze costs and available revenue sources
- ▶ Explore funding sources (ticket revenue, subsidies, LVC)

6

Public-private Partnerships

- ▶ Develop skills to structure PPPs and oversee their implementation
- ▶ Resolve funding challenges to attract private investors

5

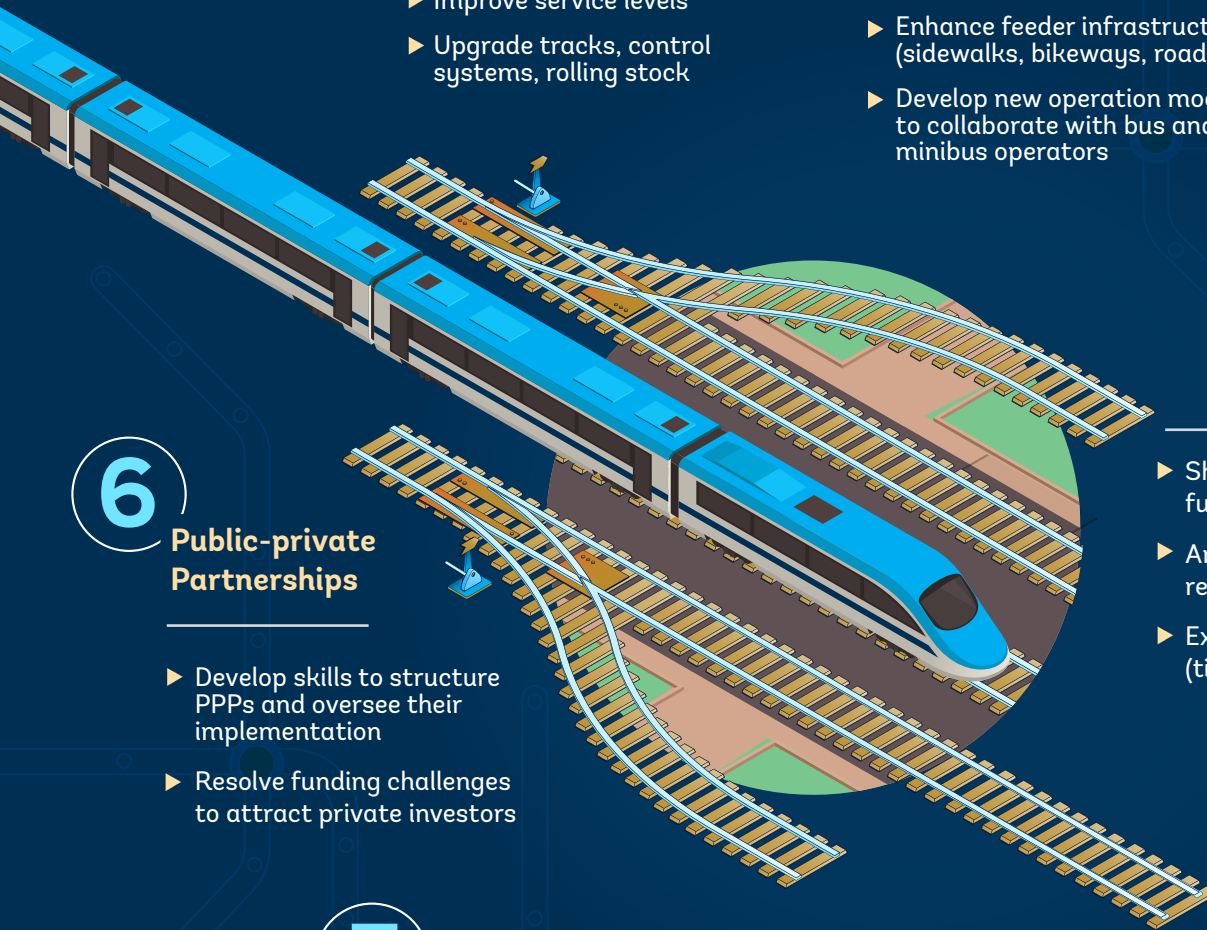
Land Value Capture

- ▶ Align interests across stakeholders
- ▶ Structure mutually beneficial deals
- ▶ Pool diverse expertise, assets, interests

4

Transit-oriented Development

- ▶ Adapt TOD strategies to local contexts
- ▶ Manage multiple stakeholders
- ▶ Allocate resources for building consensus



TOD. Although all parties seem to understand the benefits of TOD, moving from concept to implementation has proven challenging. TOD interventions designed for developed countries need to be adapted to the communities surrounding African railway stations, considering the local circumstances. Proponents need to recognize the complexity of managing multiple stakeholders with vested interests and influence over TOD implementation and allocate sufficient resources to fostering consensus around TOD plans.

LVC. While land has considerable value in African cities, successful examples of LVC in the cities studied (and in Africa, more broadly) are scarce. As with TOD, proponents must recognize that LVC requires aligning interests across a broad range of stakeholders and structuring deals in a way that benefits each stakeholder. This involves bringing together diverse expertise, assets, and interests. Financial benefits take a long time to be realized.

Public-private partnerships (PPPs). PPPs are a useful tool for delivering suburban rail service and are critical for LVC. In each of the cities studied, the groundwork for PPPs has been laid, with PPP laws in effect. To implement PPPs effectively and sustainably, governments need to develop the skills needed to structure PPPs and oversee their implementation. Since the private sector party will seek a profit commensurate with the risks assumed in the PPP, the funding challenges in suburban rail operations must be resolved before PPPs can be viable.

Addressing these challenges will enable suburban rail to anchor development corridors that contribute to the mobility, livability, and development of African cities. The World Bank encourages policymakers in Lagos, Maputo, and Nairobi as well as other cities such as Kampala, Dar es Salaam, Accra-Tema, Kinshasa, Conakry, and Luanda to explore the potential of leveraging railway right-of-way for development corridors.



1

Introduction

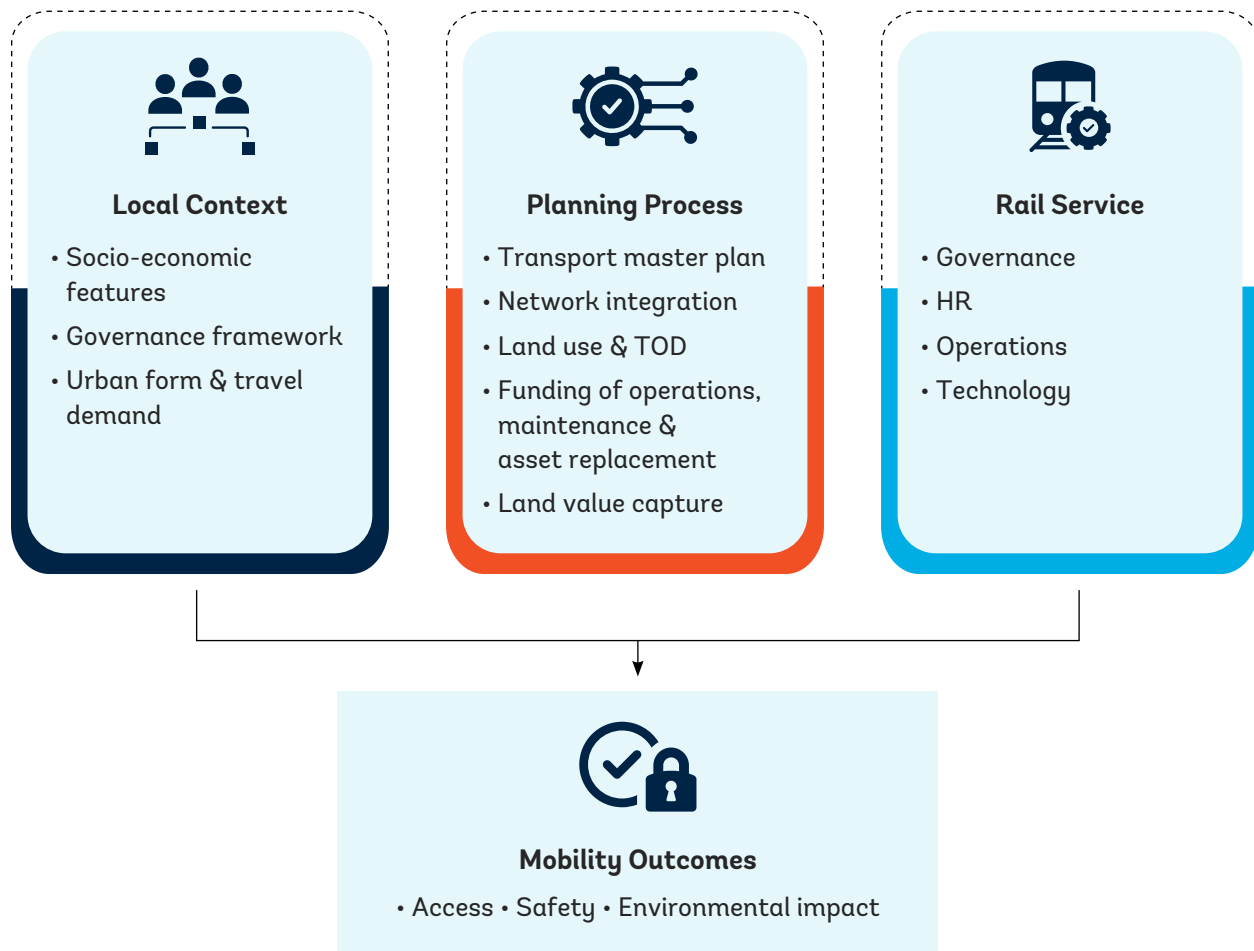
The potential for rail-based urban transit is excellent in Sub-Saharan African cities. Africa contains 11 of the world's most populous cities (Geoba.se, 2011) and urban areas are growing rapidly. Demand for urban transport is rising. Currently, a remarkably high proportion of people walk to their destinations, primarily due to affordability constraints. The introduction of rail-based public transport can help shape African cities into compact urban nodes, reducing congestion and sprawl. Investments in urban rail can support urban agglomeration and create efficient cities, currently threatened by the growth in private car ownership. Urban areas often contain freight-oriented rail systems (Transport Global Practice, 2020) with underused infrastructure. Redeveloping the railway right-of-way for urban passenger transit is a valuable opportunity to jump-start urban mass transport in these cities.

This study attempts to relate the policy and good practice literature (Pulido et al., 2018 and Suzuki et al., 2013) on urban and suburban passenger rail, much of which originates from high- or middle-income countries, to the context of developing cities in Africa. The study includes case studies from three African cities—Lagos, Maputo, and Nairobi—to identify and provide guidance on key issues for developing effective urban rail services in Sub-Saharan Africa. All three cities use existing railway right-of-way for part or all of their networks. Lagos illustrates the challenges of building a new urban rail line, where high capital investment, land acquisition, and the need to reposition existing infrastructure and utilities can result in delays and cost overruns. Maputo and Nairobi are examples of suburban rail operated by the national railway company on existing mixed-use infrastructure.¹ Improving the established right-of-way and assets provides faster and less costly option than building new, if coordination challenges can be overcome.

“ The introduction of rail-based public transport can help shape African cities into compact urban nodes, reducing congestion and sprawl. ”

The literature review (Jamme and Randolph, 2022) undertaken for this study supported development of a conceptual framework, structured around the local context, the planning processes and provision of services, that aids in understanding urban rail issues. The local context focuses on structural factors that shape transport needs and the options for addressing them. The key issues include socio-economic conditions, the municipal area governance framework, and the urban form including travel demand. The planning element includes master planning, network integration, land use, transit-oriented design, and financial planning. Rail services encompasses the forces shaping service provision, including the institutional context, human resources, and technology utilization. All these factors contribute to the transportation outcome and impact the accessibility, safety, and environmental footprint of the rail service. (Figure 1.1.).

¹ The findings and recommendations would apply generally to all types of rail service, whether light rail as in Lagos or heavy rail as in Maputo and Nairobi.

Figure 1.1. Urban Rail and the Inclusive Metropolitan Region – Conceptual Framework

Source: World Bank.

This conceptual framework provides the structure for the study and case studies. Chapters 2-4 cover the cases of Lagos, Maputo, and Nairobi. Chapter 5 discusses planning and governance issues. Chapter 6 covers TOD, land value capture (LVC), and public-private partnerships (PPPs). Chapter 7 discusses impacts. Chapter 8 summarizes the conclusion of the study.



Light Rail Corridors in Lagos

2

Introduction and Urban Context

Lagos City, the largest city and port in Nigeria, is a part of Lagos State. It is the most populous city in the continent of Africa. The current estimated population of Lagos States is more than 21 million and over 85 percent reside within Lagos City. The population growth rate is nearly 6 percent per year.

Originally built on islands at the southwest mouth of the Lagos Lagoon, Lagos is a port city. The Lagos Metropolitan Area (LMA) includes Ikeja, the capital of Lagos State; Agege; and Mushin. Lagos serves as the economic and cultural center of the country, housing more than 50 percent of the industrial and commercial facilities and 70 percent of the manufacturing industry. The gross domestic product (GDP) of Lagos State in 2010 was approximately USD 80.6 billion, representing 35.6 percent of Nigeria's total GDP. Table 2.1. provides a comparison of Lagos, Jakarta, and the Tokyo Metropolitan Area, and highlights that Lagos has high population density and low urban railway development compared to other mega cities located in Asia (JICA et al., 2014).

Table 2.1. Comparison of Lagos, Jakarta, and Tokyo

Item	Lagos	Jakarta	Tokyo Metropolitan Area
Population (million)	21	28	35
Area (km ²)	3,568	6,400	13,572
Population density (person/km ²)	5,885	4,367	2,629
No. of trips (million trips/day)	22	30.5	84.3
Length of urban railway (km)	42	235	2,308

Source: World Bank based on data from JICA and LAMATA.

Rapid urbanization in the LMA has given rise to a host of transportation challenges, including:

- deterioration of road conditions and road-based public transport services
- increase in traffic congestion
- higher transport fares
- rising road accidents
- increase in transport emissions and pollution

The LMA is over-reliant on road transport. Although main roads have been built on Lagos Island, Victoria Island, and the mainland, they are poorly maintained and cannot meet the rising demand. In response, Lagos is building mass transport systems such as urban rail and bus rapid transit (BRT).

Structure and Coordination of Rail Services

Institutional Arrangements

The Lagos Metropolitan Area Transport Authority (LAMATA) serves as the agency of the Lagos State Government responsible for policy, coordinating transport planning, and public transport infrastructure implementation in the LMA. Established in 2002 and given expanded powers in 2007, LAMATA oversees a wide range of transport activities for the LMA, including:

- Coordinating transport policies, programs, and actions of all agencies
- Implementing the Lagos Rail Mass Transit and the Lagos BRT system (BRTS)
- Managing and maintaining the 632 km of declared road network, primarily comprising bus public transport routes
- Planning, coordinating, managing, developing, and implementing adequate, effective transportation systems
- Route planning and determining the general locations of bus shelters, pedestrian ways, and bridges
- Levying and collecting transport road user charges and establishing a Transport Fund as a user financing mechanism; collecting 50 percent of net motor vehicle administration revenue
- Regulating BRT along prioritized corridors
- Coordinating the activities of the State Licensing Authority and all vehicle inspection units
- Planning the development and management of an integrated multimodal public transport system

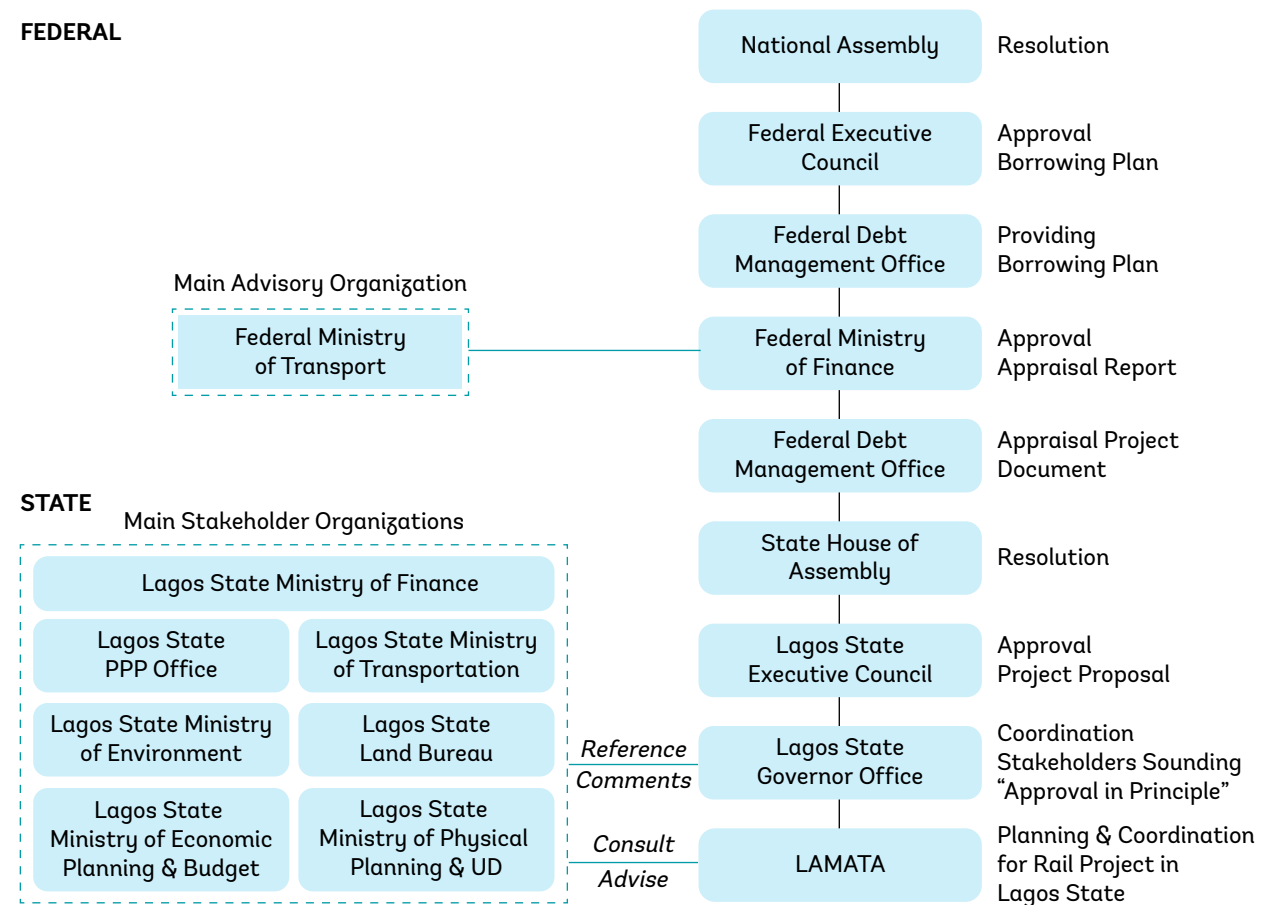
LAMATA coordinates with numerous state and federal government agencies that invest in and provide transport services in the LMA. The key agencies for developing the rail services proposed in Lagos State's Strategic Transportation Master Plan include the Nigeria Railway Corporation (NRC) and the Federal Ministry of Transport (MoT). The NRC manages all federal railway lines in Nigeria.² Any new suburban rail lines on existing NRC right-of-way are jointly coordinated with the NRC and the MoT. LAMATA has had to negotiate right-of-way issues with the NRC to leverage economies of scale in infrastructure development (The Nation, 2021).

The process of planning, coordinating, building, and financing a new suburban rail line involves several stakeholders (Figure 2.1.). The Federal or State MoT and/or their agencies are responsible for planning railway projects and have political and administrative control over them. All project proposals require the approval of the Executive Council and Parliament. Funding railway projects wholly or partially, whether through external or domestic borrowing, entails meeting regulatory conditions set by the

² Per the 1955 Rail Act, as amended in 2015 to allow for private sector participation.

National Debt Management Office within the national debt sustainability framework. While the Federal or State Ministry of Finance normally exercises financial control in accordance with the public finance regulations and guidelines, the implementation agency is responsible for implementing approved projects, as depicted in Figure 2.1. below.

Figure 2.1. Institutional Roles in Investing in Rail Service in Lagos



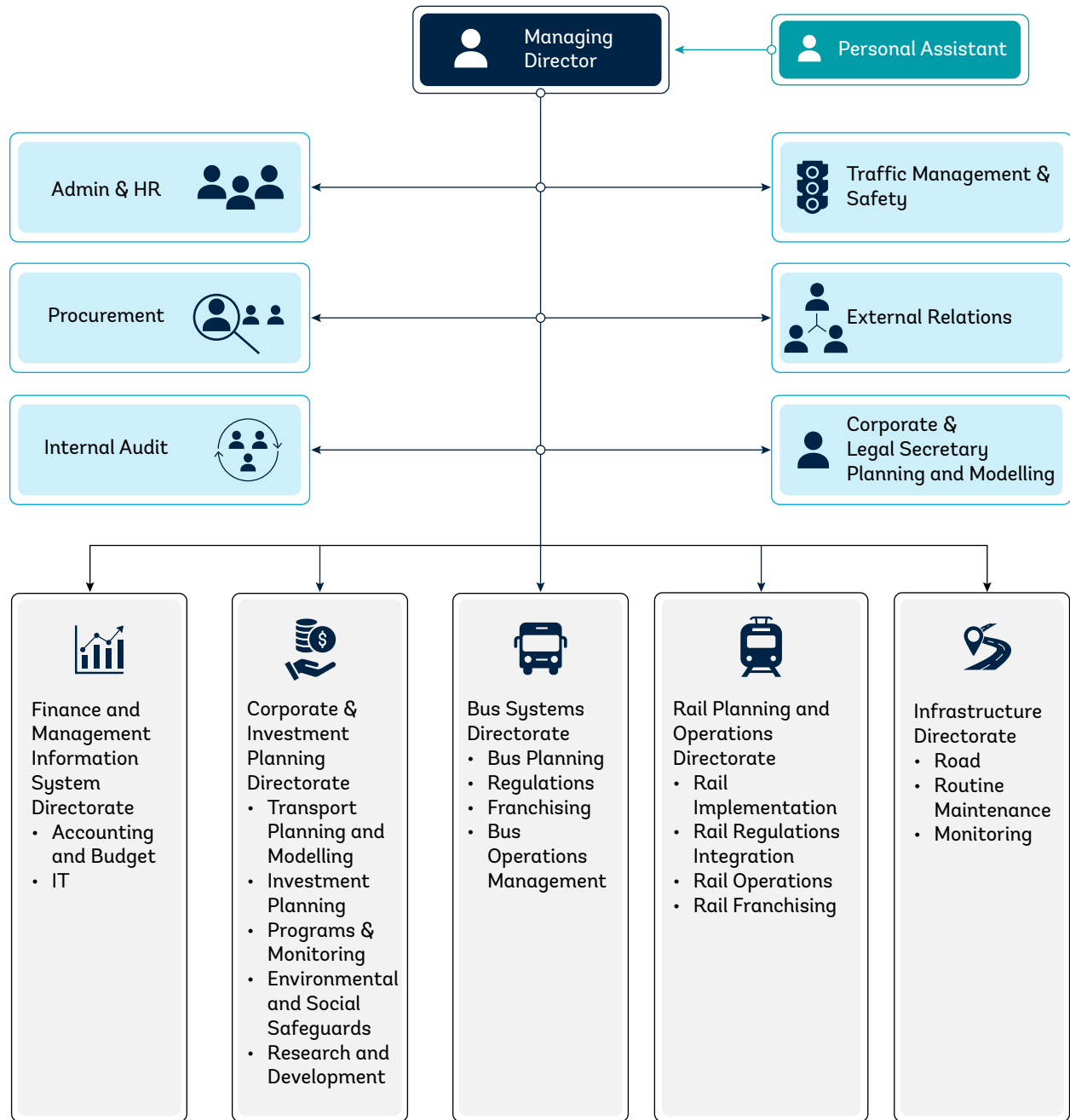
Source: World Bank.

Other state agencies involved in control and management of transportation in the metropolitan areas include the Lagos State Traffic Management Authority and the Lagos State Ferry Services. Federal agencies involved include the National Inland Waterways Authority, Federal Road Safety Commission, Federal Urban Mass Transit Authority, Nigeria Ports Authority, and NRC.

Governance

The Governor of Lagos State is responsible for appointing the Managing Director (MD) of LAMATA. The MD, in turn, appoints five directors, subject to the Governor’s approval, to head the five directorates in the LAMATA organization structure as presented in Figure 2.2. below (Sages Consult Limited, 2019).

Figure 2.2. LAMATA Organogram



Source: World Bank based on Sages Consult Limited, 2019.

Urban Transport Plans

A comprehensive urban master plan for Lagos State was updated in 2005, while urban master plans for specific districts have been formulated in recent years. Most of them cover the period 2010 to 2030.

The Strategic Transport Master Plan (STMP) for LMA, developed in December 2009, aims for the holistic development of light rail transport, BRT, water transport, and road transport. A revised STMP prepared in 2014 and projected up to 2032, included road and public transportation network plans, logistics, non-motorized transport, traffic safety measures, climate change considerations, economic analysis, and systems proposal.

The revised STMP proposed the development of both roads and railways, including light rail transit (LRT), monorail, and cable car. The short-term goal was to launch Lagos' first urban rail line (Blue Line) which opened in September 2023. The medium-term goal is to expand the LRT network, while the long-term goal for 2032 is to complete the LRT network, comprising seven lines.

Policy, Plans, and Regulations

The Nigerian Land Use Act of 1978 stipulates that the control and administration of all urban land is the responsibility of the Governor of the State where the land is situated. In Lagos State, the Land Bureau is responsible for land policy, including land acquisition, land registry, land use and allocation, and the creation and management of residential and industrial schemes.

Commercial mixed-use development is subject to restrictions related to lot coverage ratio and height with additional retail limitations. (LSURPD, 2015) Structures exceeding four floors are required to provide an underground water tank with a minimum capacity of 20,000 liters. All public buildings must have health and safety systems and structures, with certifications from the appropriate authority. Train stations need to provide adequate access, safety, and washroom facilities for the physically challenged.

LAMATA is well supported by the Lagos State Land Bureau and Lagos State Ministry of Physical Development and Urban Planning in matters pertaining to permits, allocation, and approvals of land, facilitating the fulfillment of its mandate.

“ LAMATA's central role in the planning and implementation of road, ferry, and rail transportation services enables it to coordinate transport infrastructure and services effectively in Lagos State. ”

Coordination Structures & Processes

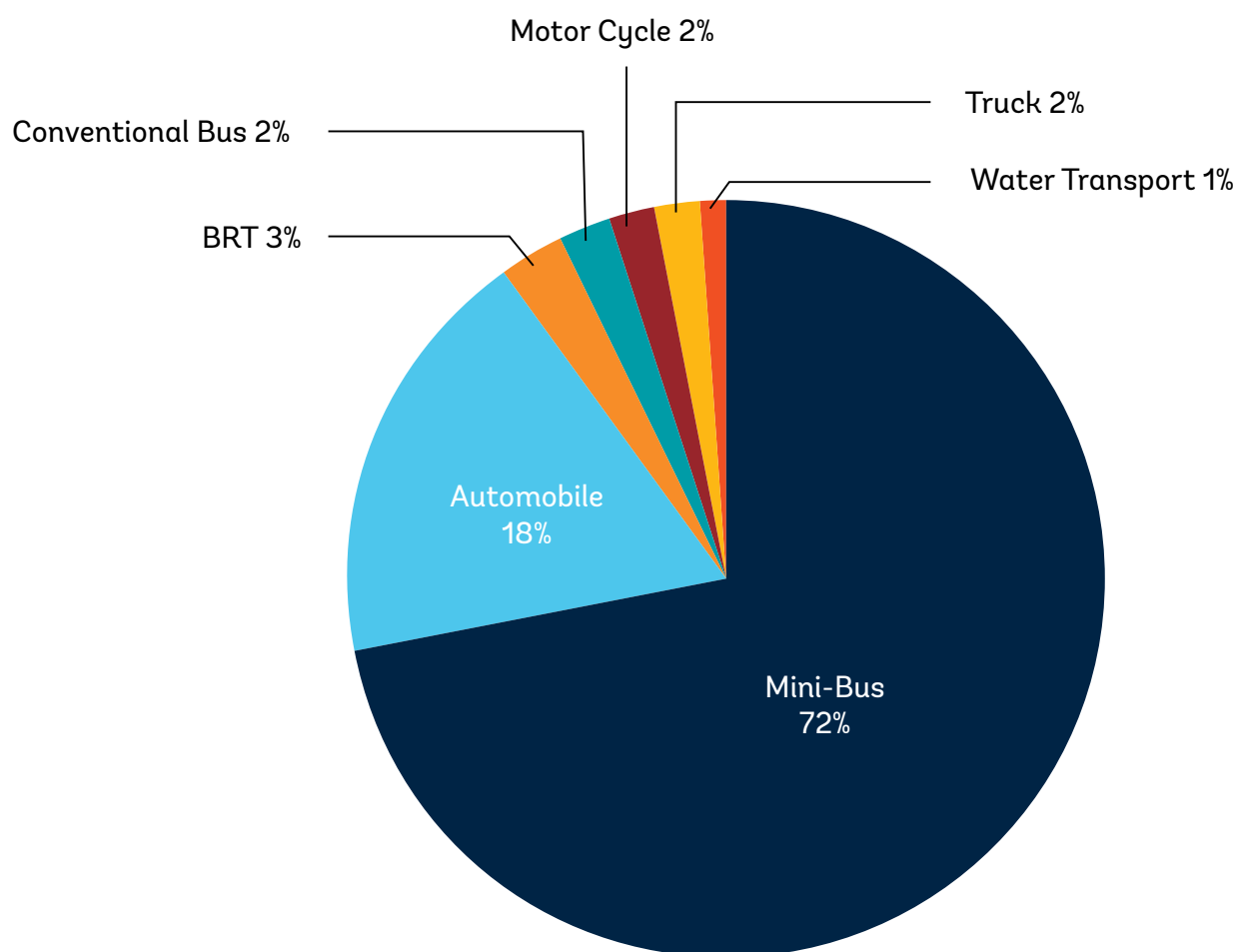
LAMATA's central role in the planning and implementation of road, ferry, and rail transportation services enables it to coordinate transport infrastructure and services effectively in Lagos State. This is evident in the spatial distribution of BRT terminals and bus stands, as well as the development of an integrated ticketing system, known as the Cowry card. Currently, this payment system is used on the BRT, buses, and ferries and its usage will be extended to non-motorized bikes, Lagos Ride (a State-owned taxi service), and the rail services.

