The Programme for Infrastructure Development in Africa:
Transforming Africa through Modern Infrastructure

Programme for Infrastructure Development in Africa

Interconnecting, integrating and transforming a continent

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Africa Transport Sector Outlook 2040

Africa Transport Sector Outlook – 2040

ACKNOWLEDGEMENTS

The completion of the Transport Sector Report and the Transport Outlook Report 2040 as part of the Programme for Infrastructure Development in Africa (PIDA) was a major milestone in defining Africa's performance and prospects in the transport sector. This helped to inform on the priority transport projects which are now an integral part of the project investment portfolio of the PIDA Priority Action Plan (PIDA-PAP) for the period up to 2020.

The support and collaboration of the Regional Economic Communities (RECs) and the Member States led not only to the success of PIDA, but also to ensuring that the ownership of PIDA rests with the RECs and Member States who are, ultimately, the drivers of PIDA as well as the beneficiaries.

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LIST OF ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Trafic
AfDB	African Development Bank
AFCAC	African Civil Aviation Commission
AFI	Africa-Indian Ocean
AICD	Africa Infrastructure Country Diagnostic
AMU/UMA	Arab Maghreb Union
ANE	National Roads Administration (Administração Nacional de Estradas)
ARTIN	African Regional Transport Infrastructure
ASEAN	Association of Southeast Asian Nations
ASECNA	Agency for Air Navigation Safety in Africa and Madagascar (Agence pour la Sécurité de la Navi gation Aérienne en Afrique et à Madagascar)
AUC	African Union Commission
BOT	Build Operate Transfer
CEN-SAD	Community of Sahel Saharan States
CICOS	Commission of the Congo-Oubangui-Sangha Bassin
COMESA	Common Market for Eastern and Southern Africa
COSCAPS	Cooperative Development of Operational Safety and Continuing Airworthiness Programme
DPW	Dubai Ports World
EAC	East African Community
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community for West African States
EGNOS	European Geostationary Navigation Overlay Service
EU	European Union
FESARTA	Federation of East and Southern African Road Transport Associations
GDP	Gross Domestic Product
HGV	Heavy Goods Vehicule
ICT	Information and Communication Technologies
IFI	International Financial Institution
IGAD	Intergovernmental Authority for Development
JICA	Japan International Cooperation Agency
MoU	Memorandum of Understanding
NAPMA	North African Management Port Association
NEPAD	New Partnership for Africa's Development
NGO	Non Governmental Organisation
NPCA	Nepad Planning and Coordinating Agency
OECD	Organisation for Economic Co-operation and Development
OSBP	One Stop Border Post
PAP	Priority Action Plan
PIDA	Programme for Infrastructure Development in Africa

PMAWCA	Port Management Association of West and Central Africa
PMAESA	Port Management Association of Eastern and Southern Africa
PPP	Public Private Partnership
REC	Regional Economic Community
SADC	Southern African Development Community
SARA	Southern African Railway Association
SSA	Sub-Saharian Africa
TAH	TransAfrican Highway
TEU	Twenty-Foot Equivalent Unit
TGV	High Speed Train (Train à Grande Vitesse)
ToRs	Terms of Reference
TRAC	Trans African Concessions Consortium
UAR	Union of African Railways
UNECA	United Nations Economic Commission for Africa
USAID	United States Agency for International Development
WAEMU	West African Economic and Monetary Union
WARSO	West African Road Safety Organisation
YD	Yamoussoukro Decision

1. INTRODUCTION

KEY MESSAGE

• The transport network considered by the Transport Outlook covers the **main Africa transports services** and includes:

- 40 key transport corridors carrying **40% of international trade;**
- 19 ports handling **70% of international trade;**
- 53 airports handling **90% of the air traffic;**

1.1 Scope and Objectives of the Outlook

The aim of the PIDA Study is to define an African regional infrastructure development programme underpinned by a strategic framework and implementation arrangements that will respond efficiently to the expected demand resulting from the economic growth of the African continent.
For the transport sector, the objective is to propose a program of investments and actions in the short, medium and long term that will lead to efficient regional transport services operating on a modern and well managed transport infrastructure network. The long-term goal is to develop quality transport services similar to the best practices in other parts of the world.
The Africa Transport Sector Outlook 2040 aims at evaluating the regional transport demand and the resulting infrastructure gap taking into account the policies relevant to regional and continental transport, both the existing infrastructure and the potential for efficiency gains.

1.2 Structure of the Report

This report first presents the definition of PIDA transport infrastructure and its macro-economic context, along with the status and trends in the transport sector (Chapter 2). This is followed by an analysis of the transport demand up to 2040 (Chapter 3) and then an analysis of future transport infrastructure capacity gaps (Chapter 4). Finally, it addresses the challenges and realistic targets (Chapter 5), the inter-sectoral synergies (Chapter 6), the strategic environmental perspective (Chapter 7) and the invectment needs and financial outlook (Chapter 8).

1.3 Definition of the PIDA Networks

1.3.1 Africa Core Regional Transport Network Methodology

The transport sector in Africa is a key element supporting economic growth and regional integration. It is particularly critical to the 15[1] landlocked countries in Africa; more than any other continent in the world (see grey areas in Figure 1).

The road and rail networks in Africa (except Nigeria, South Africa and some coastal areas) are less dense than in other continents and there are missing links in the trans-Africa transport connections. The relatively low traffic volumes in the centre of the continent limit the economic and financial interest in their development. This reflects the relative isolation of the landlocked countries and the lack of linkage across the continent due to natural features such as the Sahara desert and the Congo Basin forest, but also the location of large urban centres and economic production areas in coastal countries.

1.3.2 The African Regional Transport Infrastructure Network (ARTIN)

International freight corridors and the air transport systems are the gateways to Africa and the crucial links between countries within the continent. The performance of these gateways determines the efficiency of the international supply chains that use them and the cost of goods in Africa.

The PIDA analysis focuses on the major freight corridors and on the international air transport system. These networks together form the African Regional Transport Infrastructure Network (ARTIN). The ARTIN is composed of:

- 40 principal international freight corridors (including road, rail, river modes and major sea ports)[2]
- The Trans-African Highway network (TAH)
- The major international airports (one per country), and
- The high-level air traffic control system

[1]Including South Sudan

ARTIN Surface Transport System

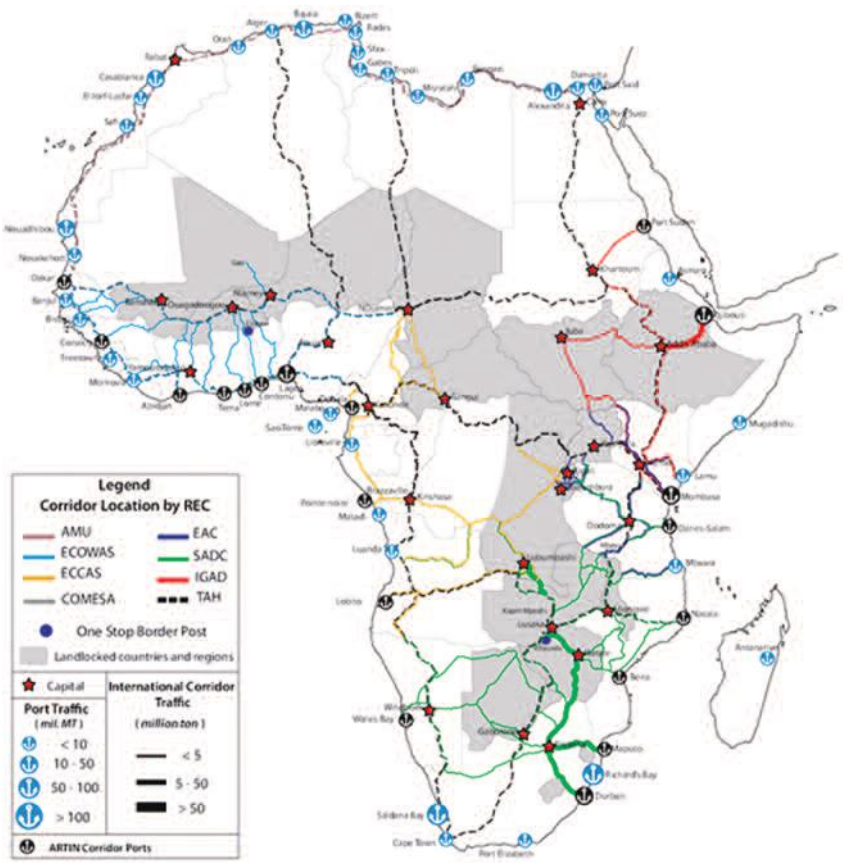
The ARTIN surface transport system includes the TAH as well 40 key transport corridors that have been created by the RECs over the past 20 years to link landlocked countries to ports and to connect the capitals of coastal countries.

The TAH were conceived in the mid-1970s and constitute the backbone of the ARTIN (although they do not carry the bulk of the traffic). Stretching over 58,000 km, they will eventually link the African capital cities and cross Africa from North to South and East to West.

The ARTIN corridors (Figure 1) carry 40% of international trade by African countries[3] (90% of trade for landlocked countries). The 40 corridors selected for inclusion in the ARTIN (38 existing corridors and 2 new proposed corridors, the Mtwara and the Lamu corridors), are based on existing roads (about 63,000 km out of a total of 2.3 million km in Africa). Sixteen also have competing/ complementary railway lines (about 20,000 km) and some corridors, such as the Central corridor and the Beira/Shire/Zambezi corridor include lake or river transport. They all terminate at ports and/or link ports. About 23,000 km of road along these corridors are also part of the TAH[4]. In some cases, ARTIN corridors are also linked to spatial development initiatives (SDI), which combine transport and other economic development planning and coordination.

ARTIN includes 19 ports, the entryways to the corridors. They handle over 70% of Africa's foreign trade.

Figure 1: ARTIN Corridors by REC in 2009

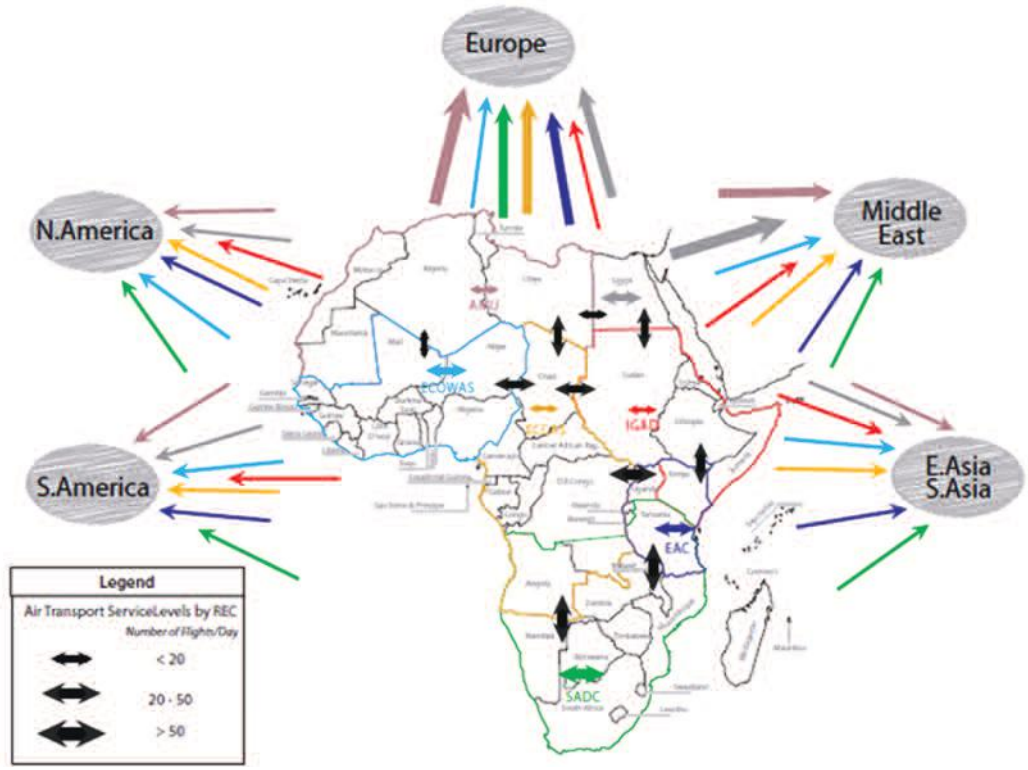


ARTIN Air Transport System

The ARTIN air transport system includes the largest airport in each country and handles 90% of the air passengers in Africa and the high level air control system. As shown in Figure 2 there is a significant variation of service between RECs.

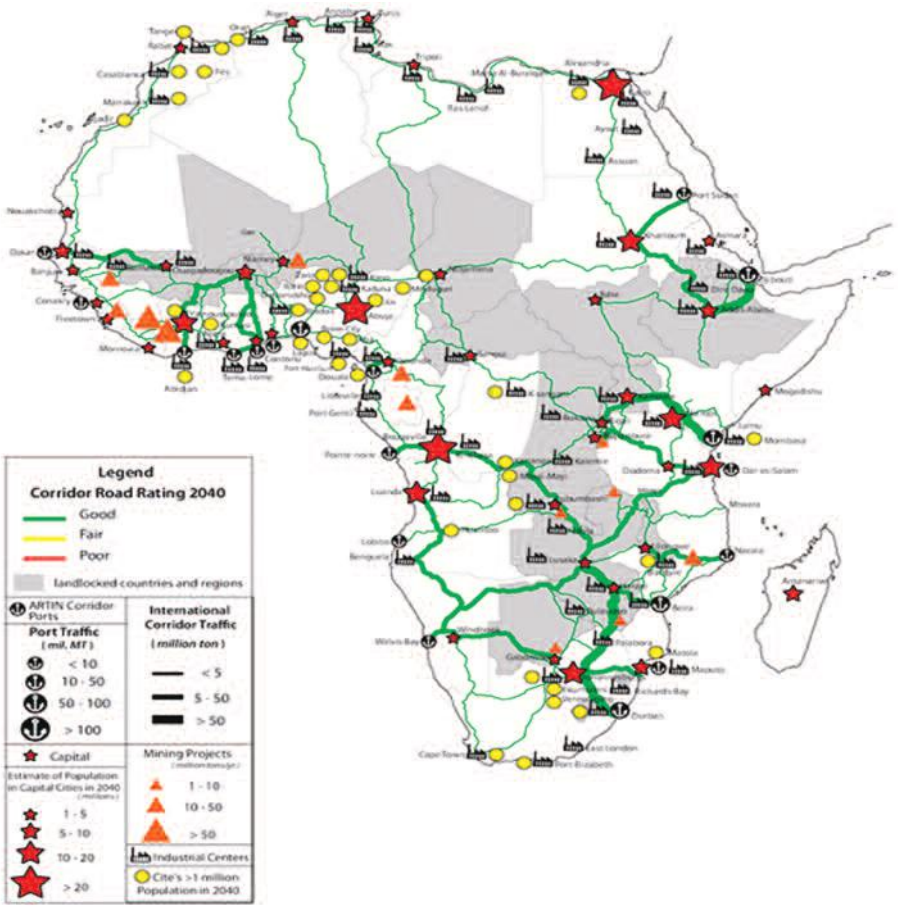
[2] As identified by the RECs - [3] Not counting trade through non-corridor ports. - [4] About 35,000 km of the TAH are not, for the time being, located on a corridor.

Figure 2: ARTIN Air Transport System Service Levels in 2009



The ARTIN links the large African centres of production (large cities, mining centres, large agriculture production projects) and the most important African consumption centres with the rest of the world via what should be modern and efficient regional transport infrastructure networks and gateways (ports and airports). The link between the ARTIN corridors and existing and future production centres and mining and agricultural areas is shown in Figure 3.

Figure 3: Link between ARTIN Corridors and Production and Consumption Centres



For the purpose of analysing the transport infrastructure, the PIDA Study considers five regions:

- North Africa (AMU+ Egypt)
- West Africa (ECOWAS)
- Central Africa (ECCAS)
- East Africa (COMESA, EAC and IGAD) and
- Southern Africa (SADC)

A summary of the components of the ARTIN in each region is provided in Table 1.

Table 1: Components of the ARTIN by Region in 2009

	Km of ARTIN roads	Km of ARTIN railways	Number of Ports located on ARTIN corridors*	Number of ARTIN airports
North Africa	7,100	1,500	-	5
West Africa	17,000	4,050	7	15
Central Africa	17,000	4,400	3	8
East Africa	10 100	5,370	3	17
Southern Africa	15,800	4,860	6	8
TOTAL	64,500	21,050	19	53

Source: Consultant estimate

*Traffic forecasts and analyses have also been carried out for 14 additional major ports which are not part of ARTIN corridors such as Libreville in Gabon and Casablanca in Morocco

1.4 Macroeconomic Context

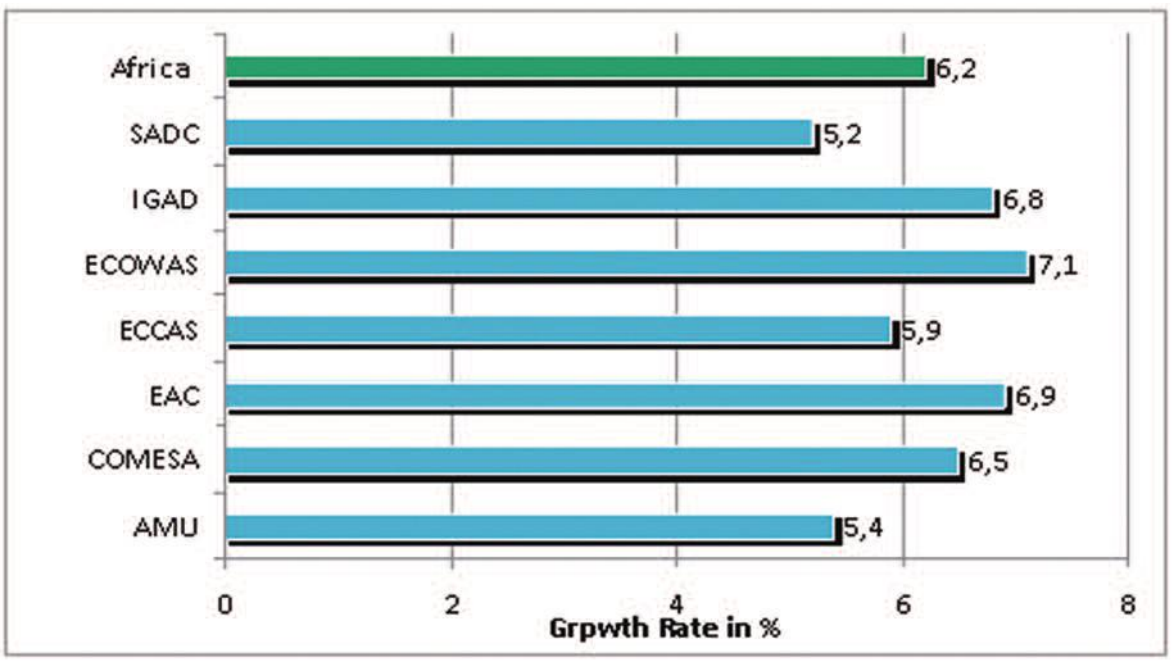
Africa's potential for growth is quite high. Using a methodology based on the Augmented Solow Growth Model, the Consultant has forecasted that the average growth rate for 53 African countries will be 6.2% per year between 2010 and 2040. Thirty-seven of the 53 countries should exhibit a growth rate higher than 5% per year on average for the period 2008–2040.

Twenty-six African countries should record an average growth higher than the continental average of 6.2%, led by Ethiopia and Nigeria, with estimated rates of 7.8% and 7.6 %, followed by Mozambique and Benin (7.2%), and Angola (7.1%).

Eight countries will exhibit an average growth rate between 5 % and 6 % per year. At the bottom of the pack, seven countries are expected to grow at a rate of less than 4 % per year—among them Guinea, Mauritius, Zimbabwe, Eritrea, and Equatorial Guinea.

The growth rates (on GDP weighted basis) by RECs are shown in Figure 4.

Figure 4: GDP Growth Rates for selected RECs



The drivers of this growth are the positive demographic trends leading to sizeable increases in working age population, as well as the level of education and technology absorption. Rapid urbanization and economic diversification beyond resource-based activities are additional factors underpinning growth.

Ten countries are leading the way in terms of economic integration (as measured by their share of intra African trade):

- Egypt and Tunisia in North Africa;
- Côte d'Ivoire, Mali and Nigeria in West Africa;
- Cameroon in Central Africa;
- Kenya and Uganda in East Africa;
- South Africa and Namibia in Southern Africa.

Three other countries (Zimbabwe, Zambia and Rwanda) lead the continent in terms of regional trade out of their total trade.

Transportation contributes to Africa's growth by assuring connectivity and market integration and making the region more accessible and competitive.

2. STATUS AND TRENDS IN THE SECTOR

KEY MESSAGES

• The value of African trade has grown at almost 12% per year over the past ten years with trade volumes growing at 6-9% per year

• The condition of the African Regional Transport Network (ARTIN) shows:
- A quarter of the ARTIN roads are in poor condition with one tenth unpaved;
- Over half of the railways are in poor condition (including 100% in West and Central Africa);
- Most ports are in good condition but with little spare capacity in container terminals
- Lake and river transport offers good potential but is almost completely neglected
- A third of airports are in poor condition and the regional air navigation systems are obsolete

• Main policy weaknesses include
- Road maintenance and harmonization of norms and standards
- Harmonization and efficiency of trade and transit
- Liberalization of the road transport industry
- Level playing field for rail and multimodal transport
- Implementation of the Yamoussoukro Decision
- The development of effective PPPs in transport

• Main institutional recommendations include:
- Harmonization is best dealt with by peer review under the aegis of NPCA and RECs
- Many aspects of corridor management can be best handled through multi national bodies using PPP arrangements with maintenance and expansion managed by concessionaires

• Suppressed demand amounts to 11% in terms of trade (26% for landlocked countries) and 13% in terms of air passenger transport

• Inefficiencies along corridors cost African economies US$ 172 billion, of which 60% is due to high annual costs of transport and 40% due to the cost of suppressed demand

2.1 Recent Developments in the Transport Sector

2.1.1 Trends in Transport Demand

As a result of the growing international trade and air travel both within Africa and between Africa and other regions of the world, the African gateways have grown substantially, both for freight and passengers. This has meant that ARTIN ports, corridors, airports and air services have had to expand to handle the traffic, whose growth is illustrated in Figures 5 and 6 below.

International Freight Demand

Total international freight demand is based on international trade in Africa, which has grown at an average of 11.7% per year from 2000 to 2009 in value terms, as shown in Table 2, despite the economic downturn in 2008-2009. The volume of trade in tons has somewhat grown at a slower rate (6-9%) due to the increase in value of the volume of both imports and exports in this period[5].

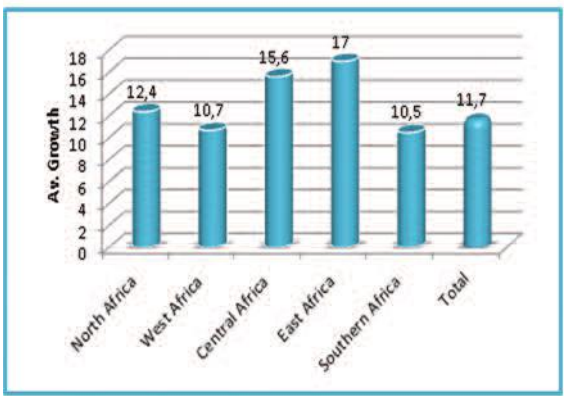
Table 2: Growth in African Trade 2000-2009 (US$ trillion)

	2000	2009	Av. Growth
Imports	107	333	13,3%
Exports	112	261	9,9%
Total	**219**	**594**	**11,7%**

Source: COMTRADE, total value of imports and exports by country, adjusted to fill gaps.

This growth in trade varied by region and REC (see Figure 5) with East and Central African trade growing the fastest (from a smaller base), North African trade growing slightly faster than average, and West African and Southern African trade[6] growing slightly slower than average (from a large base).

Figure 5: Growth in African Trade - Value by Region between 2000 and 2009



Source: COMTRADE, total value of imports and exports by country adjusted to fill gaps,

[5]Note that the sharp rise in value of oil exports is a big factor of this increase - [6]Driven by Egyptian trade growing at more than 20% per year in this period

All major ports, except for a few countries with internal conflicts, have experienced substantial increases in demand for containerized freight in the period 1999-2009.

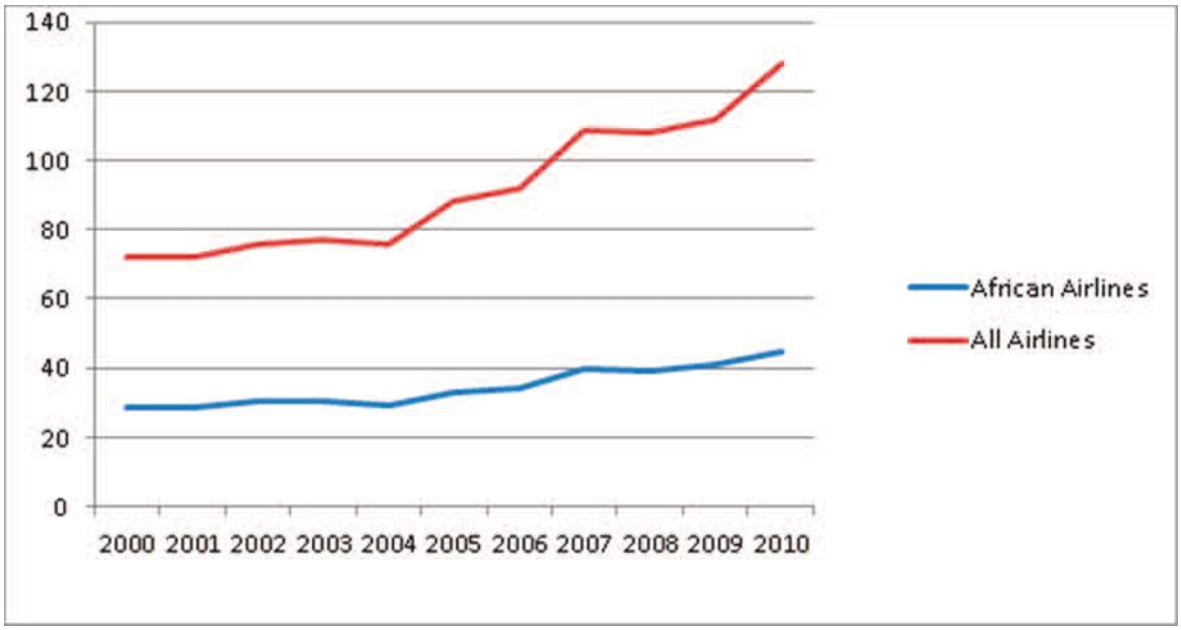
International Air Passenger Transport Demand

Air passenger transport demand has been growing steadily in Africa, despite downturns in 2001 and 2009, with annual growth averaging 4.5% per year between 2001 and 2009; 7.5% per year between 2003 and 2008 and a growth spurt of 10% for 2009-2010. This growth occurred for all types of scheduled air travel: intercontinental traffic, international traffic within Africa, and domestic travel (see Figure 6).

Intercontinental air traffic relies heavily on the three major hubs of Johannesburg, Nairobi and Addis Ababa. While the South Africa routes to the U.K. and Germany are the most heavily trafficked, there has been a faster increase in the traffic to the Middle East from all of the main hubs. European airlines carry 60% of this traffic.

International air traffic between countries within Africa grew slightly faster than total air traffic between 2001 and 2009, with traffic between other regions and North Africa growing at 25% per year for part of this period. Johannesburg, Nairobi and Cairo handle 60% of this traffic, which is dominated by the national airlines using these hubs. There are major gaps in service in West and Central Africa, due to a lack of hub operations in these regions.

Figure 6: Growth of Air Passenger Transport in Africa between 2000 and 2010



Source: PIDA estimates based on African Airlines Association data for 2010 and Bofinger, AICD Background Paper 16, July 2009.

2.1.2 Trends in Logistics and Supply Chains

One of the major worldwide developments affecting transport infrastructure and services is the increasing importance of seamless logistics and global supply chains. These are critical to the competitiveness of most businesses involved in imports and exports.

The globalization of trade has led companies involved in international trade to pay close attention to their supply chains and to try to increase supply chain efficiency through better coordination and carefully planned logistics decisions. This puts pressure on transport systems, including freight corridors in Africa, to reduce transport costs and transit times and increase reliability.

In addition, there is an increased emphasis on the security of international freight shipments. There are international systems now being put in place to monitor shipments from origin to destination. This creates new requirements for transport services, infrastructure operators and customs operations that need to be closely considered for transport sector planning in Africa.

2.1.3 Trends in Infrastructure Development and Efficiency

The development of transport infrastructure in Africa in the past ten years varies from one region to another. Overall, infrastructure planning and implementation of additional capacity tend to lag behind demand. This is

particularly true for ***ports***, many of which have not kept up with the substantial increases in traffic, especially containerized cargo, leading to congestion in container terminals and increased ship waiting times.

Road infrastructure has been receiving more investment than other modes with new construction and rehabilitation projects in all regions. North and South Africa have managed to keep their infrastructure in good condition. However, the major road corridors linking land-locked countries to the coast have not improved their low levels of efficiency, despite improvement projects in all RECs. They are still affected by poor road condition, multiple roadblocks and lengthy border crossing times. Modern coastal road corridors are developing only now in some areas.

Rail infrastructure, apart from a rail project under way in Libya (now stalled), has not developed significantly. In most countries outside of North Africa and South Africa, the level and condition of rail infrastructure has deteriorated over the past decade. The introduction of concession arrangements has not had the desired positive impact.

Airport capacity has kept ahead of demand with a few exceptions. The high level air traffic control is obsolete.

2.1.4 Trends in the Development and Efficiency of Transport Services

The shipping industry has considerably evolved in the past 20 years with rapid containerization. This has brought about major modifications in the design of ships and in port layouts and equipment.

Globalization of trade increased the volume of cargo shipped by sea and led ship operators to progressively abandon the old «one port to one port» shipping model to concentrate on models which use the hub and spoke concept.

As regards the road transport industry, there are improvements in vehicle fleet and an increased use of modern heavy goods vehicles, particularly in Southern Africa. However, many policy-related issues affecting the efficiency of road transport remain to be resolved.

The rail and multi-modal transport industries (including river and lake transport) outside of North and South Africa have become less efficient over the past three decades, despite efforts to bring in private sector management via concession agreements.

The air transport industry in Africa is dominated by European or other foreign carriers (70%), leading to unnecessarily routings through Europe. There was a serious drop in air services in West Africa in the early 2000s, but the growth of air carriers in North Africa, East Africa and Southern Africa has partly filled the gap in capacity. Africa's fleet of aircraft used for scheduled services is being renewed and adjusted for the types of markets served and the older Eastern-built aircraft (with high accident rates) are being phased out.

2.2 Condition of the Existing Stock of Regional Infrastructure

The PIDA review of the physical state of ARTIN shows that a large part of the infrastructure along the 40 corridors is in poor condition leading to inefficient regional transport services. In ARTIN corridors, 16% of roads, 60% of railways and 37% of the ports are in poor condition.

2.2.1 ARTIN Roads:

The ARTIN road corridors represent almost 65,000 km, which is less than 1% of the 2.3 million km in the total African road network. More than 5,000 km of ARTIN roads are being upgraded or rebuilt. The condition of the road infrastructure is not satisfactory as shown in Figures 7 and 8. This is because:

- Outside of North Africa and South Africa, a large portion (24%) of the network is not paved or is in poor condition. This portion is larger in ECCAS and ECOWAS (red on the map in Figure 7).
- Generally, there is a lack of adequate maintenance policies and funding.
- Only a few countries apply regional limits on large vehicle size and axle load. This results in substantial overloading of trucks and damage to the road infrastructure.

Figure 7: Condition of the ARTIN Roads in 2009

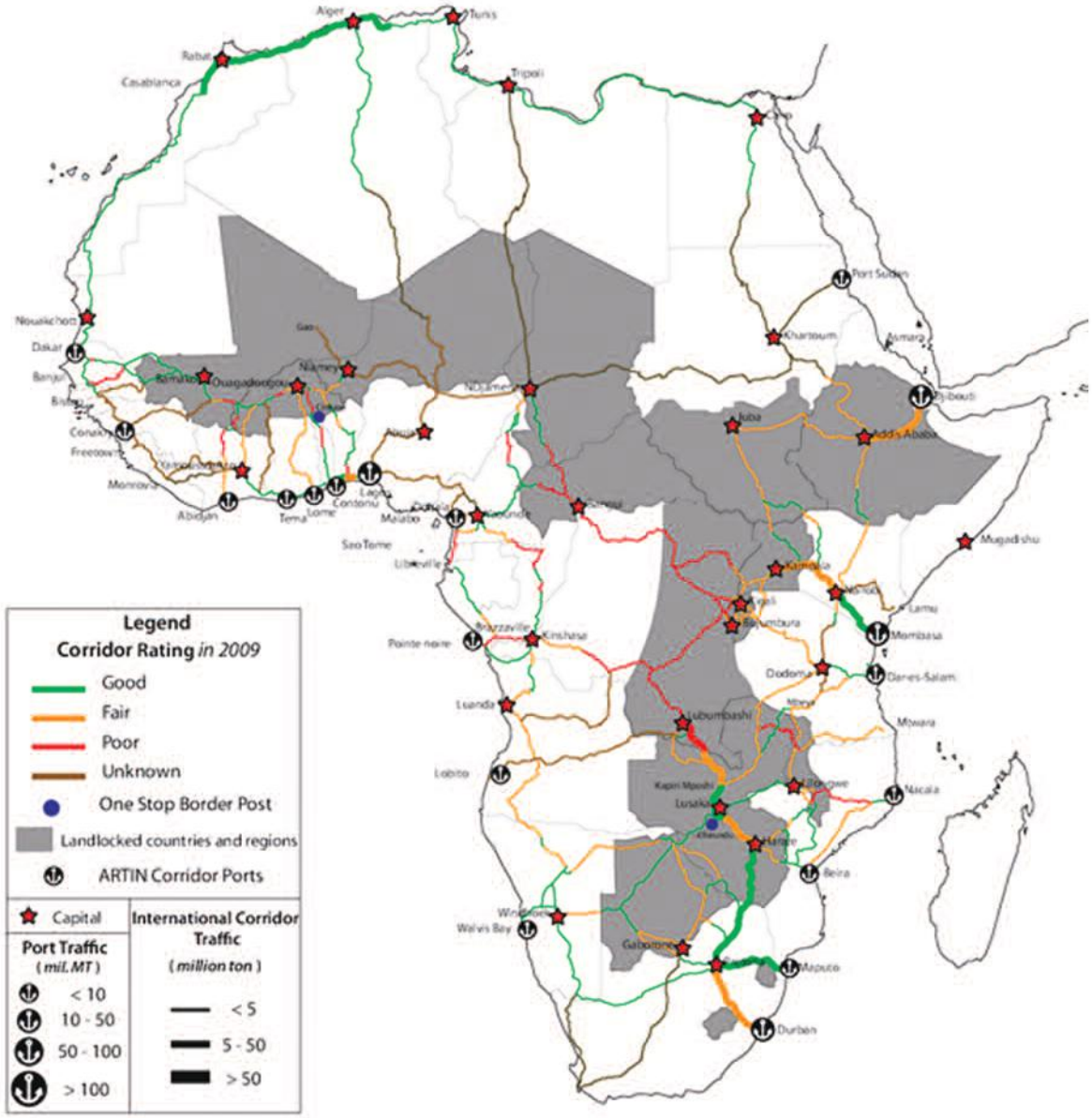
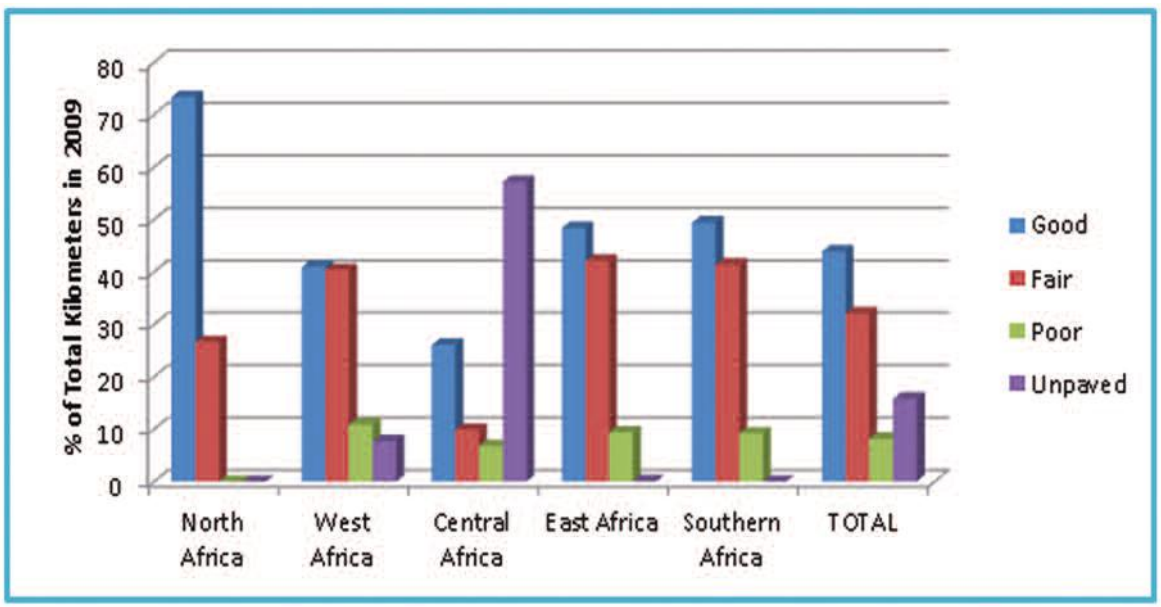


Figure 8: ARTIN Road Network Condition in 2009



Source: PIDA link-by-link analysis of road condition for all corridor roads based on national road databases and feasibility reports.

Some ARTIN corridors (such as the Maputo Corridor) comprise modern roads, but most (such as the Abidjan-Lagos Corridor) are composed of a series of national roads with widely varying design, operation and maintenance standards combined with inefficient border crossings. There are few bypasses of congested urban areas. The Nairobi-Arusha road is an example of good design ARTIN corridors.

The physical condition of the sections of the TAH not located on the 40 corridors is uneven. Some sections in North Africa have been paved and are in good condition. However, a very large part of the sections crossing West and Central Africa are in very poor condition with some sections unsuitable for motorized vehicles.

2.2.2 ARTIN Railways

The ARTIN rail corridors represent about 21,000 km or 31% of the 67,000 km in all the African railway networks. In the AMU and in South Africa, railways are in good condition (see Figures 9 and 10). In other regions of Africa, railways have been neglected during the past ten years. Not enough financial resources have been allocated to the maintenance and the rehabilitation of the tracks and signalling systems. A large part of the railway infrastructure (track, signalling system and buildings) is obsolete and there is inadequate rolling stock to meet demand. Skilled management is also in short supply despite efforts to upgrade management through PPP concession agreements.

PPP agreements have run into difficulties and all but two of the 12 concession agreements have been renegotiated with different partners. The issues relating to inadequate funding are being resolved for certain railways as part of re-negotiated concession agreements, but major policy and implementation issues are slowing down the process.

Figure 9: ARTIN Rail Network Condition in Kilometres in 2009

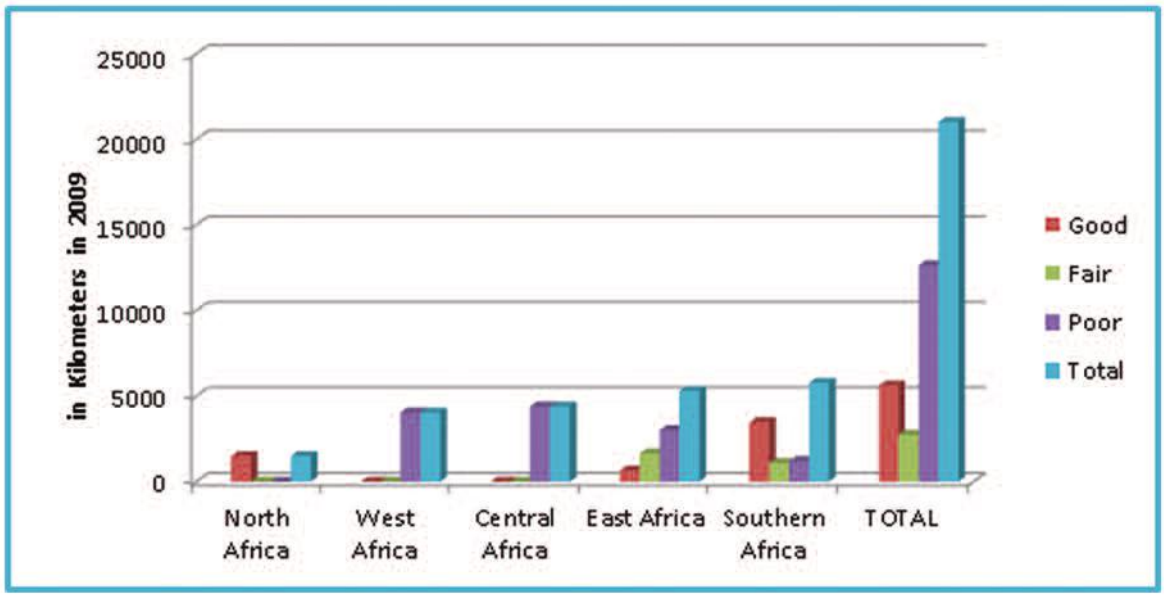
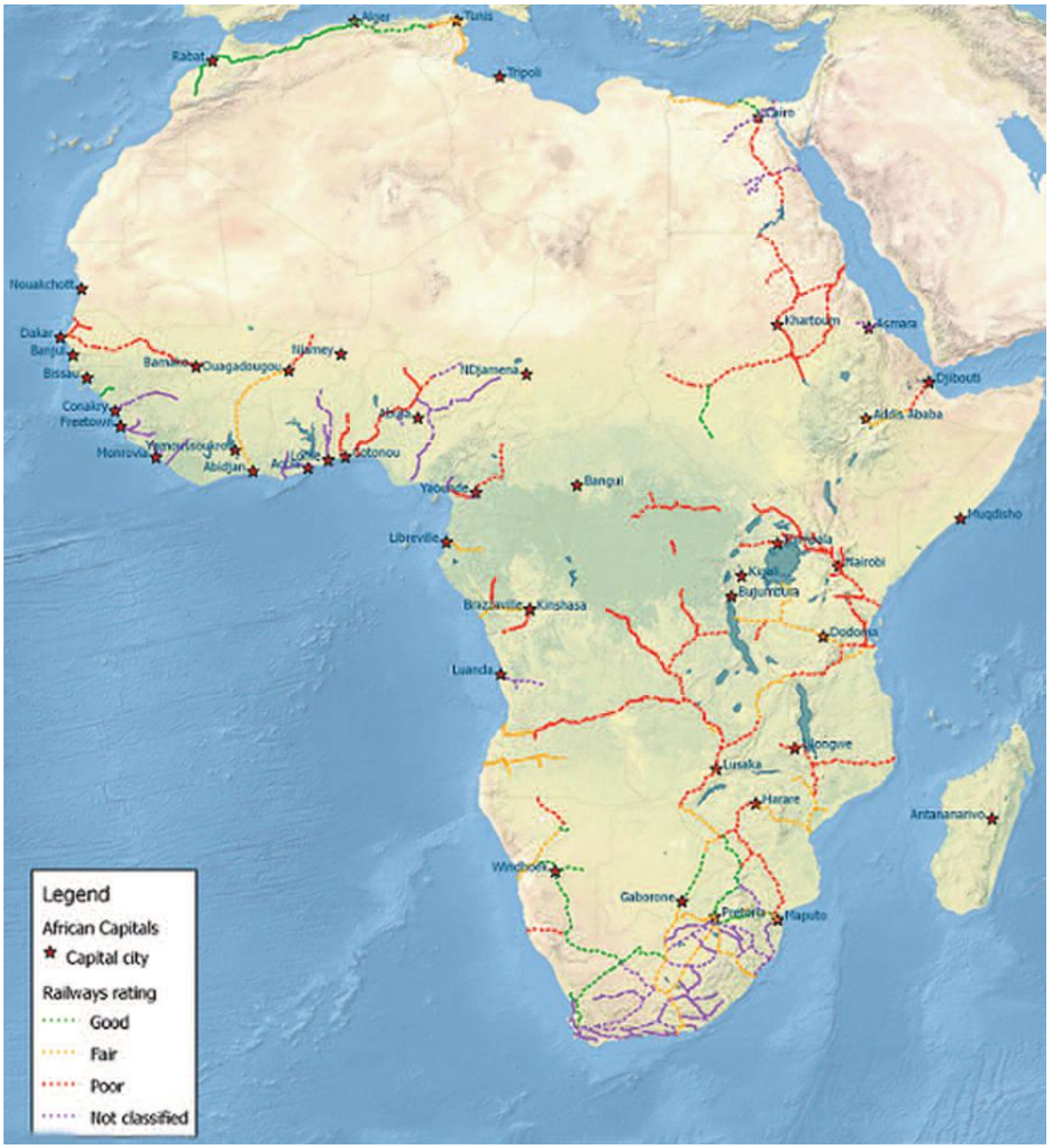


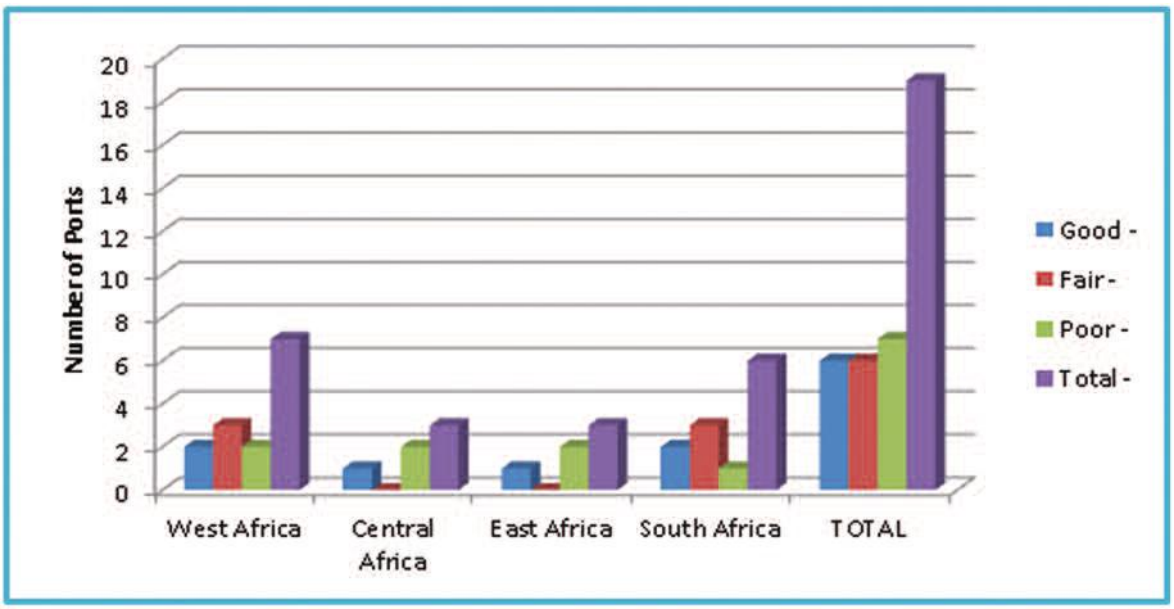
Figure 10: ARTIN Corridor Railways with Condition in 2009



2.2.3 ARTIN Ports:

There are more than 50 ports in Africa. Collectively, they handled more than 440 million tons of traffic in 2009 (excluding crude oil). Nineteen of these ports are part of ARTIN corridors. In 2009, they handled 320 million tons or 72% of Africa's international trade. Most of these are in good condition and some ports (e.g., Djibouti and Dakar) have been built to capacity levels greater than short-term demand. However, 80% of other ports and most ports in ARTIN corridors are congested since port expansion, especially container terminals, has been slow to respond to demand. The condition of ARTIN corridor ports is summarized in Figure 11.

Figure 11: ARTIN Corridor Port Condition in 2009



2.2.4 ARTIN Lakes and Rivers

The main regional inland waterways in Africa are limited to five rivers: the Nile, the Congo, the Niger, the Senegal and the lower Zambezi, and three lakes: Victoria, Tanganyika and Malawi. These international inland waterways are important, being a source of livelihood for millions of people using them as traditional channels of trade and communication. Currently, river and lake transport serves essentially the people living directly along rivers, while river and lake based long haul traffic has practically disappeared. The main reason is that the rivers and lakes are not maintained appropriately for navigation and transport purposes, for example dredging is not carried out, the navigation systems are not correctly maintained and the fleets are old and in very poor condition.

If all transport modes were operating efficiently, some cargo and particularly containerized cargo could be moved competitively from one point to another by using multimodal transport. For instance, containers arriving at the Tanzanian port of Dar es Salaam could be transferred to rail for transport to the west, perhaps to the lake port of Kigoma on Lake Tanganyika. They could then be loaded on ships or barges heading north to Burundi, west to the Democratic Republic of Congo or south to Zambia and the final stage of their journey could be undertaken by road.

The RECs have now realized the importance of river and lake transport and important projects are under preparation. In the Senegal River basin, the OMVS with support from the World Bank is preparing a Senegal River Basin Integrated Multimodal Transport System. The objective is to restore the river transport system of the Senegal River and to enhance it by connecting it to a system that integrates it to land-based ground transportation.

In the Zambezi River basin, plans exist to re-open the Shire–Zambezi waterway from Nsanje, in southern Malawi, to the Indian Ocean port of Chinde, in Mozambique. This will enable barges and medium-sized seagoing vessels direct waterway access to the Indian Ocean.

In the Congo River basin, the International Commission of the Congo-Oubangui-Sangha Bassin (CICOS) aims to develop intergovernmental cooperation to enhance interior navigation and is currently preparing a strategic plan to improve the transport along the Congo and its tributaries. Also, the potential of the Niger River must be highlighted: more than three-fourths of its total length could be used for commercial shipping.

On Lake Tanganyika, there are initiatives to make greater use of the lake transport between Bujumbura and Kigoma and other ports. On Lake Victoria, Uganda and Kenya are rehabilitating their rail ferries to make greater use of the lake transport, and Rift Valley Railway (RVR) and Tanzania Railways Limited (TRL) are planning greater use of the lake transport system. The current status of key river and lake transport locations is summarized in Table 3.

Lake Victoria is a good example of the issues. Most ports on Lake Victoria were formerly or currently owned and operated by the railroads, the primary means of transporting transit cargo was via an integrated rail/ferry system in which each port was equipped with rail link facilities for mooring and loading train/wagon ferries. Of the original five train ferries, one has been reconditioned and is waiting for Lloyds Certification (Kenya) and only one is in operation (Tanzania). During the first semester of 2010, the Tanzanian ferry was not operating due to repairs to the mainline rail track between Dar es Salaam and Dodoma. Even with a good rail service, the vessel carrying capacity for general or containerized cargo has deteriorated to the point where it is not currently an economically competitive transport mode.

On Lake Victoria, the rail links at each of the ports are relatively well maintained except for Jinja. However, only Mwanza of the Lake Victoria ports owned and operated by the Rift Valley Railroads (RVR) is currently in a position to handle increased volumes of general and container traffic. The RVR has a plan to revive multimodal lake traffic by investing in ports and train ferries.

The lake port at Bujumbura has been recently improved, but other lake ports have serious infrastructure problems. In several lake ports, there are issues concerning the weight bearing capacity of fill areas near the berths and therefore their suitability for supporting heavier cranes, such as container cranes.

Port of Kisumu is associated with a dry port operated by the Kenya Port Authority (KPA) that is approximately three kilometres from the port. Containers are transported in bond from Mombasa to the yard where they are inspected by customs and released. They are then stripped for onward distribution by truck. None of this cargo, however, goes through the port at the moment.

Table 3: Key River and Lake Transport Locations in Africa

River	Countries Served	Organization	Port Condition	Dredging	Navigation
Shire-Zambezi Rivers	Malawi, Zambia, Mozambique, Zimbabwe	-	Undeveloped, but private ports are proposed	Needed	Major potential, for coal and agriculture but undeveloped
Congo-Ubangi-Sangha Rivers	Congo, Congo DR, CAR, Cameroon	CICOS	Neglected	Needed	Major potential, but no access to ocean and poor nav. aids
Niger River	Mali, Niger, Nigeria	-	Being developed in Nigeria, otherwise neglected	Major project in Nigeria for access to the sea	Primary potential is regional or national due to major falls in Nigeria
Senegal River	Mali, Senegal Mauritania,	OMVS	undeveloped	needed	Some potential, but no access to ocean and poor nav. aids
Lake Victoria	Kenya, Tanzania, Rwanda, Burundi, Uganda, Congo DR	Rift Valley Railway	Bujumbura and Mwanza good, others neglected	Some needed	Major potential, poor nav. aids
Lake Tanganyika	Tanzania. Burundi, Congo DR, Zambia	TRL	Neglected	Some needed	Some potential, poor nav. aids

2.2.5 ARTIN Airports and Air Traffic Control

The rating of airport condition in Africa (including runways, terminals, communications, navigation and security/safety systems) shows that 70% of airports have good or fair condition/efficiency (see Table 4). The 21 airports with poor efficiency were primarily affected by terminal constraints.

The uneven growth patterns in Sub-Saharan Africa are caused in part by the decline and collapse of major carriers in the West in the early 2000s, most notably Air Afrique, Air Gabon, Ghana Airways, and Nigerian Airways. The major carriers in the South and the East are slowly rebuilding the lost capacity.

Unlike what is often reported in the public media, Africa's fleet of aircraft used for advertised scheduled services is being renewed, and is adjusted for the types of markets served. In virtually all regions, wide-bodied

aircraft have been replaced with more recent, smaller jets such as the Boeing 737. These aircrafts are more efficient for short to medium haul distances. Though the accident rate involving older, often Eastern-built aircraft is the highest in the world, the portion of the seat miles flown in these aircrafts on regularly scheduled services is now very small. Safety is still an issue, however, there are programs (COSCAPS) designed to address the issues, but investments in human resources are required.

The African high-level air traffic control system is an important part of the ARTIN air transport system. This system is obsolete and leads to inefficient use of aircraft and higher costs of air transport. A Single African Sky approach using satellite navigation has been proposed but not implemented.

Table 4: ARTIN Airport Condition as a % of ARTIN Airports in 2009

	Good		Fair		Poor		TOTAL	
	Runways	**Terminal**	**Runways**	**Terminal**	**Runways**	**Terminal**	**Runways**	**Terminal**
North Africa	35%	35%	50%	50%	15%	15%	100%	100%
West Africa	20%	10%	60%	50%	20%	40%	100%	100%
Central Africa	10%	-	40%	50%	50%	50%	100%	100%
Eastern and Southern Africa	25%	15%	50%	25%	25%	60%	100%	100%
TOTAL	**25%**	**15%**	**45%**	**45%**	**30%**	**40%**	**100%**	**100%**

2.3 Key Policy Orientations and Institutional/Regulatory Issues

2.3.1 Policy Analysis

The PIDA Study has analysed the continental and regional transport policies relevant to ARTIN. This analysis found that the objectives and policy measures adopted at the AU and REC levels, in line with the Declaration of Algiers of 2008 and the Declaration of Heads of State on Development of Transport and Energy Infrastructure in Africa in 2009, are sound for the development of the African transport system and necessary to sustain regional and continental integration.

However, several issues affecting the sector have not been resolved because key integration policies have not been implemented at country level after many years, in spite of follow-up by the RECs.

The gap between the continent-wide pursuit of key integration policies and the lack of progress at country level affects the efficiency of the transport system and has become a major bottleneck to the economic development of many African countries, in particular the landlocked ones.

2.3.2 Key Policy Issues

There are six key policy issues that have a significant impact on transport and regional integration. If correctly implemented, they would generate important savings and potential gains in increased trade. They relate to:

- The design, implementation and management of a regional road infrastructure network (road maintenance, road safety and road improvements)
- Trade and transit
- The efficiency and competitiveness of the road transport industry
- The efficient use of rail and multimodal transport
- The competitiveness and cost of air transport
- The development of effective PPPs in the transport sector

Policies affecting the design, implementation and management of a regional road infrastructure network (road maintenance, road safety and road improvements)

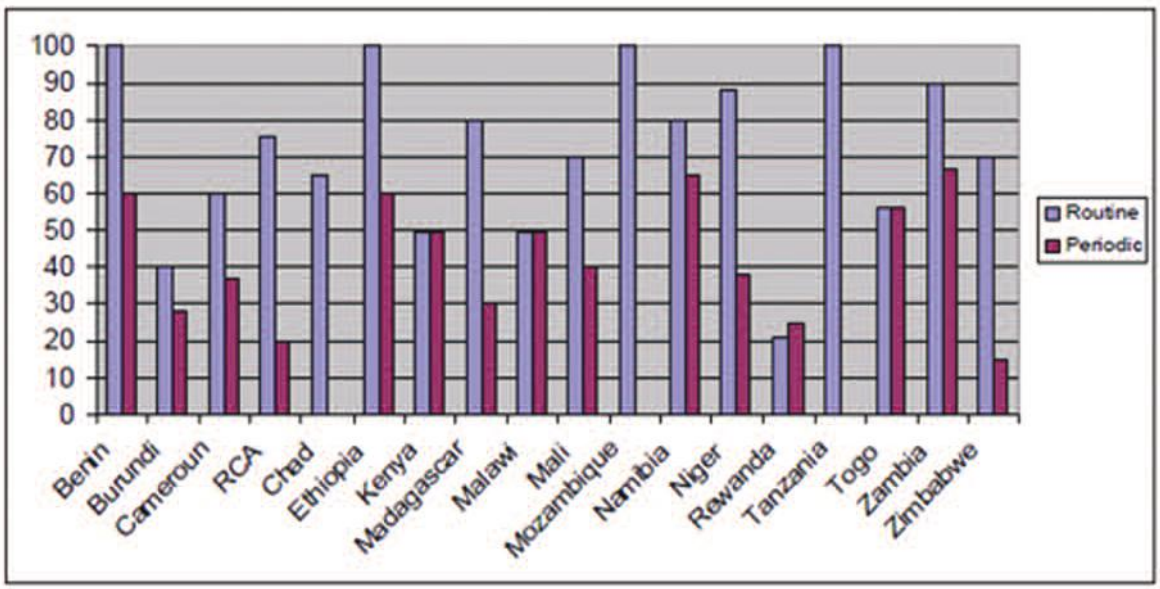
ARTIN's ambition is to become a regional road network similar to the EU road network. It would have modern characteristics, be well managed and maintained.

Several policy actions are required to achieve the objective:

- ***Ensuring adequate road maintenance***: In the majority of corridors, maintenance is the

responsibility of countries through their Ministry in charge of public works. They often rely on road funds. Many are not adequately funded (see Figure 12) and/or are used for other purposes than strict maintenance (e.g. rehabilitation and new construction). The overloading of trucks, more the rule than the exception on many ARTIN corridors (despite the best intentions of the RECs), compounds the effects of poor maintenance.

Figure 12: Coverage of routine and periodic road maintenance needs by road funds (% of total needs)



• Satisfactory maintenance has been achieved on several corridors in a few cases through arrangements with the private sector. For example, the Maputo Corridor is well maintained by its concessionaire.

• ***Setting standards and norms*** for ARTIN roads (average speed, road conditions, maximum gradient and minimum curves, crossing of towns and villages etc). This has major implications for road safety (high accident rates) in addition to efficiency. To be effective, the norms should be set at continental level in cooperation with the RECs and harmonized on the continent.

• ***Establishing regional level mechanism to:***

- Plan the long-term development of the ARTIN (existing programs focus more on the rehabilitation and construction of missing links than on harmonizing the full design of the road).

- Coordinate the design of ARTIN roads improvement projects in accordance with the agreed norms and standards.

The above-mentioned mechanism would rely primarily on the REC normal coordinating processes (such as meetings of chief engineers and Ministers of transport). In line with its mandate, NPCA would be in charge of the continental coordination and monitoring of norms and standards.

Policies encouraging trade and transit

All the RECs have approved policies aiming at improving trade and transit in their region (such as insurance, driving permit, axle load limit, etc). However, these policies are not harmonized between the various RECs and many member countries are not implementing them resulting in:

• Long delays at ARTIN border crossings.

• Low level of efficiency of customs services in ARTIN ports resulting in very long cargo dwell times, in particular for containers.

• Limited use of ITC technology in ARTIN corridors (implementation of "Smart Corridors" - freight tracking systems with integrated border management, single windows and tracking of trucks and drivers); this leads to low cargo security and significant transit delays.

The policy actions needed include:

• Develop an information management system for seamless movement of goods and passengers across national boundaries

• Reduce costs of border crossing for shippers through simplification and harmonization of regulations controlling the movement of goods across borders

• Speed-up the construction of one stop border posts along ARTIN to improve the security and speed of border crossing;

• Introduce Inland Container Depots (ICDs) and facilitation policies on corridors and their gateways (ports)

Policies to increase the efficiency and competitiveness of the road transport industry

Three key regulations significantly affect the efficiency and cost of road transport:

In West Africa, the regulations distribute cargo from the port through trucking associations, on a first come, first served basis — 1/3 to the coastal country and 2/3 to the destination country

In East Africa, the Kenyan and Tanzanian Governments require trucks and trailers to be registered for transit of domestic haulage

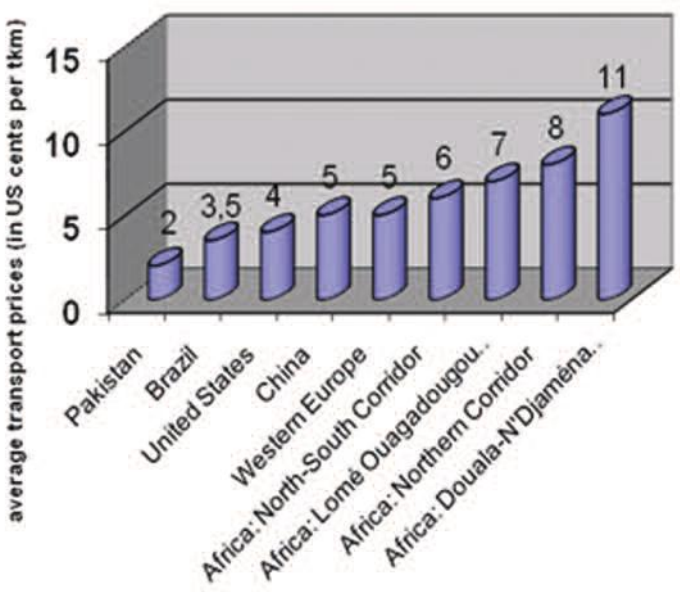
The Third Country Rule ***in Southern Africa*** prohibits a vehicle from picking up cargo from a third country without transiting the country in which it is registered. It creates empty backhauls and reduces annual truck utilization, with attendant costs for the transporters and shippers.

These regulations significantly increase the costs of road transport as shown in Figure 13, since they reduce the tonnage of transport and the annual average kilometres of loaded haul per truck (see discussion on the cost to the transport sector in the following section).

The following policy action is needed:

Deregulate and free the trucking industry in all regions and countries

Figure 13: Average Road Transport Prices, A Global Comparison in 2007



Source: Supee Teravaninthorne and Gael Raballand, Transport Prices and Costs in Africa, World Bank, 2009.

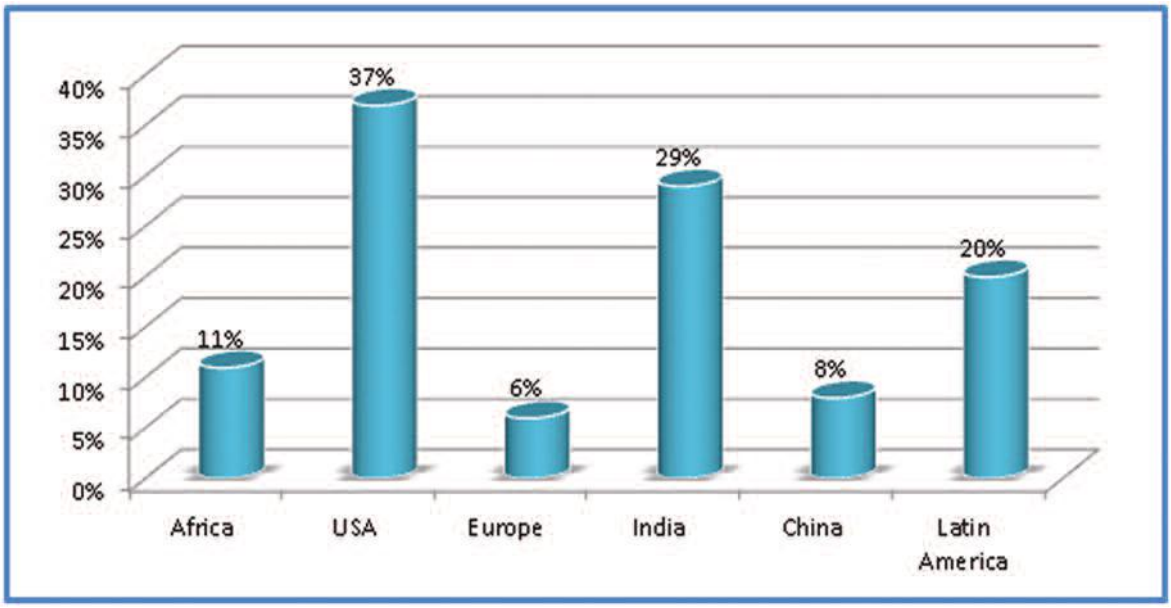
Policies related to the efficient use of rail and multimodal transport

The share of railways in African long distance transport is about 11%, dropping to 8% outside of South Africa and North Africa. This is higher than the share of rail in Europe and close to that of China, but much lower than the USA, India and Latin America, which have similar haul distances (see Figure 14).

Rail transport has a beneficial economic and environmental impact compared to long haul road transport, as it consumes about a third of the energy per ton transported.

After long declines, the worldwide trend is now towards increased rail shares. In the US, new policies to increase the role of railways started in the mid-1980s. More recently, in Europe, the EU has designed a comprehensive investment program to re-activate rail traffic. Over the past 20 years, the Indian Government carried out a large investment program to modernize its railways (10,000 km of meter gauge was upgraded to standard gauge, and many key corridors were electrified). India is now constructing 2,500 km of dedicated high performance freight corridors. China has expanded and upgraded its rail network and is now investing in high speed passenger rail lines.

Figure 14: Share of Rail Transport in Long Distance Traffic



Source: Various international statistical sources, and PIDA calculation for Africa.

In Africa, rail transport suffers from investment and tax policies that promote road transport over rail transport. Railways have been starved of investment and operating capital even where rail concessions have been put in place. Road transport has also benefited from lax enforcement of maximum load regulations (leading to more road deterioration), while railways enforce load limits.