Traffic, Markets, and Access

Traffic and Market Share

Approximately 22 million trips are made in the LMA every day. Of these, an estimated 40 percent are walking trips. Minibuses, with capacities ranging from eight to 25 passengers, dominate the motorized travel segment, followed by private automobiles. BRT, conventional buses, motorcycle taxis, and trucks all carry smaller shares of the traffic (Figure 2.3). The passenger services provided by the NRC account for less than 1 percent of the trips.³ Lagos Ferry company also carries about 18,000 passengers per day.

Figure 2.3. Modal Share of Motorized Transport in Lagos



Source: Commissioner of Transportation Lagos State (Transportation Planning in Developing Countries, 2019).

³ NRC operates an intercity passenger service from Ebutameta in Lagos State to Ibadan in Oyo State. This train stops at Agege in Lagos and can be used for commuting. The Red Line, being built in this corridor using the NRC right-of-way, will provide greater frequency and more stops for the urban rail service.

Minibuses: Around 75,000 minibuses (Danfos) and 83,000 larger minibuses (Molue) operate in Lagos.⁴ Passengers typically spend 20 percent of their disposable income on minibus fares (Henna Mahmood et al., 2019). These are largely informal services and characterised by low quality service and safety and security concerns. Three-wheeler motorcycle taxis (keke napep), accommodating up to four passengers each, are also available.

Motorcycles: About 8 million commercial motorcycle taxis (Okadas) operated in Lagos. However, due to their rising use in criminal activities, they were banned in May 2022 (Tofe Ayeji, 2022). To replace the Okada, the State intends to introduce non-motorized, public bicycle schemes and dedicated pedestrian walkways and bridges.

Buses: LAMATA supports the franchising of bus routes in Lagos. Its bus route network study has identified 485 individual bus routes for franchising, including mass transit, standard, and feeder routes. The franchising model is a public-private-partnership (PPP), wherein the Government provides the infrastructure including bus depots, terminals, shelters, and transport systems, and handles the construction and rehabilitation of roads. The private sector procures the buses and is responsible for operations and bus maintenance. The contract allows LAMATA to specify the routes, design service specifications, set standards for operations and fares, while the operator recruits, trains the crew, and manages operations. The operator enters into an agreement with the State Government to adhere to established services standards and pay the agreed franchise fees.

Bus Rapid Transit: The Strategic Transport Master Plan identifies 14 BRT routes to be developed under a similar franchising model. The first phase of the Lagos BRT was launched in 2008 and franchised to the 1st BRT Cooperatives, an affiliate of the National Union of Road Transport Workers, Lagos Chapter. The system commenced operations with 220 buses that ran from 6am to 10pm and transported more than 200,000 passengers daily. It generated sufficient revenue to repay the initial loan for the first 100 buses within 18 months. Since inception, the BRT scheme has conveyed over 380 million passengers, reducing the waiting time of passengers to approximately 10 minutes and curbing emissions along the BRT corridor.

The BRT faces competition from minibuses. Customers are price sensitive—a 46 percent increase in BRT fares led to a 72 percent drop in revenue since June 2022 (Ayeji, 2022). The unsustainability of the fuel subsidy in Nigeria has placed pressure on the fares along the BRT network in Lagos State. Plans exist to increase fares by as much as USD 0.25 per trip. Discussions on upgrading the BRT buses to use renewable energy are underway.

Access and Inclusion

New transport facilities are being designed for accessibility. The BRT and urban transit train network feature adequate lighting, 360° cameras, and open spaces catering to passenger needs. All stations are equipped with mechanical escalators, lifts ramps, and flushed platform-train interface.⁵ Walkways have been constructed to provide access to stations along the Blue Line and to

⁴ State Government has banned Molue in and around Lagos Island.

⁵ The challenge will be to keep them working properly.

facilitate the crossing of the right-of-way. However, access to last-mile transport in lower-income areas is precarious, creating challenges for residents to reach employment, health, and education facilities. Overcrowding of buses during peak times create further challenges for women and children. If rail demand materializes as forecast, trains are expected to face similar overcrowding issues, with over six passengers/m² during peak-hours.

Rail Services in Lagos

Lagos Rail Mass Transit

The Lagos Urban Rail Network (LURN) is a planned network of urban rail line covering six major corridors and one monorail route (Figure 2.4.). It extends beyond Lagos State to the border areas of Ogun State. The six lines and monorail connect the major residential and activity centers in the State, while making the most of existing transport corridors, wherever possible. The network is integrated fully with both planned and existing water transport and BRT routes. The planned lines are:

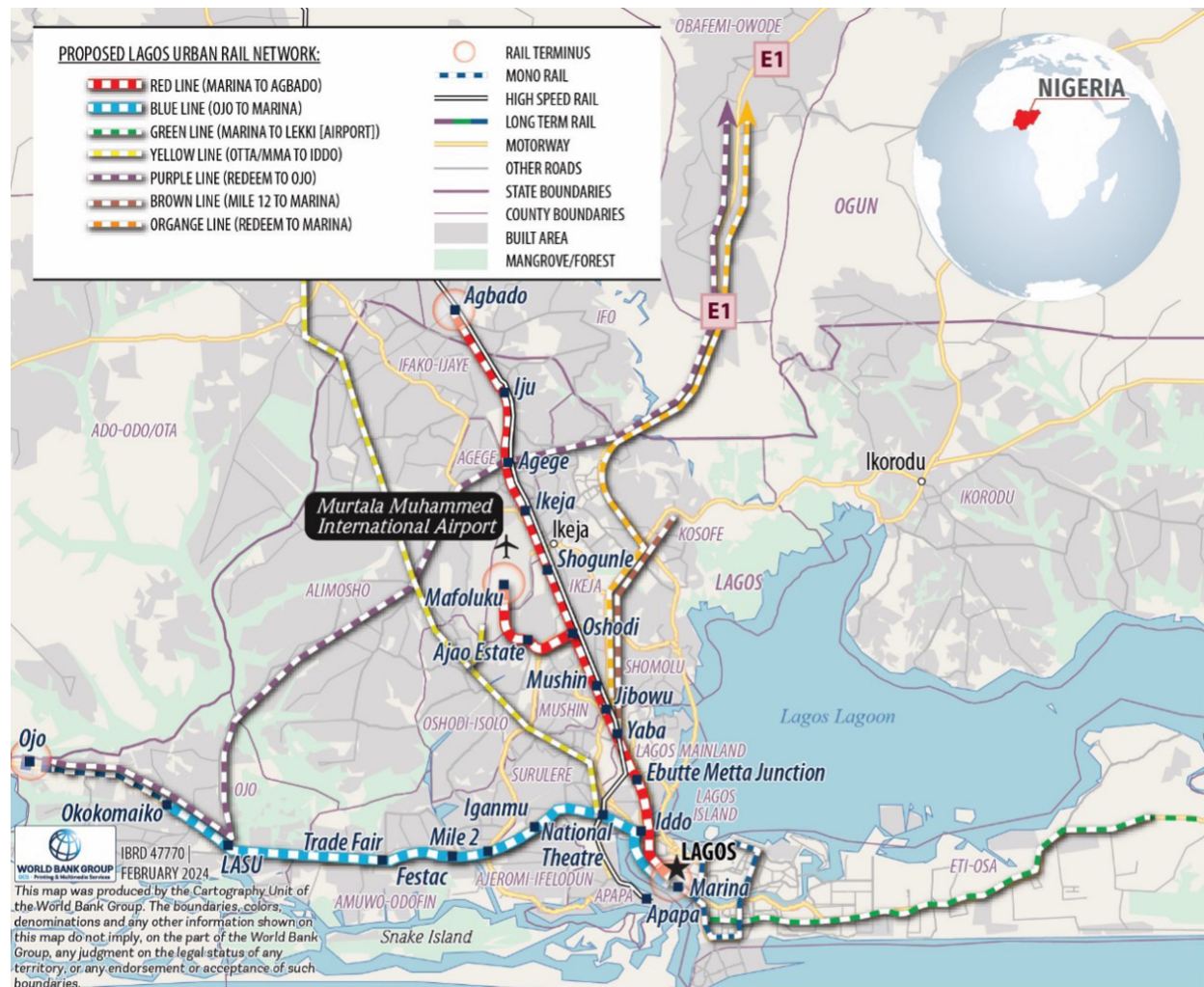
- Blue Line from Okokomaiko to Marina
- Red Line from Marina to Agbado and Agbado to Ifo
- Green Line from Marina to Lekki Free Trade Zone (Airport)
- Purple Line from Redemption Camp to Ojo
- Yellow Line from Otta to National Theatre
- Brown Line from Mile 12 to Marina
- Monorail between Lagos Island and Victoria

Image 2.1. Mile 2 station on Blue Line



Source: <https://commons.wikimedia.org/wiki/File:Mile2station-again2.jpg>.

Figure 2.4. Planned Railway Lines in Lagos Metropolitan Area



Source: World Bank.

The STMP demand forecast (JICA et al., 2014) for urban rail transport indicated that ridership in 2032 would exceed 7 million passengers per day, if the system were fully built (Table 2.2.). However, recent estimates and adjustments to plans highlight that these estimates are unlikely to materialize.

Table 2.2. Forecast Population and Ridership along LURN Network

Line	Ridership/day (Millions)	Population along the lines 2014 (Millions)	Population Forecast along the line in 2032 (Millions)	Population Growth along the line/year (%)
Blue	1.351	0.979	2.972	3.0
Red	1.238	1.768	3.069	1.7
Green	0.894	0.505	2.002	4.0
Yellow	1.148	0.962	1.792	1.9
Brown	0.570	1.314	1.661	1.3
Purple	1.661	0.880	312.4	3.6
Monorail	0.447 - 0.579	0.121	227.5	1.9

Source: World Bank based on (JICA et al., 2014).

The Blue and Red Lines are under construction. Their specifications are shown in Table 2.3.

Table 2.3. Specifications of Blue and Red Lines

	Blue Line Marina to Okokomaiko	Red Line Marina to Agbado
Permanent Way		
Line length (km)	27 km	37 km
Elevated track (km)	8 km	6 km
At-grade track (km)	19 km	31 km
Underground track (km)	NA	NA
Gauge	Standard (1435 mm)	Standard (1435mm)
Double/Single track (km)	Double	Double
Stations (number)		
Total number of stations	13 stations	13 stations
Elevated stations	2	5
At-grade stations	11	8

	Blue Line Marina to Okokomaiko	Red Line Marina to Agbado
Underground stations	N/A	N/A
Stations with modal integration	4 stations	9 stations
Stations slated for TOD	4 stations	9 stations
Number of stations equipped for disabilities (access ramps, elevators)	13 stations	13 stations
Rolling Stock (number)		
Electric multiple units (EMUs)	24 trainsets of (2T+2M) 3 procured	N/A
Diesel multiple units (DMUs)	N/A	30 trainsets 2 procured
Coaches	4 cars	10 cars
Main line locomotives	2 procured	2
Shunting locomotives	2 locomotives will be procured during the operation	N/A
Type of Traction		
Diesel	N/A	Yes
Electric (third rail or catenary)-voltage	Third rail	N/A
Number of electric substations	12 substations	N/A

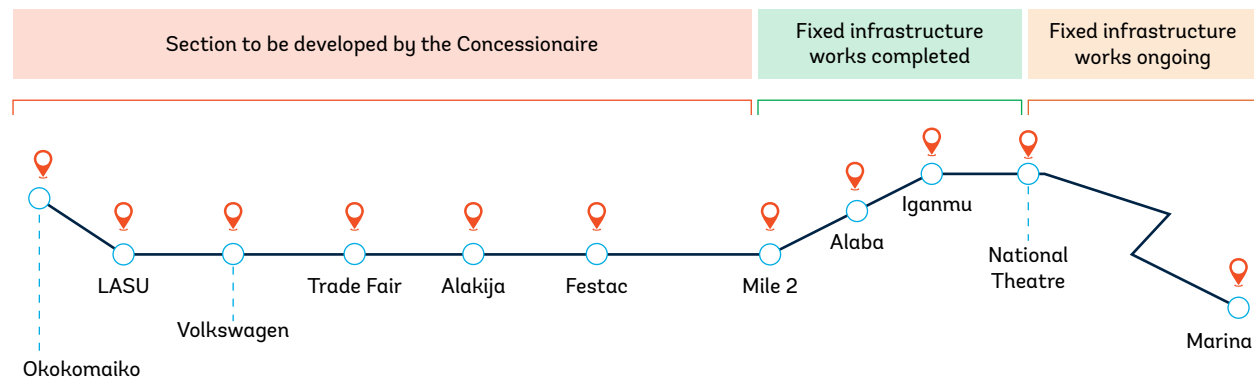
Source: World Bank.

Blue Line. The Blue Line is a standard gauge, double track, electrified line stretching 27 km west from Marina to Okokomaiko. It will have 13 stations and an end-to-end trip time of 35 minutes. (The first five stations opened in September 2023.) It boasts a secure and exclusive right-of-way, with no level crossings or uncontrolled pedestrian or vehicular access.⁶ The station designs include provision for connections to BRT and non-motorized transport as well as pedestrian walkways/overhead bridges for safe passenger access.

⁶ The line is elevated from Marina to Iganmu and in the central median Lagos-Badagry Expressway from Iganmu to Igbo-Elerin Road (Okokomaiko).

The construction contract for the section from Marina to Mile 2 was awarded to the China Civil Engineering Construction Corporation on a design-build basis, with advisory services provided by CPCS Transcom Limited, funding by Lagos State, and oversight by LAMATA. Work has been completed in the section from Mile 2 to Marina and the section opened in 2023. (Figure 2.5.).

Figure 2.5. Implementation of the Blue Line

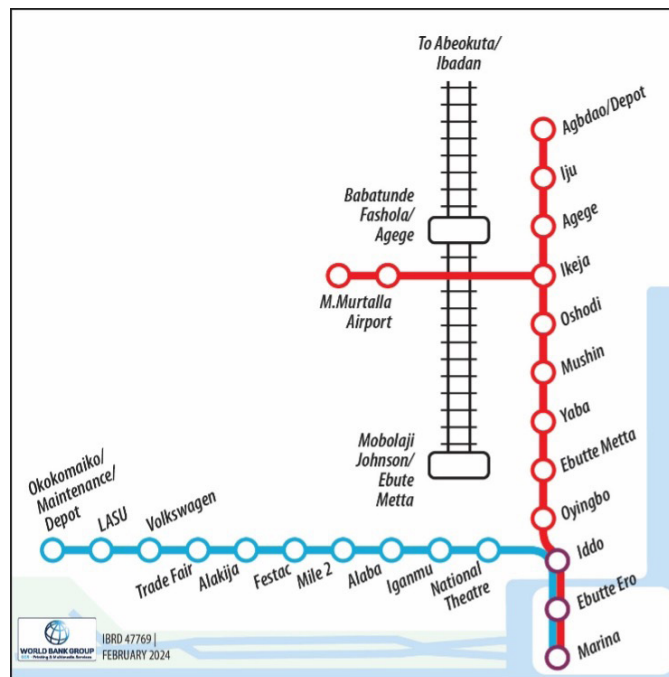


Source: World Bank based on Sages Consult Limited.

Originally, the line was envisioned to be operated through a concession in which the government would finance and construct the track and station infrastructure and the concessionaire would finance and provide rolling stock and systems (electric power supply, signaling, fare collection). However, this arrangement has not materialized. Rather, the State of Lagos has ordered three EMU trains from CNR Dalian. The Blue Line is projected to have the capacity to transport 400,000 passengers daily with 24 trainsets. Passenger numbers may increase when the entire route becomes fully operational and more frequent service is provided. The rail public transport will be incorporated into the Cowry integrated ticketing and fare systems. This integration will make travel between different public modes seamless and provide information about bus and ferry transport and timetables at rail stations to enable easier trip planning.

Red Line. The Red Line is a standard-gauge, double-track line spanning 37 km north from Marina to Agbado, with 13 stations and a future connection to the *Murtala Muhammed International Airport* (Figure 2.6.). The line is being built in two phases. The first phase extends from Oyingbo to Agbado, and the second will extend south from Oyingbo to Marina. The 31 km section between Oyingbo and Ebute Metta stations will use the NRC double track line and two existing stations. The remaining six kilometers and three stations will be elevated to ensure the connection at Marina station with the Blue Line.

Construction on the Red Line started in 2022 and is expected to open in 2024. As the NRC line is not electrified, the Red Line service will not be electrified. Lagos State has purchased two Talgo VIII trainsets for use on this line. The line, with 30 trainsets, will have the capacity to transport 750,000 passengers per day at inception and 1.1 million when fully operational with frequent services.

Figure 2.6. Map of Blue and Red Line Stations

Source: World Bank.

The potential riders in the catchment area of the Blue and Red Lines include self-employed tradesmen, civil servants, students, and tourists. A demand study focused on the Blue Line corridor rail corridor (CPCS Transcom Limited, 2008) indicates that key destinations include industrial and commercial areas that will generate trips for work, personal business and shopping. The prospective riders interviewed indicated interest in using the rail service but emphasized that cheaper fares are the main factor determining mode choice, factor despite other benefits from rail such as reduced journey time.

Human Resources

LAMATA has approximately 150 employees engaged in overseeing the construction of the Blue and Red Lines and planning of the other lines proposed for the Lagos Urban Rail Network (LURN).

The STMP emphasized training, study tours, and twinning programs to equip LAMATA and other stakeholders with the knowledge of best practices in public transport systems delivery. The program has effectively balanced technical and management training, covering areas such as engineering, geographic information systems, economic analysis, leadership, and people management skills. With operations starting, further training will be needed in developing business plans, route service contracts, procurement services, and maintenance. LAMATA's plans to train drivers, conductors, maintenance staff, and station personnel and could benefit from a twinning program with another railway operator.⁷

⁷ For example, Addis Ababa Light Rail had a program with the Shenzhen Metro at start up.

Operations and Safety

The Blue and Red Lines will be operated and maintained initially by the Lagos State Government/LAMATA until the State government's capacity to deliver transit rail services is demonstrated to potential private partners. In the future, these lines are expected to be operated and maintained by a private concessionaire that will be responsible for meeting the performance indicators outlined in a contract with the Lagos State Government. LAMATA, through its rail division, will act as a regulator and deal directly with the concessionaire until an independent regulatory agency. As currently structured, concessionaires have little or no interest in providing urban rail services, as funding arrangements for operational losses caused by a gap between social and breakeven tariffs remain unclear.

To date, users have appreciated the travel-time savings compared to road journeys, with similar origin and destination. The inauguration of service is the culmination of years of effort by the Lagos State Government to start a rail-based commuter service, an accomplishment deserving of recognition. LAMATA intends to review the lessons learned and apply best practices to conclude the construction of the Blue and Red Lines.

Financial Situation & Government Funding

So far, the Lagos State Government has funded all LURN investment projects using its own resources. The Central Bank of Nigeria's differentiated cash reserve requirement regime makes financing available for the real economy. In June 2022, the Commissioner of Transportation in Lagos State confirmed that the Central Bank had approved the release of funds from banks' cash reserve facilities to Lagos State for the rail projects. Access Bank, Sterling Bank, and Fidelity Bank have provided financing of N60 billion to Lagos State for the LURN Blue Line, with N45 billion disbursed as first tranche (Vanguard, 2021).

The Lagos State MoT is urging the Federal Government to co-finance the development of urban transport infrastructure in Nigeria. The Nigerian Government has received recommendations on establishing an agency that will provide financial and technical assistance to urban transportation systems across the states of the federation. The current Directorate of Urban Mass Transit in the Federal MoT could potentially serve as the nucleus for such an agency. Overall, securing bilateral/multilateral financing for the full roll-out of LURN will improve financing mechanisms and regulatory framework, as well as strengthen sustainability.

As noted, a source of funding support for operations of the Blue and Red Lines has not yet been established through legislation. Early operation of the lines under LAMATA will furnish useful insights into passengers' ability and willingness to pay for rail services and the share of operating expenses that will be covered from the fare box. Addressing this issue soon may be pivotal for private sector participation in the concession and completion of the proposed lines.

Potential for Service Enhancement

Private Sector Participation

In 2008, the Federal Government established the Infrastructure Concession Regulatory Commission under the Infrastructure Concession Regulatory Commission Act, 2005. The Commission is tasked with developing and issuing guidelines on PPPs, policies, processes, and procedures, including those for concessions. The Lagos State Office of PPPs is responsible for approving public or private sector-initiated infrastructure projects within the State. Federal projects within the State are scrutinized by both regulators.

Urban railway plans for Abuja and Lagos State (LRT, monorail) are expected to be financed through PPP schemes; however, Nigeria has yet to develop any railway projects through PPPs. Since 2011, the World Bank and the United Kingdom have supported the implementation of PPPs through capacity building and by preparing a PPP manual. In Lagos State, concessionaires that have expressed interest in urban rail have failed to demonstrate sufficient capacity to fund operations and maintenance.

“ If Lagos State continues with its policy of providing no urban transport operating subsidies, PPPs involving rail operations are unlikely to be financially viable for the private sector. ”

A key barrier to PPPs is the funding of rail operations. In most countries, particularly in developing countries, the fare charged to rail mass transit users is a social fare intended to be affordable to lower-income passengers. This fare is usually not high enough to cover operational costs. The resulting gap in funding can be covered through various means, including direct government subsidies, establishment of taxes dedicated to supporting transit (such as fuel taxes, real estate taxes on property near transit), and the provision of profitable land development rights. Lagos State must address its operational funding gap for rail. If Lagos State continues with its policy of providing no urban transport operating subsidies, PPPs involving rail operations are unlikely to be financially viable for the private sector.

For future phases, the Lagos State Government is considering a patronage guarantee to cover any potential shortfall caused by low uptake of services, as well as tax incentives for LURN investments. The State Government has put in place various policies and initiatives (Lagos State Government Transportation Sector Deal Book, 2018) to ensure an enabling environment for business. Private sector participation in public sector procurement is governed by:

- the Lagos State PPP Law of 2011
- the Lagos State Public Procurement Act of 2011
- regulations issued by the State Executive Council (EXCO) governing the PPP process.

These laws and regulations aim to ensure compliance with PPP contract terms and provide dispute resolution mechanisms.

Transit Oriented Development

Transit oriented development (TOD) creates compact and livable communities, planned to enable people to access daily needs through non-motorized transport and transit.⁸ TOD can be encouraged through provision of appropriate non-motorized transport infrastructure and public facilities (schools, medical, housing) near transit stations. Land use rules play an important part, as they can encourage mixed use (commercial and residential) development and greater density around stations.

“ Policy changes allowing greater land use flexibility, higher density along transit corridors, and solutions for real estate tax concerns could stimulate systematic TOD development. ”

Several factors contribute to Lagos' high potential for TOD around railway stations:

- High land use density of about 1270 formal dwellings per square km, together with the LURN designed to serve areas with high growth and transport demand.
- Good intermodal connects in rail stations: pedestrian walkways link train stations to bus stops and BRT terminals, and *Danfo* bus and three-wheeler services provide last-mile connectivity.

However, certain factors may hinder this potential:

- Land use regulations relating to commercial properties along the Blue and Red Lines limit commercial development to a 70 percent lot coverage ratio. This allows for buildings up to six floors in height, with additional restrictions on retail spaces, capped at 700m² and 7.8m in building height, and subject to approval. Residential properties with mixed use are permitted, with 30 percent lot area ratio and an eight-floor limit.
- Scarcity of land, affordable housing, and non-motorized transport infrastructure at stations and along most transit corridors.
- Real estate taxation, using market values for property taxation is controversial, with difficulties where property transactions and cadaster are often opaque (Ezemoke and Isiadinso, 2018).

These challenges suggest that while some TOD around stations is likely to occur organically, it can be encouraged through investment in sidewalks, bikeways, and affordable housing near stations. Policy changes allowing greater land use flexibility, higher density along transit corridors, and solutions for real estate tax concerns could stimulate systematic TOD development. Given that TOD is a long-term process, developing dense and diverse transport corridors necessitates consistent land use planning and regulation, with strategic coordination between LAMATA and the Land Bureau, from planning to implementation.

⁸ Sometimes, the increased accessibility resulting from TOD prompts people to pay more for land around stations, causing an increase in land value. This higher value can be captured and channeled towards supporting the development and operation of the transit. This model is called land value capture. Programs to implement land value capture typically require a structured approach to land zoning, land registration, real estate taxation, and their enforcement.

LAMATA has identified four stations on the Blue Line and nine stations on the Red Line as suitable for TOD implementation. Applying the Institute for Transport and Development's criteria for assessing the potential for TOD (Jacob Mason et al, 2021). Suggests considerable TOD potential exists at Blue and Red Line stations. The principles for the assessment are:

- **Walk:** develop neighbourhoods that promote walking
- **Cycle:** prioritize non-motorized transport networks
- **Connect:** create dense networks of streets and paths
- **Mix:** plan for mixed uses, income, and demographics
- **Densify:** optimize density and match transit capacity
- **Compact:** create regions with short transit commutes
- **Shift:** increase mobility by regulating parking and road use

The findings, for selected Red and Blue Line stations are shown in Table 2.7. They indicate that Alaba and Marina have the highest potential for TOD, while Iddo and Mile 2 exhibit less potential.

Table 2.4. TOD Assessment of selected Blue and Red Line Stations

Transit Station	Mile 2	Alaba	Iganmu	National Theater	Marina	Iddo	Ebute Metta	Oshodi
Total Score	46	54	48	45	51	42	48	49
Walk	7	7	6	7	7	3	7	7
Cycle	1	1	1	1	1	0	1	1
Connect	6	8	6	5	6	8	6	8
Mixed development	9	15	9	10	10	11	12	12
Density	8	8	14	8	13	8	8	7
Compact	9	9	9	7	10	8	9	9
Modal Shift	6	6	3	7	4	4	5	5

Source: World Bank based on Institute for Transportation Development and Policy methodology.

Technological Innovations

Several new technologies may contribute to the operational success of LURN. These include:

- **Traction:** In the future, LAMATA may consider operating electric battery- or hydrogen-powered trains (or hybrid trains) to give flexibility in operating the same trainsets on both Blue and Red Lines. Optimized traction and regenerative braking systems can enhance safety and on-time schedules through more-accurate braking distances and less wheel slip. Electrical energy recovery and energy-saving systems can improve onboard electric energy conservation.
- **Train Control:** Given the high forecasted volume of traffic on each line, communication-based train control may be considered on both the Blue and Red Lines.
- **Other:** Rolling stock may be configured with low axle load, low entrance height (low floors), and optimized wheel configuration, such as motorized bogies positioned at the two ends of the train to limit vibrations and sound level.

The main challenges of realizing these potential technological innovations include financing the upfront investment costs and upskilling workers to maintain and repair such technologically advanced equipment.

Conclusions and Recommendations

The LMA is one of the most populous metropolitan regions in Africa and is growing rapidly. Currently public transport, mainly provided by privately-operated buses and minibuses, does not meet mobility needs, even with the introduction of a high-capacity BRT. Road-based transport is causing unacceptable levels of congestion and emissions, long commute times, and a significant quantity of road accidents. Surveys also show that about 40 percent of total daily trips are by walking, suggesting that many people cannot afford public transport and have little choice but to walk long hours to reach their destinations.

The Lagos State Government has been creating the institutional building blocks to improve mobility in the LMA. It has created a Metropolitan Mobility Authority, LAMATA, which is functioning effectively. It has an Integrated Urban Transport, Land Use and Air Quality Strategy (STMP), and a detailed Rail Master Plan (LURN). LAMATA is empowered with funding mechanisms and has sought to create financing mechanisms to implement new systems. Additionally, a legal framework for private sector participation exists.

At least a decade ago, Lagos State began considering the implementation of the Blue and Red Lines, which are each forecast to transport more than 1 million passengers daily, shifting many users from road-based modes to rail. The Blue line has been partly open (Marina to Mile 2), while the construction of the Red Line, which shares a link with NRC, is still underway. This accomplishment is commendable, and Lagosians can look forward to enjoying regular rail service on both lines soon.

Although the Lagos State Government financed the first lines with its own resources, it has called for expressions of interest to complete the Blue and Red Lines with private sector participation under a Design, Finance, Build, Operate, and Maintain PPP. In this type of PPP, the infrastructure, systems, and rolling stock are financed by the private sector, which is reimbursed at each agreed milestone by the State. The operation and maintenance of these lines, for periods ranging from 20 to 30 years, would be the responsibility of the concessionaire, which must charge the agreed-upon social tariff. Elsewhere, particularly in similar systems in Latin America, the operator is typically reimbursed the difference between the social tariff and a breakeven tariff proposed in the bid. Legal impediments to Lagos State making such payments are likely to frustrate Lagos' ambition to build the next lines through PPP.