Policy actions required:

- Develop a level playing field between rail and road transport with action on tax and investment policies. Policies to this end should be adopted by the AUC and the RECs
- Develop a model PPP framework to promote public and private investment in rail infrastructure

Policies relating to the competitiveness and cost of air transport

The African aviation sector is facing serious development difficulties due to (i) the slow implementation of a liberalized pan-African aviation market (in line with the Yamoussoukro Decision), (ii) the continuing high accident rate for some African airlines, (iii) inadequate access to finance for many carriers for the purchase of modern aircrafts, and (iv) shortage of qualified operational human resources.

Outside of SADC and Egypt, and despite the influence of active hubs in Addis Ababa and Nairobi, high airfares are charged to passengers in many categories due to the lack of implementation of the Yamoussoukro Decision and to policies that interfere with the development of efficient regional air hubs. This is particularly the case in West and Central Africa. These higher airfares lead to both higher costs of transport and lower levels of passenger traffic, both for regional travel and overseas travel. They reduce tourism and business travel, which has significant economic consequences for Africa.

Policy actions needed:

- Implementation of the Yamoussoukro Decision
- Adoption and implementation of policies to facilitate airline partnerships that improve service and competitiveness by establishing regional hub airlines
- Adoption and implementation of policies to improve African airline safety
- Create an implementation program for a Single African Sky

Policies affecting the development of effective PPPs in the transport sector

Public-Private Partnerships (PPPs) are more and more considered as an efficient way to finance and manage transport infrastructure in the world. Because PPPs are an important way to bring both management expertise and investment funds to the transport sector, they have been pursued in the transport sector in Africa, but with mixed success.

The following sections summarize the experience of transport PPPs in Africa.

Roads

Only a few PPPs exist for the road sector. They are all located in South Africa (except for the Maputo corridor which is in both South Africa and Mozambique). There is an on-going program to set up PPPs on the Kenyan road network.

The Maputo Corridor road concession PPP is considered a model for PPP toll roads in Africa. It was

awarded in 1997 to an international consortium (TRAC) as a BOT (Build, Operate and Transfer) toll road concession, given by the South African National Road Agency (SANRAL), on one hand, and its Mozambican counterpart, ANE, on the other hand. TRAC was entrusted with the financing, design, construction, rehabilitation, operating, maintenance and future expansion of the N4 / EN4 highways for a 30-year period. TRAC also has responsibility for maintenance of feeder roads, management of toll plazas, and management of vehicle weigh stations.

The concession provided upgrade, rehabilitation and new road construction including a special access road to the port of Maputo. Since the introduction of the weigh stations, the vehicle overloading has been substantially reduced, which has reduced road surface damage and improved road security and traffic safety along the N4/EN4 axis. TRAC also supports a large number of small local subcontractors.

Under the concession, toll revenues plus the overload control charges have constituted sustainable resources, ensuring road maintenance operations at the required standards and on time. TRAC has adopted a management policy that ensures continuous maintenance and upgrading of the highway.

Railways

There are 12 railways under concession agreements. Overall, performance has been mixed. System performance has generally improved by increasing rolling stock and personnel productivity.

But they were formed based on a mistaken belief that concessions would allow the rail sector to be financially self-sufficient. The main reasons for this mistake were:

- Traffic gains for freight were lower than expected.
- The amount of required investments for rolling stock and infrastructure renewal was generally under estimated.
- Furthermore, ***concessions were undercapitalized***, even when considering solely the limited 5 year investment programs that were established for each concession contract.
- Concessions[7] performances were also affected by poorly crafted subsidies schemes for passenger services, which affected the relationship between governments and concessionaires, as the amount and nature of funds that the former had to transfer to the latter were never clearly established.
- Lastly, concession contracts have tended to neglect the specific characteristic of transnational networks which require synchronized policy efforts, both to ensure greater competition between modes of transport and to develop adequate investment plans.

The review of past and on-going experience suggests that governments contemplating future rail concessions need to give careful attention to the above factors and to build capacity prior to embarking upon concession or other forms of PPP. This includes setting up appropriate regulatory frameworks and clearly allocating responsibility for concession oversight (preferably not to the former defunct state railway corporation). In particular, it is essential for concession agreements to determine stakeholders' investment responsibilities in a clear and constructive manner.

In a context where track renewal investment needs are significant and traffic levels are likely to be limited in the short and medium term, concessionaires' investment responsibilities should be strictly focused on operational matters, namely the maintenance and renewal of rolling stock. However, most African Governments are currently incapable of supporting heavy investment efforts on their own. New types of PPP agreement need to be designed through which additional sources of financing can be generated.

Some important conclusions for rail transport can be taken from a World Bank report on concessions in Latin America. The majority of the South American railway companies signed concession agreements with international rail operators during the past half of 1990. Practically, they all have run into difficulty three or four years after signing for various reasons. This led to the departure of the foreign partners and the takeover of the railways by national interests. The latter financed the development and maintenance of rail infrastructure by borrowing on the local financial markets. These efforts stopped the decline in the share of rail traffic and started to stabilize it.

Confronted with the stagnation of the share of rail traffic, the Governments realized that private operators alone could not or would not be interested in substantially investing in rail infrastructure. They concluded that only the Governments through their own investment budgets could substantially increase investment in rail infrastructure in order to develop rail traffic in the sub region.

In Africa, where the rail concession agreements are facing the same difficulties as in Latin America, the policy should be similar:

- Encourage private national interests to take over from foreign investors
- Increase the role of local partners in the management and financing of concessions
- Increase the capacity of the public sector to contribute to the financing of rail network development, improvement and rehabilitation, possibly through the establishment of national or regional development funds for railways.

[7] Pozzo di Borgo AICD report (2011)

Ports

Presently 12 concession agreements have been signed for the modernization, construction and management of container terminals in Africa.

One key lesson from on-going experience for port concessions is that there is a conflict of interest that can occur if some, but not all, shipping lines are partners in the equity and involved in the management. If the concession is granted to a single user, as in most Maersk terminals, this is not a problem. The neutrality of the concessionaire, vis-à-vis its customers (shipping line operators), is a guarantee for sound competition between the customers. Shipping line operators are naturally very keen to keep confidential the commercial information appearing on manifests and to preserve them from any inquiring eye. Terminal operators must guarantee total security in that respect.

Since PPPs are generally proposed when heavy infrastructure investments are at stake, the Port Authorities are usually willing to be kept associated to a certain extent. This was the case in Djibouti for the construction and management of Doraleh Terminal by Dubai Ports World (DPW). A similar arrangement was made in Dakar port between the Senegalese Government and DPW for the first extension of the Dakar Container Terminal.

The restructuring actions since the early 2000 have produced significant improvements in terms of berth productivity, reducing considerably the waiting times for ships. Often, this improvement did not reduce container transit times. Only improvement in customs and other functions of the port, through, for example, the implementation of the single window principle, would reduce the container transit times.

Projects in East and Southern Africa

A detailed review of PPP projects has been conducted for the transport sector in South and East Africa[8]. It highlights the need to create a favourable investment climate and an effective PPP enabling environment. All interested countries should implement policies to create a favourable investment climate and establish an enabling environment for the development of PPP in the transport sector.

- ***Investment climate:*** The investment climate in the region varies considerably between countries. Botswana, Namibia and South Africa consistently score the highest across the various indicators that measure investment climate. In terms of investor perceptions (and initial decisions on whether to invest), these outcomes are likely to favour PPP investment in these countries. At the same time, these findings indicate that various reform measures are needed in the other ARTIN corridor States in order to improve their attractiveness for PPPs.
- ***The PPP enabling environment:*** It is important to establish at regional and country levels an enabling environment for PPP. This will help remove legal and institutional barriers for the successful implementation of specific PPP projects. In assessing the enabling environment, one should consider both the overall investment climate and specific past experiences with PPP implementation in the transport sector, particularly arrangements for risk sharing between public and private sectors.

A successful PPP strategy depends on an amalgam of general factors which influence a country's (or region's) investment environment and specific policy, regulatory and institutional measures which governments must implement to provide an enabling environment for PPPs. Numerous authorities emphasize that clear policies, enabling legislation, effective neutral regulation, and strong institutions lie at the heart of good governance in PPPs[9].

Following are the principal conclusions from this review:

- Most transport sector PPPs still occur in a small group of States (e.g. South Africa, Mozambique, Djibouti, Senegal, Cote d'Ivoire, Congo, Kenya, and Tanzania). Significantly, almost half the States along ARTIN have never undertaken any transport PPPs. This suggests that if viable PPP projects are identified in the latter group, concerted policy reforms and confidence-building measures will be needed from the Governments concerned to create an investment climate that attracts private investors.

The policy actions needed include:

- Countries that do not have formal PPP policies in place should establish such policies, with an appropriate legal and regulatory framework.
- Countries that do not have the institutional capacity to manage PPPs should establish dedicated units to build such capacity.
- Countries entering into PPP agreements should ensure (a) that project economic and financial forecasts are realistic, and (b) that agreements are coordinated, where needed, with those of neighbouring countries (for instance concerning cross border rail traffic).
- Countries should make special efforts to mobilize funding from local, as well as foreign, private sector partners

[8] Nathan Associates, Inc. Definition and Investment Strategy for a Core Strategic Transport Network for Eastern and Southern Africa, PPP Strategy Report, World Bank, January 2011.

[9] A Guide to Promoting Good Governance in Public Private Partnerships, United Nations Economic Commission for Europe, 2007

2.3.3 Institutional Analysis

Institutions at continental level

Continental bodies

Transport policies and strategies are part of the overall policy framework for economic and social development in Africa, under the aegis of the African Union Commission (AUC). The AUC has the responsibility for defining policies and strategies for the development of transport infrastructure aiming at increasing regional integration and the competitiveness of African products on the world market. In this respect, the AUC organized and managed a conference of Ministers of Transport of the 53 States in Algiers in April 2008. The AUC also organized another conference in October 2011. However, the AUC has no means of monitoring the follow-up and implementation of the Algiers Declaration and Action Plan by the RECs and Member States.

At the request of donors, the AUC has started a series of studies for the flagship projects of NEPAD and for some portions of the Trans-African Highway system. These studies are ongoing. In addition, AUC is closely monitoring the progress of the PIDA project.

The NEPAD Planning and Coordinating Agency (NPCA) has been established to better coordinate the continental activities including the PIDA Study.

The UN Economic Commission for Africa (ECA) has engaged in various analyses, such as a study of the implementation of the priority program of ECCAS. ECA also organised an important continental conference on road safety.

Specialized transport organizations

African Ports Associations have been in existence for a long time. Their main purpose is to develop communication, capacity building, and learning experiences among themselves.

Three groupings of ports on the continent are active:

- The PMAWCA – Port Management Association of West and Central Africa
- The PMAESA – Port Management Association of Eastern and Southern Africa
- The NAPMA – North African Port Management Association

These three associations are federated in the Pan African Ports Association. Their role has been very helpful in disseminating ideas and good practices. They have particularly contributed to help Ports Authorities accept the idea of concessioning container terminals around the continent, for example: Djibouti, Pointe Noire, Lagos Apapa, Abidjan, Dakar, although the scope of concessions and legal arrangements of the PPPs may be different. Another main concern of the associations is to define and harmonize performance indicators in order to bring costs down and benefit economic development.

The Union of African Railways (UAR) has established a new rail agenda to promote continental and regional integration. Railway policies in the past have suffered from lack of regional coordination. Sovereignty reflexes prevented the coordination of different initiatives undertaken by States individually. At the Conference of Ministers for Transport held in Brazzaville (Congo) in 2006, this institutional framework was strengthened, giving the UAR a central role in supporting policies to develop and manage railways in Africa.

Under the new setup, the African Union will have “key leadership” to coordinate and facilitate railway development and integration. The UAR will work closely with the AUC program on economic development, supported by NEPAD, as well as with other actors involved, such as the AfDB and the UNECA.

The African Civil Aviation Commission (AFCAC) is an autonomous body, and memberships are open to all African States that are members of AUC. It is a consultative body and its conclusions and recommendations are subject to acceptance by each of the Governments. Its major objectives are (1) to provide the civil aviation authorities with a framework within which to discuss and plan all measures of co-ordination and co-operation for aviation activities, and (2) to promote co-ordination, better utilization and orderly development of African air transport services.
A Trans African Highways Authority was established by UNECA in the early 80’s. However, this organization, based in Bangui, was disbanded at the end of the 80’s. Today the construction, modernization, maintenance and management of the Trans-African Highway network is in the hands of the relevant RECs and of the States crossed by these highways.

Institutions at regional level

Regional Economic Commissions (RECs)

There are eight officially recognized RECs (UMA, ECOWAS, ECCAS, CEN-SAD, IGAD, EAC, COMESA, SADC). African States are sometimes members of more than one REC. For example, the DRC belongs to four different RECs. The overlapping membership creates difficulties for the implementation of different REC policies. There has been an effort toward harmonization and cooperation in East and South

Africa with the establishment of the Tripartite (SADC/COMESA/EAC and IGAD as an observer).
In the transport sector, some RECs have established policies, strategies and investment programs (EAC, COMESA and SADC) while others have only compiled investment programs or list of priority projects (ECCAS, ECOWAS)

REC policy documents rarely refer to the Algiers Declaration and investment strategies are not harmonized. For example, the COMESA investment program considers bringing all railway line to standard gauge, while ECOWAS is aiming at improving the connectivity of its meter-gauge networks without modifying the gauge. All RECs have the mandate to improve trade facilitation and regional transport efficiency, but they have very limited resources to assist Member States in implementing agreed policies.

Regional modal organizations (for ports, rails etc)

SADC benefits from the Southern Africa Railways Association (SARA) instituted in 1996. It includes all national railway institutions in SADC (except Madagascar) and works as a lobby to promote investment in railways in the region. SARA has developed several programs to manage railways, run cross-border services, and harmonize national rail policies. It formed Corridor Management Groups (CMGs) in 1998, in charge of coordinating and implementing agreed interventions and procedures in selected corridors. Under SARA leadership, joint inspections at border posts have been instituted. Since 2001, it has developed an integrated marketing policy for all railways in the region.

The West Africa Road Safety Organization (WARSO) was launched in 2008 in an attempt to improve safety and security along the roads. 13 Member States of ECOWAS are already members.

The Federation of East and Southern African Road Transport Associations (FESARTA) is active in developing an efficient road industry in that part of Africa. Its objectives are to achieve wide recognition of the value of the road transport industry to the Eastern and Southern Africa region, and to enhance its efficiency and competitiveness through the National Road Transport Associations.

Transport corridor organizations

Transport corridor organizations in Africa have taken different forms, with the common objective of monitoring and improving performance of corridors. In Southern Africa, the SADC Transport Protocol prescribes how to improve corridor operations. In Namibia, the Walvis Bay Corridor Group (WBCG), formed as a national PPP in 1990, has been investing in the port of Walvis Bay and, for over a decade, in building highways to neighbouring parts of SADC. The WBCG championed the formation of the Trans Kalahari Corridor Management Committee (TKCMC) and was very successful in addressing problems on this new three-country route. It is now a separate entity with its own secretariat and functions, funded by the three governments and moving toward a user fee system. Next, WBCG fostered development of the Walvis Bay-Ndola-Lubumbashi Corridor Committee and is seeking to create a similar body with Angola on the Trans-Cunene Corridor.

The Maputo Development Corridor is a leading example of a corridor development organization. It was created by the Governments of South Africa and Mozambique to encourage industry development in light of the construction of a major toll road (BOT) from Pretoria to Maputo and the concession of the port. The Governments assumed that if they invested in the initiative for a period, the Development Corridor Organization would become self-sustaining. This did not happen. A new institution, the Maputo Corridor Logistics Initiative (MCLI), was created by the private sector in 2004 to motivate logistics improvements for shippers and industries. The Maputo corridor has been a key factor for the development of industries along the corridor.

In view of this successful experience the Development Corridor concept has been applied on a number of other corridors– Beira, Mtwara, and Central. Other corridor organizations are adding a development unit to transport management groups, such as the Northern Corridor. These Special Development Initiatives are quite recent and it is too early to evaluate their result.

In East Africa, the corridor institutions emerged in response to landlocked countries and regions need for port access. The Northern Corridor Transit Transport Coordinating Authority (NCTTCA) substituted a multilateral agreement for bilateral agreements to insure right of access to the port of Mombasa. Its legal basis is an agreement signed in 1985 and ratified in 1986 by Kenya, Uganda, Rwanda and Burundi and joined by DRC in 1987. It committed the participating Governments to guarantee a right of access to the port and freedom and facilitation of transit. NCTTCA has evolved to become a body also promoting infrastructure improvements and use of the corridor. It has created a private stakeholders forum, although it remains largely a government initiative. A similar group has recently been formed to connect the same hinterland to the port of Dar es Salaam. The main difference is that its board consists of the Permanent

Secretary of Transport and a representative selected by private sector from each of the 5 Member States.

The West African approach is more regional. The institutional model consists of a Regional Facilitation Committee (ECOWAS) and Joint Technical Committee (WAEMU/UEMOA), with a national facilitation committee in each of the member countries. In this context, regional transit initiatives are conveyed to the national level for implementation and problems perceived at national level are conveyed to the regional level for resolution. There were initially no corridor institutions bringing together the countries depending on a particular corridor. Corridor institutions are now being added to this structure to mobilize the initiative of private users to identify specific needs and issues.

National level institutions

National Trade and Transport Facilitation Committees (NTTFCs) have been established in many African States. Their role is to facilitate international trade. In too many countries, the NTTFCs are composed of servants and are not playing efficiently their function as facilitators.

The large majority of African States have established road funds to finance the maintenance of their road networks. A first attempt to establish road funds was not entirely successful, and we are now seeing the creation of second-generation road funds with an independent, autonomous, management board. Fees on petroleum products constitute the largest source of revenue of these road funds. Unfortunately, except in a few countries, these resources are not sufficient to cover the financing needs to properly maintain the whole road network (see Figure 5 above)

2.3.4 Key Institutional Issues

The Consultant has identified the following key institutional issues:
The existing regional/continental institutional framework for the transport sector is ill structured to respond to the challenges facing the sector, which are:

- Raising the efficiency of transport services along the corridors to international standards,
- Satisfying the medium and long term regional and international traffic demand, and
- Completing the connectivity of Africa large cities.

The weaknesses include:

- No clear splitting of responsibilities between the continental, regional and national organizations with many overlaps resulting in uncoordinated studies and lack of harmonization in policy decisions.
- Development programs of the RECs prepared with different methodologies and approaches, resulting in very different levels of analysis and proposals for new projects. This results in heterogeneous master plans for rail and road development, and the absence of regional master plans for ports and airports.
- No harmonization of legal status of transport corridors
- No harmonization of policies (road norms, axle load limits, etc) and strategies
- No systematic exchange of information (legal studies of one stop border posts conducted by SADC, WAEMU/UEMOA and UNECA by different consultants resulting in different implementation policies and strategies)
- Insufficient resources (human, technical and financial) to properly and efficiently carry out their mandate.

Policy harmonization: raising the efficiency of transport services requires implementation by the African States of the policies approved at AUC or REC levels. As has been noted in several parts of this paper, the lack of harmonization is hampering progress. The experience in other regional groupings (EU and ASEAN) shows that, short of judicial processes (used extensively in Europe to achieve harmonization), the solution lies with peer review. Both the EU (under the Maastricht Treaty) and ASEAN are using the peer review process. NEPAD has experience with the African Peer Review Mechanism (APRM). A similar approach may be useful in ensuring policy harmonization in infrastructure.

NPCA and the RECs are institutions reporting regularly to the highest levels (Ministers and Heads of State). They are well placed to monitor the progress in harmonizing policies related to road, air transport.

Beyond harmonization they could also be responsible for other tasks such as:

- Transferring knowledge among the RECs on institutional aspects (for instance, establishing OSBP or preparing PPP)
- Defining norms and standards for ARTIN.
- Planning the construction/modernization of ARTIN infrastructure (road, rail, ports and airports) to cater to the expected increases in traffic. The planning of infrastructure would be coordinated by the RECs with the relevant Member States and where appropriate (ports or high volume highways for instance) with the private sector.
- Planning of the civil works along the yet to be completed TAHs, in particular the assessment of priorities could be conducted at continental level by NPCA with the support of the RECs. The

mobilization of financing could also be conducted at continental level with the close participation of the countries involved (which should also be prepared to contribute with their own resources to these programs).

For the ARTIN corridors the following ***institutional approach*** could be considered:

- For each corridor the countries involved would enter into an agreement (MoU) for the upgrading and maintenance of the road infrastructure through a multinational entity (like TRAC in the Maputo corridor), leaving the overall Corridor Authorities in charge of trade facilitation and spatial development initiatives. To facilitate the coordination of cross border studies, they could be entrusted to the REC involved.
- The infrastructure maintenance and upgrading (of roads and railways) could be contracted to the private sector under a proper arrangement.

This approach would allow ARTIN corridors to provide a more sustainable level of service than other national infrastructure. Also the financing contribution from the States involved through their road funds to ARTIN corridors would be substantially reduced as it is replaced by toll funding, freeing other government funds for the maintenance of the rest of the network.

This approach should also be designed to appeal to local groups of private sector investors and managers (possibly with minority overseas partners) for maintenance and operation, since this was shown to be the most effective long term arrangement for PPPs in Latin America.
Naturally, port PPPs would be treated separately from other corridor infrastructure. Terminal concessions under landlord ports appear to be working well with current arrangements as long as conflict of interest is avoided.

2.4 Diagnostic of Sector Inefficiencies and their Economic Costs

2.4.1 Diagnostic of the Efficiency of ARTIN

Diagnostic of the efficiency of ARTIN corridors, border posts and ports

The efficiencies of some ARTIN corridors and modes (e.g., Maputo corridor-road mode and Transnet rail services) and ports (e.g. Walvis Bay) are comparable to the best in other developing regions, while others are well below international standards[10]. Eighteen out of 40 ARTIN corridors have developed into major trade gateways with fair-to-good overall efficiency and a significant amount of international trade (see Figure 15). There is a great variability of efficiency between ARTIN corridors and within longer ARTIN corridors. The most efficient ARTIN corridors are found in North Africa, Namibia and the Republic of South Africa, while the least efficient are found in Central Africa, particularly Democratic Republic of Congo, which also contains most of the missing links in the Trans-African Highway network.

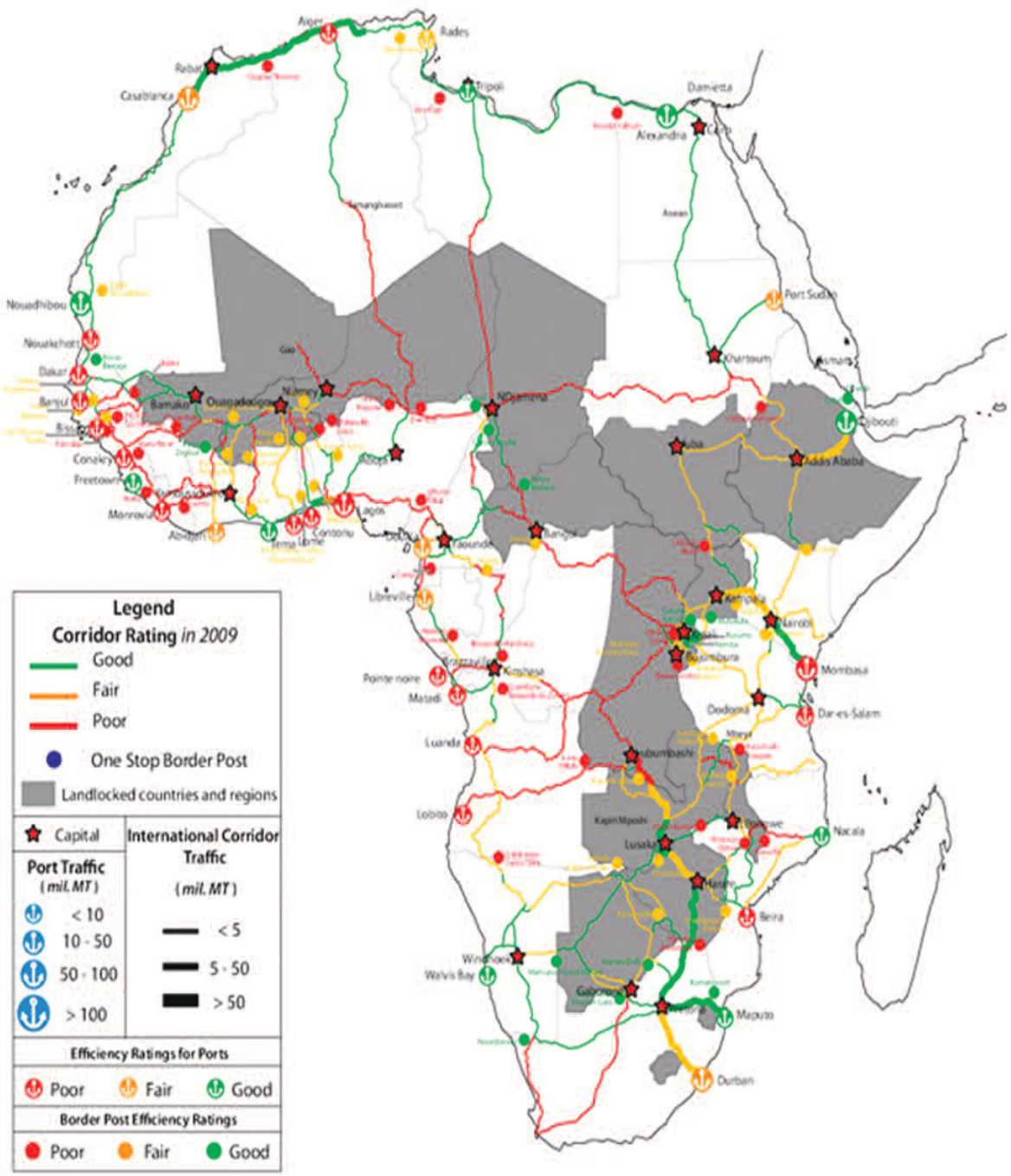
Unnecessary roadblocks reduce efficiency with informal payments along many ARTIN road corridors outside of Northern Africa, South Africa and Namibia. These delays and payments are regularly monitored in West Africa and East Africa, where they are particularly problematic.

Ports and border posts along the ARTIN corridors are congested in many locations, leading to substantial delays, particularly for transit traffic. This is a major cause of suppressed trade demand along ARTIN corridors.

Smart corridors with improved information systems, which combine single window systems for imports and exports with cargo/container tracking, weighbridge data and security information systems, are just beginning to be developed in Africa[11]. Single windows for all import and export transactions have been established in several countries but they are limited in scope and not well connected to neighbouring countries. Integrated border management systems[12] are being partially set up in Zambia and Zimbabwe. Africa needs to catch up with the rest of the world in "smart corridor" development in order to become more competitive.

[10] The efficiency of ARTIN corridors was assessed in the PIDA Study by rating each corridor element in terms of transit time and then comparing this with international norms in order to determine a rating of good, fair or poor.
[11] Ghana has electronic tagging of trucks and a genuine single window, Northern Corridor has some limited freight tracking and Kenya is working on a version of linked customs data where information is shared between customs at the port and border posts, with the effect of speeding up payments of customs duties between countries
[12] See Gerald McLinden, Contemporary Border Management, World Bank, 2009. These systems emphasize coordination between all government agencies involved in importing and exporting.

Figure 15: Efficiency Ratings of ARTIN Corridors, Border Posts and Ports in 2009



Diagnostic of the efficiency of ARTIN air services

Air transport service efficiency was evaluated in terms of flight frequency and airfare per pass-km[13] for trips of different lengths. The main conclusions are:

The SADC region (South Africa) and Egypt have the best air services and lowest airfares per pass-km in Africa (see Figures 16 and 17). Air services and airfares in the rest of Africa are much less competitive, although air transport services for the Addis Ababa and Nairobi hubs is higher than average for the region and also provide substantial connectivity across Africa (see Figure 18).

[13] During the review of the document, the point was made that high taxes explain to some extent high air transportation prices.

Figure 16: International Comparison of Airfares for Selected Intercontinental Services

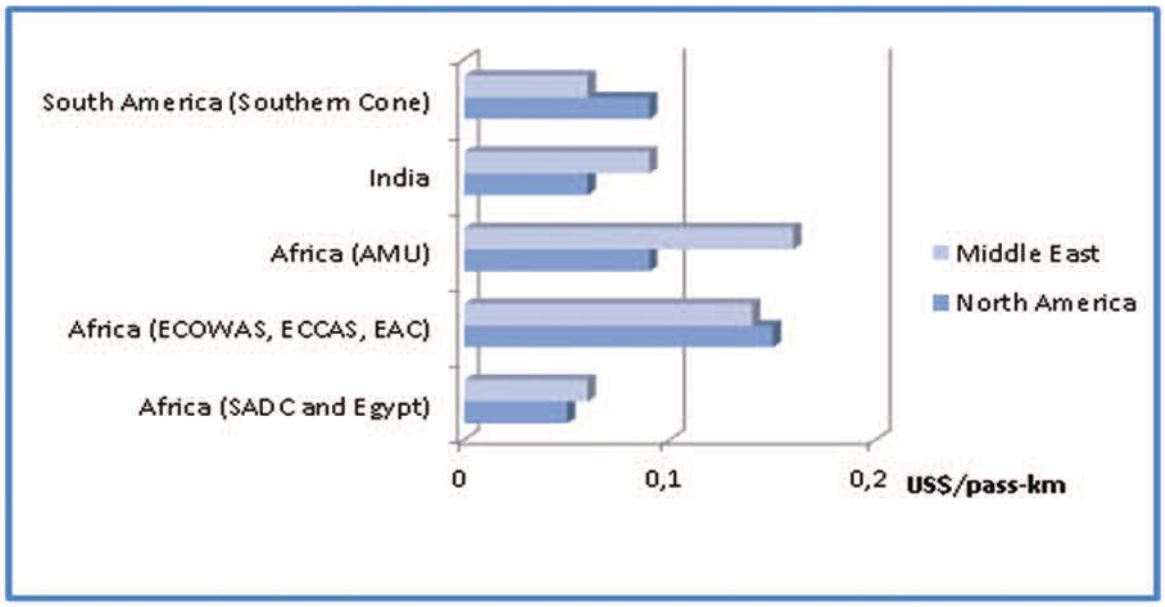


Figure 17: International Comparison of Airfares for Selected African Regional Services

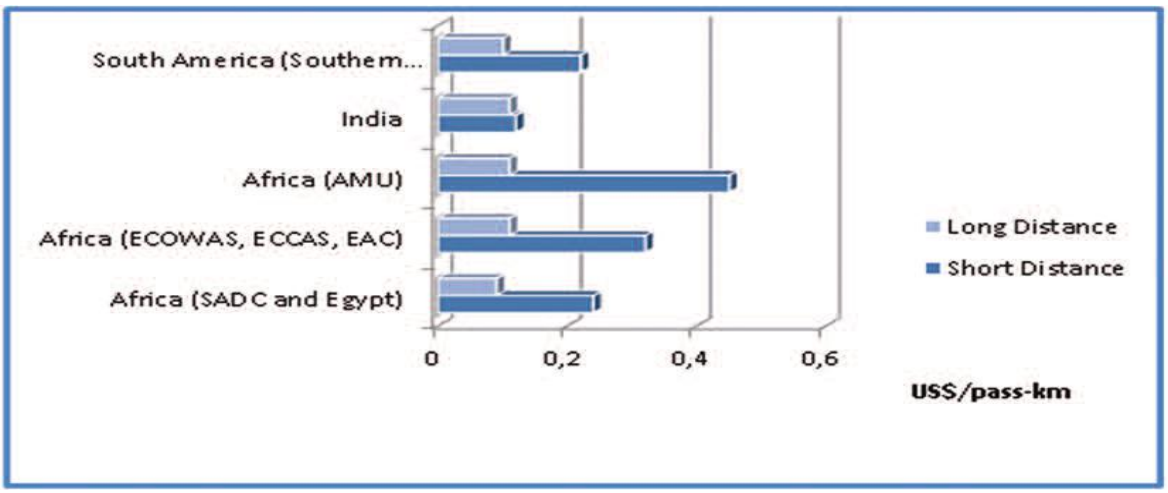
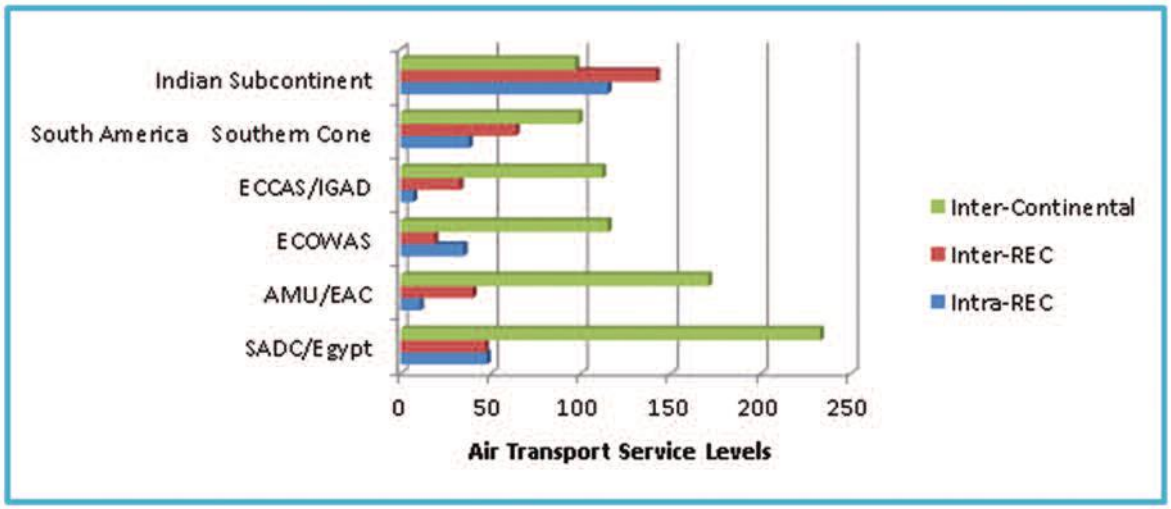


Figure 18: Comparison of Air Transport Service Levels, Africa, India and South America (average indicator of daily flights from regional hubs/centres)

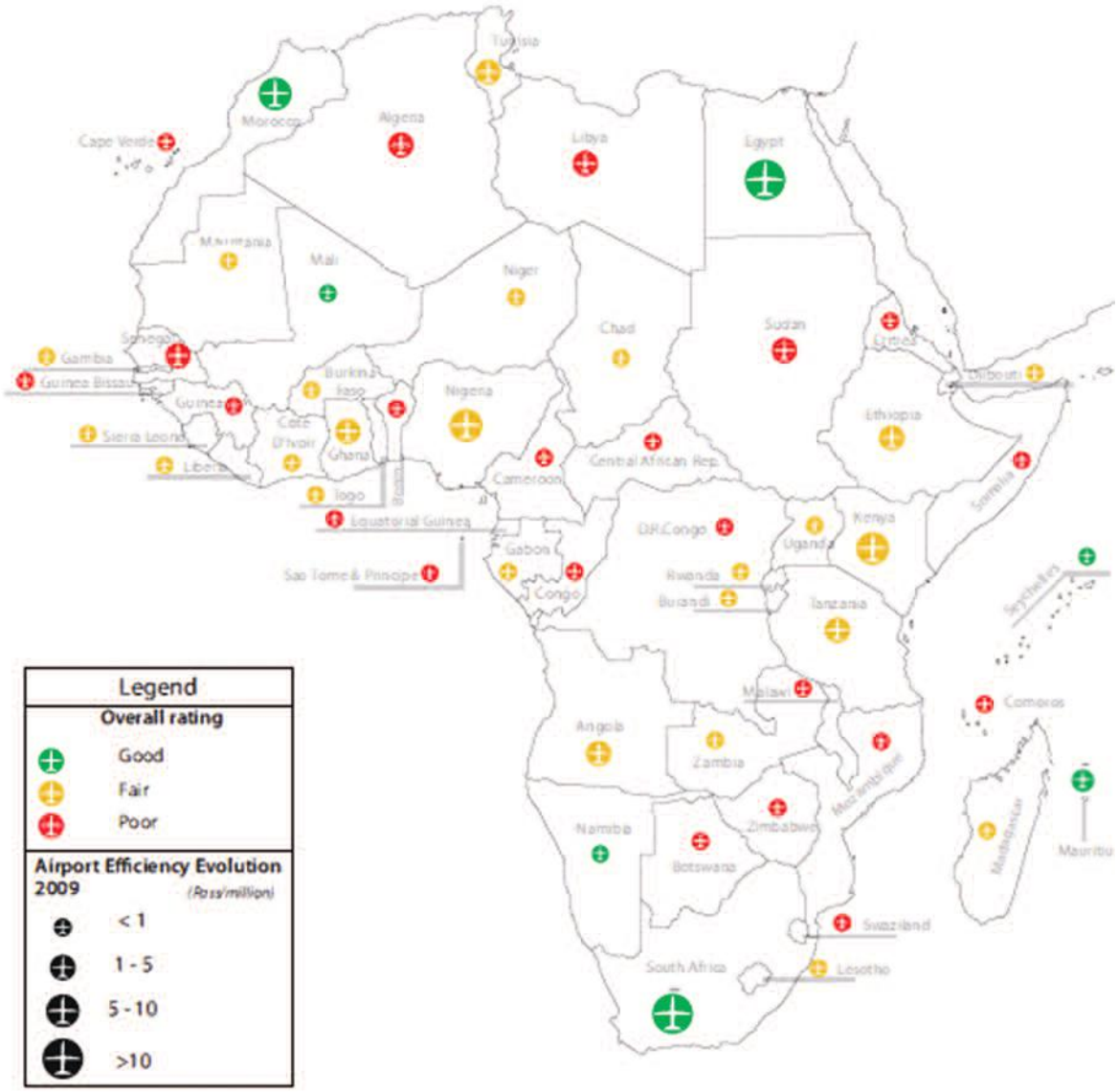


Source: Service measured from one major hub airport in each REC[14], Rio de Janeiro and Mumbai

Diagnostic of the efficiency of ARTIN airports

The overall rating for ARTIN airport efficiency is closely tied to the condition and congestion. Overall 70% of ARTIN airports have good or fair efficiency (see green or yellow circles in Figure 19). The 21 airports with poor efficiency (red circles) were primarily hindered by passenger terminal capacity constraints.