The Lagos State Government and LAMATA may consider taking the following steps to enhance the implementation of the rail network:

- **Construction Lesson.** Review the construction history of the Blue and Red Lines to draw lessons for future projects. Identify the obstacles that caused construction to be delayed (such as project design, underestimation of expropriation and resettlement schedules and costs, underestimation of relocation of utilities, unreliable financing, weak civil works contractors, opposition from bus owners) and develop mitigation strategies. Spotlight the strengths that led to the successful inauguration of the Marina to Mile 2 link in 2023 and assess how to enhance them.
- **Project Optimization.** Undertake a value engineering analysis of the next project designs by internationally recognized consultants to ensure the proposed civil works, yard, systems, and rolling stock are optimized and costs contained. This will facilitate future financing by international lenders.
- **Social vs Breakeven Tariffs.** Analyze the estimated social tariff that will attract ridership levels as described in the LURN. Compare this to estimated operating costs and the breakeven tariff for the operating link between Marina and Mile2. Similarly, design a PPP case for the completion, operation, and maintenance of the Blue Line to estimate the gap financing.
- **Enabling Legislation.** Based on the outcome of the tariff/gap financing analysis, introduce legislation, if needed, to clarify demand risk and the payment of operating subsidies in PPPs.
- **Financing.** Approach financiers with the proposed plans to seek financing/guarantee support for implementation.



3

Suburban Rail in Maputo

Introduction and Urban Context

Maputo, the capital of Mozambique, is the country's main financial, business, and commercial hub. In recent years, residential and industrial development of Maputo City has expanded into the surrounding cities and districts of Matola, Boane, and Marracuene, creating the Maputo Metropolitan Area (AMM). AMM's population, currently about 3.1 million, is expected to reach 4 million by 2035. Matola, in particular, has grown rapidly, doubling its population over the last decade. Jobs are mainly concentrated in the city of Maputo, while housing is growing on the outskirts of Maputo, Matola, and Marracuene.

The population growth has coincided with rising household income and an exponential surge in motorization. The emerging middle class is turning to private cars, partly because quality public transport alternatives are not available. The number of private cars in Maputo Province and Maputo City increased by over 332 percent between 2009 and 2019, and in 2019, they represented around 80 percent of the national fleet. The growth in road-based vehicles has created congestion, not only from higher car-ownership, but also the significant numbers of buses, mini-buses, vans, and trucks used by the lower-income population to commute to work and transport goods.

In 2010, the total daily trips in the AMM were estimated at 3.2 million. Forty percent were made by non-motorized modes such as walk-only or bicycle. Among the motorized trips, informal minibuses (*chapas, myloves*) had an estimated market share of 44 percent, the balance being accounted for by large bus operations (37 percent), and private cars (18 percent). Rail provides less than 1 percent of the daily trips. The 40 percent of residents that walk to their destinations are likely to be people who cannot afford other modes. They need to start early in the morning and spend a significant amount of time reaching their workplaces. Users of motorized transport suffer from long trip times and unreliable services whilst paying a high portion of their income for public transport (as much as 12.5-20 percent of household income). Increases in road-based vehicles, poor traffic management, and insufficient road maintenance cause numerous accidents and produce high emissions, which will worsen without reliable mass transport alternatives.

Structure & Coordination of Urban Transport

In Mozambique, urban rail and public transport are the responsibility of the national Ministry of Transport and Communications (MTC), which has oversight over the National Port and Railway Company (Caminhos de Ferro de Moçambique [CFM]), the Transport and Communications Development Fund (FTC), and the Metropolitan Transport Agency, Agência Metropolitana de Transporte (AMT).

“ In the rail sector, the most noteworthy development was the establishment of Metrobus, a company owned by a private operator that uses the CFM tracks to provide services in exchange for an access fee. ”

In 2017, the Government established the AMT to coordinate and implement the Maputo Metropolitan Area Transport and Mobility Master Plan (PDTU). AMT's mandate includes:

- metropolitan-level strategic planning and management of public transport network and assets
- defining routes
- organizing and monitoring passenger transport services, signing contracts, granting concessions for passenger transport services and assets
- ensuring service quality and approving metropolitan-level fares

The agency plays a vital role in coordinating metropolitan transport among municipalities and prioritizing investments. Moreover, as part of the MTC, AMT is a centralized hub for garnering support from donors and bilateral- and multilateral organizations, and ensures that studies align with the AMT's areas of interest.

AMT's coordination task requires collaboration with local governments, which are responsible for:

- regulating and registering all motor transport vehicles
- regulating and supervising public transport services within their territory, including tariffs
- developing, maintaining, and managing local roads
- enforcing traffic management regulations, including parking control
- providing municipal police, including traffic police

Strengthening cooperation and coordination with local governments is vital to help AMT fulfil its role effectively. Therefore, it is necessary that local governments recognize the value that AMT activities bring to their municipalities.

Urban Transport Plans

With financial assistance from donors, a Transport and Mobility Master Plan (PDTU) was prepared for the AMM in 2012. It remains a blueprint for the implementation of new projects and policies to improve the quality of mobility service. Although the original PDTU primarily focuses on road-based modes, particularly BRT, it has suggestions on how the existing CFM rail network can be enhanced and used for passenger transport. The PDTU calls for urban transport projects to align with land use management. AMT has no jurisdiction over land use management, which is the responsibility of local governments. Given the strong inter-relationship between urban transport and land use, institutional coordination is crucial.

To be effective, AMT needs financing mechanisms that enable:

- the reorganization, reduction, or addition of new bus routes
- evaluation and prioritization of new projects, including urban rail
- formulation of policies to ensure the best quality-of-service for the user

The only dedicated financing mechanism apparent for these purposes is the FTC, which funded some of the buses. The FTC comes from five percent of the fuel taxes and 60 percent of transport permitting fees. Although it aims to improve the financing of the sector's projects, its leverage has been modest, with average pre-COVID-19 resources of approximately USD5 million per year. Land value capture (LVC) has also proven challenging due to the lack of formal land use instruments.

Private sector participation is mostly observed in the road-based modes, particularly the operation of minibuses (chapas, myloves). In the rail sector, the most noteworthy development was the establishment of Metrobus, a company owned by a private operator that uses the CFM tracks to provide services in exchange for an access fee. This open access service, directed at middle-class users, has been successful in attracting auto users by offering a combination of bus and rail services. However, Metrobus services are constrained by the limited number of train slots allocated for operation, resulting in insufficient number of trains at peak-hour since freight trains are given priority.

Of the four pillars essential for sector sustainability—a coordinating agency, a transport master plan, adequate funding, and enabling environment for private sector participation—the AMM accounts for two of the most critical—the coordinating agency and the transport master plan. However, it lacks a robust financing mechanism and a solid framework to foster an environment that encourages private sector involvement in operations and investment. There is room for improvement across all pillars.

Land Use Plans and Regulations

Land use management is a local government responsibility. The Territorial Planning and Construction Directorates of the Municipal bodies are responsible for the development and implementation of all urban planning instruments. In 2021, the President announced a devolution of urban management responsibilities to districts.

In Mozambique, land and its associated resources are owned by the State. However, the Land Law grants private persons the right to use and benefit from the land (known as *Direito do Uso e Aproveitamento da Terra* [DUAT]). Although the land itself cannot be sold, mortgaged, or alienated in any way, buildings, infrastructure, and improvements constructed on the land may be mortgaged or sold. DUATs cannot be used as collateral for any borrowing, a factor with important implications for property investment in Mozambique that may limit the applicability of LVC.

To ensure sufficient land use management capacity and competencies for urban metropolitan areas such as Maputo, there is a need to reform services and to redefine and reorganize functions and responsibilities. Institutional strengthening is required to establish transparent land use management systems and processes that facilitate comprehensive and coherent urban development aligned to transport plans.

“ To ensure sufficient land use management capacity and competencies for urban metropolitan areas such as Maputo, there is a need to reform services and to redefine and reorganize functions and responsibilities. ”

Coordination

AMT is the first administrative body with a metropolitan mandate focused on transport management, but it lacks a metropolitan-wide counterpart to address joint spatial and mobility planning. AMT finds itself engaging with multiple municipal and district departments with limited planning and management capacity, who largely rely on central resources to perform their mandates. Initial efforts to coordinate transport services led to the creation of a map of semi-public transport services and subsequently, a structural map of public transport. AMT acknowledges that municipalities hardly share data on the operator licenses they allocate, exacerbating the challenge of coordinating informal transport operators.

Currently, AMT is attempting to organize inputs from transport operators through a dashboard that would allow it to have a management tool for the whole AMM. However, no official protocol exists to formalize the exchange of information. At the sub-municipal level, there is no formal coordination mechanism between the CFM or Metrobus and the respective Directorates of Mobility. Maputo Municipality perceives CFM as primarily focused on freight transport, and coordination between institutions occurs on an ad-hoc basis, depending on needs. Coordination efforts are focused on issues related to rail/road safety and security, with a particular attention given to grade-crossings. Likewise, the AMT and CFM lack a specific coordination mechanism apart from the internal system in the Ministry of Transport (MoT), to which both entities report.

The recent creation of the AMT is a significant step toward addressing the lack of coordination mechanisms, although the integration of mobility and land use issues remains unclear at this stage. Nevertheless, transit-oriented development (TOD) can be adapted to specific interventions within well-defined areas, such as those around stations through zone planning instruments. A project implementation unit could be developed as an ad-hoc implementation and coordination mechanism, with a view to institutionalizing the experience in the medium-to-long term. Another viable way forward would be to incorporate senior planning officials from the municipalities and districts in the metropolitan area into the AMT board to facilitate coordination among transport, urban mobility, and land management services.

Traffic, Markets, and Access

Traffic and Present Modal Split

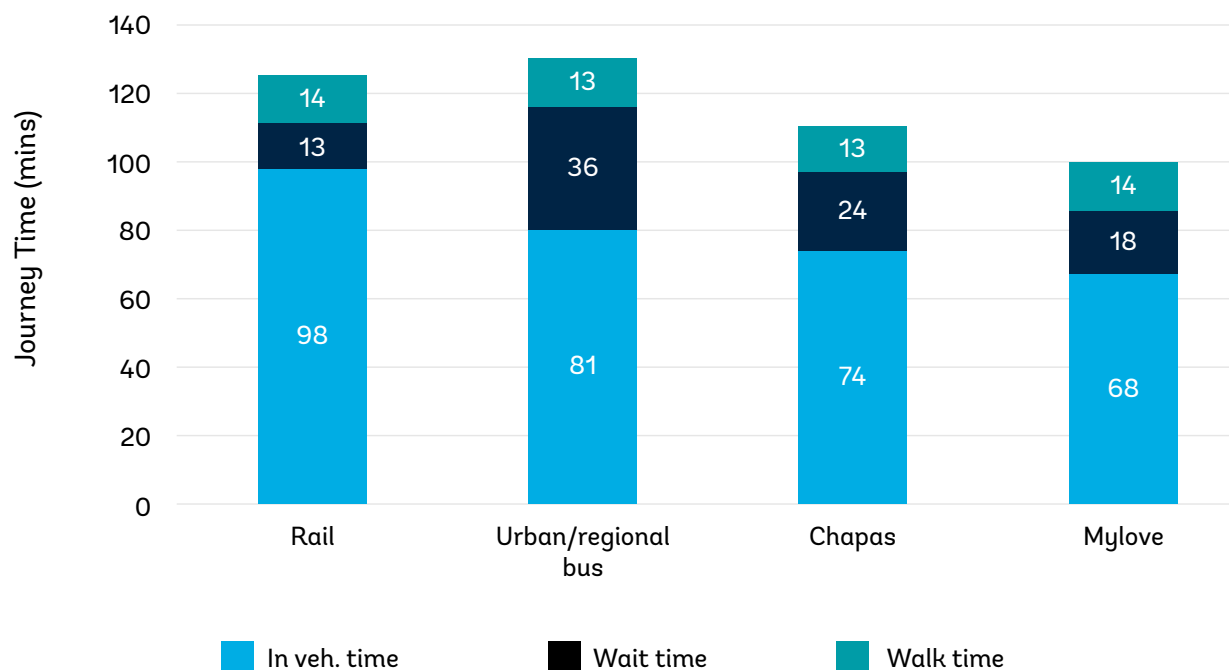
Commuter rail services are provided by CFM, the national railways, and by Metrobus using CFM tracks. CFM has a comprehensive network dating back to pre-independence times, and provides freight, intercity, and commuter passenger services. Together, CFM and Metrobus transport approximately 32,000 passengers per day. The rail share of daily trips is just 1 percent and could be increased using the existing CFM network by adding tracks, signaling, and telecommunications to increase capacity and service frequency and improve operational safety.

Metrobus is a joint venture between the private sector and CFM, offering integrated bus and rail services. It operates on CFM tracks under a track access arrangement and charges higher fares than CFM. Its service targets middle-income residents who do not want to drive and can afford higher fares.

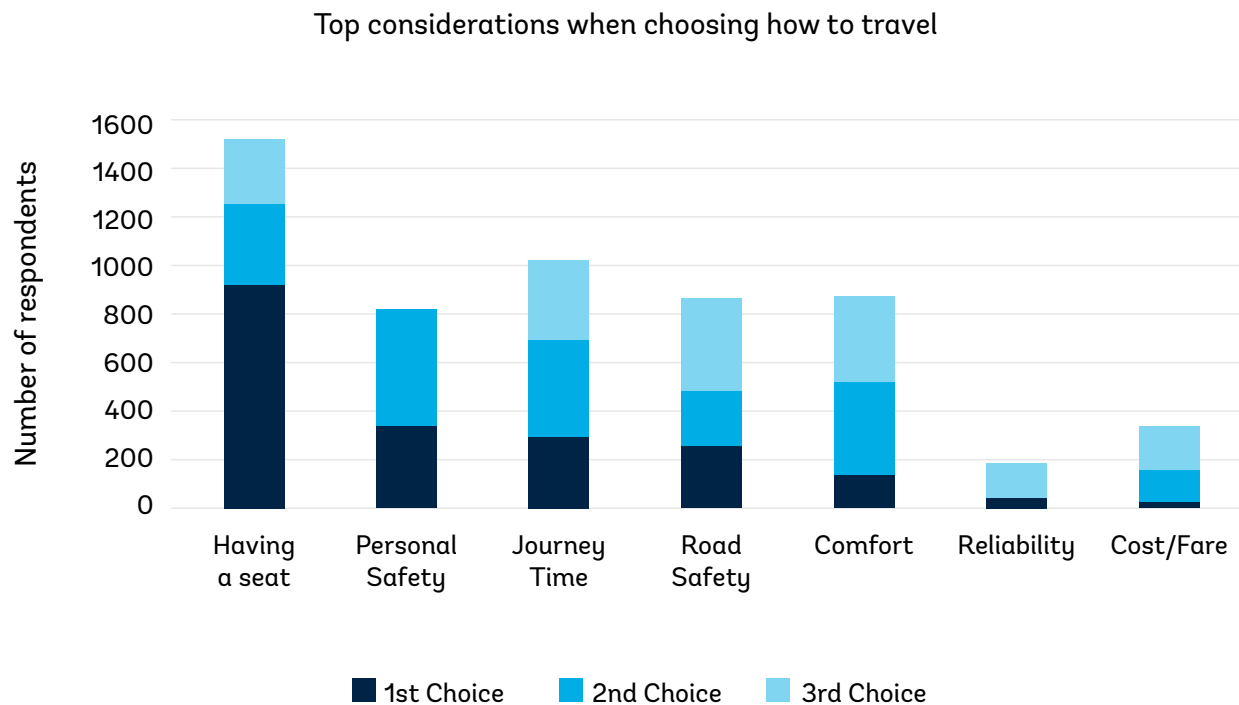
Market Potential

Recent surveys suggest that rail travel offers slightly shorter journey times than urban and regional bus services (see Figure 3.1.). Rail journeys involve an average of 1.6 transfers and a service quality rating of 2.3, which is higher than that of buses. Additionally, as illustrated in Figure 3.2., the key factors impacting modal choice include seat availability, safety, and journey time.

Figure 3.1. Breakdown of Journey Time by Mode



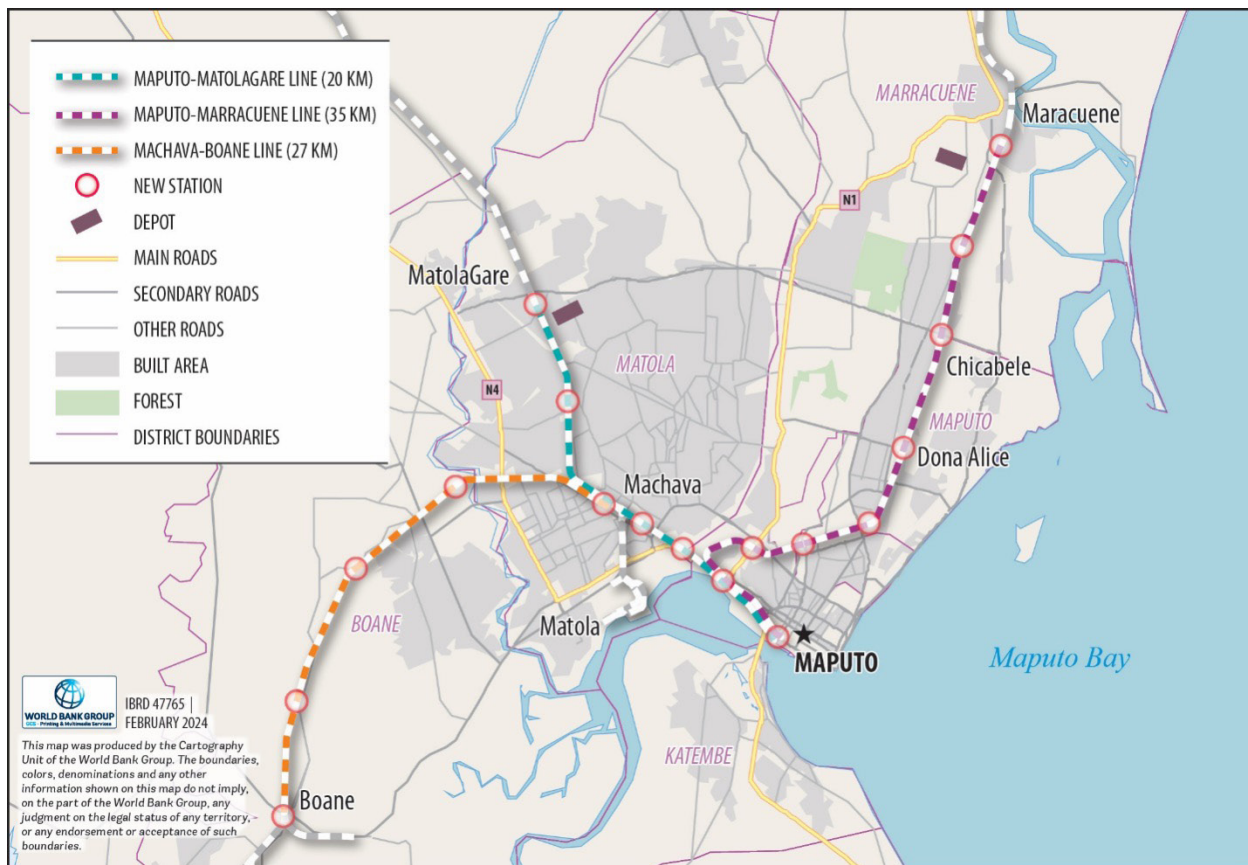
Source: World Bank.

Figure 3.2. Main Factors in Mode Choice

Source: Arroyo Arroyo, 2022.

Strong population growth is forecast along the three main existing rail corridors. According to the PDTU, the daily passenger volumes in 2035 have been estimated using the System for Traffic Demand Analysis (STRADA) model:

- **Maputo–Marracuene Line:** Spanning 35 km, this line uses the existing right-of-way serving the northeast part of Greater Maputo. Although the areas in Marracuene are currently thinly populated, they hold significant potential for development. The forecasted daily passenger volume is 237,000 (both directions), with a maximum design one-direction hourly volume of 23,700.
- **Machava–Boane Line:** Covering 27 km, this line also uses the existing right-of-way. The estimated daily passenger volume of this line is 271,000 (both directions), and the maximum design one-direction hourly volume is 27,100.
- **Machava Station to Maputo–Matola Gare Line:** While the population growth along this line is less than the other two lines, its development potential is high. It has an estimated daily passenger volume of 332,000 (both directions), and a maximum design one-direction hourly volume of 33,200.

Figure 3.3. CFM South Network in AMM

Source: World Bank.

This forecast indicates that by 2035, rail traffic will jump from the current estimated 32,000 passengers per day to approximately 840,000 passengers per day. The estimate is contingent upon investments in double tracking/sidings, automatic block signaling, improved station accessibility by other modes including walking, as well as a fare structure designed for low-income users. This forecast is optimistic as it assumes that concerted efforts will be made to develop housing and other health, education, and leisure facilities around the stations. Based on the experiences in other metropolitan areas, if an affordable integrated bus-rail fare is available, a ridership of more than 300,000 passengers per day will be possible with higher service frequencies in peak periods and better service quality. A review of the ridership forecasts is advisable under new scenarios before committing to significant investments.

Access

The transportation infrastructure providing last-mile access to low-income neighborhoods is inadequate and limits access, especially of the poor, women, and vulnerable groups, to bus and rail stations. In the informal settlements of the extensive peri-urban Metropolitan Area of Maputo, access roads are mostly unpaved, lack drainage, and are prone to rapid deterioration in the rainy

seasons, deterring bus and minibus operators from entering these areas. Consequently, many residential areas lack organized public transport, compelling residents to either rely on informal or unsafe transportation modes, which can be expensive, or walk long distances over poor infrastructure to access public transport.

Recent research in low-income neighborhoods has revealed that individuals in these areas walk more, use more informal modes of transportation (*chapas*), while private car use is low (Arroyo Arroyo, 2022). Furthermore, non-motorized transportation infrastructure and lighting are either absent or deficient in many neighborhoods. The same research and focus group discussions highlighted that a large proportion of population in those neighborhoods expressed concerns about safety and physical security. Approximately 40 percent of people surveyed did not feel physically safe on the journey to the bus/rail stop/station and 25 percent felt unsafe from traffic while walking in their neighborhoods. These challenges disproportionately affect women and the economically disadvantaged. Addressing the infrastructure and services in the first/last mile is vital to optimize the impact of investment in commuter rail services.

Suburban Railways

Caminhos de Ferro de Mocambique (CFM)

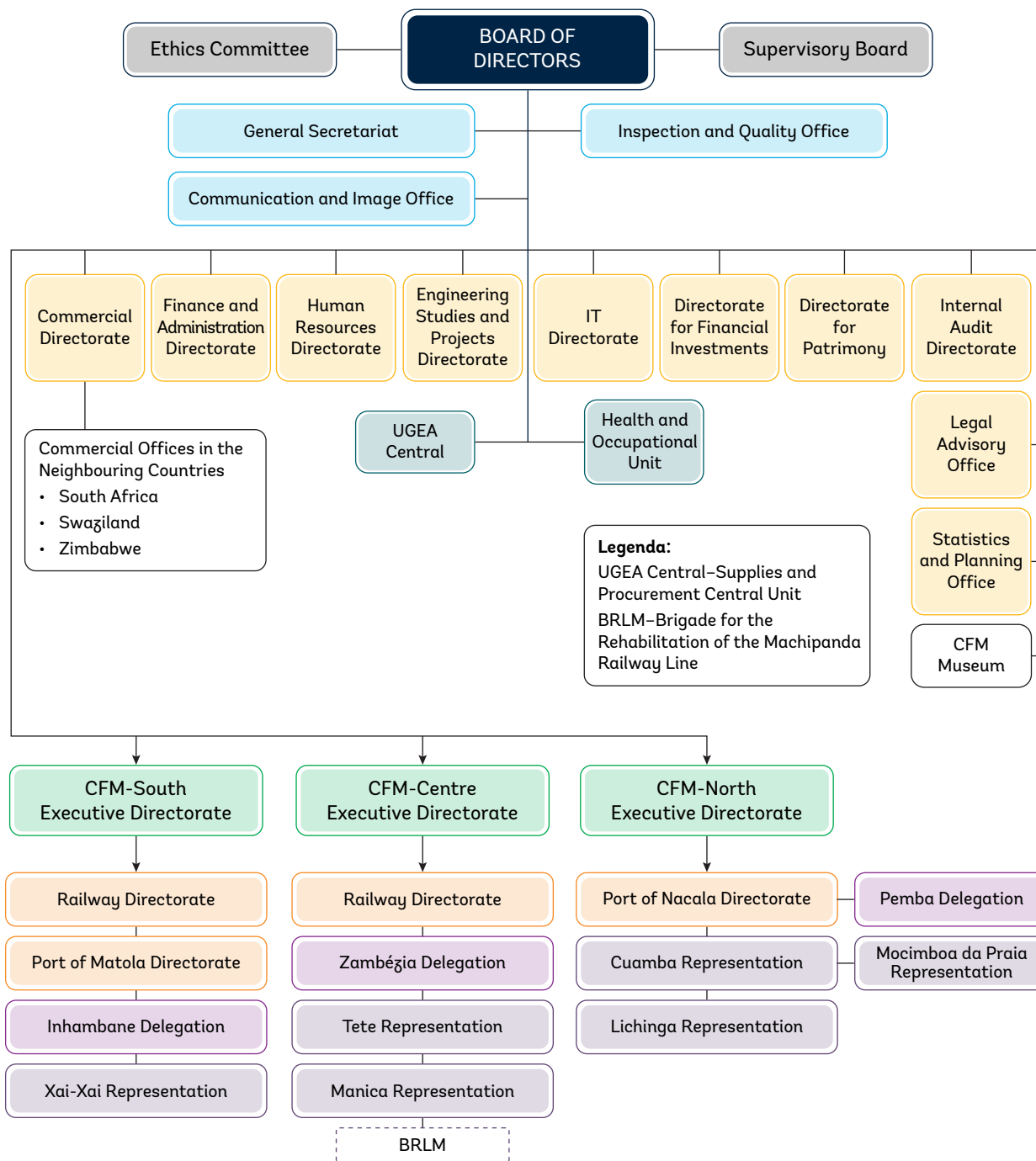
CFM is a state-owned enterprise under the MTC and manages the Ports and Railways of Mozambique (see Figure 3.4.). The AMM region is served by the CFM-South branch. The network is single track except for the stretch from Matola Gare to Maputo, which is double track. CFM owns the right-of-way along the rail track and all land extending 50 m on both sides of the outermost rails. However, unauthorized and precarious housing is encroaching on parts of the right-of-way and could pose challenges if CFM decides to expand the existing infrastructure.

Image 3.1. Maputo Railway Station



Source: AdobeStock.

Figure 3.4. CFM Organization Chart



Source: CFM website,2022.

CFM’s train operations focus primarily on freight transport, with only a few passenger trains operated. The network was designed to transport freight from neighboring countries to/from the Port of Maputo. The highest train frequency in the AMM is in the Machava–Matola Gare section,

where 21 trains are operated daily (one direction) between 5 am to 10 pm. Of these 16 are freight and five are passenger. Commuter train service, described in previous sections, is offered to the following destinations:

- Manhiça (79 kilometers) via Marracuene (two trains daily in each direction)
- Matola Gare (20 kilometers) via Machava (four trains daily in each direction)
- Ressano Garcia (88 kilometers) via Machava and Matola Gare (two trains daily in each direction)
- Goba (69 kilometers) via Machava and Boane (two trains daily in each direction)

Commuter services are complemented by intercity passenger services, which stop at many stations and, therefore, are also used by commuters in the areas around Maputo.

Operating Performance

CFM-South provides passenger services on three routes – Ressano Garcia, Limpopo and Goba. The commuter services are provided by five three-car diesel-electric multiple units (DMUs) and 12-car intercity passenger trains, which also carry commuters traveling in and out of Maputo. Vandalism has affected service, leading to disruptions in the scheduled service. Overcrowding too has emerged as an issue, as passenger loads per train have grown by 78 percent since 2014. CFM estimates that the average train occupancy on the Maputo—Ressano Garcia service is 2,100, while the Maputo—Chicualacuala service accommodates 1,600 passengers. This compares to the train capacity of a 12-car trains of 1,320 passengers (at 110 passengers per carriage).

Recent data shows a decline in passenger numbers due to COVID-19, while rolling stock continues to decline. Table 3.1. provides an overview of passenger numbers and the reduction in operating carriages.

Image 3.2. Maputo Railway Station



Source: https://commons.wikimedia.org/wiki/File:Maputo_Train_Station.jpg.

Table 3.1. CFM South Passenger Traffic by Line

Passenger Numbers CFM South	2017	2018	2019	2020	2021
Ressano Garcia Line	3,850,947	4,126,080	3,236,582	1,471,491	1,413,331
Limpopo Line	1,545,529	1,692,014	1,452,072	539,128	394,915
Goba Line	792,969	779,852	669,279	473,622	485,109
Total Passengers	6,189,445	6,597,946	5,357,933	2,484,241	2,293,355
Operational Carriages CFM South	2017	2018	2019	2020	2021
Total Carriages	83	77	62	66	63

Source: CFM Annual Statistical Information, 2021, 2020, 2019.