Figure 19: Map of Airport Efficiency in 2009



Source: PIDA Study estimates based on available information and interviews

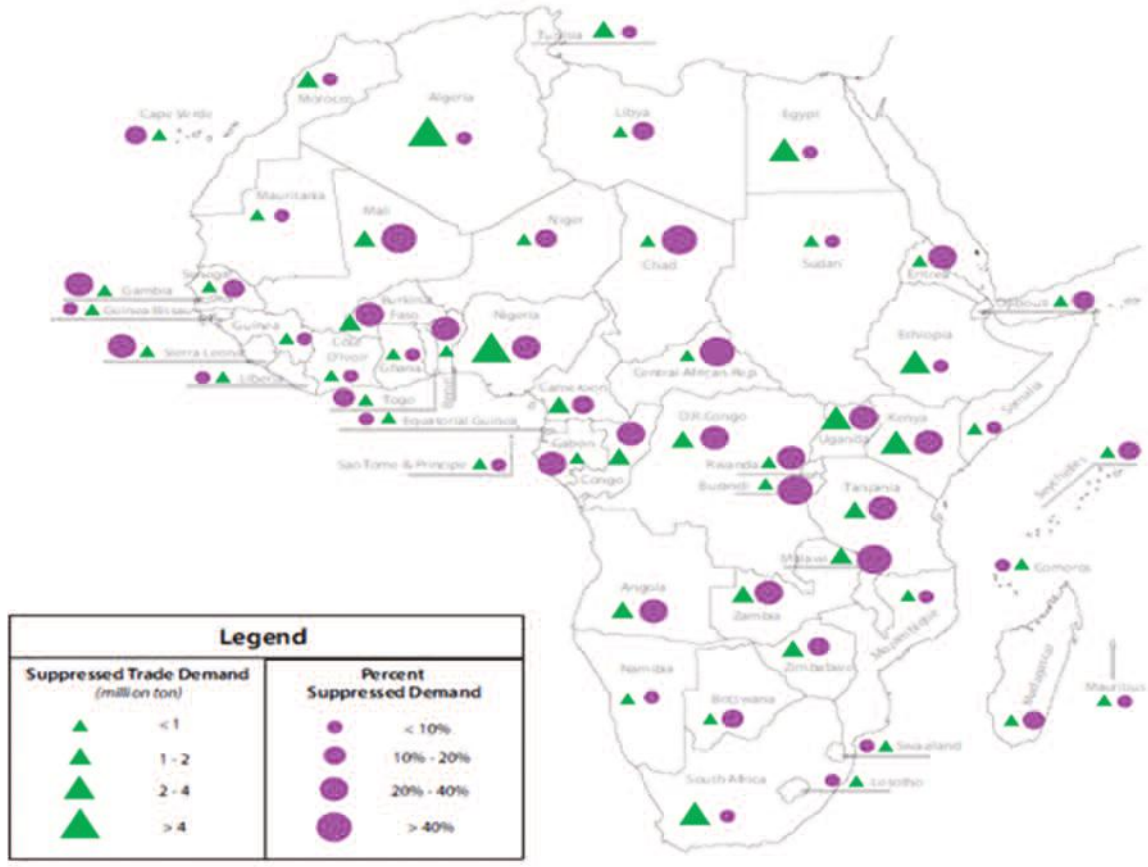
Percentage of suppressed demand due to ARTIN inefficiencies

Suppressed demand occurs when high costs, long transit times, low frequency of service and unreliability affect demand for transport. Suppressed demand is one of the major impacts of inefficiencies in Africa for both international trade and air passengers.

Suppressed trade demand

Figure 20 illustrates the amount of suppressed demand for international trade by country, based on a calculation of the excess costs paid by shippers[15] and the value that shippers place on transit time and reliability. The decrease in demand for 2009 due to inefficiencies was calculated from an estimate of the average increase in generalized costs to shippers compared with best practice in Africa and in other developing regions based on recent research in East and South Africa.

Figure 20: Suppressed Trade Demand by Country in 2009



The total volume of suppressed demand in 2009 was estimated at 56 million tons or 11% of total trade flows for the continent with a value of close to $US 65 billion. The percentage of trade lost was much higher (26%) for the landlocked countries.

[15] Including the value of transit time and reliability

Suppressed air passenger trips

Figure 21 illustrates the amount of suppressed demand for international air passengers by country, based on a calculation of the excess costs paid by travellers and the value that shippers place on transit time, direct flights and frequency of service. The decrease in demand for 2009 due to these factors was calculated from an analysis of level of service and airfares in SADC and Egypt by category of service (intra-REC, inter-REC and inter-continental) and the use of a special impact model created for PIDA.

The total volume of suppressed demand in 2009 was estimated at 12 million passenger trips or 13% of total passenger trips for the continent with a value of close to $US 7 billion.

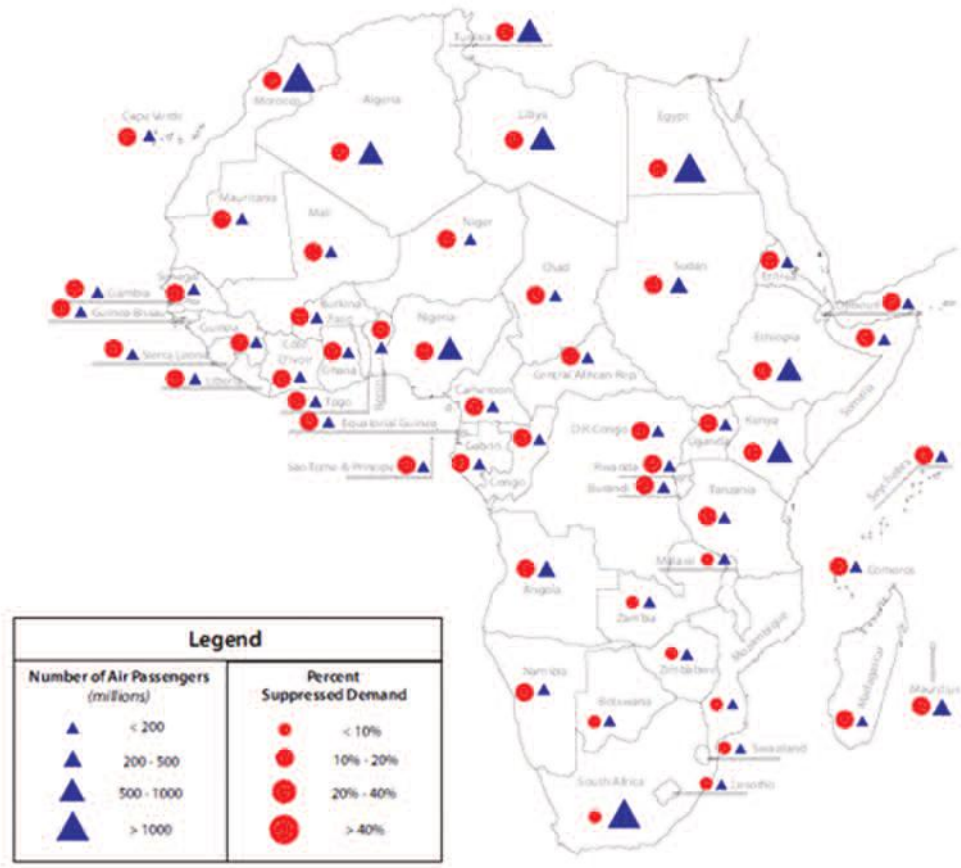
2.4.2 Economic Costs of Inefficiencies

In addition to the value of suppressed international trade and passenger trips not taken, which are one-time losses to recapture with improvements to the transport system, there are annual costs to the African economy paid by shippers and transporters that continue to occur every year when there are inefficiencies. These include:

- Costs of delays at border posts and ports
- Costs of inefficient goods transport due to policies reducing vehicle utilization
- Costs of inadequate road maintenance
- Costs of other corridor inefficiencies (unnecessary delays and payments at ports, road barriers and border posts, etc.)
- Costs of traffic shifts from rail to road due to inefficient rail operations/concession agreements and lack of government policy support for rail and multi-modal services
- Costs of excess airfares charged to passengers as a result of air service inefficiencies
- Cost of congested air terminal facilities
- Costs to airlines of inefficient routing due to gaps in air traffic control

Each of these costs is analyzed below.

Figure 21: Suppressed Air Passenger Demand by Country in 2009



Costs of delays at ports and border posts

The long delays spent by the trucks at borders and ports, raises transport costs significantly for African economies. There are also supply chain costs due to unreliability, which cause shippers to increase inventories and this leads to additional costs. The costs of border delays and unreliability were estimated at ***US$4 billion*** in 2009.

Costs of policies that reduce the utilization of goods vehicles

The policies described in Section 2.3 above that significantly reduce truck utilization also significantly raise road transport costs as shown in Figure 13. Road transport prices are higher for ARTIN corridors than for other regions of the world by 33% to 140%, resulting in a significant penalty for African shippers, producers and consumers, particularly those in landlocked countries. The total costs of these inefficiencies for ARTIN corridors are estimated at ***US$37*** billion in 2009.

Costs of inadequate road maintenance

The cost of inadequate road maintenance is a cost paid by transporters and passed on to the shippers in ARTIN corridors every year. These were estimated at ***US$460 million*** or about 1% of the total cost of corridor inefficiency, but they are all incurred by shippers to landlocked countries and they account for 3% of the excess costs for landlocked country shipments.

Costs of inefficient rail mode share

Since the railways in the ARTIN corridors, other than those in North and South Africa, are not carrying their efficient share of traffic, this results in shipments by road, which are more costly. The cost of this inefficiency was estimated at ***US$400 million*** in 2009[16].

Costs of other corridor inefficiencies

On top of the costs described above, the costs of other corridor inefficiencies due to unnecessary delays and payments at ports, road barriers and border posts, etc. are incurred by shippers in ARTIN corridors every year. These were estimated at ***US$32 billion*** or 43% of the total cost of corridor inefficiency.

Total costs of ARTIN corridor inefficiencies

The amount of increased costs to transporters and shippers due to inefficient ARTIN corridor transport is estimated at ***US$75 billion*** for the ARTIN corridors in 2009. This is an average of 19% more than the costs of efficient ARTIN corridor transport (26% more for landlocked countries).

Costs of high airfares

Passengers paid an estimated additional cost of US$23 billion in 2009 due to higher airfares charged in some regions of Africa compared to best practice in SADC and elsewhere.

Cost of congested passenger terminals

Inefficiencies due to congested terminals cost air travellers in Africa an estimated ***US$500 million*** in 2009.

Cost of inefficient aircraft routings

Airlines also incur extra costs as they fly longer routes than the shortest route in order to avoid gaps in the existing air traffic control system. These costs are passed on to passengers. The extra costs to airlines for this inefficiency are estimated at US$ 1 billion per year.

Total cost of ARTIN air transport inefficiencies

The amount of increased costs to air passengers and airlines due to inefficient air system transport is estimated at ***US$25 billion*** per year for 2009.

TOTAL COST OF INEFFICIENCIES IN ARTIN

The total cost of inefficiencies in the ARTIN corridors and air transport system was estimated at ***$172 billion*** in 2009, with about 60% made up of increased annual costs to shippers and 40% in the value of suppressed demand. These costs will rise with increased demand in the future, if improvements are not made in corridor and air service efficiencies.

[16] These transport price differentials underestimate the total penalty to shippers which includes the value of transit time and unreliability.

Table 5: Summary of Economic Cost of Inefficiencies in ARTIN 2009

Type of Cost	Amount (US$ billion)	%
Total ARTIN Corridor Inefficiency Costs	75	43
Total ARTIN Air Transport Inefficiency Costs	25	15
Total Value of Suppressed Freight Demand	65	38
Total Value of Suppressed Air Transport Demand	7	4
ARTIN total	**172**	**100**

3. FORECAST DEMAND – OUTLOOK 2040

KEY MESSAGES

- Given the expected growth in economic output and international trade (6-8% per year), there will be a very large increase in demand for freight transport by 2040.
- The structure of these trade flows is expected to change significantly over the next 30 years.
- Trade in ARTIN corridors is expected to grow faster than overall trade.
- The forecast demand by corridor expects a shift from 2009 corridor share to the most efficient corridor shares,
- In the future, containerized cargos will dominate port traffic and port traffic growth. The importance of multimodal transport of containers will increase substantially along ARTIN corridors.
- Air passenger flows are dominated by nine countries, which are major tourist destinations and major regional air transport hubs.
- Five countries (Republic of South Africa, Egypt, Algeria, Morocco, and Nigeria) account for more than half of total African trade, and they will continue to dominate in the future.
- Transit traffic from landlocked countries is expected to increase more than tenfold over the next 30 years. This will create major infrastructure capacity problems.
- Sensitivity analysis shows that even with a lower economic growth rate, the 2030 projected demand will be realized by 2040. Planning to meet this demand should begin immediately.

3.1 Assumptions, Scenarios and Methodology

The PIDA forecast demand for 2040 is based on a vision of the future with sustained economic growth and increased regional integration. This vision includes an efficient transport network, which uses best practices from Africa and other regions of the world that reduce costs and increase service levels.

3.1.1 Assumptions and Scenarios

The PIDA forecasts are based on a set of assumptions that correspond to the PIDA vision and include scenarios for development. The key assumptions are:

- GDP will grow at an average of 6% per year for the continent (with 4% per year as sensitivity scenario)
- Population will grow as forecast by the United Nations with increasing urbanization
- International trade is the driver for freight flows in ARTIN corridors
- Trade will grow in response to GDP and population growth and from large resource-based projects, which generate scenarios of international trade
- There will be a structural change in African economies that includes more value-added industries that change the types of goods traded and increase regional integration
- Air passenger growth will respond to increasing per capita income and urban populations
- Suppressed demand exists due to transport system inefficiencies that can be realized by improving the transport system (this is represented in additional scenarios)

3.1.2 Methodology

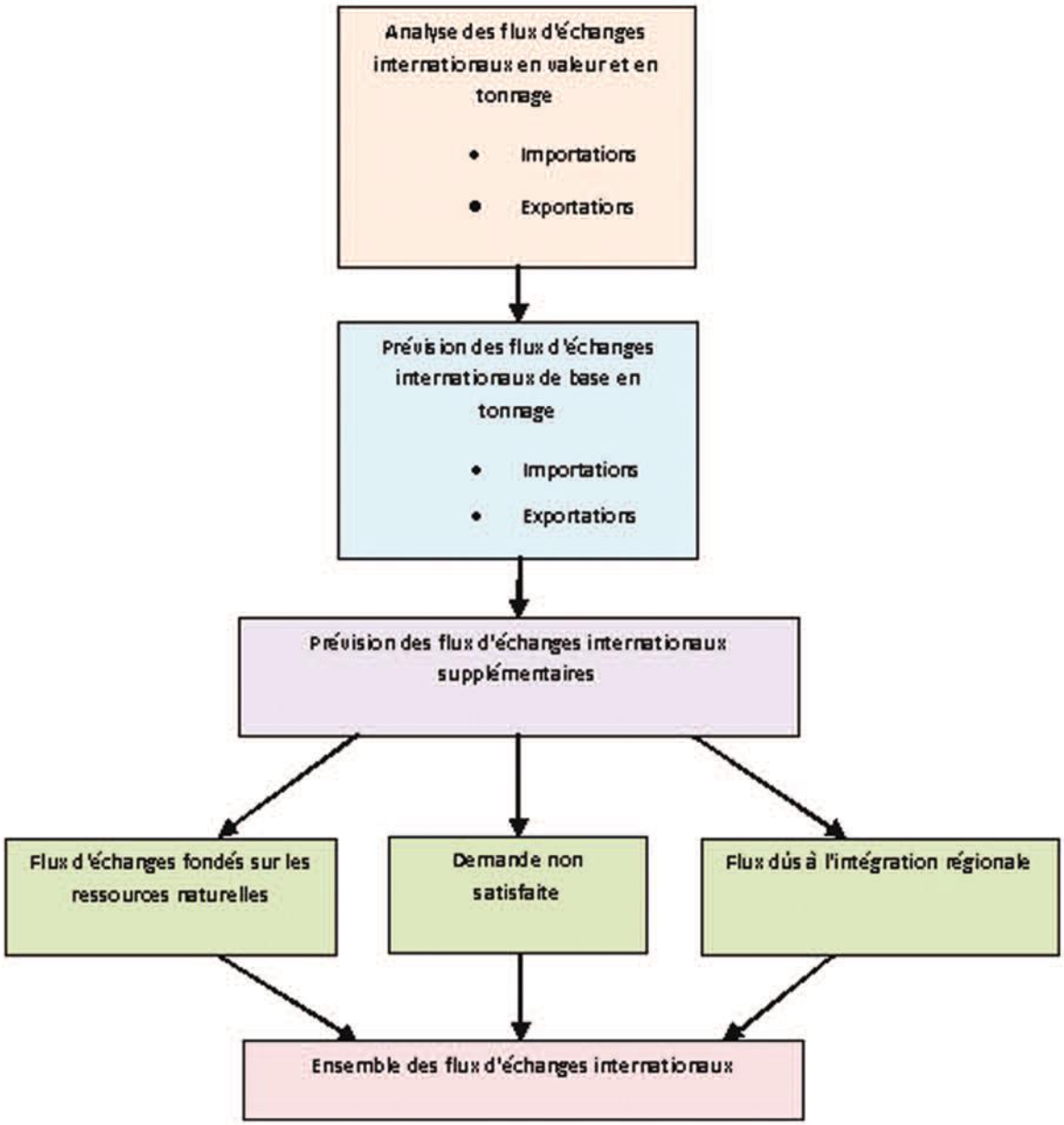
Freight Demand

The demand for freight focuses on international trade flows between African countries and between African countries and overseas regions. As shown in Figure 22, the freight demand forecast process consisted of six steps:

- Analysis of international trade flows by value and tonnage
- Forecast of base international trade flows by tonnage
- Forecast of additional flows due to resource-based development
- Forecast of additional flows due to suppressed demand
- Forecast of additional flows due to regional integration

The analysis of international flows was based on past trends in trade and in value per tonne of trade in different categories of commodities (oil, minerals, agricultural goods and non-resource-based goods). Forecasts were made for all categories except for crude oil (which is handled separately from other commodities in the transport system) and based on PIDA GDP and population forecasts and the analysis of past trends in imports and exports from COMTRADE data.

Figure 22: Freight Demand Forecast Process



Resource-based Trade Flows

Large scale projects were identified in the areas of mining and agriculture, and these were forecasted on a scenario basis. If, in a given scenario, the projects were to be implemented, they were included in the forecasts.

Suppressed Demand

Suppressed demand for transport is related to the effect of high transport costs and inefficiencies on the volume of transport as described in Section 2.4.1 above. The percentage of suppressed demand was calculated and then multiplied by the trade volumes and values in 2009. This percentage was expected to be 50% realized by 2020 and 100% realized by 2040 due to efficiency improvements and the elimination of civil unrest as part of African development.

Increased Demand Due to Regional Integration

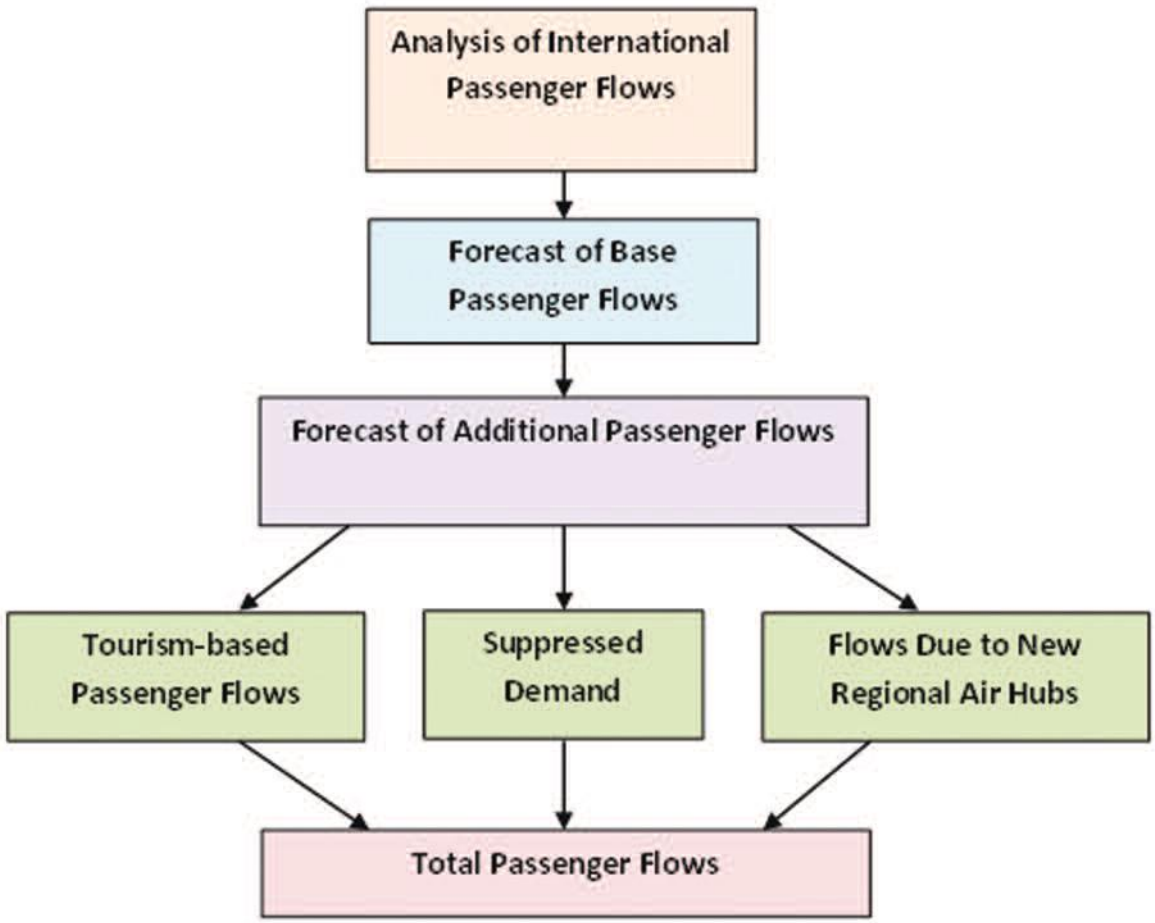
Increased demand due to regional integration is expected to come in the form of a shift from overseas trade to trade between countries within the same REC. A benchmark of a 20% share of total trade by volume for countries within a REC was established as a target for 2040 for countries with a smaller current share.

Air Passenger Demand

Passenger demand analysis and forecasting focused primarily on international air passengers, with a secondary analysis of land passenger transport at a lower level of detail. This was carried out during the gap analysis described in Section 3.4 below.
International Air Passenger Demand

forecasts followed a parallel process to that of international trade as shown in Figure 23. These forecasts are based on current air passenger traffic and an analysis of the influence of tourism, resource-based economies and the existence of an air traffic hub on these air traffic volumes. Future air traffic is related to GDP per capita and urban population. For individual pairs of air service among African countries and between these countries and other continents, the level of demand was related to the current airfares and service levels as well as GDP and population.

Figure 23: Passenger Demand Forecast Process



Tourism-based Demand

Demand for passenger travel for certain countries is partly based on the existence of air traffic hubs, partly on tourism and partly on the structure and growth of the economy. All countries have some tourist traffic and this is included in base traffic forecasts. However, there are special cases where substantially more than average tourist traffic takes place.

Suppressed Demand

Suppressed demand in the air sector is related to high airfares and inefficient service (low frequencies and lack of direct flights) as discussed in Section 2.4.1 above. There is also suppressed demand in those countries where there is civil unrest.

Demand Due to New Regional Air Hubs

The lack of air hubs in certain regions is a major hindrance to the growth of air traffic. The addition of more regional air hubs will increase regional integration as well as service levels and will also have an influence on lowering airfares.

3.2 Continental Forecasts

There are two types of continental forecasts: Freight (international trade) and Air Passengers.

3.2.1 Future Demand for Freight Transport

Future freight transport demand in Africa is tied to growth in international trade. Such trade is expected to grow from 510 million tons to 3,600 million tons over the next 30 years (see Table 6). In other words total

trade tonnage is forecast to double by 2020 and increase by a factor of 6 by 2040. This is a very large increase in demand, based on average GDP growth of 6% per year for the continent using PIDA "stretch" forecasts, and average population growth of 1.8% per year with urban population growing even faster at 2.9% per year[17].

This growth is slightly faster than historic growth of trade demand over the past decade, due to three factors:

- Sustained GDP growth is expected to be somewhat faster (6% rather than 5%)
- Trade between African countries, particularly in agricultural products in the short term, is expected to increase at a faster rate due to more regional integration,
- There will be a substantial reduction in suppressed demand, leading to a jump in trade as a result of corridor and port improvements[18].

The structure of these trade flows is expected to change significantly over the next 30 years as countries increase the value added of their exports through processing, consumers with rising incomes import more expensive goods and manufacturing and mining businesses import more expensive processing equipment. This is reflected in an increasing value per ton for both imports and exports and somewhat slower growth in trade volume compared to trade value.

Trade in ARTIN corridors is expected to grow faster than overall trade and to expand from 13% in 2009 to 18% of total trade in 2040. This growth is illustrated in Figure 24 for total trade, port traffic and corridor traffic.

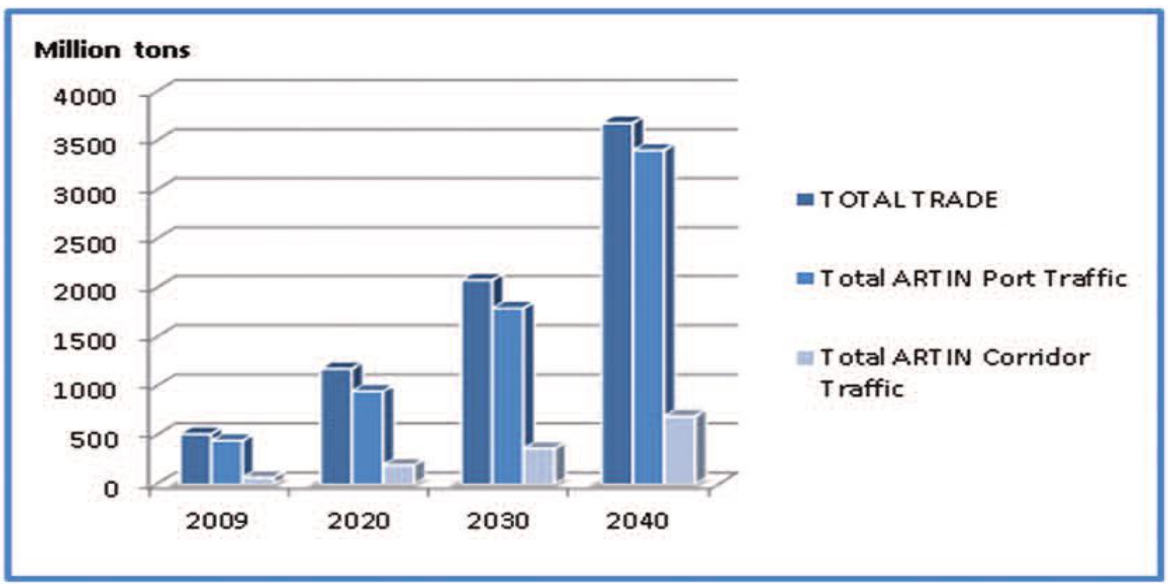
The map in Figure 25 shows the trade flows in 2040 where the size of corridor demand lines and port demand circles has grown since 2009.

Future port tonnage is expected to grow at 6% to 6.8% per year excluding large new mining projects and crude oil and at 5.8 to 7.8% per year including new mining projects, assuming ARTIN corridors achieve good efficiency (see Table 6).

Growth in container traffic is expected to grow faster than for total tonnage since containerization rates are increasing. Container growth will average 10.6% per year to 2020 (including 50% of suppressed demand which is assumed to be realized due to corridor improvements) and 7.9% from 2020 to 2040 on a sustained basis (including 100% of suppressed demand realized due to corridor efficiency improvements).

Bulk traffic growth will depend on mineral development, particularly iron ore exploitation over the next 30 years. These developments will be specific to countries with large iron ore and bauxite deposits that become economic to exploit in this period (see Figure 25). New coal shipments are also expected in ARTIN corridors (e.g., Moatize) and more copper metal from the Copper Belt countries (Zambia and the DR Congo), but at lower tonnages than for iron ore and bauxite, which will utilize special purpose-built transport facilities. In the case of copper mining and smelting development the tonnage of imported machinery and spare parts is also very large and can exceed the tonnage of exports.

Figure 24: Summary of PIDA International Trade Forecasts, Total, Ports and Corridors



Source: Consultant estimate Note: Port traffic excludes dedicated mine ports and ARTIN corridor traffic is for corridors linking landlocked to coastal countries only.