The intercity passenger trains originate beyond the Maputo area and many of their passengers come from outside Maputo. The passenger peak is reported to start at 3:00 am for people residing well outside Maputo. For those within the Maputo metropolitan area (AMM), including Matola, the peak starts around 6:00 am. Data from 2018 indicate that commuters constitute only 0.5 percent of the intercity passenger numbers.

Financial Performance

CFM-South's Finance department produces a range of reports that include: (i) monthly reports on financial and operational performance of the company for the CFM Board of Directors; (ii) annual operating budgets aligned with the standard schedule that involves all technical departments developing their own resource plans and budgets, and (iii) three-year plans serving as a commitment to the Minister of Communications and Transport. It is important that CFM's accounting system provides adequate disaggregation to provide for clear separation of revenues and operating costs between urban rail, intercity passenger, and freight, with Joint costs be allocated proportionally to each service.

Funding for CFM passenger services is secured from farebox revenue and subsidized by CFM's freight income. Fares vary based on the distance zone and line, with fares for shorter distance travel set at a modest MT 13 (USD 0.21) per trip (see Table 3.2.). CFM estimates fare evasion of approximately 25 percent.

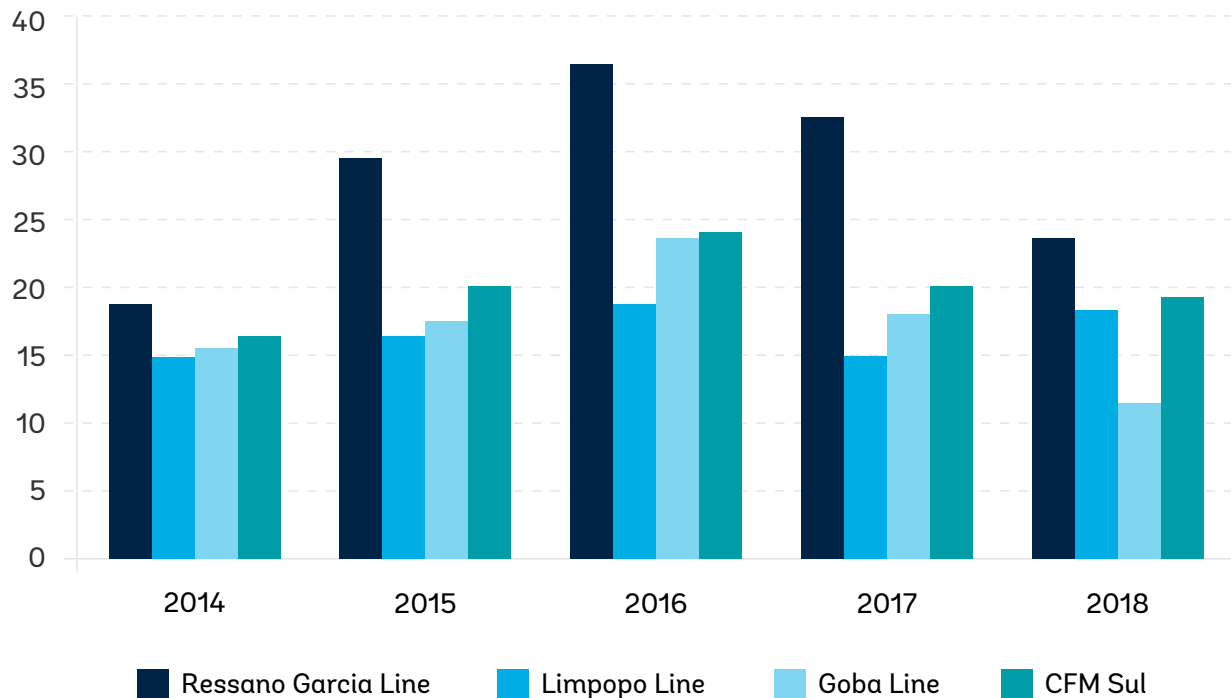
Table 3.2. CFM Passenger Fares

ZONA I		
LINHA DE R. GARCIA (13,00 MT)	LINHA DE GOBA (13,00 MT)	LINHA DE LIMPOPO (13,00 MT)
Maputo - Siduaba	Maputo - Luis Cabral	Maputo - Albasine
Siduaba - Maguanza	Luis Cabral - Boane	Albasine - Marracuene
Maguanza - Movene	Boane - 1º de Maio	Marracuene - Paquete
Movene - Ressano Garcia	1º de Maio - Goba	Pateque - Manhiça
ZONA II		
LINHA DE R. GARCIA (45,00 MT)	LINHA DE GOBA (28,00 MT)	LINHA DE LIMPOPO (28,00 MT)
Maputo - Maguanza	Maputo - Boane	Maputo - Marracuene
Siduaba - Movene	Luis Cabral - 1º de Maio	Albasine - Paquete
Maguanza - Ressano Garcia	Boane - Goba	Marracuene - Manhiça
ZONA III		
LINHA DE R. GARCIA (65,00 MT)	LINHA DE GOBA (35,00 MT)	LINHA DE LIMPOPO (35,00 MT)
Maputo - Movene	Maputo - 1º de Maio	Maputo - Pateque
Siduaba - Ressano Garcia	Luis Cabral - Goba	Albasine - Manhiça
ZONA IV		
LINHA DE R. GARCIA (80,00 MT)	LINHA DE GOBA (45,00 MT)	LINHA DE LIMPOPO (50,00 MT)
Maputo - Ressano Garcia	Maputo - Goba	Maputo - Manhiça

Source: CFM Website, 2022.

The fares on CFM trains are low (around MT 13-28 one way), and cover, at most, 15-25 percent of train operating costs. The low fares make the CFM commuter services attractive mainly to low-income residents who ride in crowded trains, often without a seat, for distances that may exceed 60 km.

Urban rail services require subsidies because the fares charged are often social tariffs, which are well below the technical tariff (the breakeven tariff). An analysis of CFM-South's revenue and cost data shows revenue growth between 2014 and 2018, although from a very low base. Costs rose during this period, resulting in a cost recovery rate of less than 20 percent in 2018 (Figure 3.5.).

Figure 3.5. CFM South Cost-Recovery, 2014 - 2018

Source: CFM Website, 2019.

Acquisition of equipment and infrastructure investments are funded by CFM or through government grants. CFM urban rail and passenger service operations are subsidized by freight services. This arrangement incentivizes CFM to minimize expenditure on the passenger service and maintain a minimal train schedule. Government should reimburse CFM for these subsidies, but it does not appear to do so.

A more effective arrangement would involve the Government contracting with CFM to expand the service, with the Government covering the difference between the technical and actual tariff. In the future, if the AMT decides to promote additional rail services, it should contract with CFM and/or Metrobus, where it agrees to pay the difference between technical and social tariff, if key performance indicators established in the contract are met.

Metrobus

Metrobus is a private company that operates integrated bus and rail services from Matola Gare and Boane to Maputo. Conceived as a PPP project with CFM, Metrobus started operations as a private initiative. Metrobus was granted access to train slots on the CFM-South rail infrastructure under a contract with CFM. The track access fee paid for the slots is linked to the number of tickets sold on Metrobus trains.

Metrobus has a series of bus feeder services with schedule designed to integrate with its commuter railway service (Figure 3.6.).

Figure 3.6. Metrobus Bus Routes Linking to Est. Central



Source: Metrobus.

Metrobus has a fleet of 16 train units (four trains of four carriages each) and more than 100 buses. The investment made by Sir Motors to launch the service is not publicly available. Through private sector investment, rail diesel multiple units (DMU), which were purchased second-hand from New Zealand and arrived in 2015, although the service did not start until 2018.

Metrobus has expressed concerns that its rail service is limited by CFM's slot availability. At present, the company operates only four services per day, carrying around 12,000 passengers. Metrobus contends that this figure could increase to 18,000 passengers per day if the operational frequency could be improved to make more efficient use of the available rolling-stock. It estimates that one train arriving per hour at Maputo would be feasible.

Metrobus introduced a cashless ticketing system, offering integrated ticketing between its rail and bus services using a Mifare type smartcard, which is presently not interoperable with the AMT FAMBA card. While the same card can be used for the rail and bus services, travelers must pay for each stage of the journey individually, with no discount for transfers.

The fares set by Metrobus target the middle-class commuter sector and are higher than the fares for the public transport, *chapas*, and private bus fares. The one-way fares for 2022 are:

- MT 25 for the feeder bus (increased from MT 18 in 2020)
- MT 47 for the train (increased from MT 38 in 2020)

Monthly passes can be purchased for 2,500 Meticais to allow unlimited travel. A typical daily commute featuring a return rail and feeder bus journey would cost MT 128, so the monthly pass would be attractive to those using the mode for more than 20 days per month. Further discounts are offered on additional monthly passes for up to four family members, with a 50 percent discount on the price of a monthly travel pass.

Metrobus' business plan (pre-COVID) was to achieve profitability by the fifth year of its operation, specifically, in 2023. Regrettably, more detailed financial information from Metrobus is not currently unavailable.

Human Resources

In 2018, CFM established a dedicated passenger service department, distinct from its freight services. This passenger service department includes four divisions: protection, safety, and environment; coordination, operation and maintenance; commercial services; and administrative services. The service team comprises 209 employees, including all management and operational personnel. Of these, 15 are principal train drivers, 15 are shunter drivers, two are circulation and traction inspectors, 88 are station staff, and 88 are circulation agents (*factores*).

National and local government, government agencies, and academia in the transportation sector lack capacity, resources, and effective institutional coordination. Different levels of government grapple with issues of manpower, specialized skills, and expertise in urban transportation planning, regulation, management, and financing. Notably, since its inception, CFM has had a tradition of training its own staff, and promotes courses for training locomotive drivers, track supervisors, maintenance workers, and other personnel in its own training schools.

As in most countries, the introduction of more sophisticated rolling stock, signaling, and telecommunications will require training by the manufacturers and/or specialized instructors, as well as the acquisition of training equipment such as train simulators. Furthermore, training

programs targeting top and middle management, including those who interact with railway users, may require specialized courses and instructors distinct from those that are focused on freight transport. Any investment in urban rail must include a comprehensive plan for training to ensure proper operations and maintenance of track and rolling stock.

Operations and Safety

CFM accident and incident statistics from January 2017 to September 2022 indicate that about 140 incidents were recorded, of which five were train collisions, 30 were derailments, 29 were grade-crossing incidents, and 48 were run-over incidents involving rolling stock outside grade-crossings. Earlier in 2002, a serious accident occurred involving a mixed freight and passenger train, resulting in the tragic loss of 200 lives and numerous injuries in the village of Tenga on the Ressano Garcia line.

Considering the high number of grade-crossings, the potential for collisions remains a concern. Improved signaling and telecommunications as well as track maintenance may be necessary as initial steps to improve the operation of CFM's existing network and improve the performance of both Metrobus and CFM's passenger services.

Single-track operation of freight and passenger trains requires very specialized staff. Should the decision be made to run DMUs, an automatic train protection system to avoid train collisions might become necessary. A study to review the overall operations practices, safety, and the use of the single track by both operators, with the main objective of improving operations and safety and minimizing accidents and derailments. Special attention should be given to grade crossings and the need to replace them by under- or overpasses whenever traffic volumes warrant such measures.

Development Potential

Transit-Oriented Development

Over the last four decades, AMM has undergone a remarkable transformation, with the core of Maputo City expanding into what were once rural areas, including Matola, Boane, and Marracuene. Notably, Matola's population recently overtook the municipality of Maputo, which continues to serve as the hub of most services and corporate headquarters of the main economic groups, public companies, and private companies. Urban growth within AMM has unfolded in the context of low density and sprawl, resulting in expansive land areas, and longer travel distances.

An analysis of AMM's urban footprint reveals that railway and bus stations and road and railway infrastructure have stimulated urban development. Although no tool⁹ is openly available for systematically assessing the urban densities and land use around railway and stations in AMM,

⁹ There have been various unsuccessful attempts to support the development of SIG for land administration and land cadaster in AMM. A recent experience was the SIGEM by PRO Maputo, but there seems to be a lack of political commitment to update these information tools and make them available to professionals.

recent innovative approaches¹⁰ have been employed to determine the quantity and quality of buildings in the ring road. This analysis indicated a surge in development from 13 percent of the area around the ring road in 2010, before its construction, to 50 percent in 2018, just before the handover of the infrastructure. While most land adjacent to the railways is occupied, a general commitment exists to preserve land for transportation purposes (Fisker, Malmgren-Hansen, and Sohnesen, 2019). Areas around transportation infrastructure are being rapidly occupied and progressively densified, underscoring the need for a coherent TOD strategy.

Despite the lack of many land use planning instruments, the TOD concept can be applied, particularly to specific areas around stations through zone planning instruments. Ad-hoc implementation and coordination mechanisms that are institutionalized can support a coherent urban development strategy aimed at intensifying investment along transportation corridors. In the short term, AMM's governance bodies could be granted formal representation on the AMT Board. This would facilitate the integration of urban transportation and land planning, aiding densification along the rail lines and generating additional ridership for rail.

Maputo's PEU categorizes population densities as: (i) high, with 300-500 inhabitants/ha; (ii) medium, with 150 to 300 inhabitants/ha; and (iii) low, with less than 80 inhabitants/ha. As a reference, the city's most densely populated neighborhoods have average densities of 200 inhabitants/ha.¹¹ From an urban planning perspective, the stations areas and the three suburban railways can be categorized into three types of sections at different stages of urbanization:

- Consolidated urban sections. These areas are fully occupied, and feature a mix of industrial, commercial, and residential uses.
- Rapidly urbanizing sections. Most of the land adjacent to railway is urbanized or has started rapid urbanization processes, and is currently occupied. Little scope exists for greenfield development. Major stations such as Maputo Central, Machava, Mavalane, Marracuene, and Matola Gare still possess space for expansion and improvements through smart design and densification.
- Non-urbanized sections. Agricultural areas located south of AMM offer potential for greenfield development, with opportunities for new stations in Zimpeto or Boane.

The World Bank's support for infrastructure investments in Maputo shows that land use change can stimulate private investment in housing and business development. If systems are in place, new formal housing units can enter the land registry and cadaster, and bolster property tax collection which can support sustained service delivery. Similarly, business development can have a multiplier effect on local job creation and growth. The implementation of a shared metropolitan spatial plan, coupled with housing policies and planning instruments, can facilitate coordination and address the impact of gentrification.

¹⁰ To offset the lack of cadastral data, convolutional neural networks were trained on approximately 200,000 tagged satellite images of structures and non-structures in the urban areas of Mozambique. High-resolution satellite images enabled researchers to classify and detect buildings between 2010 and 2018 to compare the distribution of houses before and after the construction of the ring road.

¹¹ According to the 2017 census data, the district of Chamanculo is AMM's most populated neighborhood, at 192 hab/Ha. Ka-Mavota is the second largest at 105 hab/km.

Private Sector Participation

Mozambique's experience with Metrobus underlines the potential for private sector participation in providing rail suburban rail service in Maputo and other cities. The key requirements for building upon this experience are:

- obtaining government funding to bridge the gap between ticket revenues and costs
- establishing clear processes for licensing operators. The processes should include the demonstration of technical competence, financial viability, proper insurance and good standing, and a viable operating plan and safety case
- ensuring oversight by CFM to provide sufficient train slots, fair pricing, and compliance with service agreements so that suburban services meet the mobility needs of passengers

As the rail track belongs to CFM, any expanded use of CFM's infrastructure needs to be supervised by a third party acting as a regulator; this role could be assumed by the MTC or an independent transport regulator. Additional commuter services may require government investment in infrastructure to accommodate more passenger trains while still meeting freight train requirements.

Other rail-based mass transit options are being proposed to AMT. These are likely to be built under a design, build, operate, maintain and transfer contract structure. Clarity on regulatory and oversight responsibilities will be critical for these partnerships. To attract private sector participation, defining how the difference between social tariffs and breakeven tariffs will be compensated and how risks can be mitigated and shared with the infrastructure owner will be critical. Defining the minimum operating, financial, safety, and health-related requirements for companies to qualify is also important. Table 3.3. summarizes the proposed projects.

Mozambique has adequate PPP legislation and regulations and has previously concessioned several freight and passenger corridors to the private sector. The regulatory function typically falls under the purview of the MTC, which often delegates it to CFM. To encourage greater private sector participation, the establishment of an independent regulatory agency is advisable. However, it remains unclear if MTC and/or CFM have the skilled manpower to monitor PPP contracts.

Image 3.3. Passengers boarding commuter Trains in Maputo



Source: Reddit, User: Jonas543.

Table 3.3. Rail Transportation Projects Proposed to AMT

Proposal	Description	Proposed by	Estimated Cost (USD)
Alternative 1	Use the existing CFM right-of-way and add single or double track, signaling, and rolling stock	JICA in Transport Master Plan	N.A
Alternative 2a	Share tracks with CFM freight through investments in signaling/track rehab/electrical equipment	Metrobus	112 million
Alternative 2b	Build dedicated greenfield track of 23 km	Metrobus	N.A
Alternative 3a	Build new 21 km and 7 stations between Maputo station and Machava Bunhiça to be operated with EMUs or DMU	China Rail and Bridge Corporation (CRBC)	Electrical: 850 million Diesel: 500 million
Alternative 3b	Instead of EMU, use the trackless advanced rapid transit system (ART)	China Rail and Bridge Corporation (CRBC)	N.A
Alternative 4	Build a 18.1 km new track, mostly elevated, for a rubber tire intermediate capacity transit system	Japan International Consultants for Transportation Co., Ltd. (JIC) Yachiyo Engineering Co., Ltd. Fukken Engineering Co., Ltd.	N.A

Source: AMT, World Bank Compilation based on presentations to Maputo Municipality, 2022.

Note: Costs were estimated by the proponents.

Finally, the Government should evaluate the advantages/disadvantages of establishing a separate entity within CFM to operate urban rail services itself, through management contracts, or through concessions to the private sector.

Potential Technological Innovations

Rail technological innovations needed are those that will enhance operations, safety, and capacity to operate more trains on the existing CFM network. They are: signaling and telecommunications equipment, acquisition of new rolling stock, improvement of grade-crossings, and user-friendly equipment at stations. The proposed electrification of certain CFM lines must ensure that the supply of electricity is adequate in the AMM to avoid operational disruptions experienced in other developing countries. Automatic train protection should be considered if the frequency of train services increases dramatically, as forecast in the PDTU.

AMT has already developed an automatic fare collection card; however, it is not used across all modes. Stations could be outfitted with equipment indicating arrival and departure times, escalators/elevators where required, and surveillance cameras to improve personal safety.

If one of the more advanced alternatives proposed is selected and implemented, staff training in the maintenance and operations of the equipment is imperative. This task is typically undertaken by the suppliers of equipment, but meticulous planning by AMT is needed as well.

Conclusions and Recommendations

The AMM is growing rapidly and will soon reach a population size of approximately 4 million inhabitants. An estimated 40 percent of the daily trips are by foot. Motorized trips—the remaining 60 percent, are primarily by road vehicles, which contribute to worsening congestion and accidents, becoming a serious problem. The need for cheaper housing is driving urban expansion to the periphery, while jobs and services remain concentrated in the center of Maputo. This is creating sprawl and longer commutes.

AMM has established the AMT to oversee the integrated development of urban transport, coordination of land use, management of air quality, and evaluation/prioritization of urban transport investments. A Transport Master Plan has been prepared, but periodic updates are needed. The absence of clear and reliable financing and funding mechanisms for the urban transport sector is a significant challenge. Private sector participation in urban transport is presently limited to minibus/bus operators, along with a single rail and bus operator (Metrobus). While the legal framework accommodates PPP, capacity in structuring, tendering, and overseeing PPPs is limited.

Rail accounts for only 1 percent of the motorized daily trips (about 32,000 passengers per day). CFM, the national railways and ports state-owned enterprise, operates some services and provides infrastructure to Metrorail to provide others. CFM's primary focus is freight services, and it has no incentive to prioritize infrastructure for passenger services. The fare for CFM's existing commuter services is well below operating cost and commuter services are cross subsidized by CFM's freight transport revenues, creating another disincentive to promote commuter services. Although both CFM and AMT are under the jurisdiction of the MoT, their coordination and collaboration is unclear.

The Transport Master Plan indicates that three existing rail corridors have the potential to transport more than 300,000 passengers per day in the medium-term. To attract more users, the frequency at peak hours needs to increase dramatically. Specific investments in sidings/double track, station accessibility and rehabilitation, and signaling and rolling stock would be needed. However, such investments would be considerably less than building greenfield system. If well planned, these investments would also benefit CFM's existing freight and intercity passenger services.

In addition to increased service frequency, passenger access to stations needs to be enhanced. Metrobus' combined bus/rail service, which facilitates the first and last mile of the rail user, will attract passengers unable to walk or bike to the stations. For those who walk, bike, or use road transport, facilities such as paved walk/bike paths, bike racks, bus and auto drop off, and pick up facilities at stations will enhance the appeal of rail services.

As demonstrated by the Metrobus experience, the private sector may be interested in operating on CFM tracks and paying an access fee for their use. Metrorail could extend its bus/rail combined service if more operating slots were made available. For services targeting lower-income residents, government needs to find a funding mechanism to cover the subsidy between the social tariff and the breakeven (technical) tariff before either CFM or private operators will be interested in operating commuter services. CFM or the private operator would need strong confidence in timely payment of subsidies. Otherwise service will rapidly degrade and discourage existing and potential users.

“ For services targeting lower-income residents, government needs to find a funding mechanism to cover the subsidy between the social tariff and the breakeven (technical) tariff before either CFM or private operators will be interested in operating commuter services. ”

Image 3.4. Trains at a railway station, Maputo, Mozambique



Source: Adobe Stock.

The private sector might also be interested in potentially profitable station redevelopment in main hubs such as Maputo and Matola, as well as in the development of low-income housing and advertising opportunities in stations and trains. Despite the lack of many land use planning instruments, the TOD concept can be adapted to relatively ring-fenced interventions (for example, specific areas around stations). A pilot project combining substantial rail improvements and low-cost housing along one of the lines could demonstrate whether ring-fenced interventions could be extended to other parts of the rail network. Implementation of non-rail activities must be entrusted to professionals in real estate rather than the general railway administration staff.

A mechanism to integrate land use and transport planning is needed. This could start as an ad-hoc implementation and coordination mechanism (such as a PIU), with a view to institutionalizing the experience in the medium and long term. Alternatively, integrating the municipalities and districts into the AMT Board can facilitate coordination with land management services. This will connect urban transport and land planning, facilitate densification along the rail lines, and generate additional ridership for rail.

Recommendations for the MoT, AMT, and CFM to enhance suburban rail services include:

- **Rail Master Plan.** Prepare a detailed Rail Master Plan for the AMM, emphasizing increased capacity and safety for operating commuter trains in the three existing rail corridors. This should include an evaluation of the cost and economic/financial returns for investments in track, systems, and rolling stock.
- **Investment Plans.** Based on the findings of the master plan, prepare short-, medium-, and long-term investment plans for rail for the three corridors.
- **Funding.** Define the proposed funding and financing mechanisms to bridge any gap between social and breakeven tariffs.
- **Institutional Arrangements.** Work with the MoT and CFM to define the institutional arrangements for providing enhanced and more frequent suburban service on CFM lines, either through contractual agreements or access arrangements.
- **TOD Pilot.** Develop an action plan for a pilot TOD project, potentially combining significant rail improvements with low-cost housing along one of the corridors. This will serve as a testing ground for extending ring-fenced interventions to other parts of the rail network, and ultimately, become a model for the development of the other corridors.

4



Suburban Rail
Corridors in
Nairobi

Introduction and Urban Context

The Nairobi Metropolitan Area (NMA) comprises the five counties of Nairobi, Kiambu, Kajiado, Machakos, and Muranga. The four counties served by commuter rail have a combined population of 9.4 million people, representing 19.7 percent of the total population of Kenya, and 31,000 square km (see Table 4.1). Rapid population growth strains transport infrastructure, often exceeding its existing capacity, especially during peak travel periods.

Table 4.1. Nairobi Area Served by Commuter Rail

County	Towns served	Population (persons)	Area (km ²)	Population density (persons/km ²)
Nairobi	Nairobi	4,397,073	704	6,247
Kiambu	Kikuyu, Limuru, Kahawa, and Ruiru	2,417,735	2,539	952
Kajiado	Kitengela	1,117,840	21,871	51
Machakos	Athi River and Lukenya	1,421,932	6,043	235
Total Population of the 4 Counties		9,354,580	31,156	

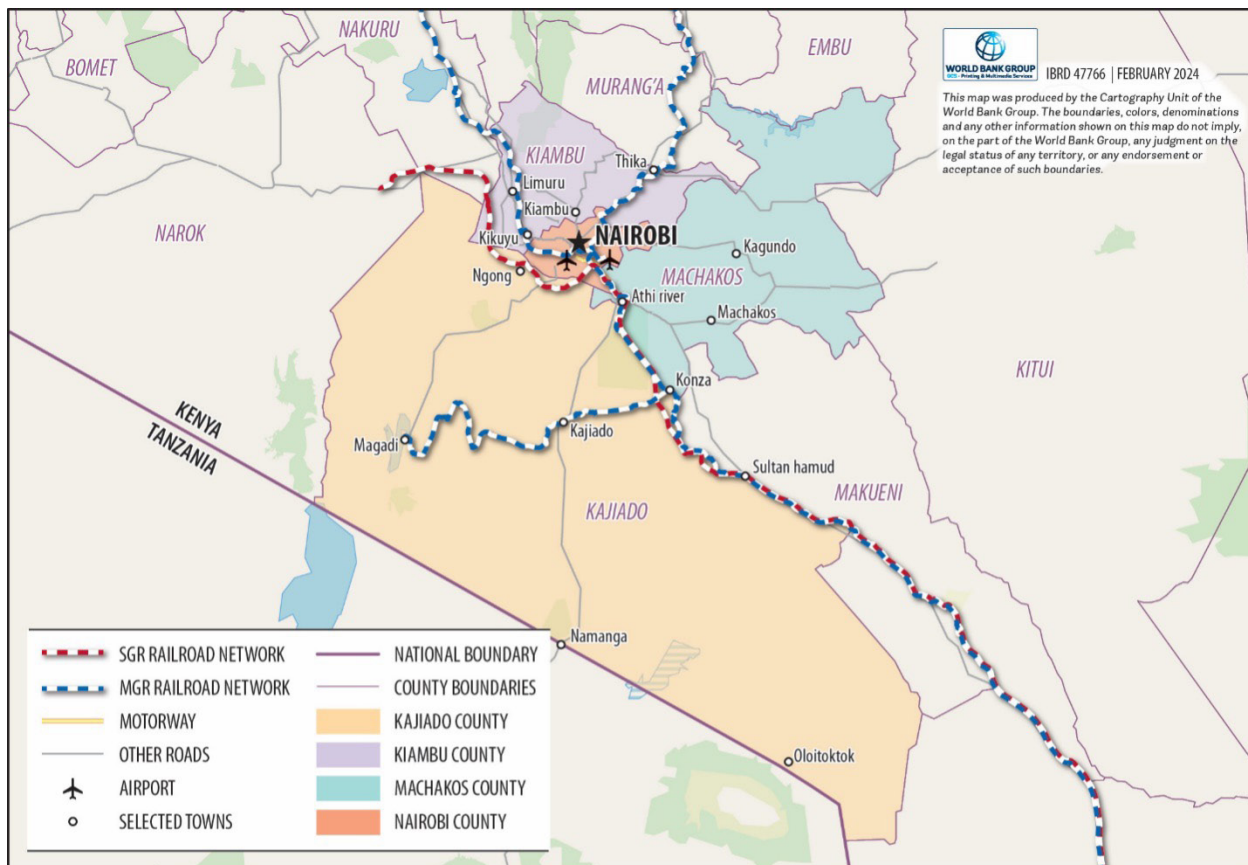
Source: (KNBS, 2019).

Urban transport in Nairobi is dominated by road-based services, including privately-owned buses and minibus taxis (*matatus*), motorcycles, private cars, and non-motorized transport. Walking is the dominant means of transport (45.6 percent trips), followed by *matatus* (40.7 percent), private transport (13.5 percent), and commuter rail services at 0.2 percent (County Government of Nairobi, Final Report, Part III – Appendix, 2014). Most low-income residents walk because of the unaffordability of public transport or its inability to connect their journey origins and destinations. Figure 4.1. illustrates the main transport infrastructure of the four counties and major towns.

Image 4.1. Nairobi Central Train Station



Source: Macabe5387/Wikimedia (CC BY-SA 4.0).

Figure 4.1. Nairobi and the Neighbouring Counties

Source: World Bank.

Structure and Coordination of Commuter Rail Services

Institutional Arrangements

Three ministries; four State Departments; and multiple public authorities, county governments, and private operators are involved in Nairobi's urban development and urban mobility (see Figure 4.2).

The roles of the key players are:

- Privately owned bus and mini-bus operators that provide transport services in the NMA, operating under the banner of Savings and Credit Co-operative Societies (SACCOs). The National Transport and Safety Authority (under the Ministry of Roads and Transport, State Department for Transport) licenses SACCOs to operate on specific corridors in the NMA.
- Kenya Railway Corporation (KRC), which operates the Nairobi Commuter Rail (NCR) services. KRC is the owner of the railway infrastructure, the sole rail services provider and regulator of rail sub-sector in Kenya. It derives its mandate from the KRC Act (Cap 397), 1979, which entrusts

it with responsibilities for passenger carriage, freight operations, ownership and maintenance of infrastructure, and safety regulation. The Act also grants the KRC Board the authority to engage in concession agreements for the provision of railway transport. The Ministry of Roads and Transport, State Department for Transport, supervises KRC.