[17] Population forecasts are from the United Nations. Total population grows by 70% in 30 years and urban population grows by 135%.

[18] These forecasts assume that 50% of suppressed demand due to less than good corridor and port efficiency is realized by 2020 and 100% is realized by 2040, when all ports and corridors are assumed to function at good efficiency, resulting in an additional 573 million tons of trade.

Trade growth for East and South Africa is the largest in total tonnage of the different African sub-regions, but Central African trade is expected to grow the fastest, as shown in Figure 26. The growth outside of Central Africa is slightly slower due to larger proportions of mineral trade with slightly slower growth rates compared to other import and export trade.

Table 6: Summary of PIDA International Trade Forecasts (million tons)

	2009			2020				2040			
Trade Component	Imports	Exports	Total	Imports	Exports	Total	Av. Annual Gr. Rate	Imports	Exports	Total	Av. Annual Gr. Rate
Non-Resource-Based	208.3	97.3	305.6	369.6	198.3	567.9	5.8%	1,217.6	826.0	2,043.6	6.6%
Agriculture	32.9	15.0	47.9	84.8	84.8	169.6	12.2%	368.6	84.3	452.9	5.0%
Existing Minerals*	20.0	140.1	160.1	27.4	192.8	220.2	2.9%	40.7	286.5	327.2	2.0%
Total Base	**261.2**	**252.4**	**513.6**	**481.8**	**475.9**	**957.7**	**5.8%**	**1,626.9**	**1,196.8**	**2,823.7**	**5.5%**
Suppressed Demand (realized)	-	-	-	49.0	48.8	97.8	n.a.	329.7	243.6	573.3	9.2%
Total with Supp. Dem.	**261.2**	**252.4**	**513.6**	**530.8**	**524.7**	**1,055.5**	**6.8%**	**1,956.6**	**1,440.4**	**3,397.0**	**6.0%**
New Mines			-								
a) using corridors	-	-	-	-	22.0	22.0		-	32.7	32.7	
b) using sep. Infra.	-	-	-	-	50-140	96.0		-	240.0	240.0	
Total New Mines	-	-	-	-	72-162	118.0		-	272.7	272.7	4.3%
Total with Mines	**261.2**	**252.4**	**513.6**	**530.8**	**597-687**	**1,173.5**	**7.8%**	**1,930.2**	**1,713.1**	**3,629.7**	**5.8%**
Container Traffic (million TEUs)			**12.5**			**38.2**	**10.6%**			**173.4**	**7.9%**

Source: Consultant estimates note that these figures exclude trade in crude oil and trade through mineral ports not reported in COMTRADE or available port data.

Figure 25: ARTIN Corridor Demand Forecasts for 2040

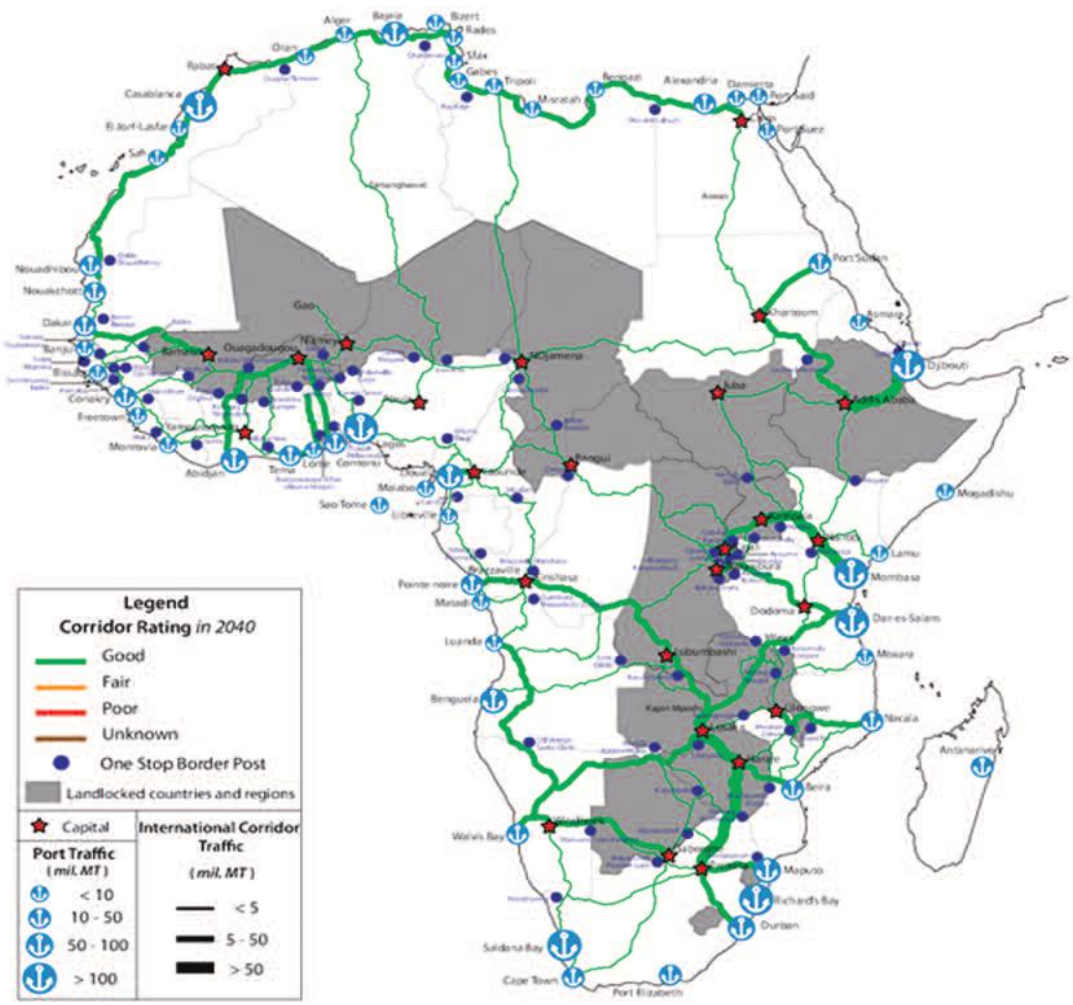
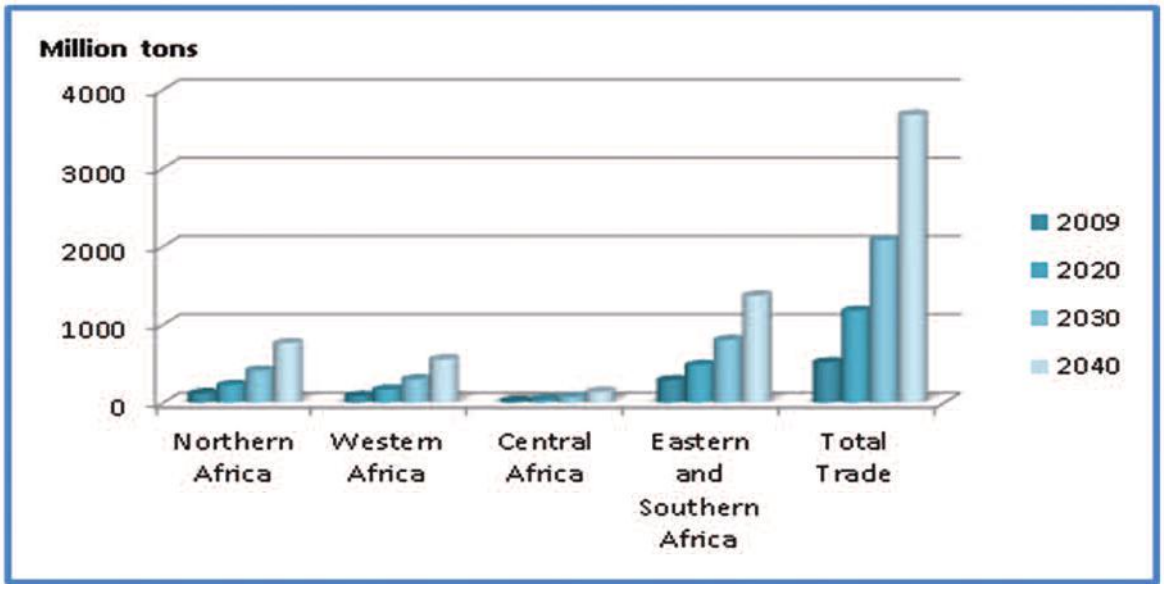


Figure 26: Summary of PIDA International Trade Forecasts, by Sub-Region



Source: Consultant's estimate. Note: t figures exclude trade in crude oil and trade through self-sufficient mineral ports not reported in COMTRADE.

In respect of each corridor, the growth will range between 5% and 11% per year depending on the countries involved. The higher growth rates to 2020 include suppressed demand realized as a result of corridor improvements.

Assumptions of Increased Efficiency of Corridor Choice and Mode Choice

This forecast demand by corridor expects shifts from 2009 corridor share to the most efficient corridor shares, assuming that railways and highways are operating with good efficiency and civil strife is resolved in Cote d'Ivoire and Congo DR and Southern Sudan acts as an independent country, using Djibouti and Mombasa ports (and possibly Lamu). This also means that Abidjan will pick up a greater share of transit traffic from Mali, and the Central and Dar corridors will increase their shares of regional transit flows. Similarly, traffic shares for railways in Northern, Central and Dar corridors will increase to levels similar to that realized by Transnet at its most efficient (50% for medium distance international traffic-e.g., Burundi, and 60% for very long distance traffic-e.g., DR Congo). Also the Beira Corridor is expected to increase its traffic with a rail share returning to historical levels of 50% of total traffic, compared to 10% in 2009. The Nacala Corridor is expected to accommodate the Moatize coal developments (although this could also be handled by the Beira rail line, if the financial conditions are made attractive, and the port is expanded accordingly).

The Maputo Corridor rail share is expected to rise to levels similar to those found for long distance traffic in South Africa, and North-South corridor rail is expected to increase its share of copper metal shipments.

Container Traffic

Worldwide trade demand is becoming more and more containerized. This trend strongly affects African ports and ARTIN corridors. Currently African containerized port traffic (12.6 million TEUs)[19] represents 35% of the non-mineral trade volume plus 10% of mineral traffic, composed of high-value mineral concentrates and metals. These rates are expected to increase dramatically over the next 30 years as containerization reaches 75% or more of non-mineral trade volumes. This means that almost all dry cargo trade will be containerized and part of the liquid bulk as well.

The net result is an increase in container traffic to 38 million TEUs by 2020 and 176 million TEUs by 2040, representing average annual growth rates of 10.6% per year and 7.9% per year respectively.

In the future, containerized cargos will dominate port traffic and port traffic growth. Similarly, the importance of multimodal transport of containers will increase substantially along ARTIN corridors. This is illustrated in Figure 27, which shows that total trade will increase by a factor of 7 by 2040 while container traffic increases by a factor of 14 in the same period.

[19] A TEU is a twenty-foot equivalent unit, which is a basic measure of the number of containers.

Figure 27: Forecast Containerized Traffic as Part of African International Trade

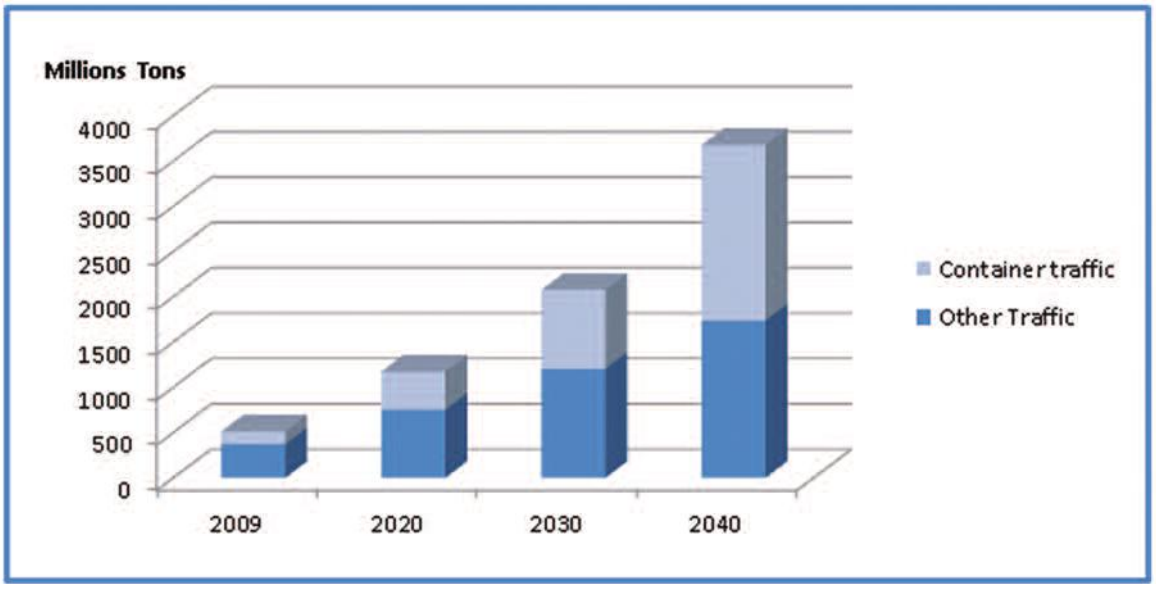
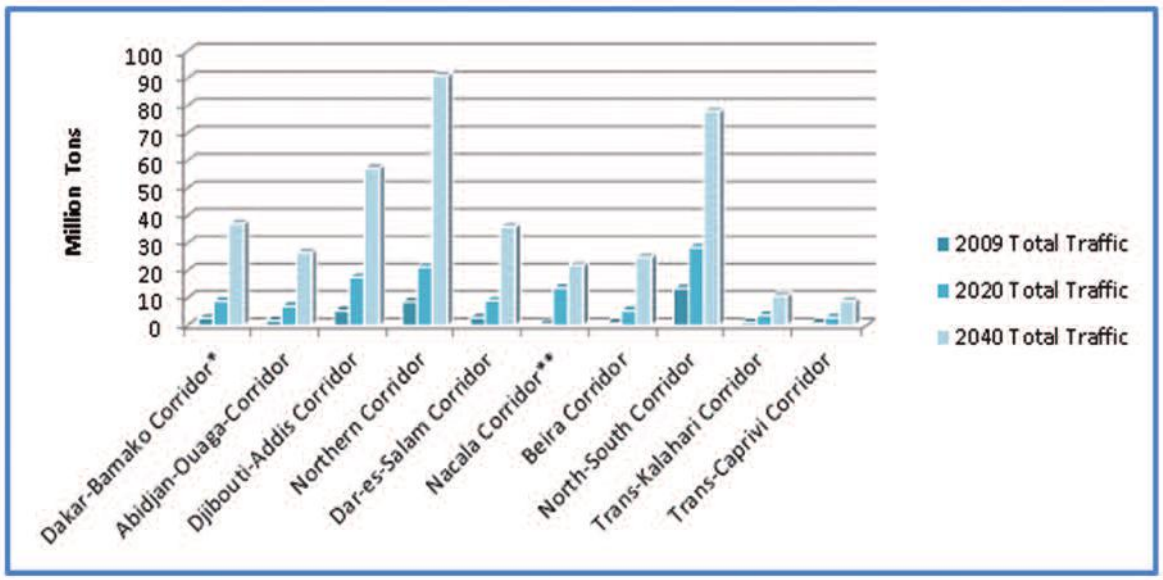


Figure 28: Examples of Corridor Traffic Forecasts (million tons)



Notes: Corridor tonnages include both road and rail transport with accuracies about +/-20%. They are recorded for the section with the most traffic in the corridor. Future forecasts assume use of the most efficient corridors.

* Shifts from Bamako-Dakar to Bamako-Abidjan are forecast since Bamako-Abidjan has an advantage with some traffic such as petroleum products.

** Forecasts for Nacala expect that 11 million tons of coal from Moatize transit the port in 2020 and these continue through 2040 (therefore the low growth rate after 2020). Nacala has not been confirmed as the export port for Moatize Coal and Beira is one of the alternatives. Moatize coal exports may also be divided between Beira and Nacala.

3.2.2 Sensitivity of International Trade Forecasts to GDP Growth

The international trade forecasts are highly sensitive to GDP growth assumptions. Since the basic "stretch" forecast of PIDA expects an average GDP growth of 6%, this results in growth in trade that is higher than in the past ten years where GDP growth has averaged 5%. The long term sustainability of this level of growth is questionable given global economic forces which cause depressions and lower growth in cycles over long periods.

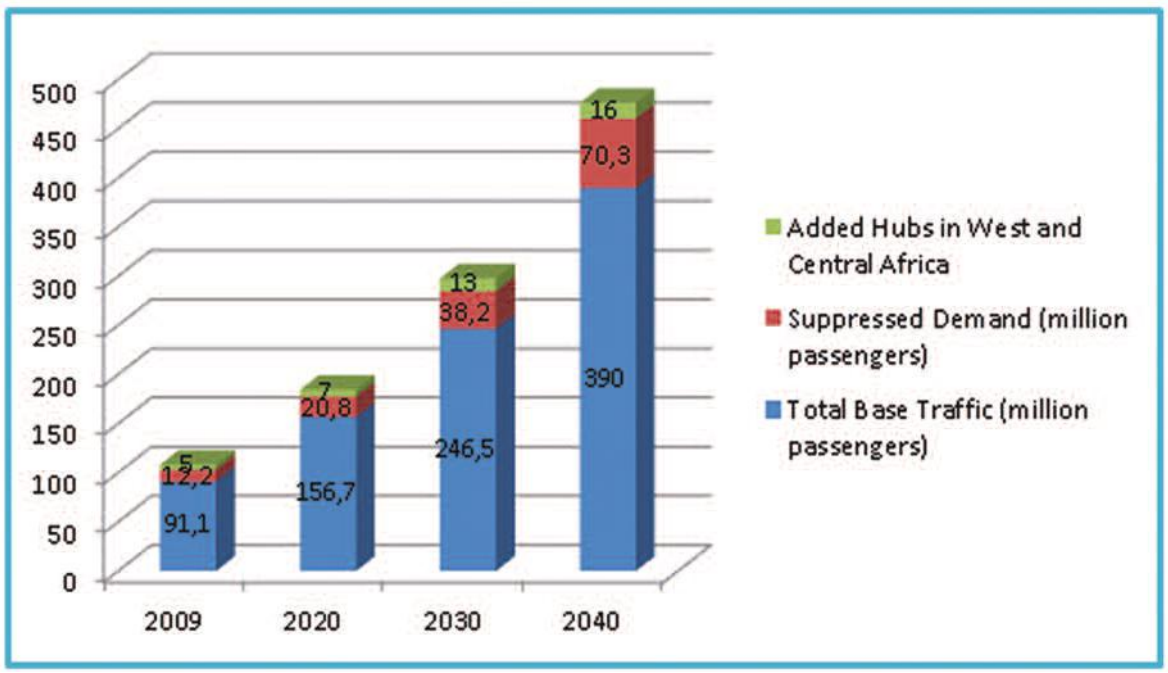
Forecasts for 2040 using a 4% GDP growth were revealed to be essentially equivalent to the 2030 forecasts with 6% GDP growth.

The message of this sensitivity test is that there will be major long term increases in trade in the future. Whether these occur in 2040 or 2030, they are still very important. At least, the 2030 forecasts at 6% GDP growth should form the basis for long term planning in the African transport sector. Although the 2040 forecasts may be delayed for ten years, they should still be considered in ARTIN corridor planning.

3.2.3 Future Demand for Air Passenger Transport

International air passenger flows are forecast to increase by 40%-90% by 2020 and by factors of 2.5 to 6 by 2040, including suppressed demand (see Figure 29 for the relative size of suppressed demand). The effects of these increases by airport are illustrated in Figure 30 (size of airport symbols indicates traffic). In general, the air passenger flows increase for all countries, although those for lower income countries grow faster from a smaller base (in line with the macro-economic forecasts). However, the total flows are still dominated by nine countries, including those, which are major tourist destinations and major regional air transport hubs.

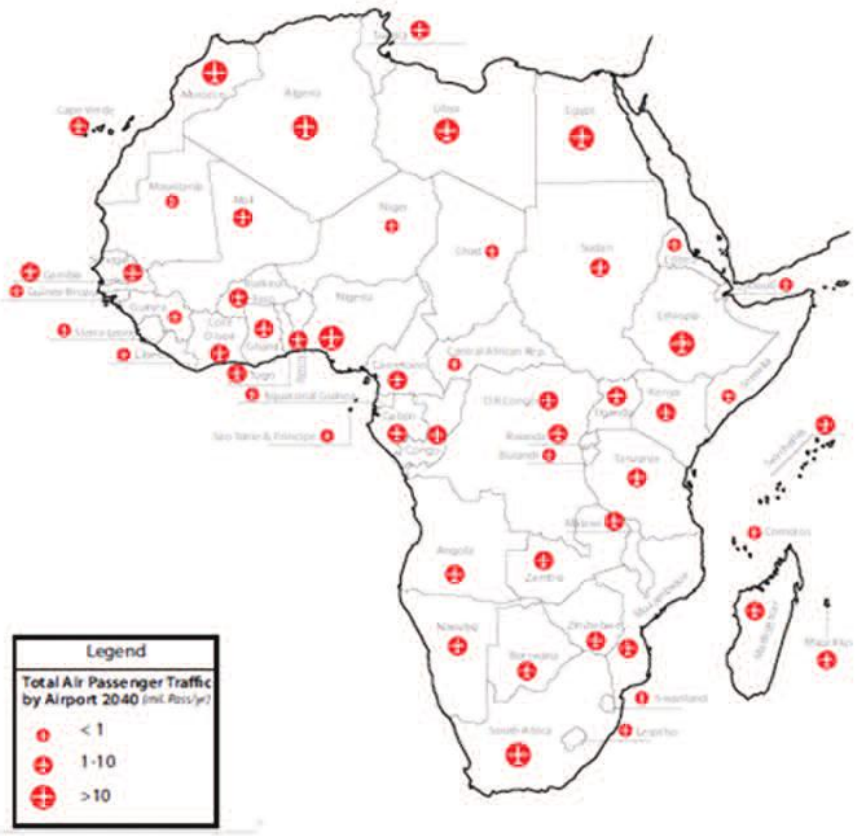
Figure 29: Forecast Air Passenger Traffic



If two additional regional air traffic hubs are established, one in West Africa and one in Central Africa, the air passenger demand in these regions would increase substantially as regional hubbing increases regional air travel and more efficient connections to other regions increases inter-REC and inter-continental air travel. The size of this increase depends on the base traffic at the selected hub airports. If an airport the size of Lagos is selected as a hub, this increase could be 7 million passengers per year by 2020. If a smaller airport were to be selected, the increase could be 3 to 5 million passengers per year by 2020. These numbers will increase for 2040 by a factor of 2-3 as air passenger demand grows.

The sensitivity of air passenger forecasts to GDP growth assumptions is similar to that for trade. In other words, the 2030 forecast for 6% growth would shift to 2040 for a 4% sustained GDP growth assumption.

Figure 30: ARTIN Air Passenger Forecasts for 2040



3.3 Regional Forecasts

3.3.1 Regional Trade Forecasts

Although the trade increases vary across countries with the poorer countries growing faster from a small base (as noted in the macro-economic forecasts) future trade is still expected to be dominated by certain large countries. Five countries account for more than half of total African trade by volume as shown in Figures 31 and 32, and they will continue to dominate in the future, although their share is forecast to decrease (increased mineral exports from countries, such as Zambia and DR Congo, are expected to reduce the share slightly more).

Figure 31: Major Countries in Current and Forecast Trade (million tons)

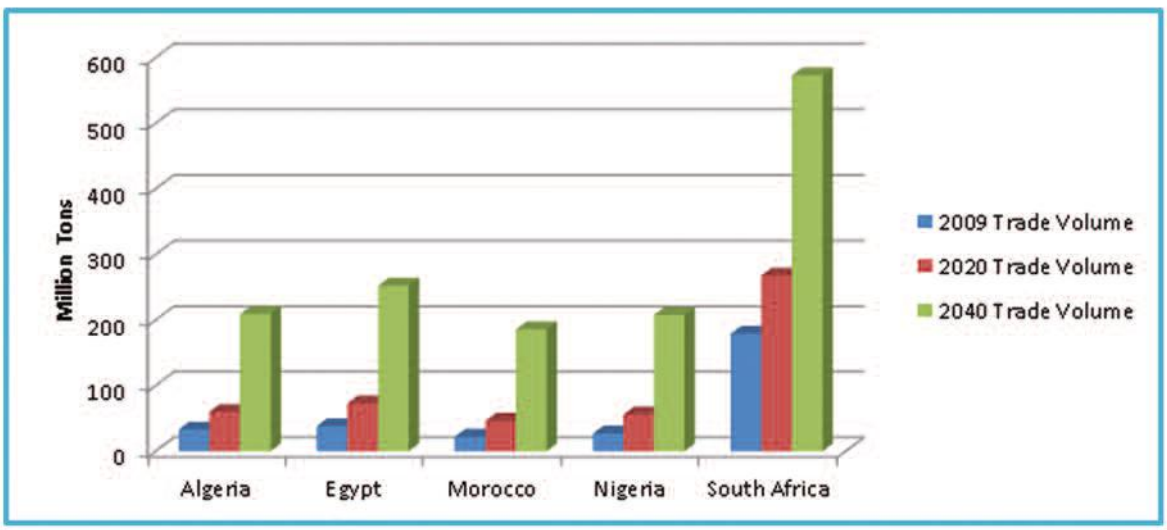
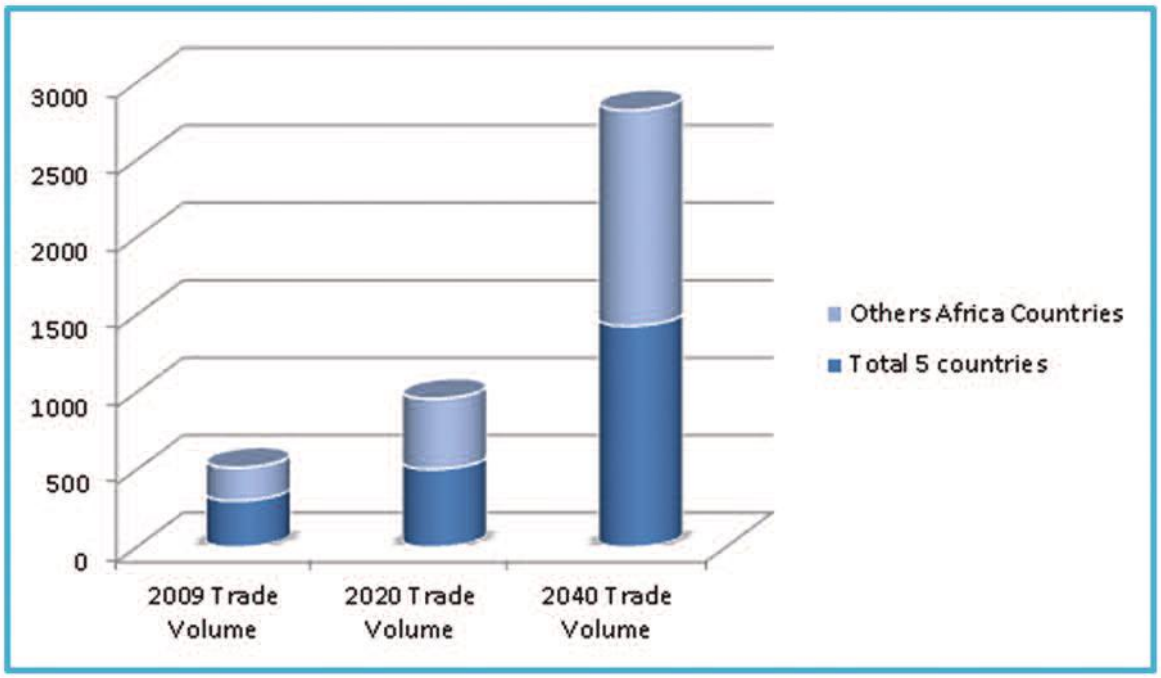


Figure 32: Proportion of Major Countries in Current and Forecast Trade



For the five regions, trade forecasts show some variation in expected growth with Eastern Africa growing the fastest and Southern Africa growing slightly slower (due to a larger base) as shown in Table 7.

Table 7: Trade Forecasts by Region (million tons)

Region	2009	2020		2030		2040	
		Volume	% Av. Growth	Volume	% Av. Growth	Volume	% Av. Growth
North Africa	20	235	6.3%	410	6.3%	760	6.4%
West Africa	7	176	6.7%	300	6.0%	556	6.3%
Central Africa	21	43	6.8%	77	6.4%	145	6.5%
East Africa	45	96	7.1%	181	7.1%	360	7.1%
Southern Africa	240	408	4.9%	617	4.7%	1,001	5.0%
Total Africa Base	**513**	**958**	5.8%	**1,585**	5.7%	**2,823**	5.9%
With Sup. Demand	**513**	**1,056**	6.3%	**1,822**	6.1%	**3,397**	6.4%
With New Minerals	**513**	**1,175**	7.8%	**1,998**	5.5%	**3,630**	6.2%

3.3.2 Regional Air Passenger Forecasts

Forecast air passenger demand is expected to increase significantly for all RECs, growing at an average rate of about 5% per year (see Table 8). However, the level of demand varies for air transport services within Africa and outside Africa as shown in Figure 33. The size of the arrows shows the level forecast demand. These are colour-coded by selected REC.

Demand for transport to Europe will be substantial for all RECs, with demand for transport to the Middle East becoming strong for several RECs and to Asia and North America for a few RECs. Demand for transport from ECOWAS and ECCAS to other regions and continents would jump with the addition of new hubs as shown in Figure 34.

Table 8: International Air Passenger Demand Forecasts by REC (millions of pass/yr)

REC	2009	2020		2030		2040	
		Number	% Av. Growth	Number	% Av. Growth	Number	% Av. Growth
AMU	21.4	34.1	4.3%	49.8	3.9%	73.5	4.0%
COMESA	34.3	60.7	5.3%	95.9	4.7%	151.7	4.7%
EAC	8.1	15.1	5.8%	25.2	5.3%	41.9	5.2%
ECCAS	6.1	9.9	4.5%	14.9	4.2%	22.6	4.3%
ECOWAS	12.4	20.6	4.7%	31.5	4.3%	48.3	4.4%
IGAD	12.9	23.8	5.7%	38.4	4.9%	62.0	4.9%
SADC	25.9	46.6	5.5%	77.7	5.2%	130.0	5.3%
Total Africa	91.1	156.7	5.1%	246.5	4.6%	390.0	4.7%

Note: Total Africa is less than the sum of all RECs due to overlapping REC membership. The growth is faster for ECOWAS, UEMOA and ECCAS with new air hubs in those RECs.