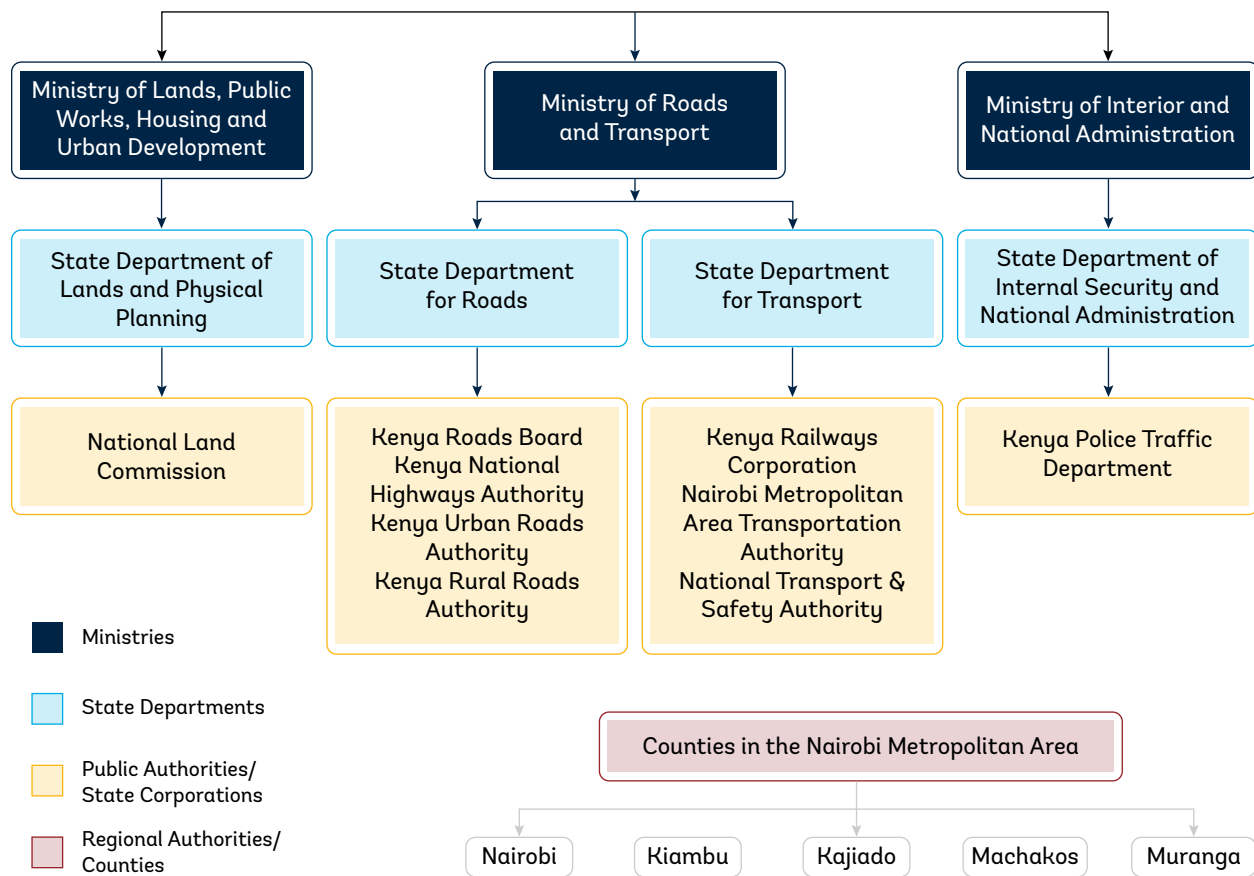
- The Kenya National Highways Authority and Kenya Urban Road Authority (under the Ministry of Roads and Transport, State Department for Roads), which are responsible for the development and management of national roads.
- The five county governments in the NMA, which manage county roads, street lighting, traffic flow and parking, and public road transport. Their responsibilities include regulation of infrastructure development and services; development of transport plans and bus routes; and promotion of non-motorized transport. They currently have no role in commuter rail services; however, they have legal mandates for land use planning and development control, including over land belonging to KRC.
- Nairobi Metropolitan Area Transport Authority (NaMATA), which is responsible for the planning and development of mass rapid transit services across the NMA. NaMATA was established through Legal Notice No. 18 of 2017 to foster an enabling environment for the orderly and structured development of an integrated mass rapid transit system (MRTS), including bus rapid transit (BRT) and commuter rail within the NMA. It is tasked with planning, regulating, and coordinating the supply of adequate and effective mass rapid transit.
- The National Land Commission, operating under the Ministry of Lands, Public Works, Housing and Urban Development, which is responsible for land administration.
- The Ministry of Interior and National Administration, which oversees the operation of the Kenya Police Service to ensure the enforcement of law and order, including the security of rail freight and passengers.

Image 4.2. Nairobi Commuter Rail



Source: Akiko Kishiue.

Figure 4.2. Institutional Framework for Urban and Transport Development



Source: World Bank.

The planning and development of urban transport is currently undertaken independently for each mode of transport by the national institutions and county governments. The planning and development of commuter rail infrastructure and services is an overlapping function of KRC, NaMATA and the county governments, but currently the legal mandate of KRC. The Integrated National Transport Policy guides that the fares regulation, minimum service requirements, and financial support should be managed jointly, but separately from service-delivery (Republic of Kenya Ministry of Transport. 2009). NaMATA has the mandate to develop a financing mechanism for the development of BRT and rail corridors.

At the operational level, urban rail services function without coordination with road-based passenger transport. Nairobi Commuter Rail (NCR) schedules only align with the standard gauge railway (SGR) passenger services to Mombasa, and the last-mile bus connectivity offered by KRC. Consequently, various transport infrastructure and services in Nairobi do not complement each other. A structured collaboration framework is needed between the relevant institutions.

The institutional coordination framework for land use planning and control is set out in the Physical and Land Use Planning Act, 2019. This legislation acknowledges the need for planning entities to consider approaches such as transit-oriented development (TOD), mixed land-uses, planning for public transport, and non-motorized transport. The Act establishes the National Physical and Land Use Planning Consultative Forum to facilitate consultations on the national physical and land use development plan. It assigns the National Land Commission the role of monitoring and overseeing land use planning throughout the country, aligning with the Constitution of Kenya. The office of the Director General of Physical and Land Use Planning is responsible for formulating national physical and land use planning policies, guidelines, and standards, and for the preparation of national physical and land use development plans.

The Act also establishes a County Physical and Land Use Planning Consultative Forum in each county for consultations on county and inter-county physical and land use development plans. County governments are entrusted with formulating county policies on physical and land use planning and fostering the integration of county-level physical and land use planning functions and sectoral planning levels.

The roles of the key players encompass:

- The Ministry of Lands, Public Works, Housing, and Urban Development, which exercises oversight over land titling, land valuation, surveying and mapping, physical planning, and plot allocation/alienation.
- The Department of Housing and Urban Development, which is responsible for providing adequate and decent housing in a sustainable environment and coordinating urban development and policy, including urban planning policies for townships, municipalities, and cities.
- The Department of Land and Physical Planning, which prepares national spatial- and cross-county plans. The National Land Commission within this department, has the constitutional mandate to:
 - manage public land on behalf of the national and county governments
 - recommend a National Land Policy and guidelines and standards to the national government
 - assess tax on land (land rent) and premiums on immovable property in any area designated by law
 - monitor and oversee land use planning throughout the country and prepare national physical and land use development plans
- The County Government Act, 2012 gives county governments the authority to undertake land use planning and approvals within their jurisdiction. The county planning framework integrates economic, physical, social, environmental, and spatial planning aspects. Transport infrastructure, including railway tracks and stations, fall within the physical aspects of this framework. Differences in county governments' land regulations concerning KRC development complicate approvals. The lack of enforcement of these regulations results in encroachments and illegal possession of KRC land and railway reserves.

The administration and management of land and land-based resources are governed by the Land Act, 2012. Although the application and approval of land development is submitted to the relevant County government, the Department of Land and Physical Planning must provide no objection for these applications. Land rates are determined and collected by the county governments.

Urban and Mobility Plans for Nairobi

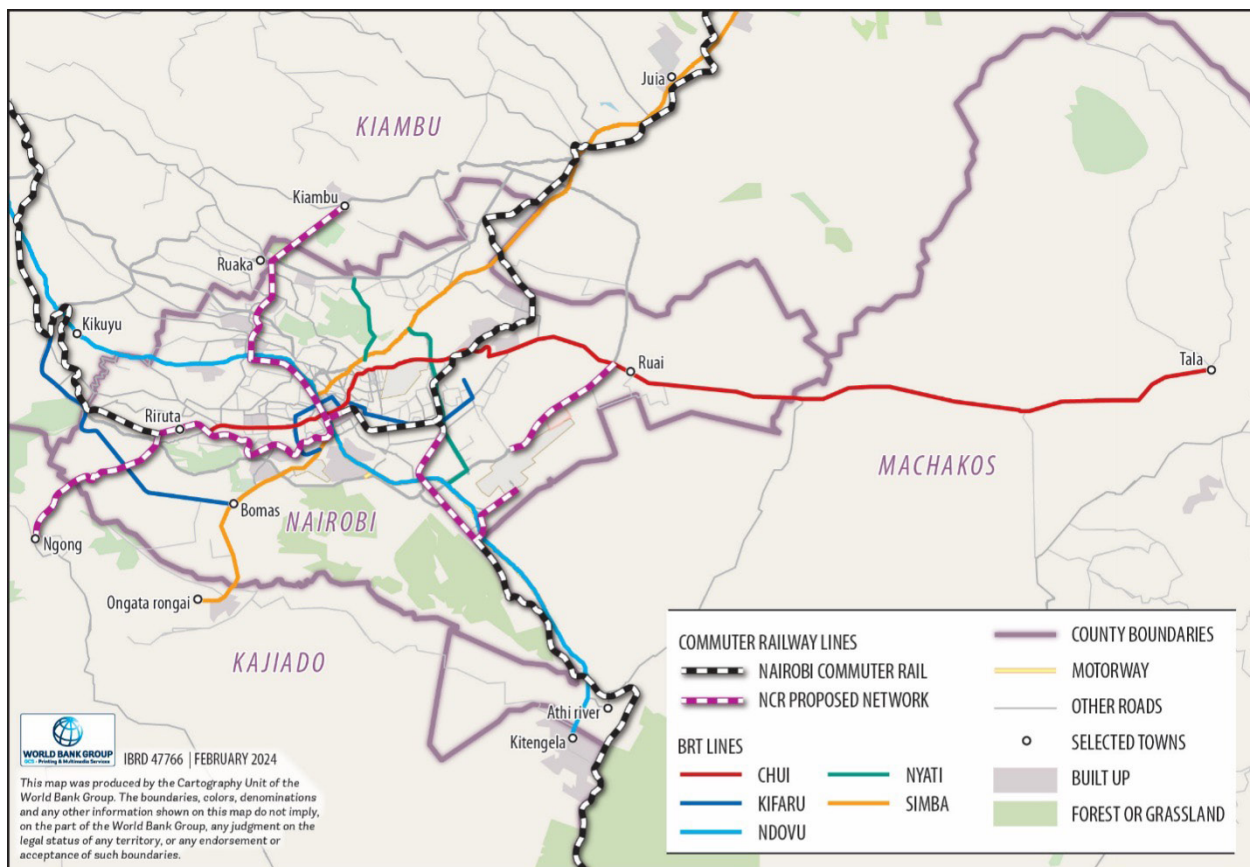
Several urban spatial plans, policies, and urban mobility plans guide the development of Nairobi. These include:

- **Nairobi City County Land Use Policy.** The policy advocates an integrated approach to infrastructure and utility service provision, encouraging collaboration between infrastructure and service providers at the planning stage of development to align with the designated land use. Mixed land uses can be developed around the stations; for example, KRC plans to develop approximately 118.17 ha of land around the Central Railway station in the “Railway City” development (NCC, 2021).
- **Nairobi City County Development Control Policy.** This policy sets out the parameters for evaluating development applications for land use and granting approvals within Nairobi City County. The development control guidelines in this policy covers various aspects including the allowable plot ratio, ground coverage, number of levels/skylines, minimum plot sizes, and development typologies within designated zones (NCC, 2022).
- **National Spatial Plan (2015-2045).** The Spatial Plan recognizes rail transport as the second most important mode in Kenya and proposes improvements in the institutional management of railway transport and development of rail transport in urban areas (Government of Kenya, 2016).
- **Nairobi Integrated Urban Development Master Plan (2014-2030).** The plan outlines an elaborate development plan for the transport sector, including commuter train operation in Nairobi City and surrounding towns. It proposes a light rail circular route in the city center, the introduction of diesel multiple units (DMUs), track rehabilitation of existing KRC lines, and the introduction of signaling system for DMU operations (County Government of Nairobi, 2014).
- **Local Physical Development Plan for Nairobi Railway City (2019).** This plan proposes three urban cores: (i) a Center Core; (ii) a commercial mixed-use infrastructure with conference and exhibition facilities, complemented by office and housing functions; and (iii) the East Core, designated as a public space area with public anchor programs. Other proposed zones include a street commercial area intended as an economic activity catalyst, a main housing area, an international office zone, hi-tech industrial/small medium enterprises zone, a financial district, and a research and development knowledge hub zone (Dohwa Engineering, 2019).
- **Spatial Concept for Nairobi Metropolitan Region.** It proposes six new towns within the Nairobi Metropolitan Region, each anticipated to accommodate a population of 100,000. This would account for around 10 percent of the envisaged population growth outside Nairobi City County. The projected population increase signifies the potential for increased demand for commuter rail services and TOD within the region (Government of Kenya, 2011).

- **Nairobi MRTS Harmonization study.** It defines the MRTS corridors for BRT and rail in Nairobi (Gauff Consultants, May 2014).
- **Commuter Rail Masterplan.** It forecasts ridership and delineates the investment needed to provide quality commuter rail service in the NMA in a phased manner.

The NaMATA Council officially declared the MRTS corridors through a legal notice in February 2019. The declared corridors are five BRT lines and seven commuter rail lines (Figure 4.3.). The seven commuter rail lines are also identified by the Nairobi Commuter Rail Masterplan. The proposed MRTS is expected to provide seamless movement within an integrated public transport service infrastructure and services, bridging road, rail, and air transport facilities in the NMA.

Figure 4.3. Mass Rapid Transit System Corridors in Nairobi



Source: World Bank.

The Nairobi Commuter Rail Masterplan (2018) includes rail passenger demand forecasts for the years 2030 and 2045. It identifies the required short-, medium-, and long-term actions, which can be justified by the increase in commuter rail ridership. The short-term actions include the modernization of the Central Station (Railway City project) and construction of several mini stations; rehabilitation of the tracks; grade separation of existing level crossings; construction of passing loops at stations;

and the acquisition of spare parts for rolling stock. It also proposes the setting up of a semi-autonomous commuter rail unit within the KRC establishment. The medium-term interventions up to 2030 include the construction of more stations, workshops, and new depot; refurbishment of the tracks; acquisition of new rolling stock and train control systems; and increasing accessibility and integration with road-based passenger services.

Since the railway functions as a system, significant outcomes can only be achieved if all key elements are in place. For the highest impact, the Masterplan should be implemented along with BRT/light rail transit (LRT) lines and feeder services such as paratransit, motorbike riders, walking, and cycling.

Commuter rail ridership is expected to increase to justify the implementation of long-term actions, which will require substantial investments between 2030 and 2045 and include: opening up new rail corridors to address higher demands; providing orbital connectivity; acquisition of land along the existing lines for additional right-of-way; construction of a new workshop outside the central station; urban integration and landscaping; power and water supply to all utility infrastructure; purchase of more rolling stock; and, installation of advanced information and telecommunication networks.

The 2030 Core Scenario network has a total length of approximately 165 km and 53 stations, and includes the existing commuter lines, extensions over existing railway lines, and two new lines. Commuter rail is forecast to provide 17 percent of all public transport trips in the NMR. The total forecast demand for commuter rail is 1.4 million per weekday. By 2030 an estimated 6.2 million people will live within three km of a Commuter Rail station. This will rise to an estimated and 9.3 million in 2045.

The other proposals in the Masterplan include:

- an operational control center and back-up center with a train to track radio communication system
- an electronic interlocking-based signaling system and an automatic train protection system
- an automatic fare collection system
- a complete passenger information and public address system
- alternative renewable energy source options

Governance of Commuter Railway

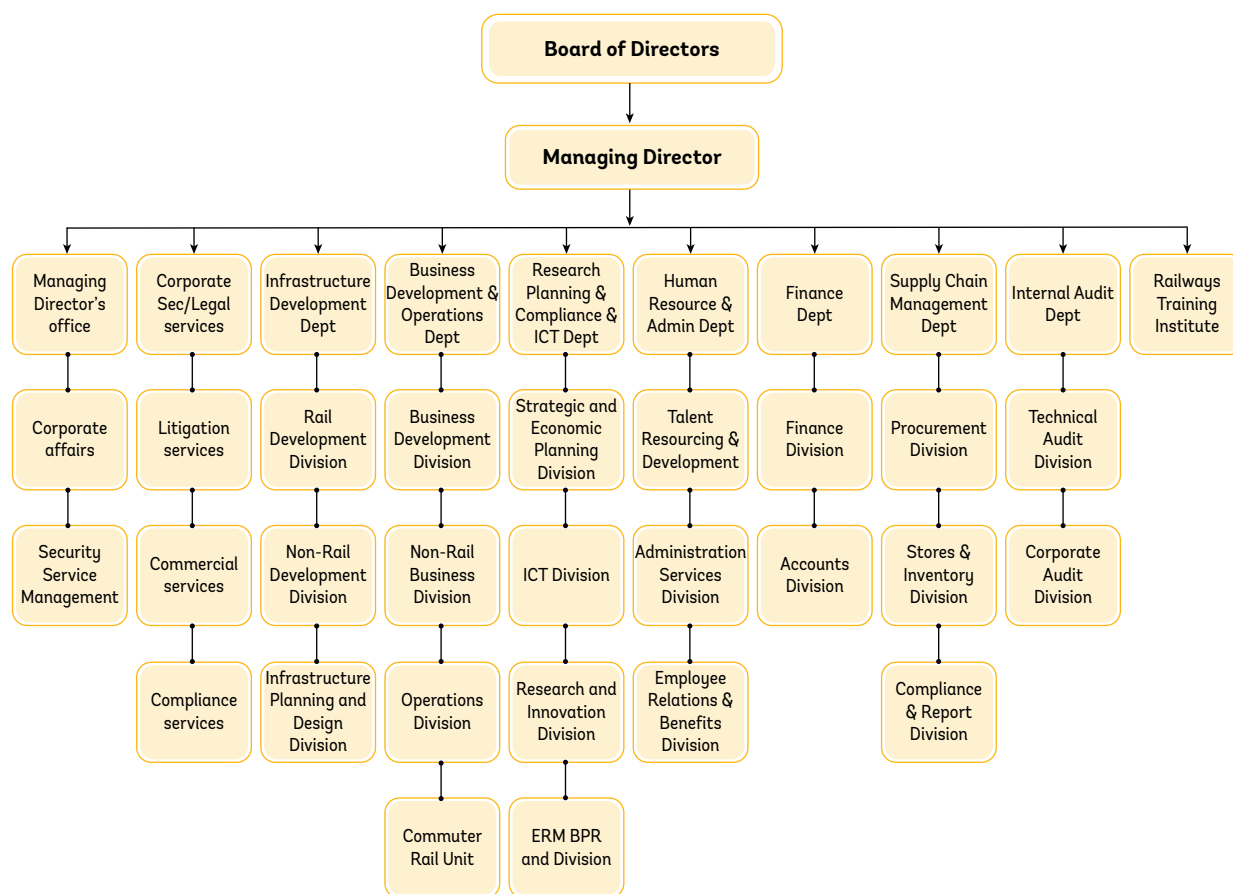
KRC is a State-owned enterprise (SOE), managed by a 11-member Board of Directors. The role of the Board is to provide strategic leadership and direction in decision-making. It makes recommendations to the Cabinet Secretary for the appointment of the key managers of the KRC. The Board is chaired by an appointee of the Cabinet Secretary of the Ministry of Roads and Transport and the Principal Secretaries responsible for Transport and Finance. The Managing Directors of KRC and the Kenya Ports Authority serve on the Board along with six independent individuals with expertise in commerce, industry, law, finance, and administration. Notably, specific passenger rail experience is not a prerequisite for Board selection.

KRC operations are guided by the national transport policy and strategies. Key performance indicators related to commuter rail in the Strategic Plan include:

- developing and rehabilitating 165 km of commuter rail tracks and stations in Nairobi
- transporting eight million urban commuters per annum by 2022
- developing and implementing a security management policy, including technology application in the security system
- engaging the private sector in rail development and operation

KRC adheres to the public sector management framework, encompassing public accounting, disclosure, compliance, and auditing. The KRC accounts are audited by the Auditor-General in accordance with the provisions of Section 47 of the Public Audit Act, 2015. Upon certification, the audit findings are presented to the Board for review and submission to the parent Ministry, followed by presentations to the Parliament. The annual reports on operating results and audited financial statements are made available to the public.

Figure 4.4. KRC Management Structure



Source: Revised strategic plan, 2017-2022.

The NCR is managed by a unit under the Operations Division of the Business Development and Operations Department, which is one of the nine departments at KRC (see Figure 4.4.). The commuter rail unit works closely with three other units:

- freight services, as they share the same tracks and locomotives for passenger services
- the workshop unit in charge of maintaining locomotives
- the security and safety unit

Additionally, the SGR unit provides commuter services between Ngong and the Syokimau stations. The other key departments that closely interact with this unit are:

- the Infrastructure Development Department, which is responsible for planning, development, and maintenance of the tracks
- the Railways Training Institute, which is responsible for capacity development in rail-related and business courses
- the Finance Department, which is responsible for accounting and financial reporting

Traffic, Markets, and Access

Traffic and Market Share

Walking is the main form of mobility in Nairobi. Motorized transport is primarily provided by privately owned and operated minibus taxis, commonly known as *matatus*. These *matatus* are organized within Savings and Credit Co-operative societies and are licensed to operate in designated corridors by the National Transport and Safety Authority. In addition to the *matatus*, Nairobi has about 13 bus management companies. Motorcycle taxis, locally referred to as *boda-boda*, are used to transport both goods and passengers. Their popularity is due to their ability to navigate congested roads faster than car taxis while being more economical, but their fares are higher than those of *matatus*.

Ridership data collected between 2018 and 2021 indicates that the Nairobi commuter rail passenger traffic was 100 million passenger-km annually. Although passenger traffic volumes had been increasing since 2018, a steep decline occurred in 2020, mainly due to the closure of two lines and the shut-down due to the COVID-19 pandemic. However, the situation normalized in 2021 following the rehabilitation of railway lines, refurbishment of old coaches, integration with feeder buses, and the acquisition of 11 refurbished diesel multiple units (DMUs). The ridership is projected to reach 200 million passenger-km after the implementation of the NCR Masterplan in 2030.

The bus and *matatu* passenger surveys undertaken for the preparation of the NCR Masterplan revealed that the railway was not a viable alternative for many passengers because it provides services only during peak hours, on a skeleton network. However, most passengers interviewed

responded that if service were available, their mode choice would primarily be influenced by its cost, comfort, journey time, frequency of services, and reliability, in that order. The results also revealed that car users were the most willing to switch to commuter rail and BRT, possibly indicating strong dissatisfaction with the levels of congestion on Nairobi roads.

The potential shift from current road-based services to commuter rail would be possible if fares remained lower for comparable trips, coaches were more comfortable, journey times reduced, and services became more frequent. This calls for a combination of interventions:

- increasing service frequency and regularity
- acquiring new rolling stock
- increasing mixed land use densities around commuter rail stations
- expanding service coverage through track rehabilitation, extensions, and construction of new tracks and stations
- integrating services and fares with road transport
- implementing variable fares policies based on time of day and distance.
- providing park-and-ride facilities with lower daily parking fee than in the central business district (CBD).

Access and Inclusion

KRC indicated that the commuter rail service mainly serves people with low to medium income living in high- and medium-density residential areas along the commuter rail lines. They commute to the CBD mainly for work, business, and educational purposes. However, the line connecting Embakasi Village and Syokimau from the CBD serves passengers heading to Jomo Kenyatta International Airport and the Standard Gauge Rail, respectively.

Setting or adjusting passenger rail fares requires approval from the KRC Board and the Cabinet Secretary, Ministry of Roads and Transport. The fare structure has two forms: a fixed fare of KSh100 for the two routes where DMUs operate and distance-based fares ranging from KSh35 to KSh100. The fares are somewhat held down to make rail more affordable than road-based services. However, a high passenger fare of Ksh250 is charged for commuter services offered by the SGR trains between Ngong and Syokimau SGR stations.

Currently, road-based passenger services and commuter rail services operate largely independent of each other with minimal physical, operational or system integration. This lack of integration arises partly because the commuter rail lines were originally built for freight transport and inter-city passenger service. Few investments have been made to physically integrate rail and road infrastructure other than station improvements.

A study on gender in urban transport in Nairobi (Kishiue, Dominguez Gonzalez, and St. John, 2020) concluded that women were more likely to choose a mode based on its cost and availability than on

comfort. It also highlighted that personal security on public transport received the lowest ratings by both men and women. Notably, KRC has not recorded any cases of gender harassment or violence at their stations and on-board the trains. KRC measure to address security include CCTV surveillance cameras at entry gates and within stations, adequate lighting, and deployment of police officers and security guards on each passenger train.

Women would like choose commuter rail, if it were available for their intended trips, as its fares are currently lower than *matatus*' or buses'. However, as train trips involve walking at both the beginning and end of trips, women and girls face a higher risk than men of robbery or harassment on this part of the trip, especially during early and late hours. This issue should be addressed by improving safety and security for pedestrians, cyclists, and motorcyclists between railway stations and neighboring residential areas.

Although the NCR has reserved spaces in the coaches for persons with disabilities, many stations lack inclusive design features. The Syokimau station is an exception, providing an elevator, escalator, and toilets for persons with disabilities. NCR stations also lack tactile features, posing a challenge for visually impaired persons.

Rail Services in Nairobi

The Nairobi commuter rail network is 148.4 km long. The lines and services provided are shown in Table 4.2.

Table 4.2. Nairobi Commuter Railway

Line	Route	Length (km)	# Train Pairs Operated
1	Limuru-Kilkuyu ~ NCR	46.1	1
2	Ruiru ~ NCR	31.8	2
3	Lukenya ~ NCR	42.2	2
4	Syokimau ~ NCR	15.3	7.5
5	Embakasi ~ NCR	13.0	7.5
Total		148.4	20

Source: Data provided by Kenya Railways.

The network has 16 stations, 10 of which were improved with World Bank support under the Nairobi Metropolitan Services Improvement Project. Another 20 halts – designated locations without facilities where the train stops to allow passengers to board and alight – are being upgraded to mini-stations.

Currently, service frequencies are very low, constrained by the availability of rolling stock. The NCR operates with seven locomotives (shared with freight services), 57 coaches, and 11 second-hand reconditioned DMUs (20 to 25 years old) purchased from Mallorcan Railway Services. The locomotives and DMUs are often out of service,¹² severely limiting efforts to increase service quality and frequency. The shared track is old and requires frequent maintenance.

The NCR also operates six buses that offer last-mile connectivity from the central station, including one service to the airport.

Human Resources and Capacity Enhancement

Currently, the NCR has a workforce of 144 employees, with 61 percent being male and 39 percent, female. The head of the Unit has a post-graduate degree, and is assisted by:

- six passenger service officers, all of whom are graduates
- 88 passenger service assistants
- 11 DMU drivers
- nine commuter locomotive drivers
- 29 station masters

Security is provided by the Kenya Police Services officers who are permanently assigned to the NCR.

KRC provides training in rail-based and other professional topics, both in-house at the Railway Training Institute (RTI) and externally. The RTI offers courses including in engineering, architecture, and quantity surveying and business courses in logistics, management, accounting, ICT, sales and marketing, supply chain, human resources, and catering. Additionally, it offers rail courses such as rolling stock inspection, signaling and communications, passenger operations, locomotive driving, and railway construction and maintenance, among others. RTI awards qualifications from technician certificate to higher/advanced diploma. The institute trains both its staff and individuals from the private sector for a fee.

Operations and Safety

The NCR faces many operational challenges stemming from inadequate infrastructure, lack of resources and outdated technology. Under the current operating conditions, NCR cannot increase passenger traffic and compete with fully commercialized road-based passenger services. The commuter rail infrastructure, rolling stock, and operating systems require major upgrades and integration with road transport before the services can have any meaningful impact on Nairobi's transportation landscape.

¹² Currently, only five of the 11 existing DMU units are in operation. Six are out of service, because of faulty compressors, which power the braking system.

The KRC provides both the rolling stock and infrastructure for NCR. As the operator, KRC sets transit times and schedules but adopts fares as approved by the State Department of Transport. The NCR network is part of the existing meter-gauge main and branch lines initially designed for freight and long-distance passenger services. The lines radiate from Nairobi's CBD to the industrial areas, through residential estates, and towns in various directions, including the North-West (Naivasha and Nakuru), the North-East (Thika and Nanyuki), and South-East (Machakos and Mombasa).

Commuter rail services are available during the morning and evening peak hours on five routes: from Nairobi to Embakasi Village (14 km), Kikuyu (31 km), Ruiru (32 km), Syokimau (16 km), and Lukenya (42 km). The services operate on single tracks, covering a total length of about 165 km, and servicing 16 active stations. No electrified lines and services are available.

Scheduled services are only provided throughout the day on two lines: the Nairobi Central Station to Syokimau line, which is linked to the SGR passenger services to Mombasa; and the Nairobi Central Station to the Embakasi village, which is linked to the Jomo Kenyatta International Airport via a KRC bus service. NCR also operates bus services that provide last-mile connectivity to and from the central station. To accommodate the rising needs of suburban transport, the NCR has proposed extending two lines: from Syokimau to the international airport (3.8 km), and Lenana to Ngong (13.6 km).

The maximum safe speed allowed on the tracks is 50 km/h for DMUs and 40 km/h for locomotive-hauled trains, although the tracks can handle 70 km/h. Maximum speeds are sometimes restricted to 20 km/h on long sections that are in poor condition, resulting in slow travel times and a loss of rolling stock productivity. These low operating speeds make rail services unattractive compared to road-based transport for passengers with other alternatives.

Based on historical passenger volumes transported per day, the line with the highest productivity in terms of number of passengers per locomotive/DMU per day is the Ruiru line at 825 passengers, followed by the Limuru line at 350 passengers, Lukenya at 75 passengers, Embakasi village at 44 passengers, and Syokimau at 42 passengers. Their productivities are low due to the uni-directional journey towards the CBD.

Using the same tracks for both freight and commuter services affects productivity, as one of the two services is halted while the other occupies the tracks or the locomotive. This issue is compounded by use of obsolete train operations software at the Operation Control Center, which lacks real-time communication capabilities with the drivers, hindering the efficient coordination of services. The system used in the Operations Control Center is outdated and currently cannot schedule services, so train timetables are prepared manually and struggle to manage increased train services. Modernizing the system is crucial to accommodate expanded services on the shared tracks.

The locomotives in use are old and occasionally breakdown, causing operational disruptions. For increased ridership, KRC needs to buy more trains that can be fully dedicated to commuter transport. DMUs have proven to be reliable, but the procurement and delivery of spare parts must be addressed. Apart from enhancing journey speeds and availability of the locomotives/DMUs, short-term productivity can be improved by increasing the number of coaches for each locomotive. The aging shared rail tracks require frequent maintenance, rendering the lines uneconomical, limiting operating speeds, and thereby, making the train service unattractive due to prolonged journey times.

The commuter rail service has periodically suffered serious grade crossing accidents. KRC reported a tragic incident in 2013, when a commuter train collided with a bus at a level crossing, resulting in 11 fatalities and 34 serious injuries. This accident was attributed to a combination of poor manual road crossing control, use of an inadequately maintained locomotives, and lack of operational discipline. Again in 2017, several people were injured after a train crashed into a fuel tanker at another level crossing. Another grade crossing accident occurred in June 2022, when a commuter train collided with a lorry, claiming the lives of five individuals and seriously injuring 12 others.

To mitigate these accidents, KRC plans to install automatic controls at all at-grade road crossings. The other measures include fencing off the tracks, deployment of guards at various sections, and restricting locomotive speeds at level crossings. Safety measures will benefit from an ITS to control and manage road and railway traffic through a signaling system and an on-track train detection system.

Financial Situation and Funding

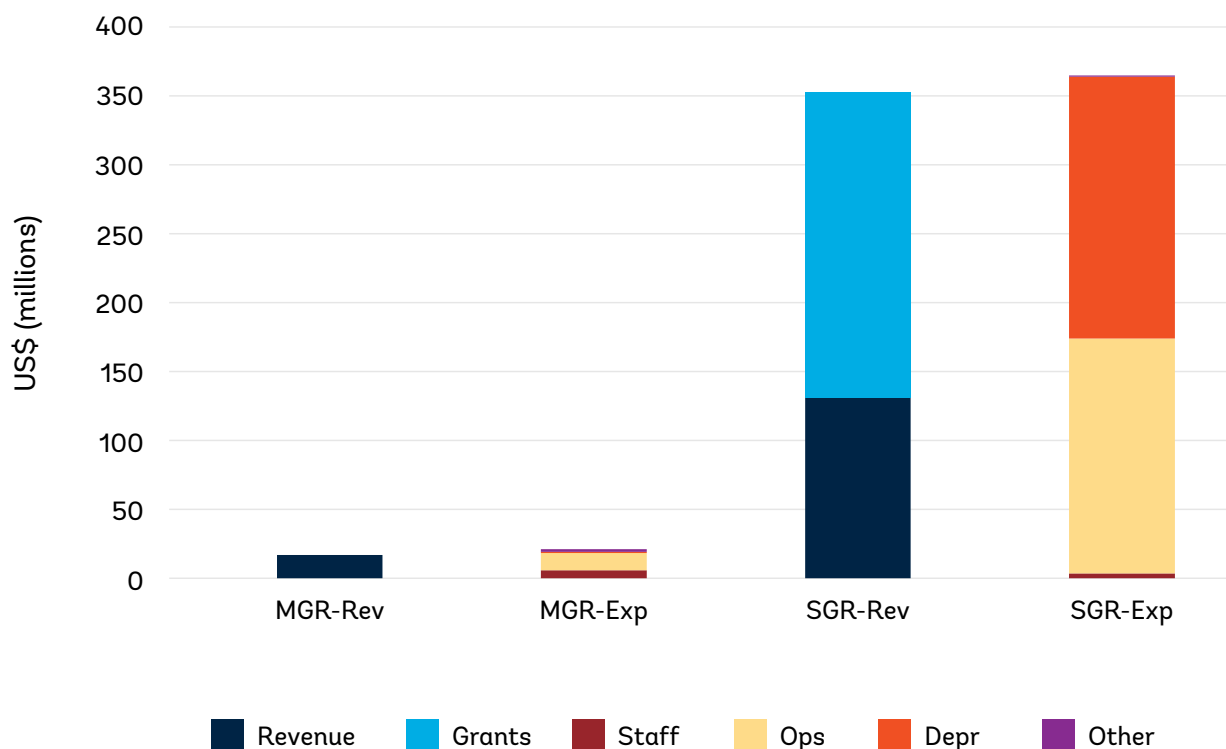
The Nairobi Commuter Rail finances are included in the overall finances of Kenya Railways and reported as part of the results of KRC's meter gauge railway operations. KRC's financial results are dominated by the standard gauge railway (SGR) operations. In the fiscal year ending June 30, 2021, the SGR earned KES 13.6 billion (~USD126 million) of passenger and freight revenue. However, this sum fell short of covering the KES 18 billion (~USD164 million) cost of the operations and maintenance contract for the line.¹³ The other large SGR operating cost was (non-cash) depreciation on the new SGR asset. The Chinese Exim Bank debt incurred to build the SGR has been on-lent to KRC. Thus, the SGR incurred KES 17.5 billion (~USD162 million) in financing charges and KES 644 million (~USD6 million) in penalties for non-payment of debt service obligations. The Government of Kenya provided operating grants of KES 23 billion (~USD 213 million) to support the SGR—almost enough to cover the gap between revenue and contract costs plus the financing charges (Figure 4.3).

Image 4.3. Passengers boarding in Nairobi Central Station



Source: Erasmus Kamugisha / Wikimedia (CC BY-SA 4.0).

¹³ KRC is gradually transferring functions under the contract to local control and staff. As this happens, the contract charges should reduce while staff and specific operational charges increase.

Figure 4.5. Kenya Railways Operating Results for FY 2020/21

Source: World Bank analysis (Kenya Railways, 2021).

The meter gauge operations also incurred losses but on a more modest scale. Its revenue of KES 1.7 billion (~USD15 million) did not cover operational costs of KES 2.2 billion (~USD20 million). The KRC's two other divisions, together, reported modest profits in FY 2021. However, when aggregating all units, KRC incurred a loss of KES 24 billion (~USD233 million) in FY 2021.

KRC's balance sheet is dominated by KES 780 billion (~USD6.6 billion) in long-term assets and capital works in process, offset by KES 569 billion (~USD5.3 billion) in China Exim Bank debt and KES 165 billion (~USD1.5 billion) of capital grants received from the Government. The negative equity reflects substantial accumulated losses.

The Government of Kenya established a 1.5 percent levy on all imports into the country to secure financing for the China Exim debt related to the SGR. Based on the value of imports, this would have brought in about USD380 million in 2021 (Brautigam, Bhalaki, Deron, and Wang, 2002). This levy is not directly reflected in KRC's financial statements but may well be the source of the capital and operating grants Government provides to the railway.

Potential for Service Enhancements

Private Sector Participation

Private sector participation in the transport services is mature in Kenya, especially in the aviation and roads sub-sectors. Private sector participation in the provision of urban commuter rail services and real estate development is possible, as S11A of the KRC Act allows the Board to enter into an agreement with any person for the execution of any of its functions..

Box 4.1. Rift Valley Railway

Between 2006 and 2017, the operation and maintenance of the main MGR lines were concessioned to the Rift Valley Railways (RVR) through a 25-year concession contract with the Government of Kenya. However, the concession terms proved overly optimistic in terms of traffic projections, investment requirements, and concession fee payments. Consequently, RVR experienced financial difficulties in 2008-2009, resulting in a change of controlling shareholder. This change was accompanied by a significant increase in the associated investment plan underwritten by a pool of commercial DFIs (IFC, DEG, Proparco, AfDB, FMO). Despite improvements in transport volumes, the concession failed to achieve financial sustainability. In July 2017, the Kenyan Government decided to terminate it for its “continuous failure of delivering the terms.”

Additionally, the Integrated National Transport Policy recommends private participation in railway infrastructure development and railway operations, and the establishment of an independent regulator for the railway subsector. The policy also proposes the alignment of transportation planning and land use planning, and the development of high-density land uses along the commuter rail line corridors and around multi-modal stations, in line with the TOD concept.

Kenya has some difficult experiences with the concessioning of railway operations:

- A dedicated industrial line for transporting soda ash from Magadi to Konga has been concessioned to Magadi Soda Company since 1995.¹⁴ The company, a subsidiary of Tata Chemicals, is substantially in arrears to KRC, but the contract terms do not allow KRC to terminate the concession.
- The MGR line was concessioned in 2006, but the concession was cancelled in 2017 for failure to deliver.
- Operations and maintenance of the SGR is concessioned to the Africa Star Railway Operations Company, Ltd. The contract costs KRC over \$100 million per year. KRC is seeking to transition operations to its own staff and conclude the contract.

¹⁴ The soda ash traffic continues on the MGR to the Port of Mombasa.

Potential avenues for private participation include maintenance management of tracks and station facilities and supply and operation of the DMUs, including ticketing. The Government, through KRC, may have to subsidize passenger service provision if the fares are to be regulated, given that the prevailing operating cost of the service is higher than the fare revenues. This proposal is in line with the Integrated National Transport Policy that supports Public Service Obligation payments to operators of railway passenger services, recognizing their unprofitability but crucial social value.

Potential for TOD

Land use planning for KRC land is governed by national laws, policies, and plans as they are public land held in trust. The Commuter Rail Masterplan envisions high density mixed-use developments, which will serve as catalysts for adjacent development and promote TOD.

The land use distribution within Nairobi city shows dominance by open spaces at 47.8 percent of the 695.3 km² area, followed by residential at 15.1 percent, and conservation areas (Nairobi National Park) at 13.9 percent (JICA, 2014). Transportation occupies 2.2 percent of the land, mainly taken up by road transport facilities. Residential spaces accounting for the second largest land area, suggesting significant potential for TOD by re-developing these spaces into mixed use higher-density developments, incorporating commuter rail lines and stations. Limited field observations carried out in June 2022 revealed varied population and development densities around the various NCR lines and stations. Higher densities were noted in the lower income zones, indicating a higher potential for TOD, if available spaces can be redeveloped into high-density mixed-use areas.

A study (NMR, 2016) conducted between 2015 and 2016 assessed the potential for TOD around nine railway stations on the current NCR network. The study defined a three-km radius around the stations as its catchment area. It further developed detailed TOD land-use plans for the nine stations, and concept plans for another 25 locations, which covered stations or halts served by the commuter rail.

The Interdisciplinary Land-Use and Transport (ILUT) study provides a detailed analysis of the development capacity around 36 NCR stations based on the population and employment growth potential projected from 2015 to 2030 (see Table 4.2.).

Image 4.4. Nairobi Commuter Train



Source: Kenya Railways Corporation – KRC.

Table 4.3. Population and Employment Growth Potential, NCR

Location	Study area (Sq. km)	Population 2015	Population 2030	Jobs 2015	Jobs 2030	Population density 2015 (Per sq. km)	Population density 2030 (Per sq. km)	Population growth to 2030 (percents)
Ruiru	3.4	14,400	84,000	7,700	41,600	4,186	24,419	483
Kahawa	3.8	24,200	83,700	4,455	31,100	6,437	22,263	246
Githurai	3.3	88,100	243,700	15,120	51,300	26,744	73,978	177
Mwiki	3.3	9,700	107,200	1,650	35,700	2,912	32,186	1005
Dandora	3.6	76,703	173,997	20,385	30,900	21,296	48,309	127
Limuru	3.7	6,700	207,000	3,050	126,800	1,833	56,644	2990
Makuyu	3.1	800	72,200	150	8,800	258	23,321	8925
Athi River	3.2	6,400	66,600	7,200	8,600	1,987	20,674	941
Kitengela	3.1	3,500	114,000	1,002	1,800	1,128	36,727	3157
Kikuyu	3.1	6,100	107,300	2,100	34,800	1,942	34,167	1659
Thogoto	3.1	9,500	91,600	3,200	16,000	3,025	29,168	864
Thika	3.1	21,600	100,600	8,000	37,200	6,878	32,034	366
Juja	3.1	1,800	120,600	700	10,800	573	38,402	6600
Lukenya	3.1	3,800	49,600	1,300	5,500	1,210	15,794	1205

Source: JICA NIUPLAN.

The study concluded that substantial capacity was available along the commuter rail lines to accommodate increased development density, combined with greatly improved accessibility and urban amenities. It highlighted the available land suitable for creating and increasing residential densities, job opportunities, and employment growth, and supporting the potential development of an urban rail passenger transportation system. To attract investment into these areas, provision of basic infrastructure such as water supply, electricity distribution, access roads, and pavements is crucial.

The existing frameworks for private sector involvement in developing KRC land include leasing, joint ventures, and unsolicited expressions of interest. The legal and policy frameworks for engagement between KRC and the private sector in various land development projects include the Public Procurement & Asset Disposal Act, Public Private Partnership Act, the National Land Policy, and the KRC Land Policy. KRC offers leases to private developers, including short term leases ranging from six to nine years, medium term leases ranging from 10 to 15 years, and long-term leases ranging from 21 to 45 years.

KRC's signature TOD project is Nairobi Railway City, spanning 425 acres between Haile Sellasie Avenue, Uhuru Highway, Landhies Road, and Bunyala Road. This development aims to expand and decongest the city's CBD. A majority of this land is owned by Kenya Railways, Kenya Railways Staff Retirement Benefit Scheme, and other Government agencies. During the groundbreaking ceremony, President William Ruto announced that the first phase of the Nairobi Railway City will also involve the construction of 10,000 houses on 40 acres within the development (Kenya Railways, 2022).

Potential Technological Innovations

KRC should move towards smart transportation to enhance passenger services and strengthen security measures. The potential innovations that are relevant to the NCR include:

- an automated fare collection system comprising ticket vending machines, passenger detection devices, gate access machines, and other self-service stations (see box 4.2)
- trainsets using electric battery, battery–diesel hybrid, or hydrogen fuel cell traction power
- asset management systems to deliver sustainable suburban rail performance with reduced volumes of work
- drone technology for monitoring railway infrastructure such as tracks and switching points, without any downtime or interruption of railway activities
- a back-up operation control center station to supplement the main center in case of failure and the introduction of the radio communications system (terrestrial trunked radio [TETRA]) for communication between the control center and the train. TETRA facilitates both voice and data communications, making it highly flexible and freely configurable to allow operators to perform as effectively as possible
- railway traffic control using an electronic interlocking-based signaling system

Box 4.2. Automatic Fare Collection System in Nairobi

The urban transport stakeholders in Nairobi are interested in developing an automatic fare collection system through the Ministry of Roads and Transport to establish a framework and standards allowing:

- multiple vendors to issue transit cards for multiple modes (rail, BRT, matatu)
- multiple fare types (individual fare, monthly pass)
- multiple payment types (credit card, mpesa, cash)
- multiple media (fare cards and mobile phones)

A neutral central clearing house would handle the revenue collection and distribution.

The system is envisioned to start with the Nairobi Commuter Rail and expand over time to the BRT, matatus, and other transport providers.

Conclusions and Recommendations

The NMA has a rapidly growing population of about 10 million people. An estimated 40 percent of the daily trips are made by foot and a comparable share of residents are below the poverty line. Motorized trips are made primarily by privately-operated buses and minibus taxis, leading to escalating congestion, accidents, and urban sprawl, which increase commuting times between home and work.

NaMATA was established to oversee the integrated development of urban transport in the Nairobi metropolitan region. Numerous urban, land use, and transport policies, studies, and plans exist, including the Nairobi Integrated Master Plan, the MRTS Harmonization Plan, and the Commuter Rail Master Plan. While bus and minibus operators recover their operating cost from fares, a clear funding mechanism for higher density modes such as rail and BRT, with affordable fares for poorer residents is needed. Private sector participation in urban transport is limited to the bus/minibus operators. While the legal framework accommodates PPP, capacity in structuring, tendering, and overseeing PPPs is limited.

The Kenya Commuter Rail has significant potential to address the urban mobility needs of the Nairobi metropolitan area. The Ministry of Roads and Transport, KRC, and other stakeholders can take several steps to realize this potential. They include:

- **Transformational investment:** The service currently provided by KRC is too slow and too infrequent to attract many customers. A step change in the service offered is needed and will require comprehensive investment in tracks, train control systems, and rolling stock to deliver a competitive and attractive product.

- **Physical and modal integration:** KRC stations need to be connected to the neighborhoods they serve through improved pedestrian, bicycle, and road facilities. KRC needs to integrate its services with those of private bus and matatu operators to extend the reach of the rail service and provide passengers with last mile connectivity. This will require KRC stations to be retrofitted with drop-off and pickup facilities for buses and matatus.
- **TOD:** Although multiple stakeholders express support for TOD around KRC stations and market conditions appear favorable, concrete TOD projects have not been implemented. Successful realization of TOD plans requires the inclusive involvement of multiple stakeholders in their development. KRC and Nairobi County, with support from Ministry of Lands, Public Works, Housing and Urban Development, NaMATA, and other stakeholders, may collaboratively pilot some simple TOD projects connecting the commuter railway stations with the community, creating mixed use, walkable spaces around the stations.
- **Funding:** Ensuring commuter rail services are affordable for lower-income residents will require financial support. A dialog should be initiated, starting with a well-documented analysis of the support required. Addressing the funding gap might entail discussions on (i) improved ridership and increased ticket revenue (ii) improved commercial revenues at stations; (iii) subsidies from local or national government; and (iv) land value capture (LVC).
- **Land Value Capture:** LVC is frequently discussed but successful examples in Africa are few. As with TOD, multiple stakeholders have an interest in LVC and must be included in project development. Capacity building in PPPs structuring, real estate development, and LVC is crucial for developing and implementing simple, small-scale, first-generation projects to gain experience in implementing LVC.

5

A high-speed train, possibly a Shinkansen, is shown in motion on a track. The train is silver and blue, with a sleek, aerodynamic front. It is moving towards the viewer. The background shows a complex network of overhead power lines and support structures, typical of a high-speed rail system. The lighting suggests it might be late afternoon or early morning, with a warm, golden glow.

Planning and Governance of Urban Rail Corridors

Introduction

The case studies of Lagos, Maputo, and Nairobi illustrate many of the opportunities and challenges of implementing urban rail services in Africa. The need for improved mobility is strong and the potential value of rail solutions, high. The cities have adopted good practices in planning and governance with the creation of Metropolitan Mobility Authorities and development of master plans. Yet, challenges remain with funding, coordination, and implementation. This chapter draws upon these case studies to relate the economic and policy literature on urban rail to the local circumstances, planning, and governance of urban rail in Africa.

Investment in rail corridors can facilitate urban agglomeration and create economic value. It expands economic options for both firms and workers, stimulates the labor market, and increases innovation and productivity. To support urban efficiency, increase transport safety, and reduced emissions, public investment must incentivize the use of public transport and discourage the use of private transport. Affordable urban rail, providing equitable access, can support sustainable, compact, and efficient African cities.

Suburban rail is suited to the conditions in many African cities. High densities in suburban areas imply significant ridership opportunities for rail systems, especially when combined with the congestion on poorly developed road networks (Poku-Boansi, Michael and Patrick Brandful Cobbinah, 2018). Sprawling cities with densely populated lower income suburban areas create demand for affordable, long-distance travel. For example, research in Kumasi, Ghana highlights the value of commuter rail over long distances (Pirie, 2014). The Nairobi case demonstrates the potential for suburban rail service to reduce travel times and transport costs in dispersed urban settlements. As a “rule of thumb,” corridors with peak hour travel of 10,000 passengers are suitable for new rail transit while those with peak hour travel of 5,000 passengers are promising candidates for improved service.

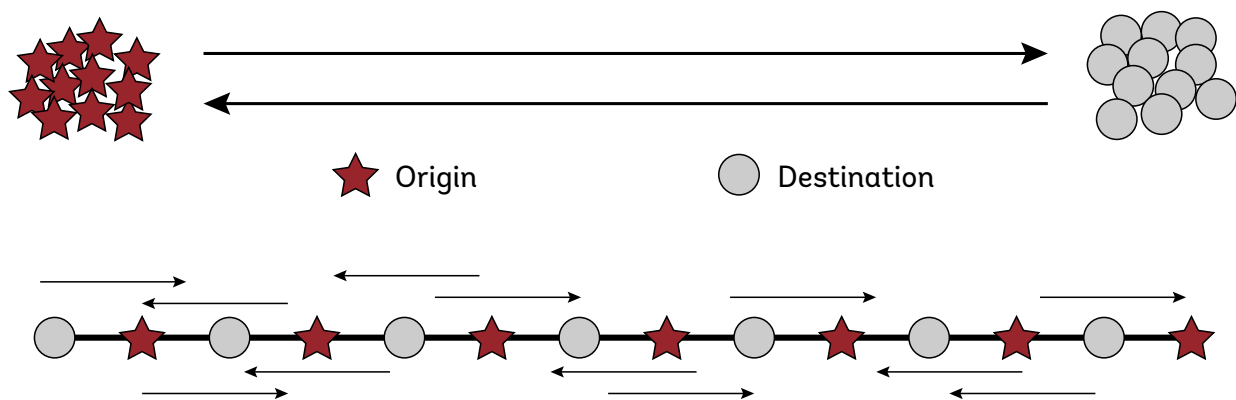
Image 5.1. Trains at a railway station, Maputo, Mozambique



Source: Adobe Stock.

A rail service is most effective in places that combine population density and diversity of land use. Population density provides necessary ridership for the service to be economically viable (Lawrence and Bullock, 2022). When land use concentrates jobs in the central city and residences on the outskirts, trains operate full in the commuting direction and mostly empty in the reverse direction. Diverse land uses create more reasons to board and alight the train along the route, improving train utilization. Figure 5.1. illustrates the difference between a commuting pattern with density at origin and destination, and a travel pattern with multiple origins and destinations and greater balance in traffic direction resulting from mixed-use development.

Figure 5.1. Impact of Density and Diversity on Urban Transport





Source: Van Ryneveld, 2018.


A review of land use around rail transit in the cities studied revealed opportunities to improve density and diversity around rail corridors. What matters most for transit and land-use integration is not average population densities but articulated densities - densities strategically distributed across parts of a metropolitan area (Suzuki, Cervero, and Iuchi, 2013). In Nairobi, capacity was available along the commuter rail lines for increased density of development combined with improved accessibility and urban amenities. A compact urban re-development strategy, including the possibility of reclamation and decentralization of congested development, is recommended in Lagos to achieve diversity as well as ensure densification.

Local Context

The local context defines the environment in which suburban rail transport operates and shapes its effectiveness in meeting transportation needs. Table 5.1. summarizes key local factors in Lagos, Maputo, and Nairobi. These factors underscore that all three cities contend with high levels of poverty, high levels of walking and high levels of informal transport (minibus, *matatu*). Urban sprawl emerges as a universal concern.

Table 5.1. Summary of Local Context Factors in Lagos, Maputo, and Nairobi

Local Context	Factors	Lagos	Maputo	Nairobi
 Socio-economic features	Country population	211,400,704	32,163,045	47,564,296
	Country GDP (\$)	514 billion	16 billion	110 billion
	GDP/capita (\$)	2,085	500	2,006
	Population under poverty line (%)	40.1	46.1	36.1
	Urban population (mil)	21	3.1	9.4
	Metropolitan regional economy as share of national GDP (%)	35.6	17	21.7
	 Land use and transport governance	Institutional arrangements for urban rail and land use management	<p>LAMATA is responsible for public transport policy, regulation, planning and operations, as well as establishing the Transport Fund from user charges.</p> <p>The Lagos State Land Bureau is responsible for land policy, including acquisition of land, land registry, land use and allocation, and creation and management of residential and industrial schemes.</p>	<p>ATM is responsible for strategic planning and management of the public transport network and assets. It defines routes, contracts for transport services, oversees services and approves fares.</p> <p>Local government issues public transport operating licenses for operators and is responsible for land use management.</p> <p>Commuter rail services are provided by CFM the national railways operator. Metrobus (private operator) provides rail services on CFM tracks.</p>

Local Context	Factors	Lagos	Maputo	Nairobi
 Urban form and travel demand	Geographic access and spread	Lagos is a port city. Lagos Metropolitan Area includes Ikeja, Agege and Mushin Local Government Areas. Concerns of urban sprawl.	Maputo is a port city. Maputo Metropolitan Area include Matola, Boane and Marracuene districts. Concerns of urban sprawl.	Nairobi Metropolitan Area include Kajiado, Kiambu, Machakos, Murang'a and Nairobi City counties. Concerns of urban sprawl
	Trips per day	22,000,000	3,200,000	14,900,000
	Transport modal split (%)	Non-motorized: 40 Minibus: 43 Bus & BRT: 3 Automobile: 11 Motorbike: 1 Truck: 1	Non-motorized: 40 Minibus: 26 Bus: 22 Automobile: 11 Rail: 1	Non-motorized: 45 Bus & matatus: 41 Private transport 13 Commuter rail 0.2

Source: World Bank analysis.

Poverty and economic informality shape the market for rail transit. Across the three cities studied, between 36 and 46 percent of residents subsist on incomes below the poverty line. Many jobs are informal—in sub-Saharan Africa non-agricultural employment in the informal economy represents 66 percent of the total employment (74 percent for women) (ILO, International Labor Organization, 2015). Nearly eight out of ten employed individuals in this region engage in vulnerable forms of employment (ILO, International Labor Organization, 2015).

Low wages in the informal economy make motorized transportation unaffordable for many (ILO, 2021). More than 40 percent of residents in the cities studied do not use motorized transport at all. They walk to their destinations, incurring substantial time and opportunity costs and their options for employment, education, and healthcare are limited by walking distance.

Middle-income households struggle with the cost of transportation and largely use buses and minibuses. In Lagos minibuses (*Danfoss*) transport 72 percent of public transport users and on average cost 20 percent of Lagosian's disposable income. Similarly, in other African cities, minibus services provide access at a high cost to users, but often with safety concerns. For example, in South Africa's cities, the average proportion of household income spent on public transport is 26 percent for commuters using minibus taxis, 31 percent for buses, 29 percent for trains, and 39 percent for those using multiple modes (Turok, 2015). Similarly, the Maputo case highlights unreliable services, extended journey times, and a substantial portion of commuters' income spent on daily trips.

At the other end of the economic spectrum, car ownership is growing rapidly. Car ownership in Lagos increased by 234 percent between 2001 and 2009, while in Maputo, it increased by 332 percent between 2009 and 2019. This surge exacerbates road congestion, triggering demands for more and better roads. It also contributes to urban sprawl, further separating low-income workers from job opportunities.

Cities will have to balance the priority of equitable access to public transport with the desire of rail transport operators to recover as much cost as possible from farebox revenues and land value capture. Bringing a share of the 40+ percent of people who can only afford to walk into rail transit would require very low cost (or free) tickets, which will reduce revenue and cost recovery for the rail operator¹⁵ (see box 5.1). Similarly, the concept of LVC hinges on the rise in land value because rail users have income to spend on housing and services located near stations. While concepts of TOD align with transit serving low-income riders, expectations of land value capture from TOD may need to be in lower income areas. Focusing on public housing in proximity to rail lines could be a more viable approach.

Cities will also have to balance the goals to (i) shift private car owners to public transport (Onguka, 2018); (ii) transition ridership from minibus; and (iii) provide access to public transport for the poor. The Gautrain experience in South Africa illustrates this trade-off. Gautrain, which provides a high level of service, has been successful in attracting middle- and high-income riders and in shaping development in the Gauteng region, while reducing travel time and emissions. However, Gautrain was expensive to build, is expensive to operate and charges high ticket prices which inhibit access for lower-income individuals. The CFM and Metrobus services in Maputo provide a more hopeful example. Here, a private operator provides higher quality service at a higher price, while CFM provides a less expensive service for lower-income passengers, allowing multiple objectives to be met using the same fixed investment.