Figure 33: Forecast of Air Transport Demand by REC and Air Service – 2040 with Existing Air Hubs

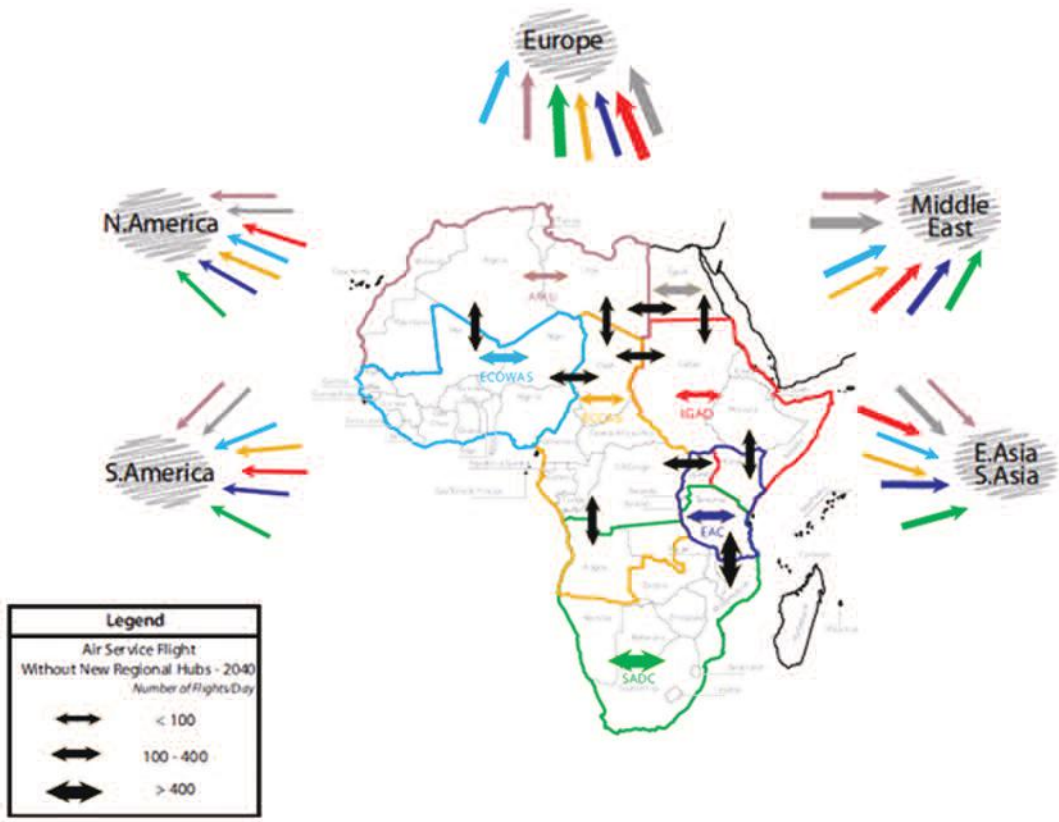
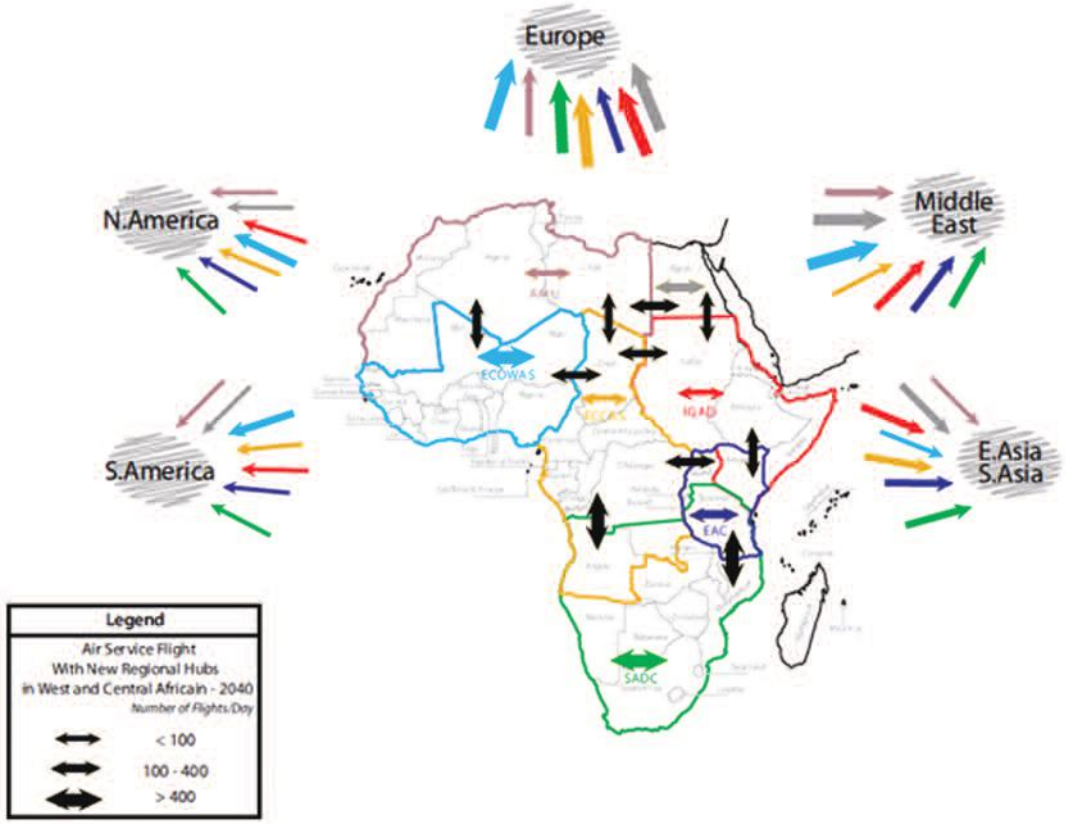


Figure 34: Forecast of Air Transport Demand by REC and Air Service – 2040 with New Hubs in West and Central Africa



3.4 Forecasts by Group of Landlocked Countries

Transit traffic from landlocked countries is expected to increase by 10-14 times over the next 30 years as shown in Table 9 for four groups of landlocked countries.

In West Africa, this transit traffic will rise from 6 million tons to 65 million tons in 2040. For Southern Africa, this traffic will increase from 13 million to 148 million tons, in East Africa this traffic will increase from 10 million tons to 149 million tons as Southern Sudan exports through this region. Finally, Djibouti will face transit traffic increases from 9 million tons to 76 million tons. 2030 forecasts amount to 1/3 to 1/2 of the 2040 tonnages, but are still 4-5 times current traffic levels.

Table 9: Transit Traffic Forecasts for Groups of Landlocked Countries

Group of Countries	Total Traffic (million tons)				
	2009	2020	2030	2040	Av. Annual Growth Rate
Mali, Burkina Faso, Niger	6.0	14.9	27.7	65.6	8.0%
Botswana, Malawi, Southern DR Congo, Zambia and Zimbabwe	12.7	32.0	50.7	147.6	8.2%
Burundi, Eastern DR Congo, Rwanda, Uganda and 70% of Southern Sudan	10.2	27.7	55.8	148.8	9.0%
30% of Southern Sudan and Ethiopia	8.6	19.2	34.0	76.5	7.3%

These forecasts show future trade that will create major infrastructure capacity problems. These are discussed in the following chapter.

4. TRANSPORT INFRASTRUCTURE CAPACITY GAPS

KEY MESSAGES

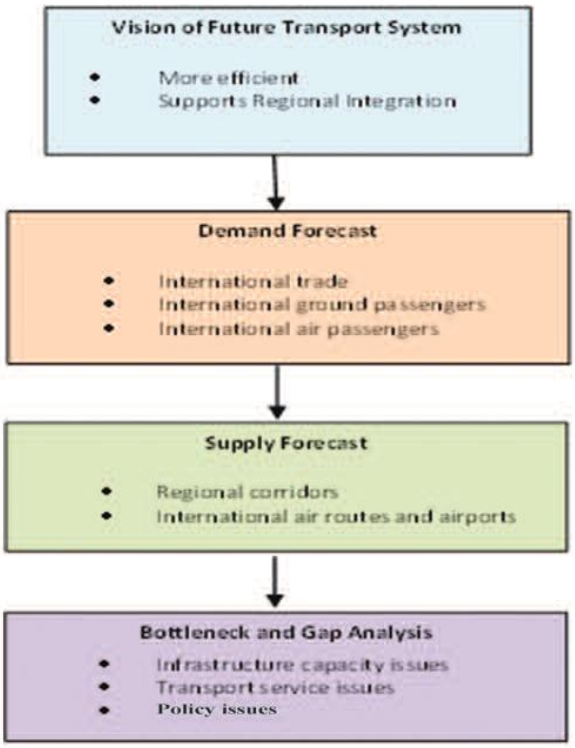
- ARTIN corridor border posts, railways, ports, and airports can potentially derive major increases in capacity from improvements in policies and institutional actions.
- Forecast demand will exceed capacity in all areas of the ARTIN corridors by 2040 and in some corridors by 2030, despite the expected implementation of planned improvement projects. There will also be a number of short term gaps by 2020.
- Three regions (West Africa, East Africa, and Southern Africa) face short-term port container capacity gaps by 2020 even after currently planned port and terminal expansion projects are completed. By 2040, these three regions will have much larger gaps that will require both additional port expansion and new port development. This situation calls for regional port master planning, which will be a new departure for the RECs.
- Eleven of the 43 most important ARTIN border crossings will experience a capacity constraint by 2020. These constraints are entirely due to border post operations, not road infrastructure. By 2040, 11 of these border crossings are expected to have road capacity bottlenecks as well,
- All 11 cross-border railways will need expansion by 2040 to meet freight demand with efficient mode shares for rail services, some by 2030.
- New rail connections (and efficient rail operations) will be required by new ports as well as by major port expansions, particularly where the expanded port will function as a regional port.
- Additional regional airline hubs are needed in West Africa and Central Africa.
- The high-level regional air navigation and air traffic control systems are obsolete and need to be upgraded to European standards.
- All airports on the continent will need to be expanded or supplemented by additional airports by 2040 in order to handle the expected air traffic.

4.1 Assumptions, Scenarios and Methodology

The methodology for capacity gap analysis starts with the vision of the potential future transport system for Africa that supports regional integration and improved efficiency of transport that was described in Chapter 3. The demand forecast described above was then applied to the forecast efficient ARTIN corridors and air transport system.

Once the demand was assigned to the network, the supply capacity of the existing transport infrastructure and services were evaluated to determine gaps and bottlenecks in the transport system that currently exist or will appear in the future. This methodology is represented in the flow chart in Figure 35.

Figure 35: Overview of Outlook Methodology



4.2 Potential Capacity Gains via Policies and Institutional Actions

ARTIN corridor border posts, railways ports and airports can potentially derive major increases in capacity due to improvements in policies and institutional actions as summarized in Table 10. These types of improvements are needed to create a future efficient transport system that can handle the forecast demand with a minimum of investment. They are assumed to be implemented in order to reduce costs, increase efficiency and realize suppressed demand.

4.3 Remaining Infrastructure Capacity Gaps (2020, 2030, 2040)

Forecast demand will exceed capacity in all areas of the ARTIN corridors by 2040 (see Figure 36 and Table 11), and in some corridors, despite the expected implementation of planned improvement projects. North Africa would be less affected than the rest of the continent, since transit corridors are less a factor in that region.

There will also be a number of short term gaps by 2020, despite the added capacity of planned projects, even if corridor infrastructure is being operated at its highest efficiency level.

Table 10: Potential Gains in Capacity from Policies and Institutional Actions

Mode	Type of policy action	Type of institutional change	% Capacity increase
Ports and multimodal facilities	Eliminate constraints on containers for inland use and reduce stripping of containers in ports or inland depots	Developing inland container depots and dry ports to move container processing out of the ports, institute single window, re-engineer customs processes to reduce dwell times	10%-30%
Railways	Restructure concession agreements to provide public funding for track improvement and rehabilitation.	Restructure concession agreements to support more equipment and rolling stock provision by private partners, and incentives for best practice management	100%-500%
Border posts	Support single window, integrated border management and smart corridor technology to reduce border transit times	Implement One-Stop Border Posts and smart corridor technology	100%-200%
Air Navigation System / Airports	Develop new means of financing for satellite-based air navigation system	Implement satellite-based air navigation system and change means of financing air navigation	10%-30%

Figure 36: Forecast Capacity Gaps in ARTIN Corridors

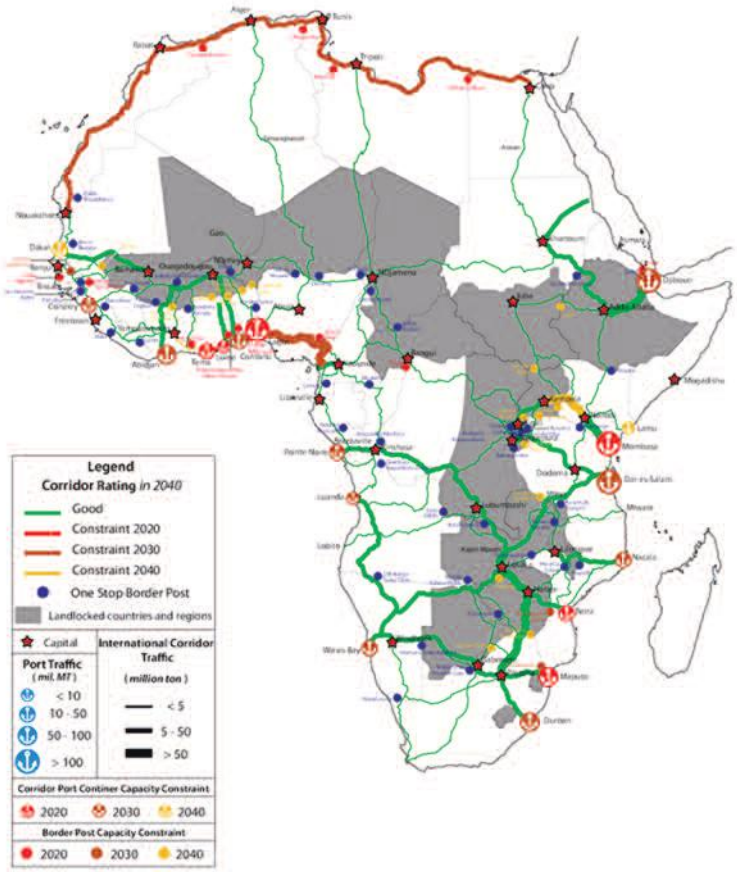


Table 11: Timing of Bottlenecks in ARTIN Corridors

Corridor	2020 Bottlenecks	2030 Bottlenecks	2040 Bottlenecks
Trans-Maghreb (Coastal)	Border Posts	Roads	
Abidjan-Nouakchott (Coastal)	Border Posts		
Dakar-Bamako	Railway		Border Post
Bissau-Bamako	Border Posts		
Abidjan-Ouagadougou		Port, Railway	Border Post
Abidjan-Lagos (Coastal)	Border Posts	Roads	
Tema-Ouagadougou	Port		Border Post
Lome-Ouagadougou			Port, Border Post
Cotonou-Niamey		Border Posts	Port
Lagos-Niamey	Port		Border Posts
Lagos-Douala (Coastal)	Border Post	Road	
Douala-Ndjamena		Port	
Douala-Bangui	Border Post	Port	
CICOS (Congo River)	River		
Pointe Noire-Kinshasa		Bridge, Border Post	
Djibouti-Addis Ababa	Railway, Border Post	Port	
Northern	Port, Railway, Lake		Border Posts
Central		Port	Border Post
Dar-es-Salam		Port, Border Post	
Nacala	Port, Railway		
Beira	Port, Railway		Border Post
Maputo	Port, Border Post	Railway	
North-South	Railway	Border Posts	
Trans-Kalahari		Port	
Trans-Caprivi		Port	
Trans-Cunene		Port	

Note: Only cross-border railways are analysed for this table. Some border posts will still be bottlenecks if they are excluded from the list of current OSBP projects or traffic will exceed their original OSBP capacity. Port capacity is analysed for container terminals only. Port capacities assume currently planned projects are implemented, including major expansions in Abidjan, Cotonou and Durban. Lamu Corridor construction would reduce Northern Corridor bottlenecks. If the bottleneck is not resolved in the year shown, it will continue for later years.

4.3.1 ARTIN Corridor Capacity Gaps

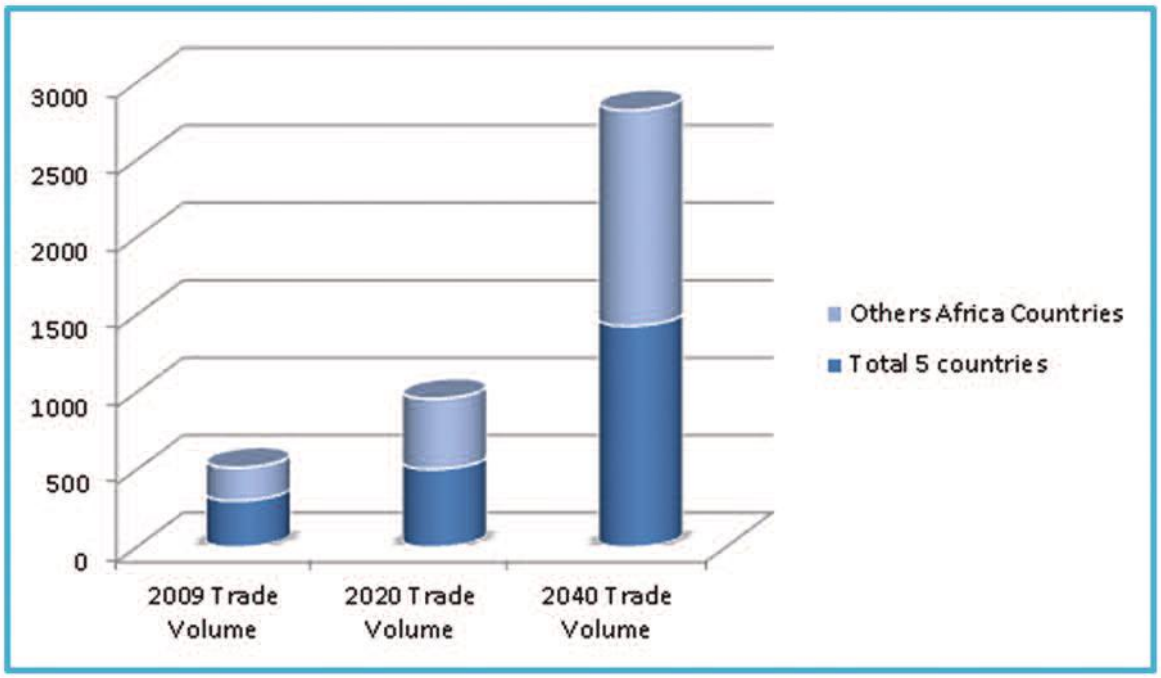
There are two critical issues in corridor infrastructure: (i) port capacity gaps and (ii) gaps in corridor linkages through and at borders between countries.

Port Capacity Gaps

Due to the dominance of container traffic in future port forecasts, port capacity[20] gaps were analyzed primarily in terms of container terminal and berth capacity. There are many ports in Africa that currently exceed their design capacity for containers as shown in Figure 37.

[20] There will also be a substantial demand for special purpose mineral ports, especially for iron ore and manganese developments. However, these will be almost all independent of ARTIN corridors and will be driven by the private sector. PPPs may be the most appropriate form of port development for mineral ports. Liquid bulk may also have important short term demand but this will be phased out in the long term as vehicles shift away from petroleum-based fuels.

Figure 37: Current Traffic/Capacity Analysis for Container Traffic in Selected African Ports



Source: AICD Ports Database, 2008.

Only three ARTIN corridor ports - Dakar, Djibouti and Nacala – can currently accommodate an increase of 100% in container traffic. However, on-going expansion projects in several ports such as Dar-es-Salaam, will provide adequate container capacity up to 2020. Nevertheless, short term port capacity gaps were identified in 6 ARTIN corridors by 2020 (see Table 12). However, planned capacity increases for Abidjan (Ile Boulay) and for Cotonou (Sémé) will put off congestion at those ports (see further discussion below on longer term port capacity issues).

Table 12: Short Term Container Capacity Gaps in ARTIN Corridor Ports (million TEU)

Port	Port Container Capacity*	2020 Container Demand Forecast	2030 Container Demand Forecast
Tema	0.4	0.5	1.2
Lagos**	1.5	2.1	5.1
Mombasa	1.2	1.9	5.5
Nacala	0.05	0.2	0.4
Beira	0.1	0.3	0.9
Dar-es-Salam	1.0	0.8	1.1

*After planned projects are taken into account

** Additional container terminals are planned for Niger River ports that will supplement Lagos port container capacity.

A special case for ARTIN corridor gaps revolves around Moatize coal, which is being developed for export with an estimated annual 11 million tons. The Nacala rail line is one choice for the export of Moatize coal, but it would require major restructuring and some infrastructure investment to handle large coal trains and the development of Nacala port. Beira, the other choice for Moatize coal, also requires major restructuring and the port has less draft. The coal could also be transported on the Zambezi River or divided between Beira and Nacala rail lines and ports.

Road and Border Post Infrastructure Gaps

Gaps in road capacity were identified for corridor links near border crossings, which have a significant level of traffic (650 AADT or more for basic border posts and 8-12,000 AADT for basic two lane highways)[21]. There is a major push in all RECs to implement one-stop border posts (OSBPs). There are only two currently in operations (Cinkase in Burkina Faso and Chirundu in Zambia) but there are projects to implement 55 OSBPs, of which 27 are in ARTIN corridors.

As shown in Table 13 and Figure 36, eleven of the 43 most important ARTIN border crossings will experience a capacity constraint by 2020. These constraints are entirely due to border post capacities, six of which could be addressed by basic OSBPs and the others by more elaborate border post improvements. None of these border crossings will experience road capacity constraints by 2020 (except perhaps parking space near border posts).

Table 13: Key Road Border Crossings with Capacity Constraints by 2020

Corridor	Border Crossing	2020 Traffic (AADT)	Road Capacity (AADT)	Border Post Capacity (AADT)	Border Post Capacity Gap
Trans-Maghreb Corridor	Morocco – Algeria (Oujda Tlemcen)	11,200	12,000	10,000	**(1,200)**
	Algeria – Tunisia (Ghardimaou)	6,700	12,000	5,000	**(1,700)**
	Tunisia – Libya (Ras Adjir)	4,300	12,000	1,750	**(2,550)**
	Libya-Egypt (Mousaid-Soloum)	7,100	12,000	1,750	**(5,350)**
Dakar-Bissau Corridor	Senegal – Gambia (Sokone – Toubakouta)	1,600	12,000	1,750	**(150)**
	Gambia – Senegal (Seleti – Bignona)	800	12,000	650	**(150)**
Abidjan-Lagos Corridor	Cote d'Ivoire - Ghana (Elubo/Noe)	1,900	12,000	1,750	**(150)**
	Ghana – Togo (Kodjoviakope/Aflao)	5,400	12,000	5,000	**(400)**
Douala-Bangui Corridor	Cameroon – Central African Republic (Garoua Boulai)	800	10,000	650	**(150)**
Djibouti-Addis Ababa Corridor	Ethiopia-Djibouti (Diwele)	1,800	10,000	1,750	**(50)**

Source: Consultant's estimate Note: Trans-Maghreb traffic assumes closer regional linkages in the future

By 2040, 11 of these border crossings are expected to have road capacity bottlenecks, primarily those in the coastal corridors (Trans-Maghreb, Abidjan-Lagos and Lagos-Douala) and the part of Maputo Corridor which is not yet 4 lanes, along with 19 additional border crossings would need to be improved (see Figure 36 and Table 13 for the timing of capacity gaps at border crossings)[22].

Railway and Rail Border Crossing Infrastructure Gaps

There are two types of gaps in the ARTIN railways (i) some neighbouring countries do not have efficient interconnections across borders and (ii) significant capacity constraints facing freight railways. The rail interconnection issue applies to North Africa, which has been planning for connectivity across the region[23], but it has not been achieved. This is a border-crossing issue with political implications that need to be resolved.

[21] These capacity calculations take into account the passenger car equivalences of trucks and buses which reduce these threshold traffic levels in terms of AADT. Trucks make up 25-90% of total traffic on corridors to landlocked countries. Although in coastal corridors outside of urban areas, trucks account typically for about 10% of total traffic.

[22] See PIDA Phase I report for detailed capacity calculations.

[23] Including planning for a potential high speed rail link to Europe

The freight rail capacity was analysed for cross-border railway lines (see Table 14). This analysis indicates that 6 of the 11 cross-border rail lines (Dakar-Bamako, Rift Valley/Northern Corridor, Djibouti-Addis Ababa, Nacala, Beira and North-South) would need physical expansion by 2020 even if their operations and equipment were greatly improved to reach good efficiency before then. In this table, Nacala shows a large increase in demand, as the most logical port for exports of Moatize coal.
Another railway (Benguela) is being reconstructed to meet future demand and there is a project to rebuild the Djibouti-Addis Ababa Railway. All 11 cross-border railways would need expansion by 2040 to meet demand with efficient mode shares for rail services, some by 2030.
There is scope for building new, modern rail lines in nine of the 11 corridors, where demand by 2040 in the PIDA forecast would exceed 10 million tons. These forecasts assume that the railways would be run as efficiently as Transnet railways in South Africa and would be competitive with road transport for long distance traffic. This will require major modernization and the development of container trains as well as bulk unit trains with the appropriate operating systems and track capable of handling at least 18 ton axle loads (see further discussion under choices and challenges). Border management for rail transport will also need improvement at these higher traffic levels.

Table 14: Key Railway Border Crossings with Capacity Constraints by 2020

Corridor	Border Crossing	2020 Traffic* (million tons)	Railway Capacity (million tons)	Capacity Gap (million tons)
Dakar-Bamako	Senegal-Mali	3.8	3.1	**(0.7)**
Djibouti-Addis Ababa	Djibouti-Ethiopia	6.5	Formerly 3.5	**(3.0)**
Northern/Lamu Corridors**	Kenya-Uganda	5.6	5.0	**(0.6)**
Nacala Corridor	Malawi-Mozambique	16.2 (incl. 11 million Moatize Coal)	4.1	**4.1**
Beira Corridor (Alternative choice for Moatize coal)	Mozambique-Zimbabwe	2.8	3.7	**n.a.**
North-South Corridor	Beit Bridge, Victoria Falls	9.3 5.9	4.3 (except RSA side of border)	**5.0** **1.6**

*Traffic assuming increased mode share for rail to 50% of international traffic (from current 20% for Dakar-Bamako and 30% for Beira traffic from Zambia and Zimbabwe) and increased use of the Beira Corridor over other corridors.
** Overflow from the Northern Corridor could be accommodated by a rail line serving the port of Lamu, if this port is developed. About 70% of Southern Sudan traffic is assumed to take Northern/Lamu corridor in addition to Ugandan traffic which dominates the forecast flows.

Summary of long term corridor capacity gaps

Ports

There are three regions that face short-term port container capacity gaps by 2020 even after currently planned port and terminal expansion projects are completed:

- West Africa (Tema and Lagos)
- East Africa (Mombasa)
- Southern Africa (all Mozambique ports)

By 2040, these three regions will have much larger gaps that will require both additional port expansion and new port development. These gaps are demonstrated in Table 15 for four groups of landlocked countries, and the port planning issues are illustrated in Figures 38-39-40 for each region.
The main issue is that domestic demand for port capacity will be growing and in most cases it will take up port capacity and not leave any extra capacity to meet the transit traffic demand. In these figures, the arrow indicates the transit traffic demand, and the box shows the sum of the domestic container demand for the ports with red circles, which are the traditional ports carrying this transit traffic.

In two of the three cases (East and West Africa), the domestic demand exceeds the total available capacity by 2030, leaving no place for transit traffic. In the third case (Southern Africa), domestic demand plus transit traffic will exceed available capacity in 2030, despite a major port expansion in Durban, and the situation is worse in 2040.
This situation calls for regional port master planning, which will be a new departure for the RECs. However, it is critical to the future efficiency of the regional trade, and it is also interlinked with the development of land transport to serve the new or expanded ports.

Table 15: Analysis of Port Container Capacity for Groups of Landlocked Countries (Million TEU)

Group of Countries	Demand		Available Capacity*	
	2030	2040	2030	2040
Mali, Burkina Faso, Niger	1.9	4.5	0	0
Botswana, Malawi, Southern DR Congo, Zambia and Zimbabwe	6.1	12.0	1.5	0
Burundi, Eastern DR Congo, Rwanda, Uganda and 70% of Southern Sudan	4.7	9.9	0	0
30% of Southern Sudan and Ethiopia	3.2	6.6	1.4	1.2

Source: Consultant's estimate

* Available for all corridors serving these countries. Zero available capacity means that all planned port capacity is taken by forecast domestic demand.

Figure 38: Analysis of Long-Term Port Capacity Gaps in West Africa

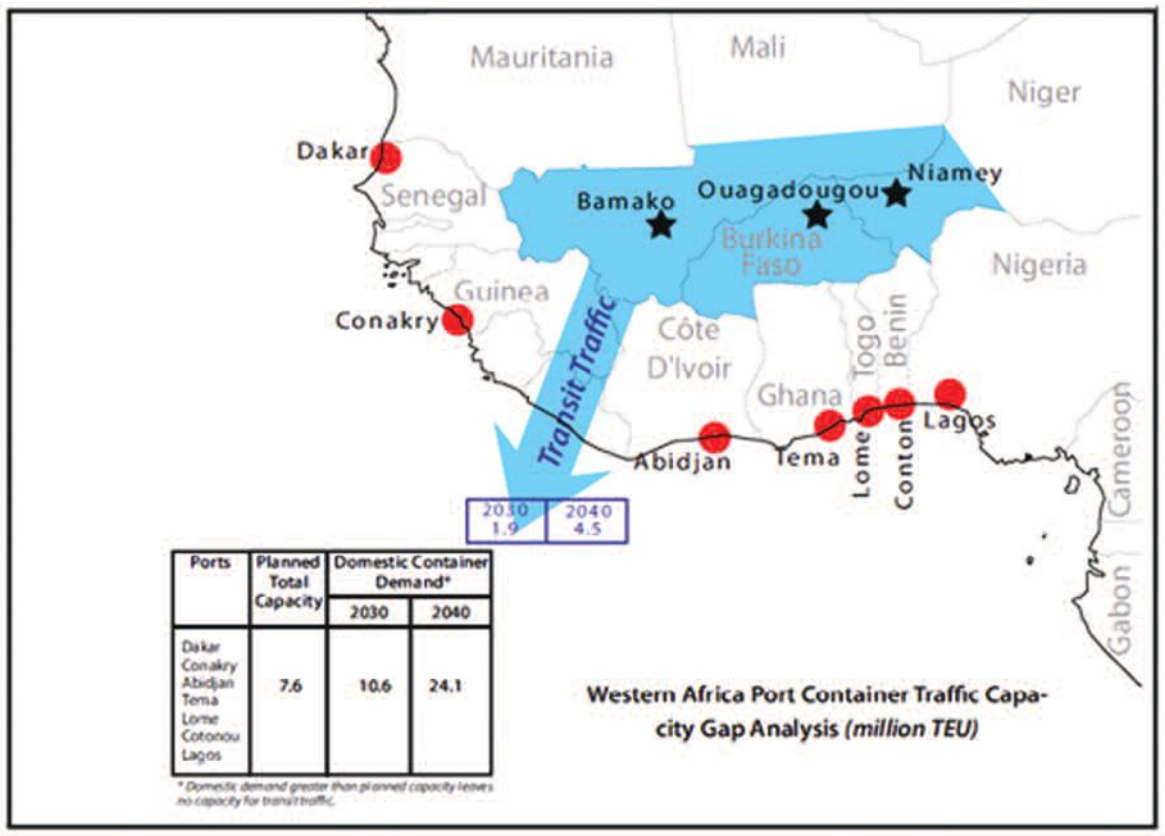


Figure 39: Analysis of Long-Term Port Capacity Gaps in East Africa

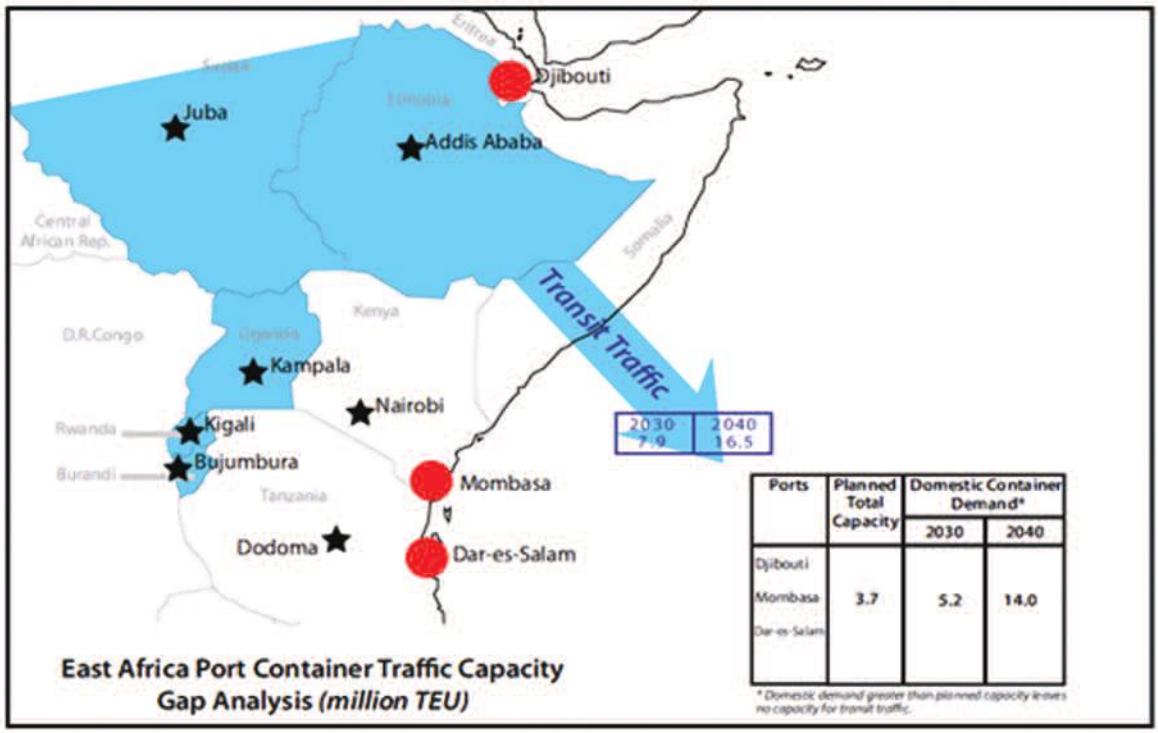
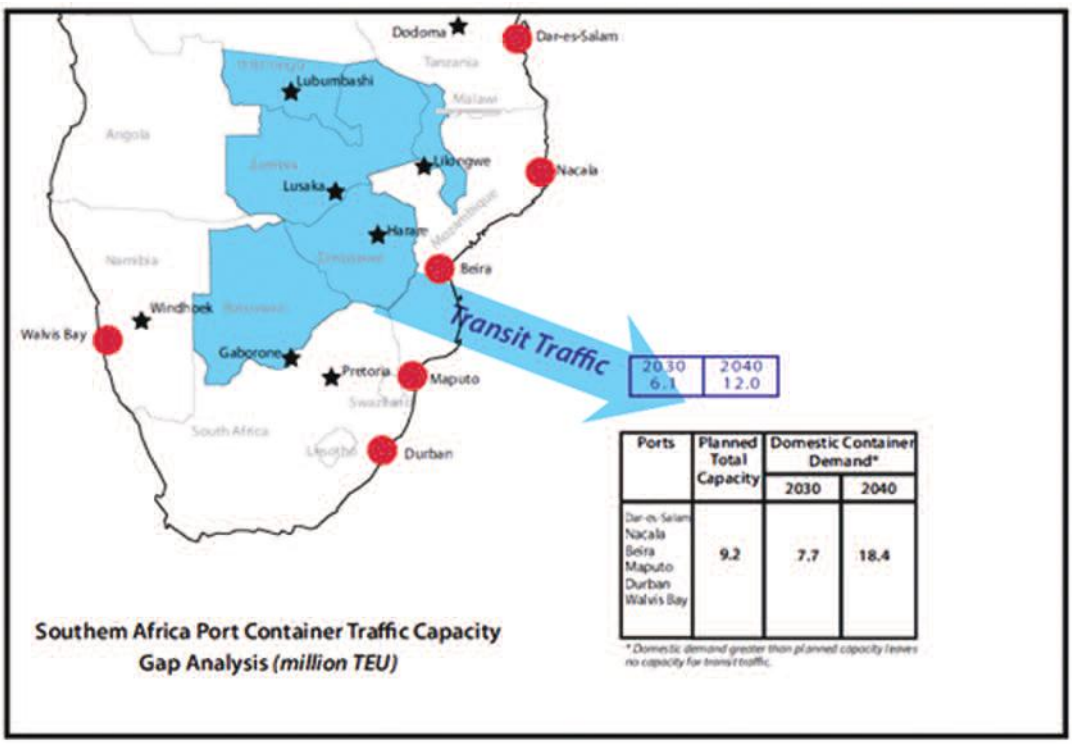


Figure 40: Analysis of Long-Term Port Capacity Gaps in Southern Africa



Roads:

There are four corridors that will face demand of more than 15,000 vehicles per day by 2030, which would require the construction of modern four-lane motorways. All of these are coastal corridors

- Trans-Maghreb Corridor
- Abidjan-Lagos Corridor
- Lagos-Douala Corridor
- Maputo Corridor

All the missing links in the TAH should also be completed by 2040.