Box 5.1. Free Public Transport

Over 100 cities worldwide have or are offering free public transportation, with the aims to shift people from cars, increase use of public transport, and improve the access of disadvantaged groups, who otherwise might find public transport unaffordable. UITP suggests that free transit is a “blunt instrument” and suggest that authorities seek out “more targeted measures [that] may be both more effective and manageable within the budget limitations faced by many public authorities.”

Source: UITP, 2020.

A window of opportunity exists to leverage rail together with TOD to shape urban areas more efficiently. Automobile ownership in African cities is still low, and many people still rely on walking. However, the window of opportunity is closing (Pan, Li, Shen, and Cheng Shi, 2017). If private

¹⁵ Many cities offer free transit vouchers or discounts to disadvantaged groups, such as the poor, elderly, and students, with governments paying a “technical fare” to the rail operator that covers the operator’s cost of transporting them.

vehicles become dominant, they will shape the urban development toward sprawl. Research shows that at that point, lower-capacity road-based systems such as BRT may be more appropriate (Ingvarðson and Nielsen, 2018). Three pivotal aspects contribute to the success of rail commuter lines: (i) fostering housing and commercial activities near the stations; (ii) ensuring reliable “last mile” transport to the stations; and (iii) providing reliable and frequent rail service at an affordable tariff.

Governance Framework

Good governance is key to meet market demand for mobility, provide efficient services, ensure financial sustainability, and manage transportation assets over the long term (World Bank, “Modern Railway Services in Africa: Building Traffic – Building Value,” 2020). The governance structure needs to address three roles (Pulido, Darido, Muñoz-Raskin, and Moody, 2018):

- i. **Authority:** Long-term mobility planning, funding and fare policy, integration across modes and coordination with other agencies;
- ii. **Implementing/Management Agency:** Planning, supervision, investment, project cooperation and coordination of project stakeholders; and
- iii. **Operator:** Service planning, service delivery, and maintenance.

Establishing clear lines of responsibility and authority for these different roles is important (Suzuki, Murakami, Hong, and Tamayose, 2015). Often, one entity handles more than one role. Separation between the Authority and the Operators of services is beneficial, as it allows commercial or concessioned operations.

A leading institution, responsible for mobility and access, is needed to coordinate transport modes across various jurisdictions in a metropolitan region, and coordinate with other government agencies and stakeholders.¹⁶ Creating a new organization is unnecessary if an existing one can manage the responsibilities.¹⁷ Often called a Metropolitan Mobility Agency (MMA), this agency is responsible for the following functions:

- long-term transport planning for the metropolitan area with appropriate, integrated use of different motorized and non-motorized transport modes
- fare policy and funding strategy for public transport services to achieve social and economic objectives, provide clarity on the level of subsidization and funding principles, reduce revenue risk, ensure comparable fares to existing services, support sustainability, gain market appeal and support integrated ticketing strategies
- institutional coordination between transport and land use management in the metropolitan area to encourage densification of land use around stations and promote mixed-use TOD

¹⁶ See (SSATP, Publication Pending) for a detailed discussion of lead institutions.

¹⁷ For example, a Provincial Ministry of Transport in South Africa can handle this role.

- coordination with agencies in charge of urban infrastructure in the metropolitan area ensure complementary infrastructure such as sidewalks, roads, lighting, water/sewer, electricity, and residential development around transport nodes

An MMA had been established in all three cities studied (LAMATA in Lagos, NAMATA in Nairobi, and the AMT in Maputo). Each MMA is coordinating implementation of the transport master plan in its city and makes efforts to coordinate with other agencies, including those in charge of land use for TOD.

The MMA should develop the funding strategy for public transit services. Ideally, the MMA would also control funding for mobility investments and services, empowering it to enforce coordinated service provision. However, the MMAs in Nairobi and Maputo have not developed funding strategies and do not control funding. LAMATA is mandated to collect and levy transport road user charges and to establish a transport fund as a user-financing mechanism aimed at augmenting the low level of cost recovery in the transport sector, and to sustain the performance of LAMATA.

The MMA, or an alternate body serving as the implementing/management agency should create an enabling environment for the operator, ensuring operational autonomy consistent with clear performance objectives and reliable funding. This includes (Pulido, Darido, Munoz-Raskin, and Moody, 2018):

- well-defined and binding roles, responsibilities, and performance objectives for the operator. This may be accomplished through an operation contract with performance measures and bonus/penalties for performance
- financial sustainability through stable, multi-year subsidy arrangements, appropriate fare policy, and the operator's ability to generate and spend non-fare revenue
- autonomy to undertake strategic decision-making and business-oriented management practices

Currently, a comprehensive funding mechanism is missing in all three case study cities. The absence of sustainable funding measures hinders the MMAs' ability to establish performance objectives. In Nairobi and Maputo, the national rail carrier provides the suburban services and subsidizes it. This complicates the governance structure, as the commuter rail operation reports to and is funded by an organization beyond the MMA's jurisdiction. Options for overcoming this challenge include: (i) contracting between the MMA and the national railway for providing urban passenger services (ii) devolution of the urban rail service to the metropolitan or regional government; (iii) joint venture between the national railway and metropolitan or regional government to provide urban rail services. All these options require local government to shoulder responsibility for funding services.

An empowered metropolitan-wide planning agency, with authority over both transportation planning and land-use regulation, is ideal for implementing TOD (Sharma and Newman, 2018).¹⁸ However, such integrated authority seldom occurs in practice, complicating the implementation of TOD (Pirie, 2014). Options for coordinating transport and land use planning include:

¹⁸ For example, research on Bengaluru Metro showed that where public authorities are siloed and separate, successful TOD outcomes are unlikely.

- Prescribed processes for mandatory consultation at specified decision points in the planning process. For example, in Kenya, the Physical and Land Use Planning Act, 2019 recognizes the need for planning entities to consider approaches to plan for TOD and mixed land-uses, providing a well-defined coordination framework and consultative forum for physical and land use planning
- Governance integration, through representation from the land use authorities or metropolitan municipalities on the board of the MMA or on a land use committee that provides input into the transport master plan.
- Establishing the MMA at the same government level as the organization(s) responsible for land use management. The feasibility of such devolution may depend on the history, political economy, and context of each country. Currently, metropolitan transportation authorities operate at the state level in Nigeria and at the national level in Kenya and Mozambique.

National policies supporting mass transit, TOD, and public-private partnerships can facilitate planning and cooperation at city level and can provide national funding or specify funding sources available for transit. For example, the Integrated National Transport Policy of Kenya recommends private participation in railway infrastructure development and railway operations, and the establishment of an independent regulator for the railway subsector. The policy also proposes the alignment of transportation planning and land use planning, and the development of high-density land uses along the commuter rail line corridors and around multi-modal stations, in line with the TOD concept.

Oversight of Rail Services

An effective governance framework is needed to enable the rail operator to provide urban mobility services responsibly and transparently. Ideally, the MMA would contract with the operator for the services it requires¹⁹ and be able to pay for them. Such an arrangement would enable the monitoring and incentivizing performance and make the urban service financially self-sustaining. The effective governance framework would include the following characteristics:²⁰

- Government decisionmakers and funders hold the MMA accountable for planning and rulemaking
- The MMA holds the rail operator accountable through scrutiny of proposals, regulation, and contract administration
- Operators are shielded from political decisions that may have long-term operational and financial impacts
- Strong lines of communication between the operator and the MMA
- A risk management strategy that allows for the identification, assessment, mitigation, allocation, and monitoring of risks

¹⁹ The operation contract should set out levels of service that the operator/concessionaire is obligated to meet. Performance monitoring and operational benchmarking instill confidence in investments and provide feedback to improve service levels and quality.

²⁰ <https://brtguide.itdp.org/branch/master/guide/fare-policy-and-structure/fare-structure-options#discounts>

The reality in the case study cities differs from this ideal in several respects. In Nairobi and Maputo, the MMA operates at the metropolitan region level, while the rail service provider is part of a national railway entity, creating an asymmetry in power. Additionally, the MMAs do not have funding to support rail services, giving them little leverage over the railways' decisions about service provision. Thus, the lines of accountability in the ideal framework are lacking on the ground.

A starting point for improving the governance framework is establishing an urban rail business unit within the railway. This is consistent with good commercial practice that structures the railways to focus on markets and customers (World Bank, 2017). The urban passenger business unit would coordinate with the MMA for service planning and intermodal integration. It should have dedicated management and staff, assigned assets (including rolling stock), specific performance indicators, and segregated financial accounts. Depending on geography and scale, it is likely to share infrastructure and some facilities with other business units of the railway, and this use could be charged to the unit to develop an accurate understanding of costs. The segregated financial accounts, with accurate, reliable, and audited costs, are necessary to advocate for adequate funding for the urban rail service.

Kenya Railway has created a dedicated organizational unit for operating its urban rail service and CFM has created a dedicated passenger unit. However, no structure has been established yet for operating railway lines in Lagos. Areas for potential enhancement include bolstering communication between the suburban rail unit and the MMA, segregating the suburban rail unit's financial accounts, implementing performance indicators, and developing credible and reliable funding mechanisms.

Planning Processes

Investment in urban rail provides the greatest regional benefit when integrated into a multimodal transportation system (Pulido, Darido, Munoz-Raskin, and Moody, 2018). A transport master plan provides the basis for planning alignment and coordination among various urban, state, and national institutions. The MMA is well-positioned to develop the regional transport master plan and to lead processes for aligning various spatial, infrastructure, and service plans. (see box 5.2) With sufficient governance support, the MMA can overcome strategic challenges relating to multiple players. Including management, pricing, and land use measures will strengthen the master plan to achieve transportation objectives.

Box 5.2. Rail or BRT?

The transport master plan will analyze modal alternatives to determine the best public transit options to address passenger demand. Key considerations are expected demand and cost. When building new infrastructure, BRT is usually much cheaper than rail, and would be used when traffic is ~10,000-40,000 passengers per hour per direction. When demand is above 40,000, passenger rail is the only viable option. However, when a right of way already exists, as in Nairobi and Maputo, the capital cost can be comparable or lower than BRT's, rendering rail the preferred option.

A transport master plan provides the long-term regional vision of the metropolitan transportation network. It is a dynamic plan that provides an integrated mobility strategy, encompassing (Pulido, Darido, Munoz-Raskin, and Moody, 2018):

- realistic forecasting of traffic demand
- road, rail, and non-motorized transportation infrastructure investments
- a multi-year financial plan with revenue and costs projections
- operational management for all modes of public transportation and private transportation, network management and traffic control, telecommunication, and passenger information
- capacity development in the sector, education, and public awareness

Ideally this plan should be part of an integrated urban transport, land use, and air quality strategy for the metropolitan region.

A transport master plan guides alignment and coordination among various institutions responsible for transportation and urban investment. Good practice would be for the MMA to develop the transport master plan and coordinate its implementation among key institutions. A key challenge is developing residential, commercial, and employment hubs in proximity to one another and connecting them with the most efficient means of transportation (Pulido, Darido, Munoz-Raskin, and Moody, 2018). The way cities are shaped affects transportation demand and has a significant impact on the cost of providing services. All three case study cities are experiencing urban sprawl. The MMA can support municipalities or local government groups to put in place arrangements to work collectively throughout the planning, implementation, and operation phases of the urban rail infrastructure (Pulido, Darido, Munoz-Raskin, and Moody, 2018). The Nairobi case highlights the need for a central authority, as mass transit planning falls under NaMATA, commuter rail operations under KRC, and land use regulation and development approvals under the national and local governments, respectively.


The funding and financing strategy, as well as a risk mitigation strategy, is central to the MMA's urban rail planning. The success of an urban rail system is often determined by the extent to which its long-term funding strategy enables the operator to make timely investments to meet service expectations (Pulido, Darido, Munoz-Raskin, and Moody, 2018). The transport master plan is necessary to prioritize investments relating to urban planning, transport systems, business planning, traffic control, technology integration, and funding and finance strategies.

The transport master plan should connect rail to other modes to create a transportation network that provides good accessibility (Cervero, 2020). Urban rail, on its own, can only provide convenient access to the population immediately around its alignment. However, with modal integration, the value of the rail corridor is broadened to a much larger catchment area. This principle is well recognized. The Nairobi Master Plan, for example, recommends the integration of BRT and light rail transit lines into the urban rail public transportation system, connected to feeder services such as paratransit, motorcycles, cycling, and walking.

All three cities studied had transport master plans in place, with MMAs endeavoring to implement them. Challenges include network integration strategies, funding plans for urban rail, and clear transit-oriented development plans. Table 5.2. provides a summary of key planning processes in the three cities.

Table 5.2. Summary of Factors Relating to the Planning Process

Planning Processes	Factors	Lagos	Maputo	Nairobi
 Transport Master Plan	Metropolitan Mobility Authority	LAMATA is the agency of the Lagos State Government, responsible for policy, coordinating transportation planning, and public transportation infrastructure implementation in the Lagos Metropolitan Area. LAMATA oversees the implementation of the Lagos Urban Rail Network.	AMT was created to coordinate and implement the Transport and Mobility Master Plan. AMT is mandated to (i) perform strategic planning and manage public transportation network and assets, (ii) define routes, (iii) organize and monitor passenger transportation services, to enter into contracts or grant concessions for passenger transportation services and assets, and (iv) ensure quality in service provision and approve metropolitan-level fares.	NaMATA is responsible for the planning and development of mass rapid transit services. It provides an enabling environment for orderly and structured development of an integrated mass rapid transit system, including BRT and commuter rail. The Authority is responsible for planning, regulating, and coordinating the supply of adequate and effective mass rapid transit.
	Master Plan	Strategic Masterplan and Rail Master Plan (2014 Revision): Lagos Rail Mass Transit 7 Lines (298km) and a monorail (24km)	Transport and Mobility Master Plan 2014 (PDTU) 4 major residential growth areas and an industrial area connected by passenger rail services - both intercity and urban rail.	Nairobi Railway City Master Plan 2019 and Nairobi Integrated Urban Development Master Plan 2014-2030 Extended Lines (7 Commuter Rail and 5 BRT) total 163km and high-density mixed-use developments

Planning Processes	Factors	Lagos	Maputo	Nairobi
 Funding, Financing and partnerships	Funding	Lagos State funds rail investment. Funding for rail operations is unclear.	Investment funded by freight revenue and income from the Transport and Communications Fund. Operations cross-subsidized by freight. To be effective, AMT needs a funding and financing strategy.	The Government funded the upgrading of commuter rail stations, new diesel multiple units, a ticketing system and access roads (KSh. 6.6 billion) from the Railway Development Levy Fund.
	Financing	N60 billion financing facility	No financing mechanism in place	KRC is financed though loans from the Central Government.
	Partnerships	Policy preference for PPP, however funding arrangements/traffic guarantee is not in place	Metrobus service operating via trackage rights on CFM. Regulatory processes and oversight needed.	The Integrated National Transport Policy recommends private participation in railway infrastructure development and railway operations, and the establishment of an independent regulator for the railway subsector.

Source: World Bank analysis.

Railway services and facilities should be designed with the needs of diverse users in mind. In lower- and middle-income countries, women generally have limited access to private vehicles, making them particularly vulnerable to the deficiencies of public transportation systems. Additionally, women often have different mobility and usage patterns in public transportation compared to men, yet their specific requirements are overlooked in the planning of rail services. (see box 5.3)

Railway services should be coordinated with other formal and informal transport. While the MMA manages this at the planning level, railways can further integration by:

- surveying diverse users about their travel to/from the rail station when designing or improving stations
- coordinating with the relevant authorities on connecting infrastructure such as roads, sidewalks, and lighting

- ensuring that railway station premises facilitate transfers to other modes, providing space for pickup and drop off, including for informal buses and minibuses, sidewalks for pedestrians, and bicycle parking
- engaging with representatives of informal buses and minibuses to encourage them to provide feeder services to the railway stations

Fare integration should complement physical integration and ensure that fare collection systems are compatible across modes. Full fare integration eliminates penalties for mode changes.²¹ Achieving this requires central administration of fare policy, fare collection, and revenue distribution. It creates a systematic mechanism for separating the payments to service providers (technical fares) and fare revenues collected from passengers. It allows subsidization of intermodal transfers to keep transfer costs low and can offer low fares to low-income residents.

Box 5.3. Gender Issues in Urban Rail Transport

Women, often shouldering a disproportionate responsibility for care-related trips, require services accommodating both work-related travel and care-giving duties. Therefore, they need services to be provided throughout the day, extending beyond peak commuting times.

Facilities need to be adapted to suit female passengers, many of whom frequently travel with children and strollers. Safety, especially within the station and during travel to and from the station and on trains, poses a particular concern for women. This concern can be addressed through measures such as better lighting of areas and increased presence of female staff on trains.

Employing more women across all levels in the rail industry can help tackle these issues and shape a more inclusive public transport service.

Source: World Bank, *Paths Toward Green Mobility*, 2022.

Network integration should include informal transportation modes as feeder and distribution services for urban rail. Despite the drawbacks associated with the informality of minibus services, their flexibility and accessibility is evident in commuters' preferences. Railways can encourage collaboration with informal transportation by creating station areas that are conducive to informal pick up and drop off (Boutueil, Lesteven, and Nemett, 2020).

Last-mile infrastructure (road and pedestrian facilities and lighting) and safety are important, yet often neglected, aspects of the transit network. This was evident in all the case study cities. For instance, in the informal neighborhoods of the extensive peri-urban Metropolitan Area of Maputo, the access roads are mostly unpaved, lack drainage, and tend to deteriorate rapidly in the rainy seasons.

²¹ <https://brtguide.itdp.org/branch/master/guide/fare-policy-and-structure/fare-structure-options#discounts>

Financial Planning for Rail Services

Financial planning should be a core part of planning for any rail service. The financial plan should cover both investment and operations and include adequate provision for maintenance and renewal of assets. Funding for operations and maintenance/renewals should be identified when services are conceived, and investments are first contemplated. While operational costs may seem smaller than investment costs, overlooking them in the pursuit funding for investments is short sighted and can result in expensive investments underperforming due to insufficient operational funding or poor maintenance.

Ticket revenues are often not sufficient to fund rail operations. Many urban rail services provide a public service to poorer residents and cannot fully recover operating costs from ticket sales alone. Globally, on average, user fare collection covers only about 75 percent of the operating costs of urban metro systems (Pulido, Darido, Munoz-Raskin, and Moody, 2018). Suburban rail systems, which typically have lower density of traffic and often serve low-income residents, might have even lower cost coverage. In African cities, fares are likely to cover an even smaller portion of the operating expenditure: “Public investment and fare subsidies will be essential to allow an African metropolis to offer a transportation system that is competitive with other alternatives such as bus or private vehicle”(African Development Bank Group, 2015).

None of the case study cities had a clear, dedicated funding mechanism for urban passenger rail operations. In Lagos, operations have just started, and the focus has been on securing investment funding. Maputo’s operations are subsidized from CFM’s freight earnings, while In Nairobi, the commuter rail operating deficit is combined into the railway’s overall losses, with most of the overall funding coming from freight revenue. A comprehensive financial plan should include a realistic assessment of the costs covered from ticket revenue, regularly adjusting ticket prices for inflation, and identifying other sources to cover the balance. Funding arrangements may involve agreements among multiple parties, including various local, state, and national government jurisdictions.

Cross subsidization from freight services is problematic. When the national railway provides urban passenger service at a loss, the railway has a financial incentive to minimize the services provided and the losses generated. This situation is evident in both Maputo and Nairobi, where the frequency of urban services provided is very low. In Nairobi, DMU trainsets were being sidelined for want of expenditure on replacement parts. If the national railway provides urban rail services, it should create a dedicated urban rail business unit with separate financial accounts to operate the service. This will enable the railways to work with the government to secure the necessary funding for passenger services.

A diverse range of other funding sources can be considered to support urban rail projects. The most common source is public funds from government budgets, comprising general taxes collected by the national government (such as income taxes) or by local governments (such as property taxes). Measures discouraging private car use, such as parking levies, congestion charges, fuel taxes, and tolls, can support public transport. Environmental charges, such as carbon taxes, may also be earmarked. LAMATA, for example, has the mandate to collect and levy transportation road user charges and establish a Transport Fund as a user financing mechanism to increase the low level of cost recovery in the transportation sector, and sustain its operations.


Some urban rail systems leverage non-fare commercial revenues as an additional source of funding. These sources include advertising, leasing of commercial spaces, naming rights on stations, and merchandising. In a few urban metro systems, these alternative sources of revenue have become significant, even approaching 20 percent of fare revenues (Pulido, Darido, Munoz-Raskin, and Moody, 2018). Non-fare commercial revenues would typically be less substantial for suburban rail systems. The objective of maximizing revenues from commercial activities must be embedded in initial project planning, regardless of the project delivery model.

Commercial real estate development is a potential source of revenue for railways, especially considering their extensive landholdings. Some of this railway-owned land holds significant unrealized commercial value. Commercial development of this land can create a steady stream of funding for the railways, which could be used to support urban rail. KRC has used its properties to raise revenue. When this land is developed with TOD principles in mind, the railway gains by increasing demand for the rail service and increasing ticket revenue, while the local authorities benefit from the creation of more livable urban spaces.

However, commercial real estate development requires specialized skills not readily available in railway staff. Typically, railways recruit specialized personnel to manage their land development efforts.²² This team systematically assesses the railway's holding to identify the land suitable for different types of development. The actual development is usually financed and executed through partnerships among commercial construction and real estate development companies, the railways, and often, other key stakeholders.

²² International development finance institutions can help national and local governments develop policies and institutional capacities to tap financial resources other than public sources, through concessionary finance, grants, and project development schemes.

6

A photograph of a modern transit station platform. The platform is wide and paved, with several people walking or sitting. There are covered seating areas with tiled roofs. In the background, there are various buildings, including a prominent church with a bell tower. The sky is clear and blue. The text is overlaid on the bottom left of the image.

Transit-oriented
Development, Land
Value Capture,
and Public-private
Partnerships

The concepts of transit-oriented development (TOD), land value capture (LVC), and public-private partnerships (PPPs) are widely accepted among urban and transportation planners in African cities. While many TOD plans have been developed, few have been implemented. Land value capture, with many successful examples in Europe, North America, and other high-income countries, is often promoted as the solution to the funding challenges of urban rail but lacks successful examples in Africa. Public-private partnerships, a mainstay of rail service provision and TOD/LVC, are challenging in Africa. The cities studied offer insights into these challenges and potential solutions.

Transit-Oriented Development

TOD aims to align urban development and transportation investments to create compact and diverse urban spaces enabling efficient provision of and access to services. This alignment can enhance a city's economic competitiveness, reduce local pollution and global greenhouse gas emissions, and promote inclusive development (Suzuki, Cervero, and Iuchi, 2013). Principles of density, diversity, and design have traditionally guided sustainable urban development to support mobility and access (Cervero and Kockelman, 1997). Over the long-term, supported by land use and spatial development plans, cities can incentivize mixed development along transportation corridors to reduce the need to travel and travel times.

Effective TOD requires integrated land use and transportation planning. A comprehensive TOD plan includes density/intensity mixes, including residential density and job intensity/diversity. The main goals of the plan are to ensure metropolitan multi-modal connectivity and equitable access to opportunities. The urban development policy should support compact mixed-use development, prioritize walkability, reduce parking, and foster community-driven development and place making (Pulido, Darido, Munoz-Raskin, and Moody, 2018). TOD requires strong governance and institutional capacity to provide the necessary planning and policy frameworks to foster, regulate, and optimize land use changes (Cervero, 2020).

TOD is supported by robust regional property market demand stimulated by economic growth. Other important factors are supportive policies, sufficient bulk infrastructure, available land, and enabling investment (Suzuki, Cervero, and Iuchi, 2013). Best practice in developed cities indicate that land use change requires active policy interventions to intensify land use around stations. These interventions many include offering densification bonuses, supporting development rights, establishing transferable development rights, and proactively acquiring land near rail stations to support development though public leases or resale (Cervero, 2020).

Densification of land use typically follows transportation investment. For example, in Maputo, the construction density around the ring road area significantly increased after its completion (Fisker, Malmgren-Hansen, and Sohnesen, 2019). The aim of a TOD plan is to guide the process through land use rules and targeted investments, encouraging mixed use, walkability, and the creation of appealing community spaces. Public consultation is important to strike a balance between government-sponsored (re)development of spaces and promotion of organic development.

Displacement and gentrification can have significant social consequences (Goel and Tiwari, 2014) and need to be considered in any TOD plan. Urban inclusion can be promoted through TOD principles by aligning affordable housing investment with transportation plans. For example, in the Rio de Janeiro Metropolitan Region, the state government's policies and planning were strengthened to promote the provision of affordable housing along rail lines and create social development programs targeted at the urban poor.²³

TOD requires efforts to meet both existing transportation demand and promote efficiency in future urban development. The objective is to reshape urban spaces and address existing sprawl in African cities while serving the current transportation needs of residents. TOD around rail stations benefits the railway by increasing ridership and seat renewal.

Initially, TOD may prompt businesses to merely shift their offices closer to transportation corridors (redistributive development), which increases access without creating any additional economic value. However, a TOD strategy underpinned by a transportation master plan can support long-term economic development, attracting new business to efficient African cities (generative development). For both scenarios, it is important to ensure site attractiveness and transportation accessibility and introduce land use incentives and private vehicle disincentives. This is to ensure increased land values around development and support transport, urban design, and long-term economic objectives (Suzuki, Cervero, and Iuchi, 2013).

The case study cities demonstrate strong potential for and interest in TOD. In Lagos, the demand for development space along transportation corridors is estimated to increase from 535 km² in 2019 to 698 km² in 2050. Lagos has a high land use density of about 1270 formal dwellings per km², and the Lagos Urban Rail Network was designed to serve areas of high growth and transportation demand. TOD-specific plans can build on this network, focusing on land uses of public land in transit station areas, as well as housing and commercial (re)development incentives. Maputo plans a multicentric urban form.

Image 6.1. El Giza Railway Station, Egypt



Source: Moody Man/flickr (CC BY-NC 2.0).

²³ <https://projects.worldbank.org/en/projects-operations/project-detail/P122391>

TOD is recognized in Kenyan legislation and provided for in the Nairobi Integrated Urban Development Master Plan 2014–2030. In Nairobi, population densities and employment opportunities around all rail stations are projected to grow exponentially by 2030, indicating significant potential for TOD in the areas. Station area plans have been developed around selected commuter rail stations. However, these plans were not developed with the active engagement of KRC or the affected counties, so they have not been accepted or implemented.

While TOD principles are relevant to all railway station areas, TOD plans and investments should be based on location. Large-scale development should be considered where either the railway or government has a large land parcel in a prime location. An example is the Nairobi central station, where the railway possesses a well-situated station along with extensive landholding in railway offices, workshops, and other facilities. LVC strategies (discussed later) are appropriate in these larger-scale developments. The governments may encourage development of such locations and leverage their potential by:

- eliminating/reducing/reviewing limitations on density and usage to encourage densification and mixed use
- providing the bulk infrastructure, such as water and electricity, needed for development
- making nearby public land available for development purposes
- coordinating with the expansion of public housing near the development

Small scale, incremental development is appropriate when land in the station precinct is limited, surroundings are already built up, and where most of the economy is informal. For example, in Nairobi, many of the commuter stations in the outskirts are on small plots, in built-up areas. The scope for LVC is lower at these stations. TOD plans in these settings should encourage organic densification and mixed-use development. Elements of this approach might include:

- station design and management with the informal economy in mind, so that informal retail and other services can thrive and improve the passenger experience (see box 6.1)
- providing bulk infrastructure, such as water and electricity, needed for development of the area surrounding the station
- providing basic connecting transportation infrastructure including roads, sidewalks, and bike ways
- providing safety infrastructure, such as lighting and sidewalks, for secure station access

Box 6.1. Kiosks for Commercial Development and Safety

KRC is considering establishing small kiosks along the outer perimeter of some railway stations, offering space, electricity, and sanitation facilities for small traders. In addition to providing shopping amenities for passengers, the kiosks will serve as a live barrier, preventing people from cutting across the railway's tracks and channeling them to a safe overpass.

Where the railway lacks large landholding around the station, the municipal government may acquire and develop land in the station vicinity. In this situation, the public sector must manage land acquisition and assembly, zoning, land-use changes, urban design, and building standards (Newman, Davies-Slate, and Jones, 2018). Such projects may involve multiple stakeholders, including various municipalities, the railway, private sector real estate developers, landholders, and residents (Suzuki, Murakami, Hong, and Tamayose, 2015) (see box 6.2).

Box 6.2. Tsukuba Express: Land Readjustment Process

Tsukuba Express is the latest large-scale suburban railway development in the Tokyo metropolitan area, opening with 20 stations in 2005. This urban redevelopment project involved the construction of a taller, higher-quality building on land prepared by assembling small parcels; construction of an underground metro station; and provision of public infrastructure such as wider roads, a station plaza, and amenities. In the Tokyo metropolitan area, the Urban Renaissance Agency and municipal governments secured railway development land along 13 stations for the new Tsukuba Express.

The land readjustment process involved the landowners within the designated areas surrendering a percentage of their land for public use. The aggregation of these lands creates the necessary space for the new transit facilities. Although the original landowners are left with smaller land parcels after the finished development, the value of these parcels appreciates due to the presence of new infrastructure.

To capture the potential accessibility benefits conferred by the transit station, the local government initially converts zoning codes from single use to mixed-use, with higher floor area ratios. Subsequently, the assembled land parcels are transferred to the railway construction agency at an assessment price, significantly simplifying the laborious land acquisition process. The local governments and the public housing agency also promoted the TOD of townships around the stations. This involved coordinated efforts with original landholders and new residents to manage land parcels reserved for sale and public facilities around the new stations.

Source: Suzuki, Murakami, Hong, and Tamayose, 2015.

Establishing clear and fair rules for sharing costs, benefits, and risks among stakeholders is essential to ensure the long-term commitment of public agencies and private entities to deliver transit projects, promoting transit-supportive activities, and maximizing benefits in and around stations (Schrag, 2014). Sharing the increase in land value among stakeholders allows for maximizing value of public land while retaining the focus on sustainable urban planning. This approach aligns investment with economic and population growth trends, adheres to a regional master plan and provides flexibility in zoning systems (Sekar and Gangopadhyay, 2016). Aligning rail systems with nearby real estate development attracts tenants, new investors, and transit riders (Suzuki, Cervero, and Iuchi, 2013).

Land Value Capture

LVC can provide a long-term revenue stream for urban rail. The increased in accessibility from urban rail development increases land value. Monetizing this value can generate long-term funding to repay financing for development investments or support services (See box 6.3). Two main types of LVC can be used to leverage the increase in land prices associated with urban rail development:

- i. Tax-based LVC, which uses new or existing local government land or property taxes to capture the increase in land value
- ii. Development-based LVC, which harnesses the increase in property value of station areas and other land adjacent to the urban rail system through land sale, leasing, joint developments, or sale of air rights

The successful implementation of a LVC project starts with careful planning that defines the necessary steps and processes to implement the project. The business case for the project should be established early with careful evaluation of the potential land value increase and market sounding with potential private sector partners. The lead agency or agencies must ensure close collaboration among the many parties involved in the project and secure appropriate agreements among them (Siemiatycki, Fagan, and Arku, 2023).

Box 6.3. Hong Kong: Financing Infrastructure through LVC

Hong Kong has gained global recognition as a leader in LVC. The Mass Transit Railway Corporation (MTRC) relies on real estate income to finance the capital and operating costs of new railway lines.

In Hong Kong, land is state-owned, empowering the government to grant development rights above and around stations to the MTRC at market prices before rail infrastructure development starts. Serving as a master planner, the MTRC selects development partners and subsequently engages in negotiations to secure funds for property construction. Diverse financial approaches, including land leases, upfront payments for development rights, and profit-sharing arrangements, are tailored to the individual projects. Through this model, the MTRC generates substantial revenue streams from the private partners, enabling the funding of new infrastructure, as well as the operation and maintenance of the entire system.

Distinguishing itself from traditional LVC models, the model endows MTRC with a high level of control over all transit and real estate projects and the generation of revenue. The diverse revenue sources of the MTRC, including development revenues, fares, and commercial leases, have proven remarkably resilient, underscoring the model's adaptability.

Source: Siemiatycki, Fagan, and Arku, 2023.

LVC mechanisms need to be tailored to the specific spatial and local context (see box 6.4). An in-depth analysis of the risks associated with LVC and the development of effective mitigation strategies should consider prevailing real estate market conditions. With development-based LVC, market and construction risks can be transferred to the private sector. An example is a deal structure with upfront payments from developers in exchange for development rights and joint development agreements. However, it is important for the public authorities to retain control over the master plan and zoning to ensure the integrity of the overall development vision.

Successful LVC requires well-functioning instruments supporting land availability, zoning, and development incentives. These include cadastral data and systems essential for title deed registration, property taxes that reflect market dynamics, and policies that support efficient land use. However, this may be challenging in many African cities. For example, in Nairobi and Maputo, the lack of cadastral data and title deed registration data increases the likelihood of land disputes and overlapping jurisdictions. Similarly, in Lagos, real estate taxation complexities are compounded by the opacity in property transactions and cadaster records (Egemoke and Isiadinso, 2018).

Box 6.4. Kuala Lumpur Sentral Station: LVC and Development of Wider Station Area

The KL Sentral Station in Kuala Lumpur, Malaysia, serves as an example of a successful LVC project. The area surrounding the station housed an obsolete railyard owned by the national railways. Recognizing the potential for transformation, the Government planned to develop a new railway station and seized the opportunity to revitalize the surrounding land. However, financial constraints prevented the railway operator from developing the station independently. As a solution, a private developer was granted the adjacent land for real estate development on the condition that it would develop the railway station.

Today, the KL Sentral Station has more than 200,000 daily passengers and the surrounding station area has evolved into a vibrant new central business and residential district, contributing to the city's economic and urban development. Leveraging available land resources owned by public authorities, the project demonstrated the potential for creating thriving urban hubs and achieving positive economic and urban growth. However, the financial constraints faced by the railway operator, compelling the involvement of a private developer, highlights one of the main obstacles encountered by projects related to LVC.

Source: World Bank, 2023.

LVC from station development takes a long time, often 15 to 20 years (Lawrence and Ollivier, 2015). In the medium to long term, the development of these instruments could enable the implementation of LVC on a larger scale in most African cities. In the short term, cities may prioritize the development of readily available areas adjacent to stations, which may already be owned by public authorities or the rail agency.

Public-Private Partnerships

PPPs are a potentially useful tool for delivering urban rail services. PPPs can provide benefits including efficiency by reducing overstaffing, political interference, and corruption; improved service levels; risk transfer; and lifecycle management by aligning interests to reduce risks (Pulido, Darido, Munoz-Raskin, and Moody, 2018). PPP contracts typically involve designing, constructing, operating, maintaining, and financing urban rail projects, often in exchange for payments, revenue sharing from tickets and other sources, and/or rights for land development. Key performance indicators relate to reliability and punctuality, customer satisfaction, cleanliness and general upkeep, access and security, ride quality, and noise pollution.²⁴

PPPs can encompass delivery of an entire project or specific project functions/components. A bundled approach can be cost-effective and lower the interface risks (among civil, mechanical, electrical, rollingstock, operations, and maintenance) and firewall risk (performance interdependences). However, it might heighten counterparty risk (public exposure to the risk of neglected assets) and reduce competition during procurement. Unbundled contracts provide greater flexibility, support future expansion, and increase competitive pressures, but introduce interface and firewall risks (Pulido, Darido, Munoz-Raskin, and Moody, 2018). The Lagos experience shows that when risks such as ridership levels are solely with the private sector, PPPs can fail. The private sector will require some form of passenger guarantee or other risk mitigation measure.

Assessing value for money, determining affordability, undertaking a proper risk allocation, and providing correct incentives are crucial. The SADC PPP Regional Framework (SADC, 2022) recognizes the importance of firm policy foundations, solid institutional structures, and rules that govern the enforcement of PPP agreements. These guidelines consider past failures (KIPPRRA, 2020) and recognize the need and commitment required to engage in PPPs. The SADC report emphasizes the importance of developing national legal frameworks to provide market certainty and sufficiently define the roles and powers of the contracting authorities, procurement agents, regulating bodies, and approval entities.

An independent regulator overseeing PPP implementation adds confidence to private sector participants, assuring fair treatment in contract disputes. Although a legal framework for PPPs exists in all three cities studied, only Lagos has a fully independent regulator (see Table 6.1.).

²⁴ Detailed guidance and case studies on structuring PPPs in rail, including pros and cons of different models, can be found in the Pulido, Darido, Munoz-Raskin, and Moody, 2018; Mandri-Perrott, Cledan, 2013; World Bank 2023 and www.PPIAF.org.

Table 6.1. Conditions for PPPs in Suburban Rail

PPP Success Factors	Lagos	Maputo	Nairobi
National/Federal/State Law on PPPs	<ul style="list-style-type: none"> Federal Infrastructure Concession Regulatory Commission Act of 2005 The Lagos State PPP Law of 2011 The Lagos State Public Procurement Act of 2011 Regulations issued by the State Executive Council (EXCO) governing the PPP process 	<ul style="list-style-type: none"> Law no 15/2011 (“PPP Law”). Decree no 31/1996 (“Toll road concessions law”); Decree no 16/2012 (“PPP regulations”) Decree no 69/2013 Decree no 5/2016 (“PPP procurement procedure”), Decree no 45/2009 (“Investment regulation”). 	The Public Private Partnership Act of 2021
Regulatory Agency for Rail Concessions	<ul style="list-style-type: none"> Federal Infrastructure Concession Regulatory Commission of 2008 Lagos State PPP Office LAMATA 	<ul style="list-style-type: none"> Ministry of Transport and Communications CFM 	<ul style="list-style-type: none"> Ministry of Roads and Transport Kenya Rail Corporation
Staff Trained in Procuring/Supervising PPPs	Unclear: LAMATA aims to complete the Red & Blue Lines through PPP	Some: Several freight corridors have been concessioned to private sector	Some: KRC has experience overseeing the concession of the standard gauge line
Interest in PSP in Rail	LAMATA intends to have PPPs in all 7 lines	<p>Metrobus is an example of PSP</p> <p>Several rail freight corridors</p>	Open to PSP in station development, advertising, LVC
Ongoing PSP or PPPs	Blue and Red Lines	Metrobus	O&M contract for standard gauge

Source: World Bank Analysis.

To capitalize on the benefits of PPPs, project-implementing agencies need to invest in strong project preparation and contract management capacity. Competency is required in procurement, transaction structuring, contract management, budgeting, and governance. While many resources outline options for structuring urban rail PPPs,²⁵ the agencies need staff with practical experience in PPPs to apply them. Considering the scarcity of such experience in the potential concessioning agencies of the three cities, seeking expert advice in transaction structuring could be valuable. Experience is also needed to oversee the implementation of any PPP to ensure that transactions deliver the desired result. Both CFM and KRC have some familiarity with PPPs in rail operations but their exposure to other types of PPPs, such as station and real estate development, is limited.

A key barrier to PPPs in rail services is inadequate funding. A private sector operator will require revenues to cover operating costs and yield returns on any invested capital. Given that many urban rail services serve poorer residents and cannot fully recover operating costs from tickets, public subsidies must be provided with a level of certainty or guarantee for these PPPs to be viable, while still encouraging the private operator to develop traffic (World Bank, “Modern Railway Services in Africa: Building Traffic – Building Value,” 2020).²⁶ In Lagos, the State government’s policy to not provide any urban transportation subsidy has so far precluded PPP opportunities. Similarly, in Nairobi and CFM’s commuter services, funding of rail commuter operations must be addressed before PPPs are possible.

In Maputo, however, a private company—Metrobus—is operating a commuter service on CFM’s infrastructure targeting middle-income customers. This service charges a fare approximately three times higher than CFM’s commuter train fare and provides a higher quality of service. At this fare level, Metrobus was able to invest in rolling stock and projected a profit by the fifth year of its business plan. Metrobus also provides bus service to and from the rail stations, enhancing the last mile service for users.

An obvious opportunity for PPP is the development of railway station areas and surrounding land. In such transactions, the private sector’s skills in real estate development are complementary and the potential funding from sale or leasing of the developed real estate could be sufficient to cover all costs and provide a return to both parties. Nevertheless, ensuring the private company’s vested interest in the project’s success is crucial. For example, in Kuala Lumpur, a private developer was granted land adjacent to the Kuala Lumpur Sentral station for real estate development. In exchange, they redeveloped the railway station. This arrangement incentivized the developer to create the best possible railway station, thereby enhancing the value of the surrounding land they had acquired (World Bank, 2023). To realize these PPPs, railway agencies need to build competence in PPP structuring and understand the dynamics of local real estate markets.

²⁵ See, for example, Pulido, Darido, Munoz-Raskin, and Moody, 2018 and Mandri-Perrott, 2013.

²⁶ PPP aspects are similar in structure for both urban metros and suburban rail services, but ridership is typically higher in metros.






7

Mobility Outcomes

Investing in urban rail can result in greater access, improved transportation safety, and lower emissions. Aspects of these outcomes for the case study cities are reflected in the summary in table 7.1. below.

Table 7.1. Summary of Factors Related to Realizing Transportation Outcomes

Transportation Outcomes	Factors	Lagos	Maputo	Nairobi
 <p>Access and inclusion</p>	Inclusion	<p>Start-up of service will increase access.</p> <p>New transportation facilities are being designed with accessibility in mind.</p>	<p>More frequent service will increase access and ridership.</p> <p>Non-motorized infrastructure and lighting are either lacking or deficient in neighborhoods.</p>	<p>Although the NCR has reserved spaces in the coaches for people living with disabilities, the boarding platforms at many stations do not have proper facilities. Most stations lack inclusive design features.</p>
	First, last-mile access	<p>Stations are well connected to other transit modes. Pedestrian walkways link train stations to bus stops and BRT terminals and last-mile around stations connect to Danfos bus and three-wheeler services.</p>	<p>Transportation infrastructure providing last-mile access to low-income neighborhoods is inadequate and limits access, especially of the poor, women, and vulnerable groups, to bus and rail stations as transportation needs are not met and people feel unsafe walking.</p> <p>Metrobus offers a rail+bus service to higher income users.</p>	<p>Access roads to some of the stations and halts are in poor condition and impassable during the rainy seasons.</p>

Transportation Outcomes	Factors	Lagos	Maputo	Nairobi
 <p>Safety</p>	<p>Operations and passenger access</p>	<p>LAMATA has not made public the safety management system that will be applied to ensure safe operations on the Blue and Red Lines as they start operations.</p> <p>Overcrowding is expected to create safety problems in rail, as currently in other modes. If demand is as high as expected, stations may require platform doors to prevent people from falling onto the tracks.</p>	<p>Given the high number of grade crossings, improved signaling and telecommunications as well as track maintenance may be necessary as a first step to improve the operation of CFM's existing network and allow a better performance.</p> <p>In low-income neighborhoods, 40 percent of people surveyed did not feel physically safe on the journey to the bus or rail station.</p>	<p>The commuter rail service has periodically suffered serious level crossing accidents. To mitigate against these accidents, KRC is planning to install automatic controls at all at-grade road crossings.</p> <p>There is a need to improving safety and security for pedestrians, cyclists, and motorcycle riders between the railway stations and the neighboring residential areas.</p>
 <p>Environmental Impact</p>	<p>Emissions and pollution</p>	<p>Lagos metropolitan area is over-reliant on road transport that increase emissions and pollution.</p>	<p>More road-based vehicles and poor traffic management generate high quantities of emissions, which will worsen if reliable mass transportation alternatives are not provided.</p>	<p>A shift to rail will reduce GHG emissions from transport and help break the link between growing the economy and growing transportation GHG emissions.</p>

Source: World Bank Analysis.

Access and Mobility

Urban rail enhances quality of life by giving citizens affordable access to employment opportunities, essential services, urban amenities, and neighboring communities (Pulido, Darido, Munoz-Raskin, and Moody, 2018). For passengers in far-flung urban spaces, rail can offer greater mobility by reducing travel times.

Accessible urban rail expands the size of a metropolitan labor market by increasing the number and range of locations to which a worker can feasibly commute (Blanquart and Koning, 2017). The increase in effective density and thicker labor market should result in better labor market matching, as both workers and firms will have more choices, enhancing the overall productivity of the regional economy (Duranton and Puga, 2003).

Urban rail will improve regional job accessibility by leveraging its exclusive right-of-way, fast travel speeds, higher capacity, and better quality of service to reduce travel times between existing origins and destinations (Pulido, Darido, Munoz-Raskin, and Moody, 2018). For instance, the new Lagos rail line from Marina to Okokomaiko (Blue Line) is estimated to have the initial capacity to carry 400,000 daily passengers with 24 trainsets. In Maputo, the rail services carried 5.4 million passengers in 2019. Overcrowding is an issue and passenger loads per train have grown by 78 percent since 2014, indicating the rising demand for more services. Similar transportation demand pressures in Nairobi project that the current 100.7 million annual commuter rail passenger kilometer (pkm) will double with the implementation of the Nairobi Commuter Rail Masterplan in 2030.

For journeys between 15 and 80 km, urban rail typically offers the fastest end-to-end travel times, despite slower access and egress (Anderson and Condry, 2022). Journey time is an important consideration in choosing transportation, as reflected in the Maputo surveys that shows rail having shorter journey times than buses (Arroyo Arroyo, 2022). The 27-km Lagos Blue Line is expected to have an end-to-end journey time of 35 minutes.

Affordability of services is a key aspect of access in African cities. In Maputo, the average expenditure on transportation is between 12.5 and 20 percent of a family's income, higher for those living on the periphery. In Lagos, commuters using minibuses paid an average of 20 percent of their disposable income on transport. Understandably, this makes commuters price-sensitive.²⁷ In Nairobi, suburban rail fares have been set at about 60 percent of bus fares, ensuring affordability for users.

In all three case study cities, around 40 percent of trips are made by walking, primarily due to unaffordability of transport. Providing low fares will allow lower income residents access to jobs and service beyond their walking radius—a valuable public service. Service planners and the MMA) should explicitly consider this aspect when setting fares, recognizing the tradeoff between low fares and other goals such as cost recovery.

²⁷ In June 2022 a 46-percent increase in fares on the Lagos BRT resulted in a revenue drop of 72 percent.

Urban design and last mile connectivity also shapes accessibility. The experience in Ghana highlights the demand risk when alternative transportation modes are preferred over the recently developed suburban rail line, because last mile services are not in place (Alimo, Agyeman, Zankawah, Yu, Cheng, and Ma, 2022). Simple interventions like street paving, lighting, and sidewalks can improve the accessibility of rail services. Land use planning, TOD and participatory planning mechanisms can improve accessibility by situating housing and services near rail stations.

Safety

Rail transportation is deemed safer than road transport, considering the substantial safety risk posed by road transport in many regions around the world, especially in low-income countries. Low- and middle-income countries account for more than 90 percent of all road traffic deaths despite having less than 60 percent of the world's motor vehicles (WHO, 2021). This is largely due to deficiencies in road safety standards and enforcement, vehicle safety and maintenance, the design and implementation of policies, and safe transportation infrastructure (Heydari, Hickford, McIlroy, Turner, and Bachani, 2019).

International data shows the risk of death from a train accident is one-third that of bus transportation and 28 times lower than for private car occupants (IRSC, 2019). Nigeria has the highest rate of death from motor accidents in Africa, with Lagos State identified as a high-risk area with 32 traffic deaths per 1,000 people (Atubi, 2012). A survey conducted in Kenya highlighted passengers' perception of feeling safer from accidents when travelling by train compared to other modes (Onguka, 2018).

Safety is important for all passengers but particularly for women. Thoughtfully designed services and infrastructure can enhance accessibility for female passengers, informal traders, and disabled users. Railways can actively monitor and address concerns of passengers throughout the network through initiatives such as staff training, protocols, and public campaigns against gender-based violence and harassment. For instance, in Nairobi, the Kenya Railways Corporation installed CCTV surveillance cameras at gates and within stations, provided adequate lighting, and deployed police officers and security guards on each passenger train.

Ensuring the safety of rail operations is also important. This involves considering the safety of the railway operational system and its interactions with the surrounding environment. Signaling improvements and strengthening maintenance of infrastructure and rolling stock are top safety priorities for the existing rail operations in Maputo and Nairobi. To reduce level crossing accidents, the KRC is planning to install automatic controls at all at-grade road crossings.

Additional safety measures to reduce level crossing and pedestrian accidents include track fencing, deploying guards at high-risk sections, and restricting locomotive speeds at level crossings (International Finance Corporation, 2007). All railways collect safety performance data, which should be monitored against performance indicators and regularly analyzed for insights into the root cause of accidents (Pulido, Darido, Munoz-Raskin, and Moody, 2018).

Environmental Impact

Improving urban rail service in African cities will have a positive environmental impact. A study on selected African cities shows all five cities studied exceeds the World Health Organisation guidelines for large particulate matter,²⁸ while Abidjan, Dar es Salaam, and Rabat also exceed the small particulate matter guideline (African Development Bank Group, 2017). Urban rail interventions can change the trajectory of increased emissions as incomes increase - a trend observed in both Nigeria and Kenya, where personal car use increases with economic growth (Olubusoye and Musa, 2018).

Shifting traffic from road-based transportation to urban rail will also reduce GHG emissions. Suburban rail typically provides mobility in urban regions with substantially lower emission levels than competing road modes. Rail emissions, measured in CO₂e/passenger-km, are typically one-third of the emissions from road transportation (Lawrence and Bullock, 2022). Emissions rates per pkm in any specific case are strongly influenced by the occupancy of both road and rail vehicles. Notably, in the case study cities, rail vehicles are operated over capacity so would have very low GHG emissions per passenger kilometer.

The more urban rail can shift passengers from road-based transport, the greater the environmental benefits will be. If fares are set to facilitate greater mobility for the poor, who currently lack access to affordable motorized transport, the development impact of increased labor mobility will be significant in relation to the limited environmental impact.

²⁸ Large particulate matter <10 µm aerodynamic diameter; small particulate matter <2.5 µm aerodynamic diameter



8

Conclusions

Lagos, Maputo, and Nairobi are rapidly growing cities, emblematic of the ongoing urban transformation in Africa. Lower cost housing on the periphery, but jobs concentrated in the city center has led to urban sprawl, resulting in extended commute times that adversely affect the both the quality of life and the efficiency of the city. Mostly informal transport—walking and privately operated buses and minibus taxis—are no longer meeting the mobility needs of the cities.

City planners have recognized the need for higher-capacity, smaller-footprint transportation options and higher density, livable communities. They have started to create the plans and institutions to retrofit their cities toward this new vision of mobility. All three cities studied have created Metropolitan Mobility Agencies to coordinate transit across agencies and jurisdictions. They have developed urban transit and development plans. They aspire to create transit-oriented development.

Suburban rail corridors can play an important role in achieving these goals. Key insights about developing such corridors from the experience of Lagos, Maputo, and Nairobi are summarized in Figure 8.1. and described below.

Transformational Asset/Investment. In congested cities, the existing railway right-of-way is a unique and valuable asset that municipalities can leverage to deliver improved mobility. Lagos' Red Line, for instance, will upgrade and use a 31-km section of NRC line. Suburban rail services are already being provided in Maputo on CFM lines and in Nairobi by KRC. However, the CFM and KRC lines were not designed for urban passenger service and a step change in the level of service offered in Maputo and Nairobi is needed. This will require comprehensive investment in tracks, train control systems, and rolling stock to deliver a competitive and attractive service.

Multimodal Connectivity. Suburban rail can serve as the backbone of a transit system, but it needs to be connected to lower-density transportation that can connect passengers to the station. This requires complementary investment in feeder infrastructure such as sidewalks, bikeways, and roads. In most cities, a variety of national and local government authorities are responsible for such infrastructure. Coordination is needed among them to connect the railway station to its surrounding community effectively. Complementary bus and minibus services are also needed. The private sector operators of these services view the railway as a competitor. A new, model of working with bus and minibus operators within feeder networks is needed.

Funding. Ensuring commuter rail services remain affordable for lower-income residents will require financial support for operations as well as investments. This is a shift from the current practice in road-based transport of the government only providing infrastructure, and private operators recovering the cost of services through passenger fares. A well-supported analysis of the costs of providing the rail service and the revenues available to cover them must be the starting point. The typical sources of funding for suburban rail—ticket revenue, commercial revenues at stations, subsidies from local or national government, and land value capture—must —must be examined realistically to ensure that suburban railway service is financially sustainable. Ultimately, the government, not the railway, is responsible for ensuring that the service is financially sustainable.

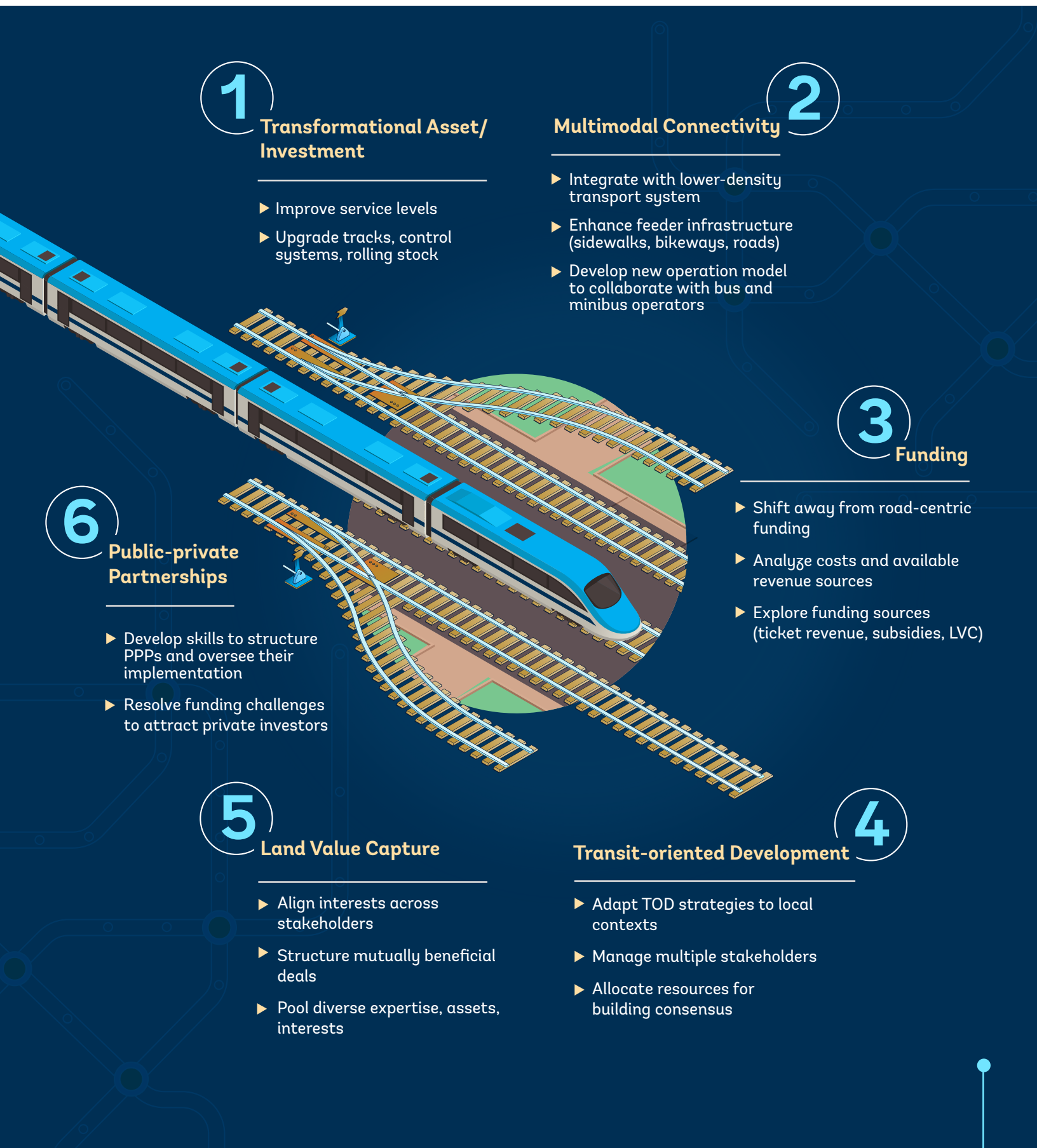
Transit Oriented Development. While all parties appear to understand the benefits of TOD, implementation has proven challenging. TOD interventions, originally designed for developed countries, need to be adapted to the communities surrounding African railway stations, applying TOD principals to local circumstances. Proponents need to recognize the complexity of managing multiple stakeholders with interest and influence over TOD implementation and devote sufficient resources to building consensus around TOD plans.

Land Value Capture. While land has considerable value in African cities, successful examples of LVC in the cities studied (and Africa more broadly) are scarce. Similar to TOD, proponents need to recognize that LVC requires aligning interests among a broad range of stakeholders and structuring agreements that result in favorable outcomes for each party involved. This requires bringing together a broad range of expertise, assets, and interests, and takes a long time for financial benefits to be realized.

Public-private Partnerships. PPPs are a valuable tool for delivering suburban rail service and integral to LVC. The groundwork for PPPs has been laid in each of the cities studied, with PPP laws in force. For PPPs to be implemented effectively and be sustainable, governments need to develop skills in structuring these partnerships and overseeing their implementation. Since the private sector party will seek a profit commensurate with the risks assumed in the PPP, funding for suburban rail operations must be resolved before PPPs in rail operations will be viable.

All these challenges can be addressed, enabling suburban rail to anchor development corridors that contribute to the mobility, livability, and development of African cities. The World Bank stands prepared to assist clients in developing tailored solutions to tackle these complex issues.

Figure 8.1. Resolving Urban Mobility Challenges in Africa with Rail Solutions



1 **Transformational Asset/ Investment**

- ▶ Improve service levels
- ▶ Upgrade tracks, control systems, rolling stock

2 **Multimodal Connectivity**

- ▶ Integrate with lower-density transport system
- ▶ Enhance feeder infrastructure (sidewalks, bikeways, roads)
- ▶ Develop new operation model to collaborate with bus and minibus operators

3 **Funding**

- ▶ Shift away from road-centric funding
- ▶ Analyze costs and available revenue sources
- ▶ Explore funding sources (ticket revenue, subsidies, LVC)

6 **Public-private Partnerships**

- ▶ Develop skills to structure PPPs and oversee their implementation
- ▶ Resolve funding challenges to attract private investors

5 **Land Value Capture**

- ▶ Align interests across stakeholders
- ▶ Structure mutually beneficial deals
- ▶ Pool diverse expertise, assets, interests

4 **Transit-oriented Development**

- ▶ Adapt TOD strategies to local contexts
- ▶ Manage multiple stakeholders
- ▶ Allocate resources for building consensus

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