Border Posts:

There are nine border crossings that are expected to exceed 2,000 heavy goods vehicles (HGVs) per day by 2040 with three of these reaching that level by 2030. This level of HGV traffic requires special corridor development with modern motorways and special truck facilities. The three priority corridors are:

- Djibouti Corridor
- Northern Corridor
- North-South Corridor

Railways:

Similarly, six rail corridors by 2020 and three others by 2030 would require capacity exceeding 4 million tons (10 million tons in four cases, rising to over 20 million tons by 2040), if they were operated in a competitive fashion. This level of traffic would justify the construction of a modern railway:

- Dakar-Bamako Corridor (2020)
- Djibouti Addis Ababa (2020)
- Northern/Lamu Corridors (2020)
- Nacala and Beira Corridors (2020)[24]
- North-South Corridor[25] (up to Kapiri Mposhi) (2020); and
- Abidjan Ouagadougou (2030)
- TAZARA (2030)
- Maputo Corridor (Mozambique side – 2030)
- North-South Corridor (up to Lubumbashi) (2030);

New rail connections (and efficient rail operations) will be required by new ports as well as by major port expansions, particularly where the expanded port will function as a regional port with significantly larger traffic flows.

Regional rail master plans need to be linked to new and expanded port development.
The corridors where this approach applies are:

- Nacala Corridor
- Lamu Corridor
- Lome-Ouagadougou/Niamey Corridor

These short and long-term corridor bottlenecks are summarized in Table 14 above.

4.3.2 Gaps in the ARTIN Air Transport System

Three types of gaps are analysed below for air transport: (i) gaps in air passenger service, (ii) gaps in air navigation system and (iii) gaps in airport capacity.

Air passenger service gaps

Two main issues in air service are (i) the number of stops required between origin and destination, which are much greater for African flights in many RECs than for other parts of the world and (ii) high regional airfares. In many cases, this appears to be the result of inefficient or missing regional air services, especially in the ECOWAS and ECCAS regions, and to a lesser extent in IGAD and AMU regions. SADC air service appears to avoid this problem and is a good example for the rest of Africa and the hubs in Addis Ababa and Nairobi also provide good second tier connectivity on the African continent.
If additional regional airlines hubs were established in West Africa and Central Africa, the air transport system would become more efficient and also air traffic would increase substantially at these new hubs. Analysis indicated that regional air services could be expected to both increase while airfares would decrease.

Air navigation system gaps

African air traffic control and navigation aids system has major gaps, which need to be addressed. This includes:

- Gaps in the coverage of areas currently not equipped with traditional aid instruments (VOR, DME)
- Gaps in the accessibility of regional airports to national, intercontinental and intra-African flights
- Gaps in the exchange of air traffic with Europe due to different levels of air navigation systems between Africa and Europe
- Gaps in the ability of airlines to optimize routes and make flight diversions
- Gaps in the precision of vertical guidance at the time of the airport approaches

All of these gaps could be addressed through the extension of the European EGNOS satellite navigation system that improves navigation, supports the optimization of air routes, and simplifies approach procedures. The current satellite coverage of the system includes Africa, but lacks the complementary infrastructure on the ground to extend EGNOS services to the African continent.

This would provide:

- Coverage of areas currently not equipped with traditional aid instruments (VOR, DME)
- Economic opening-up of airports and isolated regions, by making regional airports accessible to national, intercontinental and intra-African flights
- Facilitated exchange with Europe, through the harmonization of operational flight procedures that integrate services offered by satellite-based augmentation systems between Africa and Europe
- Savings on investments at local level, by reducing drastically the need of ILS-type ground facilities at

[24] Northern and Lamu Corridors are considered together here because their sources of demand are the same.
[25] Sharing demand for export of Moatize coal.

airports, and consequently, their maintenance costs;
- Savings obtained by the choice of optimized routes and fewer diversions
- Vertical guidance of greater precision (i.e. safer) at the time of the airport approaches

Airport capacity gaps

There are 17 airports whose capacity will be exceeded by 2020 according to the base case forecasts, of which four are already programmed for expansion. These are listed in Table 16 and shown in Figure 41. All airports on the continent will need to be expanded or supplemented by additional airports by 2040 in order to handle the expected air traffic including the suppressed demand (giving total increases of 350% to 600% over current air passenger levels).
Additional air passenger traffic due to two new hub operations in Western and Central Africa could be generated in Dakar, Ghana or Lagos and Douala. This hubbing activity more than doubles the base traffic in hub airports (see more discussion under Choices and Challenges below.).

Summary of long term air transport system gaps

There are seven existing airports that will face demand of more than 3 million air passengers per year by 2040 (over 2 million by 2030), which would require airport expansion (see Figure 41).
These are by region:
- North Africa (Algiers, Cairo and Casablanca)
- East Africa (Addis Ababa, Nairobi)
- Southern Africa (Johannesburg)
- West Africa (Lagos)

Two of these (Johannesburg and Cairo) may reach over 10 million passengers by 2040. As air passenger demand at these airports increases, the number of direct flights between countries in the same REC will increase without going through the hub airports (e.g., Harare-Namibia), thus providing even better connectivity where there are some gaps in the current system.

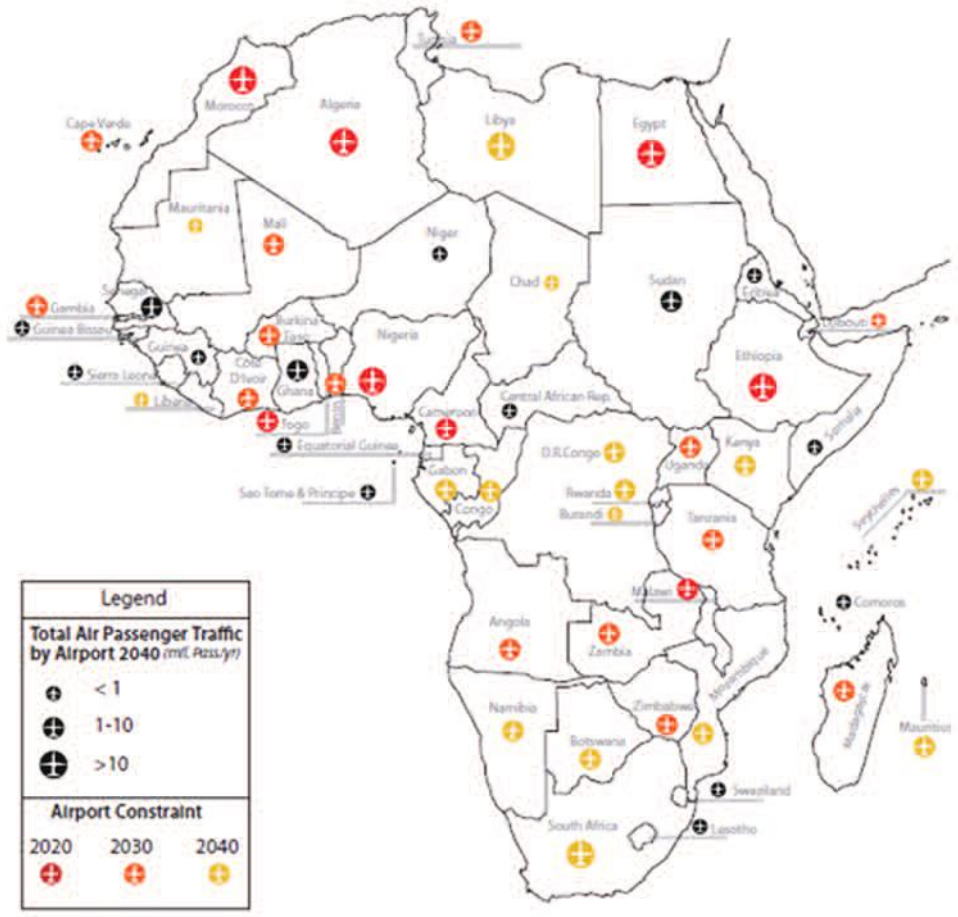
Also the high-level air traffic control system will reach saturation between 2020 and 2030 and will need to be replaced with a satellite-based air traffic control system. There are also gaps in the communications systems at and between airports in many areas of the continent.

Table 16: Airports with Capacity Constraints by 2020

Country	Airport	% of capacity used with current traffic	% of capacity used with 2020 traffic
Algeria	Aéroport d'Alger Houari Boumédiène	80%	124%
Cameroon	Aéroport International de Douala	70%	113%
Congo, DR	Aéroport de Kinshasa/Ndjili*	70%	133%
Congo, Rep. of	Aéroport international de Brazzaville Maya	80%	121%
Egypt, Arab Rep.	Cairo International Airport*	80%	121%
Ethiopia	Addis Ababa Bole International Airport	80%	160%
Ghana	Kotoka International Airport*	70%	126%
Kenya	Jomo Kenyatta International Airport*	90%	164%
Malawi	Lilongwe International Airport	70%	134%
Mauritius	Plaine Magnien SSR International Airport	80%	124%
Morocco	Aéroport Mohammed V (Casablanca)	70%	127%
Malawi	Lilongwe International Airport	70%	132%
Nigeria	Murtala Muhammed International Airport	80%	110%
Senegal	Aéroport International Léopold Sédar Senghor*	70%	156%
Tanzania	Julius Nyerere International Airport	80%	109%
Tunisia	Aéroport International de Tunis Carthage	80%	128%
Zambia	Lusaka International Airport	70%	124%

* Airport expansion project already committed

Figure 41: ARTIN Air Passenger Forecasts and Airport Gaps for 2040



4.4 Regional Capacity Gaps

The capacity gaps by region are summarized in Table 17.

Table 17: Summary of Major ARTIN Capacity Gaps by Region

Region	Ports	Roads	Railways	Border Posts	Lake/River	Airports/ Air Navigation System
North Africa	No port gaps	Trans-Maghreb Corridor has gap in modern design	Railways are not inter-connected	Five border post capacity issues by 2020	N/A	3 airports with gaps by 2020, all by 2040
West Africa	2 ports with short-term gaps, all by 2030	Abidjan-Lagos Corridor has gap in modern design, 2 coastal corridors need widening by 2030	One rail gap by 2020, and one by 2030 for border-crossing railways, need to focus on modern rail to new port/expanded port in long term	Three border post capacity issues by 2020, one more by 2030 and five more by 2040	Minor regional potential on Senegal and Niger Rivers	Two airports with capacity constraints by 2020, all by 2040, Major hub needed now
Central Africa	Long-term gaps in larger ports, more domestic than transit issue	Coastal road and TAH gaps in short and long term	Long-term gap in one railway, more domestic than transit issue	One border post capacity issue by 2020 and one by 2030	Congo River port and navigation upgrade needed	Two airports with capacity constraints by 2020, all by 2040, Major hub needed now
East Africa	2 ports with short-term gaps, all by 2030	No road capacity gaps, only modern corridor design needed	Two rail gaps by 2020, need to focus on modern rail to new port/expanded port in long term	Two border post capacity issues by 2040	Lake Victoria and Lake Tanganyika port and navigation upgrade needed	One airport with capacity constraints by 2020, other large airports by 2040
Southern Africa	3 ports with short-term gaps, all by 2030	No road capacity gaps, only modern corridor design needed	Three rail gaps by 2020, need to focus on modern rail to new port/expanded port in long term	One border post capacity issue by 2020, one more by 2030 and one more by 2040	Zambezi-Shire Waterway a PPP possibility	Two airports with capacity constraints by 2020, other large airports by 2040
Continent-Wide						Continental up-grade of air navigation system required

5. CHALLENGES AND REALISTIC TARGETS

KEY MESSAGES

- Rail transport has potential economic and environmental advantages over road, but must be related to specific freight demand greater than 4 million tons with long haul distances
- Lake and river/multimodal transport has been neglected but has potential in certain locations
- The establishment of new regional air hubs in West and Central Africa is critical
- The location of substantial new port capacity is a major planning and implementation challenge in West Africa, East Africa and Southern Africa
- Realistic targets by mode have been identified for major cost savings and service increases

5.1 Choices and Challenges

The analysis above concluded that Africa will need to implement large investment programs in the short, medium and long term for the transport sector in order to raise transport infrastructure capacity along ARTIN corridors and for the ARTIN air transport system to efficiently satisfy the expected transport demand, even with the added capacity from projects planned or underway.

The problem faced by the African continent is to select the best, more efficient corridors together with the best combination of transport modes in order to minimize total economic costs and reduce prices for shippers and passengers.

5.1.1 Modal Choices

Modal choices define the best alternatives for each category of transport (in term of volume, distance, type of products) in a given corridor environment (availability of modal alternatives such as rail, road, river or lake efficiency, availability of required capacity).

There are five key objectives, which are used to analyze modal choices below. These are:

- Limiting impact on environment (reducing pollution and noise, limiting damage to the biological environment, etc.)
- Limiting energy consumption per ton/km
- Improving transport safety and security
- Reducing transit time of goods
- Reducing overall transport costs for the shippers

Table 18: Objective Compatibility Matrix by Mode

Objective	Road		Rail		Lake/river		air
	SH	LH	SH	LH	SH	LH	LH
Limiting impact on environment	-	-	+	+	+	+	-
Limiting energy consumption per ton/km	-	-	+	+	+	+	-
Improving transport safety and security	+	-	+	+	+	+	+
Reducing transit time of goods	+	+	-	-	-	-	+
Reducing overall transport costs for the shippers	+	-	-	+	-	+	-

Note: SH = Short haul transport, LH = Long haul transport, - Indicates negative impact on objective, + indicates positive impact on objective

Rail transport has a beneficial economic and environmental impact compared to road transport since it consumes about a third of the energy per ton. It is also much safer than road transport (in terms of damage to freight and harm to passengers from accidents).

Rail transport is usually slower than road transport but for long haul traffic, bulk or container transport it is much cheaper per ton-km, and, in some cases, more reliable. For many cases of mineral transport, rail may be the only viable transport mode (although road transport is used extensively for copper metal transport in Southern Africa).

Due to the significant infrastructure investment cost, there is a minimum level of traffic needed to justify the

construction of a new railway. These volumes vary in function of the type of terrain (flat, hilly or mountainous) and of other technical parameters, (such as the number of river crossings, etc.)

The analysis of these factors indicates that for haul distances greater than 500 km, the construction of a new railway line can be economically feasible for traffic of 4 million tons per year (2 billion net ton-km) in relatively flat terrain and 6 million tons (3 billion net ton-km) in hilly terrain.

As soon as 2020, traffic to and from several landlocked countries could justify the construction of new modern railways from these countries to coastal gateway ports.

Road transport is by far the most important mode of transport both for national and regional traffic. Currently, the design and implementation of a modern regional network is not being pursued in most ARTIN corridors, with design standards varying, from country to country.

The rapid development of an African regional road network similar to the European road network would be a major contribution to the increased future efficiency of ARTIN road corridors. Common norms and standards should be defined and implemented as quickly as possible (through road modernization projects) and a sustainable maintenance system put in place (see Chapter 2 above).

Lake and River transport has been neglected during the past 10 years. However, various investment programs are under study, particularly in the Lake Victoria region. Rail, river and lake transport is much less polluting than road transport, consumes much less energy per tkm and is less expensive. However, they are slower and often require one or more intermodal transfers, thus causing delays and increasing the cost. This means that these solutions should be favoured only for corridors where traffic is concentrated and efficiencies can be gained without reducing corridor competitiveness for shippers and passengers (e.g., rail ferry service between Kisumu and Port Bell, which may be revived by Rift Valley Railways).

Investment programs for river transport are under study in the master plans being prepared by CICOS for the Congo River[26] and for the Shire-Zambezi River project, as well as smaller projects on the Senegal and Niger Rivers[27]. These proposed projects are still at an identification or prefeasibility level.

Air transport efficiency varies greatly between the RECs, with the Western and Central part of Africa being by far the less efficient. This is largely due to the way air service is organized without effective regional hub airports in these regions.

Due to the conflicting interests involved, a political decision is needed (in consultation with the private sector) to nominate a few airports in Central and Western Africa as hubs (with numerous and direct flights to Europe, Asia and the other regions of Africa). This should be combined with full implementation of the Yamoussoukro Decision in order to attract good efficient intra-REC air services (spokes) that could reach the level of efficiency of world-class air services in the SADC region and Egypt.

Port services in the future will require the addition of new ports such as feeder ports or transhipment ports. This decision is dominated by the private sector, considering their market interests. This means that the construction of additional capacity for containers for example might not result in the full use of this capacity, if it does not fit with the interests of at least one major shipping line. Regional planning with major stakeholder participation, including shipping lines and freight forwarders is the best solution to this problem.

In any case, Africa needs to substantially increase its port capacity during the next 20/30 years. Presently, the preparation and implementation of port projects are largely done at national level with only limited contribution from the RECs or corridor authorities. To identify the best ways to increase port capacity, concerted planning efforts by the RECs and the private sector with the port authorities are needed.

5.1.2 Challenges

The basic issue in 2040 is that there will not be enough capacity for many components of the ARTIN corridor and airport systems. To overcome these capacity constraints will take a combination of different and complementary actions.
Both corridor and air system development will face two types of major challenges:

- How to expand existing operations to handle 2020 trade forecasts (which involve increases by 100%-200% in many cases)
- How to develop options to cope with future traffic increases beyond 2020 to 2040 (where growth rates of 6-10% per year lead to increase factors of 6-10 from current trade levels)

The regions are facing major challenges with respect to the future of ARTIN and its corridors.
With respect to corridor infrastructure development they involve:

- The identification and development of new port

[26] The Congo River used to have a thriving transport system shipping millions of tons in river barges. However, it has all but disappeared due to the lack of investment and civil strife in the DRC.
[27] There is a large project to dredge the lower Niger River and build terminals for ocean-going vessels, but this is a national project.

locations, in combination with railway and/or road transport
- The potential introduction of standard gauge railway lines
- The increased use of multimodal transportation
- The best use of PPP initiatives

There are also specific challenges related to the infrastructure needed to support private sector mining developments. Since these developments depend on private sector initiatives and investment, but are still dependent on government-owned transport infrastructure, PPPs are needed. This applies to both port and rail facilities.

The challenge in air transport is to encourage the development of efficient air services and air hubs, which will increase service levels and decrease costs. Providing the incentives to make this happen will take a certain amount of political will.
The final challenges are to ensure the funding and maintenance of infrastructure and efficient coordination of road and rail transport across borders, as well as border crossing facilities and processes that facilitate trade and regional integration.

5.2 Realistic Targets

Given the large number of challenges facing this sector and the current constraints, from both policy and institutional perspectives, it is cautious to set some realistic targets for PIDA implementation in the sector. These targets should be given a time frame, in this case short term (2015-2020) and long term (by 2040 or earlier)

Targets can be grouped in terms of:
- Cost Reductions
- Service Improvements
- Facilitation Actions

These can be related to a mode, or a broader objective, as follows:
- Road Transport System Improvement Targets (Table 19)
- Rail Transport System Improvement Targets (Table 20)
- Port, Border Post and Customs Improvement Targets (Table 21)
- Air Transport System Improvement Targets (Table 22)

Table 19: Road Transport System Improvement Targets

Target Type	Objective	Short-Term Improvement Targets	Long Term Improvement Targets
Cost Targets	Reduce road transport costs in ARTIN corridors to international levels	▪ Reduce road transport costs in corridors to at most 110% of international costs per ton-km	▪ Reduce road transport costs in corridors to at most 100% of international costs per ton-km
Service Targets	Reduce transit times in ARTIN road corridors to international levels	▪ Increase average road speeds to 60 kph in ARTIN corridors ▪ Eliminate unnecessary road delay times in ARTIN corridors	
Facilitation Action Targets	Eliminate policies that increase vehicle costs and reduce annual loaded kilometres in ARTIN corridors	▪ Eliminate restrictions on transport of cargo in at least 50% of neighbouring countries along ARTIN corridors in all RECs	▪ Eliminate restrictions on transport of cargo in 100% of neighbouring countries along ARTIN corridors in all RECs
	Eliminate vehicle overloading in ARTIN corridors	▪ Eliminate vehicle overloading in at least 50% of neighbouring countries along ARTIN corridors in all RECs	▪ Eliminate vehicle overloading in 100% of neighbouring countries along ARTIN corridors in all RECs
	Bring ARTIN corridors up to modern smart corridor standards	▪ Obtain agreement among RECs on establishing smart corridors ▪ Establish at least one smart corridor in all RECs	▪ Implement smart corridors in all ARTIN corridors
	Improve road maintenance and operations in ARTIN corridors to international standards	▪ Implement toll road authorities using Maputo Corridor model or institute fully funded performance-based maintenance in at least 50% of all ARTIN corridors	▪ Implement toll road authorities using Maputo Corridor model or institute fully funded performance-based maintenance in 100% of all ARTIN corridors

Table 20: Railway Transport System Improvement Targets

Target Type	Objective	Short-Term Improvement Targets	Long Term Improvement Targets
Cost Targets	Reduce rail transport costs in ARTIN corridors to international levels	▪ Reduce rail transport costs in ARTIN corridors to at most 110% of international costs per ton-km (already achieved in South Africa)	▪ Reduce rail transport costs in ARTIN corridors to at most 100% of international costs per ton-km (already achieved in South Africa)
Service Targets	Reduce transit times in ARTIN rail corridors to international levels	▪ Increase average railway speeds to 40 kph in ARTIN corridors ▪ Eliminate unnecessary rail delay times in ARTIN corridors	
Facilitation Action Targets	Bring all existing ARTIN railway concessions to a best practice model	▪ Realign railway concessions to best practice standards in all RECs for ARTIN railways	
	Bring existing public rail operations to international best practice standards	▪ Increase public rail performance in at least 50% REC railways along ARTIN corridors to international standards	▪ Increase public rail performance in 100% REC railways along ARTIN corridors to international standards

Table 21: Port, Border Post and Customs Improvement Targets

Target Type	Objective	Short-Term Improvement Targets	Long Term Improvement Targets
Cost Targets	Reduce port costs in ARTIN corridors to international levels	▪ Reduce port costs in ARTIN corridors to international costs per ton in 80% of case	▪ Reduce port costs in ARTIN corridors to international costs per ton in 100% of cases
	Reduce border post costs in ARTIN corridors to international levels	▪ Reduce border post costs in ARTIN corridors to international standards in 50% of cases	▪ Reduce border post costs in ARTIN corridors to international standards in 100% cases
	Reduce customs costs in ARTIN corridors to international levels	▪ Reduce customs costs in ARTIN corridors to international costs per ton in 80% of cases	▪ Reduce customs costs in ARTIN corridors to international costs per ton in 100% of cases
Service Targets	Reduce transit times in ARTIN ports to international best practice standards	▪ Reduce container dwell times to 4 days for imports and 2 days for exports for transit traffic in 80% of ARTIN corridor ports	▪ Reduce container dwell times to 4 days for imports and 2 days for exports for transit traffic in 100% of ARTIN corridor ports
	Reduce transit times at border posts in ARTIN corridors to international best practice standards	▪ Reduce transit times at border posts to less than 8 hours in 50% of border posts	▪ Reduce transit times at border posts to less than 8 hours in 100% of border posts
Facilitation Action Targets	Implement single window and integrated border management for imports and exports	▪ Implement single window in 50% of all REC countries	▪ Implement single window in 100% of all REC countries
	Implement integrated border management for imports and exports	▪ Implement integrated border management in 50% of all REC countries	▪ Implement integrated border management in 100% of all REC countries
	Implement One-Stop Border Posts	▪ Implement One Stop Border Posts on all ARTIN corridors	

Table 22: Air Transport System Improvement Targets

Target Type	Objective	Short-Term Improvement Targets	Long Term Improvement Targets
Cost Targets	Bring airfares in line with international standards	▪ Reduce airfares to at most 110% of international airfares in all RECs (Already achieved in SADC and Egypt)	▪ Reduce airfares to at most 100% of international airfares in all RECs (Already achieved in SADC and Egypt)
Service Targets	Bring air services in line with international standards	▪ Improve air service (number of flights and % direct flights) to key destinations to at least 80% of international standards (Already achieved in SADC and Egypt)	▪ Improve air service (number of flights and % direct flights to key destinations to at least 100% of international standards
Facilitation Targets	Establish new air hubs in West and Central Africa	▪ 100% implementation of Yamoussoukro Decision by RECs ▪ Develop a model package of air rights and PPP enabling environment for regional air hubs ▪ Develop agreement among States for regional air hubs and their location ▪ Attract private partners for regional air hubs	
	Establish a Single African Sky (extension of European satellite-based system to Africa)	▪ Create a funding mechanism for Single African Sky investments and operating costs ▪ Create a plan for implementing Single African Sky	▪ Implement Single African Sky

6. INTERSECTORAL SYNERGIES

KEY MESSAGES

- Transport links to spatial development initiatives are an important synergy to be encouraged
- Links between road and rail lines and ICT developments for alternative ICT infrastructure and smart corridors can have a significant positive impact
- Adequate regional transport may be a key factor in developing large scale coal projects.
- Regional Transport will play a key role in food transfer from surplus river basins to deficit ones.

6.1 Linking Roads and Rail Lines with Economic Development in the Same Corridor

6.1.1 Support Spatial Development Initiatives in ARTIN corridors

There are currently several examples of spatial development initiatives in ARTIN corridors, particularly in SADC and COMESA countries. The interaction of transport development with the development of other economic sectors is a priority for these corridors and the corridor committees associated with them. This linkage has the potential for a win-win relationship.

Recommended Actions:

- Create spatial development initiatives in ARTIN corridors, wherever practical.

6.2 Linking Roads and Rail Lines with ICT Infrastructure

6.2.1 Using ARTIN Road and Railway Corridors to Develop ICT Networks

This strategy builds on the proposed development of smart corridors above, which is closely associated with ICT development. Another link would be using road and rail corridor to support optical fibre networks (alternative infrastructure) or other ICT developments, particularly in the more remote areas where border posts are located. This will require policy changes and institutional development.

Recommended Actions:

- Create model policies to support combined corridor and ICT development
- Develop legal and regulatory models to support combined corridor and ICT development
- Implement these models as pilots in selected ARTIN corridor countries

6.2.2 Create "Smart Corridor' Development Programs for Seamless Trans-border Shipments

The low level of usage of modern ITC technologies in ARTIN corridors greatly impedes the seamless trans-border shipments of goods and containers. International standards have been set in Europe, North America, Japan, Korea, etc., for smart corridors which incorporate, cargo/container tracking, single window technology for imports and exports, and commercial vehicle and driver tracking and information systems. These standards are driven by both logistics efficiency concerns and cargo security concerns along international shipping and logistics supply chains. Very little progress has been made on these systems in ARTIN corridors, although cargo tracking and single window have been implemented in Ghana and there has been some experimentation in the Northern Corridor. In other developing regions, Syria and Jordan are moving more quickly to implement these concepts and systems.

The slow development of one stop border posts (OSBPs), despite the adoption of this standard in all the RECs, is also a major factor, when combined with inadequate ITC technology in preventing seamless trans-border shipments. This is the case despite the efforts of international donor agencies (JICA, EU, USAID) to support and fund OSBPs.

Recommended Actions:

- Develop a model of smart corridor development for ARTIN corridors drawing on international standards and expanding on existing ARTIN corridor components, where they exist.
- Develop a financial model for all aspects of smart corridor financing, including PPP approaches
- Set standards for OSBP facilities and information systems.

6.3 Linking Transport and Energy infrastructure

The development of large-scale coal mining projects (such as Moatize discussed in Chapter 3) may depend on adequate regional transport.

Recommended action

- Include potential mining projects in corridor and port planning

6.4 Linking Transport and Water Infrastructure

6.4.1 Link the Planning of ARTIN Corridor Projects to Water Network Development

There are few strategic linkage options between road and water development. However, there should be consideration of mutual support between transport corridors and trans-boundary water projects in terms of the priority of selection of corridor projects for the transport of food from surplus river basins to deficit ones.

Recommended Actions:

- Give priority to corridor projects which support trans-border water projects.

6.4.2 River Transport in TWR

The construction of reservoirs in trans-boundary river basins may contribute to the development of river transport.

In the Congo River basin, the International Commission of the Congo-Oubangui-Sangha Bassin (CICOS) aims to develop intergovernmental cooperation to enhance interior navigation and is currently preparing a strategic plan to improve the transport along the Congo and its tributaries.

Recommended action:

- Give due consideration to river transport opportunities when planning transport corridors and river basin developments

7. STRATEGIC ENVIRONMENTAL PERSPECTIVE

KEY MESSAGES

- The need for environmental impact analysis is widely accepted, but the specifics vary from mode to mode
- Road safety is the most visible of health and safety issues and very costly
- Case studies of PPPs indicate that environmental and social safeguards should be explicitly embedded in agreements between project sponsors and public or private operators
- Climate change is expected to have significant impacts on road pavement maintenance, especially in tropical environments
- Sea level rise could be significant for ports

It is recognized that transport projects, like other infrastructure projects inevitably impact the physical and social environment in which they take place. The operation of the transport system and the choices of system users also affect the environment, in ways that may be more difficult to manage than project impacts. This chapter (a) describes the policy and institutional framework for environmental management in the transport sector, (b) reviews lessons learned from transportation projects in Africa in the past; (c) discusses, in particular, health and safety issues related to transport investments; and (d) reviews the current state of knowledge regarding the impact of transport on climate change and the likely impacts of climate change on the transportation system.

7.1 Policy and Institutional Framework

Managing the physical environment for sustainable socio-economic development is one of the principal challenges facing the continent. Africa holds enormous environmental wealth of significance to the entire world. Human beings have heavily exploited this vast natural wealth over the past two centuries. Africa now faces new challenges in managing not only its natural resources, but also the environmental consequences of urban and industrial development. As Africa integrates further into the global economy, it will share a greater portion of both the costs and benefits of global environmental management. The challenge of development is to find ways of reducing poverty and increasing human welfare without undermining the supportive capacity of the environment.

Most African governments have established laws, policies, and institutions to protect human health and environmental quality in the process of development. However, these laws and policies have had limited effect, and the institutions charged with their enforcement have had limited capacity. It has been particularly difficult to implement environmental controls when the developer's responsibility also rests with government. A greater role for the private sector in initiating and managing development projects should enable government to revert to its proper regulatory role. Foreign investors, both public and private, will be concerned to ensure sound management practices because of the global visibility of their projects. Therefore, the prospects are good for Africa to set out on a path towards truly sustainable development.

The Declaration of Algiers, which provides the continental policy framework for transport development, includes a reference to environmental concerns where it encourages the use of subsidies to encourage the reduction of environmental externalities, notably potential impacts on climate change. This translates primarily into the use of public money to support railway investment in order to encourage a shift away from road traffic, with consequent reductions in greenhouse gas emissions.

Continent-wide policies for railways, maritime transport, and aviation also stress the need to respect the environmental requirements of Member States, to conduct environmental impact studies for new investments, and to address particular health and safety concerns (see Section 7.3 below). In rail transport, the main concerns are the potential environmental impact of new investments and the safety of ongoing operations. For ports, lake/river and maritime transport, there are also concerns about impacts on environmentally sensitive areas (lake and river margins, coastal zones), and the management of oil spills and other hazardous wastes. In the air transport sector, there is little environmental concern except for the impacts of future airport expansion projects. In contrast, safety is a very prominent concern in this sector.

Road transport policies are not harmonized across the continent. However, the various treaties and conventions that have been agreed over the past fifty years express a common concern for protecting the environment through national standards and

regulations. Although the U.N. Environment Programme (UNEP) is based in Africa and there is an active Conference of African Ministers of Environment (AMCEN), there is no institution, which pays particular attention to the environmental impacts of road transport on a continental level. In contrast, there is widespread concern about road safety (road accidents are a major cause of deaths in Africa, more important than malaria or HIV/AIDs) and the potential role of road transport in spreading diseases, especially HIV/AIDs.

The Regional Economic Communities (RECs) are charged with coordinating the economic development of sub-regions in Africa, including, in at least some cases, monitoring the overall impact of development activities on the sub-regional environment. REC involvement in the definition, selection, design, construction and monitoring of regional transport projects can be very useful, not only in ensuring that national environmental and social policies are respected, but also in foreseeing, managing and monitoring impacts that may cross country borders. RECs may also help harmonize environmental policies across countries to facilitate the smooth implementation of projects. Some RECs already have extensive environmental databases that can be useful in identifying potential impacts and designing appropriate mitigation measures.

At national level, many Ministries of Public Works have developed environmental units to set norms and standards for road improvements, to evaluate feasibility and design studies, and to monitor construction performance. This requires coordination with national Ministries of Environment. On road health and safety, national transportation planners also coordinate with Ministries of Health and, in some cases, with Ministries of Education.
Respect for national environmental requirements and the use of environmentally sound road management and maintenance strategies have also been integrated into the mandates for international corridor management authorities.

7.2 Lessons of Experience

There is no shortage of transportation projects in Africa from which lessons can be learned. However, there has not been a great deal of research on this subject after the fact. Many environmental impact studies have been conducted over the past twenty years, as a basis for project investment decisions. These studies include environmental management plans that aim at avoiding, mitigating, or compensating for negative impacts, while (sometimes) enhancing positive impacts. Such plans usually include provisions for monitoring their implementation and evaluating the results, including identifying unanticipated impacts. Where these plans have been implemented, they have produced generally good results.

This section focuses on lessons that can be learned from projects involving the actual construction of physical infrastructure. Many other projects aim at policy reform, institutional strengthening, and/or transport service improvements, without involving major new construction. These projects, too, have environmental and social implications, but generally environmental impact assessment is not required or is carried out only in a very general way. Recently, some countries have begun to implement strategic environmental assessments that look at the environmental and social consequences of national or sector programs, including both policies and investments.

African countries began developing and implementing National Environmental Action Plans in the early 1990's. The implementation of these plans included building environmental management and oversight capacity in their transport sector institutions. For major projects, this has included financing the preparation of Environmental Impact Assessments (EIAs) and related environmental management plans. EIAs of transport projects mainly concern the likely impacts of construction activities on the environment and the local population. Issues may include: right-of-way acquisition, which may displace residents and/or destroy local livelihoods; handling of hazardous materials; location and management of borrow pits; minimization of noise and dust impacts; location and management of worker camps; worker health and safety issues; impacts on soils and watercourses; impacts on wild lands and protected areas; impacts on indigenous peoples and other vulnerable groups. In some cases, important archaeological, historical, or cultural sites may be affected by a transport project. Where negative impacts are anticipated, the principle is: avoid if possible, mitigate (reduce the impact to a negligible level through design changes) where avoidance is not possible, and compensate those who bear the cost when neither avoidance nor mitigation can eliminate those costs.

Transport projects that involve the construction of infrastructure in sparsely populated rural areas can generally be designed and managed to minimize negative impacts. Transport projects in urban areas, such as port extensions or new roads or railway lines, pose greater challenges, as they are likely to affect large numbers of people. In both cases, consideration needs to be given to the effects of traffic during the operating period as well as to construction impacts. This includes direct effects such as air pollution due to congestion in

urban areas, or safety hazards near villages in rural areas, as well as indirect effects such as the impact of increased traffic and related economic activity on natural resources, human health and safety, and local livelihoods. A striking example of this has been the concerted effort in Africa to address the transmission of HIV/AIDS along transport corridors.

Not all environmental impacts of transport projects are negative. Projects that reduce congestion and increase average speeds (within limits) have a positive impact on air quality and a strong social impact related to time savings for both people and goods. Such projects facilitate the flow of information and knowledge, as well as the physical provision of social services such as health and education. Especially in combination with increased access to electricity, transport projects help to create an enabling environment for small business development in both urban and rural areas, facilitating the envisaged transition from an economy largely dependent on extractive activities (including agriculture) to a diversified and more urbanized economy based on a wider range of value adding activities and greater productivity in all sectors.

The case studies of transport projects conducted for the PIDA Phase I report offered relatively little new information regarding environmental impacts. In the case of Djibouti port, the implementation of port improvements by an internationally respected private sector operator of international standing probably ensured that the improvement and ongoing port operations are carried out using sound environmental management practices. At the Kazungula Bridge site, approvals were delayed by the lack of a resettlement plan for the proposed location of border facilities within an existing community in Zambia, and by concerns about potential flooding of the proposed border post site in Botswana. Another reason for the delay in completing the EIA process was the different approaches used by Botswana and Zambia to approve the EIA Report, despite similarities in the EIA legislation in the two countries[28].

The North-South corridor carries a high proportion of hazardous materials, including petroleum, chemicals, explosives, and other goods that present risks to traffic, travellers, and local communities. There was a need to harmonize national policies regarding regulation and enforcement of safe handling procedures, as well as planning to meet potential emergencies. Hazardous goods are expedited through the Chirundu border post with special procedures to insure the commodities are not delayed. The corridor also serves an important tourist traffic, which will benefit wildlife conservation and the maintenance of protected areas.

The Arusha-Athi River Road, part of the international corridor linking Tanzania and Kenya, had a poor safety record due to its severely deteriorated condition. The project includes a number of provisions to increase safety for pedestrians, bicyclists, and local residents, as well as for truck and bus traffic on the road. It also includes construction of access roads to link local communities to the highway. The improvements are expected to bring economic benefits to a wide area, including commercial farms and industrial development zones near Nairobi, as well as to the tourist industry. Social benefits are anticipated in terms of increased provision of health and social services.

The Maputo Corridor runs through secondary and primary production areas, including petrochemical plants, steel mills, quarries, mines, and smelters, as well as plantation forests, sugar cane, bananas and citrus plantations. The corridor region has an important tourism potential, with numerous ongoing and planned projects. The key road link was completed through a BOT agreement and is operated as a toll road. The concessionaire is now responsible for road operation and maintenance as well as for the safety of traffic and the surrounding communities. Rail and port improvements in the corridor have also been carried out in the context of concessions to private operators.

Air transport projects in Africa have been largely confined to policy reform, institutional strengthening, and safety improvements, with only minor impacts on the physical environment. However, a number of new international airports are under construction or under study. These will raise all the usual issues regarding land acquisition, building construction, impacts on soils and waterways, impacts on wildlife, handling of hazardous materials, etc. Inclusion of environmental impact assessment in the preparatory studies and implementation of environmental management plans during construction and operation of these airports should enable these issues to be addressed in a timely and satisfactory way.

A general conclusion from these case studies is that environmental and social safeguards should be explicitly embedded in agreements between project sponsors and public or private operators. Much depends on the state of development of the enabling environment in each country with regard to environmental legislation and regulations and institutional capacity for monitoring and enforcement. Where there is a significant disparity between countries, RECs have a role to play in harmonizing the norms and standards applied to multinational projects. Private operators involved in large projects are generally aware of international standards and wish to avoid the negative publicity associated with poor performance,

[28] SADC Secretariat, "Progress Report on the Kazungula Bridge and Border Facilities, June 2010." Posted on the Web at http://www.trademarksa.org/node/2645

so they may apply good practices even in the absence of contractual obligations.

Transport projects in Africa have generally not aroused organized opposition, as has been the case, for example, with dam projects. The main concern of the NGO community has been the potential impact of transport projects located in remote areas on wildlife, tropical forests, and indigenous peoples. There have been cases where project implementation in urban areas and densely populated corridors has been delayed due to land acquisition and resettlement issues. Almost invariably, this occurs when the issues are not identified and addressed early enough in the planning process, and the affected people are not informed or allowed to participate in planning in order to help determine satisfactory solutions. There may eventually be a need to harmonize national policies in these areas in order to successfully implement trans-boundary projects, as affected people on both sides of the border will expect and demand equal treatment.

7.3 Health and Safety Issues

Health and safety is a particularly salient concern in the planning of transport projects. Over 800 000 deaths occur on Africa's roads every year[29], more than the number of deaths due to malaria or HIV/AIDS. 70% of the casualties are pedestrians and 75% are economically active. The cost of this loss of life, in addition to non-fatal injuries and disabilities and damage to the vehicle fleet, to Africa's economy is staggering. Annual road accident costs are estimated to be between 1 and 5% of Africa's GDP and are expected to increase by 80% by 2020.

The crisis of road-related deaths and injuries led NEPAD to propose a road safety program for 20 international corridors. This program is currently being implemented on the Northern Corridor and the Central Corridor, with support from the Total petroleum company and the World Bank. It will be expanded in three phases over the next eight years.

At regional level, road safety has long been a concern in ECOWAS. The National Facilitation Committees set up to monitor the implementation of regional agreements include national Directors of Road Safety.

The regional action program includes introducing road safety awareness in schools, harmonizing road signs in the region, and building Public-Private Partnerships to promote road safety. A West Africa Road Safety Organization was launched in 2008 in an attempt to further improve safety and security along the roads. Thirteen Member States of ECOWAS belong to this organization. ECOWAS has also instituted periodic controls of the condition of large vehicles carrying international traffic.

In EAC, the Standing Committee on the Road Network Project is monitoring progress on the harmonization of traffic regulations and road safety programs, including a special task force set up to address the problems of enforcing safety requirements. Vehicle inspections are mandatory throughout the sub-region. However, there is not yet any requirement for driver training as a condition for the renewing of driving licenses.

In ECCAS, road safety issues were recently analysed in an ECA study on harmonization of road standards. The HIV/AIDS epidemic in Africa raised serious concerns about the role of road transport in facilitating the spread of the disease. The RECs have played an important role in coordinating interventions in this area across countries and sectors.

Safety is also a major concern in the rail, maritime transport, and aviation sectors. Recent railway accidents have heightened public concern about the condition of tracks and rolling stock, as well as the transportation of hazardous materials by rail. In addition to the renewal and modernization of rail infrastructure, there is a need to identify and implement modern technologies for the management of commodities and the protection of passengers transported by rail, as well as to build capacity for accident response and protection of people living along rail lines.

In the maritime sector, there are safety issues associated with port operations (handling of hazardous materials, disposal of ship wastes, etc.) as well as navigation on inland and coastal waterways. There is a need for better navigational aids and effective vessel inspection systems. Every coastal country should have an Oil Spill Contingency Plan and should allocate the resources needed to implement these plans in the event of an emergency. NEPAD and the RECs should facilitate the adoption by every State of the safety regulations drawn up by the International Maritime Organization. Recent events underline the need to find effective ways to combat piracy on the high seas.

Air traffic safety is a particular concern in Africa, which has experienced a relatively high rate of air accidents and had had some national airlines quarantined by international partners, in part because of safety concerns. African countries need to ratify and implement international agreements on air safety; NEPAD and the RECs could take a pro-active part in facilitating this. There should be more inter-country coordination on air safety issues, which could be developed in the context of existing institutions in the sector. Air traffic management and communications

[29] "A review of global road accident fatalities", G D Jacobs and Amy Aeron-Thomas

capacity, both human and technological, at African airports has to be upgraded in many cases. Finally, there is a need to improve the search and rescue capabilities of countries in Africa in the event of air accidents.

7.4 Impacts of Climate Change

The time has past when policy makers could afford to argue about whether climate change was happening or not. Climate change is with us now, and all we can do is to attempt to mitigate its effects by controlling the human contribution, insofar as possible. Transportation decisions can affect the rate of climate change, and climate change can be expected to affect the future performance of transportation systems.

As for the human contribution to climate change, the principal effect comes through the release of greenhouse gases into the atmosphere. A major positive contribution to reducing the impact can be made by shifting the transportation of goods, and to a lesser extent that of passengers, from road transport to rail and/or waterway transport. Another important contribution can be made by increasing the fuel efficiency of vehicles and controlling vehicle emissions. This applies not only to road vehicles but also to rail, waterway, and air transport. Shifting from petroleum-based energy sources to electricity-based systems could have an even more positive impact, especially in Africa where a large part of electrical energy is generated using hydropower and potentially solar, wind, and geothermal systems. However, this shift implies access to a power distribution network which is far beyond current capabilities in Africa.

Secondary impacts induced by transportation development may also contribute to climate change, by releasing large amounts of carbon, currently stored in forest ecosystems, into the atmosphere. Subsistence agriculture in Africa usually involves periodic burning of vegetation to clear land/or and restore soil fertility. If transportation projects are intended to serve, or appear likely to induce, significant agricultural development, particularly in currently underutilized areas, such development should be based on the use of new technologies that can further sequester carbon rather than release it. New industrial development also needs to be carefully controlled so that emissions of greenhouse gases are kept to a minimum.

On an international level, transportation planners have begun to study the likely effects of climate change on transport infrastructure and services. Most of this research is still ongoing with no specific results as yet. However, transport planners and engineers in NEPAD and the RECs should monitor research in this area in order to capture and implement findings that may be significant for the PIDA project.

In road transport, there is concern about the effects of climate change on future maintenance requirements for the existing and planned road network in Africa[30]. The implications are less important for the paved road network than for gravel and especially earth roads, which are vulnerable to changes in rainfall and temperature. However, higher temperatures are expected to make pavements more brittle and liable to cracking, which means that water may enter and undermine the roads, unless adequate and frequent maintenance is provided. The authors recognize that this means higher costs for road maintenance, but they estimate much higher costs for future road rehabilitation if maintenance is not carried out[31]. Impacts on road maintenance costs are expected to be higher across Central Africa, where the climate will become hotter and wetter, than in the Northern region, where the climate will become hotter and drier, and the Southern region, where temperature and rainfall increases are not likely to exceed levels that can be sustained by the existing network.

Other consequences of climate change have been identified by road and railway organizations, such as the need for new design standards reflecting an increased frequency of flooding, the need to control vegetation growth that may damage infrastructure and obscure signs and signals, and the need to anticipate sea level rise and increased storm surges in the location of coastal infrastructure. Increasing groundwater salinity, combined with higher water tables, may reduce the structural strength of pavements and reinforcements in concrete structures[32].

A recent report from the U.K. Transport Research Laboratory provides detailed technical information, which forms the basis for a forthcoming U.K. Department of Transport guidance document, “Maintaining Pavements in a Changing Climate.” This technical report describes the impact climate has on the different types of pavement; asphalt, concrete, modular and unbound. The vulnerability of a pavement

[30] Chinowsky, Paul, Amy Scheikert, Nike Strzepek, Kyle Manahan, Kenneth Strzepek, and C. Adam Schlosser, “Adaptation Advantage to Climate Change Impacts on Road Infrastructure in Africa through 2100.” United Nations University, World Institute for Development Economics Research, Working Paper No. 2011/25, April 2011. Although the authors give cost estimates, it is not possible to determine a cost estimate for the ARTIN road network, as the costs are not divided between paved and unpaved roads.

[31] This finding reinforces the recommendation of this report to finance the construction and maintenance of international corridor roads through tolls collected by corridor authorities, releasing national road maintenance budgets to meet the future demands on the road networks not included in the international system.

[32] Norwell, Gary, Project Manager, “Impact of Climate Change on Road Infrastructure.” Austroads Publication No. AP–R243/04, 1994

to climate depends on factors such as pavement type and condition, local geology, traffic flow, and proximity to hydrological features. The key climate variables for pavements are temperature, precipitation and soil moisture. The report describes the implications of changes in these variables for the maintenance of the different pavement types. Recommendations are given on how to adapt to the changing climate and advice is provided for highway engineers on assessing the risk of different climate hazards for their network. The use of adaptive maintenance practices such as permeable pavements and polymer modified binders is encouraged. Other more general actions, such as improving the overall condition of the pavement and providing adequate drainage systems, are also encouraged[33].

Another U.K. project considers the effects of climate change on railway operations. After recognizing the positive contribution of rail transport in reducing greenhouse gas emissions, it goes on to consider the adaptations that will be needed to make railways more resilient to climate change. Although the study is based on European conditions, the general findings are relevant to Africa as well. The main effects of climate change are anticipated to be an increase in track buckling, severe strain on drainage systems, and increased disruption due to extreme weather events[34].

With respect to ports and waterways, the main concern has been the likely impact of sea level rise on port infrastructure and operations. A recent study indicates that the sea level may be rising three times faster than the rate predicted by the Intergovernmental Panel on Climate Change in its ground-breaking report[35]. This means that the anticipated sea level may rise by as much as a meter by the year 2100, while the IPCC only anticipated a rise of about 30 cm. The impact of sea level rise will be exacerbated by storm surges associated with a greater frequency and intensity of extreme weather events.

The likely impacts are not only on port infrastructure but also on port operations. Port capacity is highly sensitive to the number of days that operations can take place. Mitigation measures may include changes in the location and/or design of port facilities to accommodate higher water levels and stronger wind/wave action, as well as changes in vessel design and the use of navigation aids. The International Association of Ports and Harbors recommended in 2009 that "ports should effectively prepare for the impacts of climate change to ensure their role as the indispensable nodal points of global logistics systems." African port planners in both the public and the private sector should take this mandate seriously[36].

For inland navigation, the consequences of climate change are mainly related to the reliability of water supply. A small change in the level of water in lakes, rivers and ports, due to a change in the seasonal pattern of rainfall, may well affect the number of days per year that waterways can be used without restriction. For industries using navigation as the primary mode of transportation for their products, climate change considerations may be important in the future location of their production facilities[37].

[33] Willway, T., L. Baldachin, S. Reeves, M. Harding, et al, "The effects of climate change on highway pavements and how to minimise them: Technical report." Transport Research Laboratory (U.K.), 2008.

[34] Baker, C.J., L. Chapman, A. Quinn, and K. Dobney, "Climate Change and the Railway Industry: A Review." Published in the Journal of Mechanical Engineering Science, U. K. Institute of Mechanical Engineers, Vol. 224, 2010

[35] Professor Konrad Steffen of the University of Colorado, quoted in Alex Steffen, "How to prepare ports and waterways for climate change?" posted on the Worldchanging Website, downloaded 7/22/2011.

[36] Gallivan, Frank, Kathleen Bailey, and Laurence Matthew O'Rourke. "Planning for Impacts of Climate Change at U.S. Ports." Transportation Research Record no. 2100, U. S. Transportation Research Board, 2009

[37] PIANC (World Association for Waterborne Transport Infrastructure; originally the Permanent International Association of Navigation Congresses), Environment Commission Task Group 3, " Waterborne transport, ports and waterways: A review of climate change drivers, impacts, responses and mitigation." PIANC, undated.

8. INVESTMENT NEEDS ESTIMATE AND FINANCING OUTLOOK

KEY MESSAGES

- Total financing needs of the transport sector (investment and maintenance of the national, regional and continental network) is estimated at US$ 68 billion per year or about 2.1% of total African GDP in 2009.
- The total financing required for the investment and maintenance of ARTIN is estimated at US$ 8.6 billion per year. This represents 12,5 % of the total yearly needs of the sector and 0.3% of 2009 African GDP.
- The financing available in 2009 (both international and national) was not sufficient to cover all the financial needs of the sector. The financing gap is estimated at US$ 13.2 billion (or about 20% of the total estimated needs). This financing gap explains the poor condition of the transport network in Africa and the large inefficiencies along the ARTIN corridors.
- This gap could be covered by:
  - Increasing the contribution of road users to the maintenance and rehabilitation of the road infrastructure through more efficient road funds,
  - Creating an air transport user fee to support air transport system improvements[38],
  - An increase of the contribution of the private sector through PPP (e.g., toll roads) and
  - An increase of the budget contribution to the sector through a larger contribution of the public investment budget to the transport sector.

  The contribution of the private sector would largely be domestic and financed on the local markets.

8.1 ARTIN Infrastructure Needs

8.1.1 Road Infrastructure Needs

The completion of ARTIN road connectivity and the needed increase in capacity will require the paving of more than 10,000 km of road and the rehabilitation/reconstruction of more than 5,000 km. More than 16,000 km of four lanes expressways would have to be constructed and an additional 20,000 km of road would have to be rehabilitated during the PIDA period. The total financial needs for the ARTIN roads (including periodic maintenance on all the networks when rehabilitated or reconstructed) amount to US$ 70 billion over the 30 year period. The required investment in ARTIN road is in addition to the billions of dollars, which will need to be spent by the countries on their national road networks.

8.1.2 Rail Infrastructure Needs

The rail traffic forecasts along ARTIN corridors foresee that the share of rail traffic will shift to fulfil its most economic role so that the rail corridors with logistics and cost advantages to shippers (once they are operated efficiently) will increase their shares of traffic from the present and rail share will increase as well. On this basis, traffic along eight rail corridors will be over 10 million tons in 2040 and above 3 million tons in four others.

The PIDA Study estimates that modern railways[39] should be built in eight corridors involving about 12,000 km of track. Assuming a cost of US$ 2 million per km, the total investment needs would be US$ 24 billion over the next thirty years.

8.1.3 Port Infrastructure Needs

Total port traffic (national and regional) in the ports that are part of the ARTIN reached about 320 million tons in 2009. This traffic should reach 635 million tons in 2020 and about 2,000 million tons in 2040.

The total investment needs for port would be US$ 1.35 billion by 2015 and US$ 27.5 billion by 2040 or an average of 0.5 billion per year up to 2015 and then between 1 and 1.4 billion per year for the following years.

8.1.4 Airport Needs

As mentioned above, 17 of the 53 PIDA airports will be saturated by 2020 and extension projects are only programmed for six of these, although airport expansion projects are planned for 11 other airports. By 2040, the airport capacity will need to increase by 400% on average either through the extension of existing airports or the construction of new airports. The total investment cost to satisfy the transport demand by 2040 would be about US$38 billion.

[38] Revenues from airports and air traffic are probably high enough to finance the necessary investments, but are not currently captured by the sector.
[39] Modern railways have a suitable track alignment for train speeds of 80-100 kph, separated crossings in urban areas and modern signaling and communications systems. They also have modern passenger, freight and multimodal terminals.

8.1.5 Air Traffic System Needs

African air traffic control and navigation aids need to be improved. This could be accomplished through the extension of the European satellite navigation system that improves navigation, supports the optimization of air routes, and simplifies approach procedures. The current satellite coverage of the system includes Africa, but requires the development of complementary infrastructure on the ground to extend EGNOS services to the African continent (see section 4.3.2 above).

This investment is estimated at US$ 500 million with the operations and maintenance costs covered by savings in operating costs of the existing systems.

8.2 Financing Outlook for the ARTIN

8.2.1 Current Funding of Transport Investment Needs

The analysis of the physical condition of the African Transport network in Section 1.2 above shows that a large part of the existing ARTIN is not in good condition often due to a lack of maintenance and also there are many missing links. One of the key reasons for this is the lack of available financing.

The PIDA Study has developed an estimate of the financing gap built up from the various modes of transport, based on extrapolation of past studies.
The AICD report indicated that the spending for the transport sector in Sub-Saharan Africa (SSA) averaged US$ 16.2 billion per year during the period 2001-2006 (US$ 7.8 billion for operation and maintenance and US$ 8.4 billion for capital expenditure). According to this report, the SSA countries spent an average of US$ 4.5 billion per year from their own budgets on transport infrastructure capital investment (0,7% of total GDP).

The remainder of the financing came from official development assistance and private participation reaching a total of US$ 8.4 billion per year on average during this period.

The AICD report estimated the total financing needs for the sector at US$ 18.2 billion showing a relatively small financing gap that could be resolved by increasing the efficiency of the sector.

In a study on road maintenance covering 15 African countries, the World Bank estimated that about 1.2% per annum of African GDP should be devoted to road infrastructure maintenance and construction. Assuming a total GDP for Africa of about US$ 3,000 billion, the total requirement for the entire road network would be around US$ 36 billion per year. It is difficult to evaluate the financial needs for properly operating and maintaining the other modal infrastructure (railways, lake, and rivers, ports and airports). However, the AICD Study estimates these needs at 88% of the needs for the road sector or about US$ 32 billion per year.

On this basis, the PIDA Study has estimated the total financing needs of the transport sector at US$ 68 billion per year or about 2.1% of total African GDP in 2009.
In its 2009 annual report, the Infrastructure Consortium for Africa (ICA) estimates that the total commitment for infrastructure projects in Africa was more than US$ 38 billion of which US$ 19.5 billion come from ICA members and US$ 11.4 billion came from the private sector.

Another significant point made by the ICA report is that the commitments to regional projects jumped from US$ 1.9 billion in 2008 to 3.7 billion in 2009.

The commitment of the ICA members for the transport sector amounted in 2009 to an impressive US$ 7.2 billion (more than twice the 2006 level of commitment).

On the other hand, the contribution of the private sector to the transport sector that amounted to close to US$ 5 billion in 2006 was reduced to only 1 billion in 2009.

Summing up the commitment of ICA, the non-OECD countries and the private sector gives a total of US$ 10.8 billion. The gap to be financed by the African States through their budgets or PPP amounts to about US$ 57.2 billion or about 1.9% of GDP.

The PIDA Study has estimated the total contribution of the national budget to the transport sector at about US$ 44 billion in 2009 by assuming that, on an average, African countries spent 1.4% of their GDP on the transport sector, except for South Africa and North Africa which spent an average of 2% of GDP.

Table 23: Estimated Public Funding for the Transport Sector in 2009 (US$ billion)

Country	GDP 2009	% Public Funding	Total Funding
Total Africa	**3,158**	**1.4%**	**44.1**
Total North Africa	1,176	2.0%	23.5
Republic of South Africa	517	2.0%	10.3
Total Sub-Saharan Africa (excl. RSA)	1,465	0.7%	10.3

According to these computations, the financing available in 2009 was not sufficient to cover all the financial needs of the sector.

The financing gap is estimated at US$ 13.2 billion (or about 20% of the total estimated needs)

This gap could be covered by:

- Increasing the contribution of road users to the maintenance and rehabilitation of the road infrastructure through more efficient road funds,
- Creating an air transport user fee to support air transport system improvements[40],
- An increase of the contribution of the private sector through PPP (e.g., toll roads) and
- An increase of the budget contribution to the sector through a larger contribution of the public investment budget to the transport sector.

8.2.2 Road Infrastructure Financing

The roads along the ARTIN corridors total 64,560 km (including both the Trans-African Highways and the regional corridors). About 84% of these roads are paved and 16% are gravel or earth roads. In respect of paved roads, 52% are in good condition, 38% are in fair condition and only 10% are in poor condition.

ARTIN road network represents 3% of the total African road network. Considering that a total of US$36 billion should be spent each year (based on 2009 requirements) to adequately maintain the total road network, we estimate the financing required to correctly maintain the ARTIN corridor roads at about US$ 2 billion per year, assuming that maintenance costs for the ARTIN network are twice the cost per kilometre of the rest of the network.

In order to achieve the connectivity of the ARTIN and increase road capacity to satisfy the expected demand, the total financial needs for the ARTIN corridor roads (including periodic maintenance on all the networks when rehabilitated or reconstructed) amount to US$ 70.1 billion over the 30-year period or an average of US$ 2.3 billion per year. The investment should begin with the urgent rehabilitation and/or reconstruction of the network (in particular along the Trans African Highways) and the modernization of the road along the corridor. Later, when the traffic level will justify it, the investment should focus on the construction of the required four lanes expressways.

By adding the maintenance costs, African States would need to spend about US$ 4.3 billion per year to expand, modernize and correctly maintain the regional road infrastructure network (or 0.15 % of GDP).
Road maintenance costs should largely be covered by road users through:

- Their contribution to national road funds
- The introduction of tolls along these corridors
- The setting up of efficient charge system for transit traffic.

The modernization and extension of the ARTIN could be financed by:

- The donor community;
- The countries' investment budgets;
- The private sector

The recommendation of the Consultant is to call on the private sector to operate, maintain and modernize the road network through PPP to be signed at national or regional level. Experiences such as the Maputo corridor show the interest of private operators to modernize and maintain section of roads assuming that they can charge the required toll systems. The revenues from the tolls depend on the level of traffic (AADT) and of the level of tolls. It can be assumed that step by step, all the road corridors would reach the required level of traffic to attract private operators. Studies should be conducted, on each corridor, to analyze:

- The costs of raising the physical condition of the road to agreed regional standards and to properly maintain it.
- The willingness of the road user to pay toll (as a result of saving such as time saving, reduction of informal stop etc.)

This analysis would help in defining the best ways to assess the financing needs. The study would, in particular, show when and for which corridors the States or the multinational road authorities could call on private operators.

[40] Revenues from airports and air traffic are probably high enough to finance the necessary investments, but are not currently captured by the sector.

If we assume, as seen above, a total yearly expenditure of US$ 4.3 billion on the ARTIN road network, or about US$ 190 per km per day, we would need a daily traffic of about 2,000 vehicles per day to cover these costs, assuming a toll of US$ 0.10 per vehicle-km.

8.2.3 Railway Infrastructure Financing

The rail traffic forecast along the ARTIN corridors indicates that traffic will be over 6 million tons in 2040 along with at least five rail corridors and above 3 million tons in two others.

With the development of modern railway systems along these corridors, it is probable that part of the traffic presently carried on the road network will divert to rail.

On this basis, the PIDA Study estimates that modern railways should be built along the seven corridors or over 10,000 km of track before 2040.

Assuming a cost of US$ 2 million per km, the total investment needs would be US$ 20 billion during the next thirty years or about US$ 700 million per year.

These investment needs should be added to the requirement of maintaining (routine and periodic maintenance) the existing rail network extending over 20,000 km whose costs are estimated at US$ 400 million per year. This gives a total investment need of US$ 1.1 billion per year or 0.04% of GDP.

As mentioned earlier, the costs of maintaining, modernizing and expanding the rail network should largely be covered by private operators through concession. However, that part of the costs resulting from the rehabilitation of the network should be covered by the countries as the revenue from the concession is not high enough to cover these costs. The States can use their own budget resources to cover these costs (one of the key recommendations is to treat road and rail on a level playing field in term of taxation and investment). When the level of rehabilitation is high, the States can call on IFIs.

Two important conclusions can be drawn from the experience of rail concessions in other part of the world:

- Successful rail concessions are the ones that are organized with strong national participation financed by local financial sources (pension funds national investment funds, etc.)
- In order to increase the share of rail traffic in total long haul traffic, some public contribution to the development of the rail infrastructure network is required.

8.2.4 Port Infrastructure Financing

The total investment needs for ports would be US$ 1.35 billion in 2015 and US$ 27.5 billion in 2040 or an average of 0.45 billion per year up to 2015 and then between 1 and 1.4 billion per year in the following years (or about 0.05% of GDP).

A large part of the physical infrastructure for the ports (quays, warehouses etc.) could be financed by private operators through concession agreements.

General port improvements, such as access road construction or deepening of the access channels would probably need to be financed by the government as well as all trade facilities (such as customs, smart corridors, etc.), although user fees could pay a substantial portion of these costs.

ARTIN port maintenance costs are estimated to be on the order of US$ 300 million to US$ 500 million per year. These are covered by port charges except for maintenance dredging, which in some cases exceeds available revenues.

8.2.5 Airport Financing

As mentioned above, at least 24 ARTIN airports will be saturated by 2020 and extensions are currently only programmed for 7. By 2040, airport capacity should, on average, increase by 400% either through the extension of existing airports or the building of new airports. The total investment cost to satisfy the transport demand by 2040 would be approximately US$ 38 billion or US$ 1.3 billion per year, (or 0.01% of GDP).

It is expected that the largest part of these investment could be covered by the private sector.

Airport maintenance costs are estimated to be on the order of US$ 300 million per year. These are covered by airport user charges except for runway periodic maintenance, which in many cases exceeds available revenues.

8.2.6 Air Traffic/Navigation System Financing

The financing needs for improvement to the air navigation system investment, and operating costs of the satellite system and its ground-based components could be covered by user fees charged to the airlines or generated by an aviation gas tax. These would amount to an estimated US$ 100 million per year.

Revenues from airports and air traffic are probably high enough to finance the necessary investments, but are not currently captured by the sector.

The total financing needs to comply with the objectives of PIDA for the transport sector would amount to more than US$ 155 billion over the 2010-2040 period or an average of US$ 5.2 billion per year.

8.2.7 Total ARTIN Financing Needs (investment plus maintenance)

Table 24: Summary of Total ARTIN Financing Needs (US$ billion)

Component	Annual investment Needs	Annual maintenance needs	Total Financing Needs	% 2010 GDP
Roads	2.3	2.0	4.3	0.15%
Rail	0.7	0.4	1.1	0.04%
Ports	1.2	0.4	1.6	0.06%
Airports	1.3	0.3	1.6	0.06%
Total	**5.5**	**3.1**	**8.6**	**0.30%**

8.2.8 Financing Outlook and PPP

As noted in the "Brief for the G-20 Multi-Year Action Plan ***Financing Africa's Infrastructure: New Sources and Trends"***, one of the pre-requisite for successful PPPs is adequate risk sharing between the government and the private sector. Another pre-requisite, where African Governments can take a pro-active stance, is an adequate institutional framework, comprising of political commitment, effective governance, and a transparent legislative and regulatory framework. Absence of such a framework makes it challenging to attract high quality and irreversible investment.

Given their limited experience with PPPs, many African Governments will also need to acquire the skills needed for a successful implementation of PPPs, in particular, as regards project appraisal and risk assessment. Developing a comprehensive and transparent list of contingent liabilities, such as implicit and explicit government debt guarantees, is usually a first good step towards building capacity for assessing tax related risks stemming from PPPs. Experience of countries that established well-functioning PPP units in their Ministries of Finance (Senegal, Kenya, South Africa, Uganda) points to the positive impact of these units as effective PPP enablers.

As shown in the South America experience, the sustainability of concessions in the transport sector requires that a large part of the required financing comes from local sources. The key providers of these funds are:

- Infrastructure bonds in local currency
- External sovereign bonds
- Commodity-linked bonds, and
- Diaspora bonds

The use of these bonds is still very low in Africa and it is important that each Government identify the best ways to develop them as they should constitute, in the next 30 years, the basis for financing the private sector in its involvement in transport infrastructure development

A mixture of financing – traditional and innovative; private, public, mixed (e.g., PPPs) – is needed to close the infrastructure gap. The public sector will remain a key part of the financing, especially in low income and fragile countries, also by crowding-in private investment. At the same time, the private sector has increasingly a vital role to play. New financing sources can be tapped, including local currency bond markets; external bond markets, and, in resource-rich frontier markets, also sovereign wealth funds.