CORRIDOR DIAGNOSTIC STUDY OF THE NORTHERN AND CENTRAL CORRIDORS OF EAST AFRICA

ACTION PLAN

Volume 2: Technical Papers

C. Corridor Diagnostic Audit

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Acronyms

BOL	bill of lading
CCTFA	Central Corridor Transit Transport Facilitation Agency
CD	chart datum
CDS	Corridor Diagnostic Study
CFS	container freight stations
COFC	container on flat car
COMESA	Common Market for Easternand Southern Africa
CY	container yard
DRC	Democratic Republic of Congo
EAC	East African Community
EIR	equipment interchange report
EIRR	Economic internal rate of return
FONA	First Order Network Assessment
GRT	gross register tonnage
HCM	Highway Capacity Manual
HDM	Highway Design Manual
ICD	inland container depots
IRI	International Road Indices
KMA	Kenya Maritime Authority
KPA	Kenya Port Authority
Km	kilometers
LoLo	lift on-lift off
LOS	Level of service
M	Meters
MCT	Mombasa Container Terminal
MHC	mobile harbor crane
MLL	Marine Logistics Ltd.
NCTTCA	Northern Corridor Transit Transport Coordination Authority
OCR	Optical Characteristic Reader
PPP	Public Private Partnership
RA	Revenue Authorities
RAHCO	Reli Assets Holding Company
RFID	Radio Frequency Identification Device
RMG	rail mounted gantry
RoRo	roll on-roll off
RTG	rubber tire gantry
RS	Reachstackers
RVR	Rift Valley Railways
SADC	Southern African Development Community
SPM	single point mooring
STS	ship to shore
SUMATRA	Surface and Marine Transport Regulatory Authority, Tanzania
TICTS	Tanzania International Container Terminal Services

TAZARA	Tanzania-Zambia Railway Authority
TEU	twenty-foot equivalent unit
TOFC	trailer on flat car
TOS	terminal operating system
TPA	Tanzania Port Authority
TRC	Tanzania Railways Corporation
TRH	Tanzania Road Haulage
TRL	Tanzania Railways Limited

1. Introduction

This technical paper presents the results of the diagnostic audit of the performance of the Northern and Central Corridors that was conducted from November 2009 through September 2010. The diagnostic audit was performed using the a software and audit methodology called *FastPath*® to apply to transport logistics chains to measure the current state of performance (in terms of time, cost, and reliability) and to identify bottlenecks and potential solutions.

Scope and Structure of the Working Paper

The Corridor Diagnostic Study reviewed the infrastructure condition and regulatory policy of the Northern Corridor anchored by the port of Mombasa in Kenya, and the Central Corridor, anchored by the port of Dar es Salaam in Tanzania, which are principal and crucial transport routes for national, regional and international trade of the five East African Community (EAC) countries, namely; Burundi, Kenya, Rwanda, Tanzania and Uganda. (Figure 1). The CDS analysis also includes the extension of the Northern and Central Corridors to the Democratic Republic of the Congo and links to Southern Sudan, Ethiopia and Zambia.

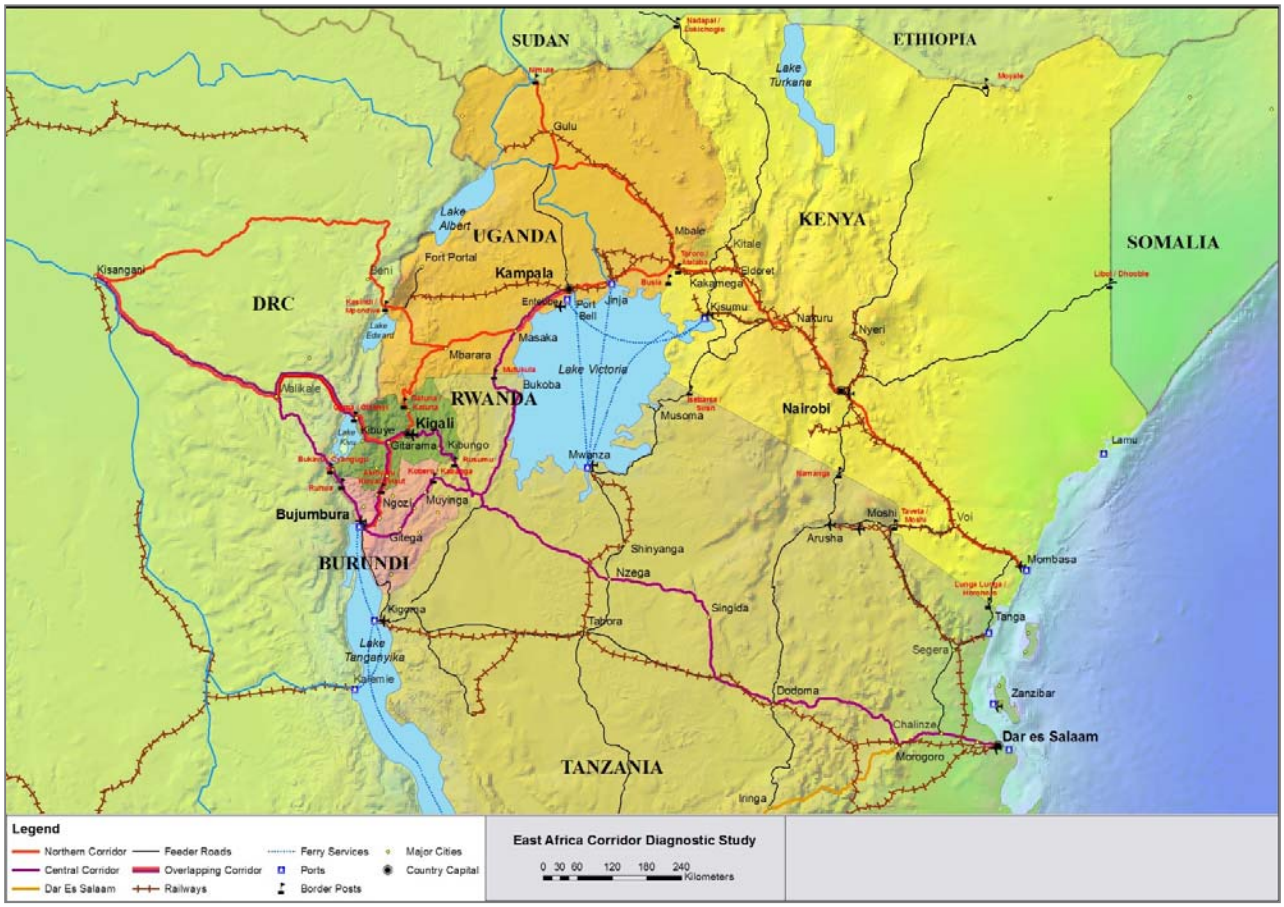
Following this introductory chapter, Chapter 2 presents the FastPath Methodology and interview process. Chapter 3 presents a description and condition of the corridor infrastructure by transport mode or logistics component for the Northern and Central Corridors.

The assessment of the Northern and Central Corridor's current performance and a comparative analysis relative to each other and to the performance of other corridors in Africa and other regions is presented in Chapter 4.

Chapter 5 presents the analysis of the impact that future projects will have in both corridors performance and also the effects on trade flows.

Finally two appendices present further details. Appendix A presents the supplemental diagnostic assessment of the Dar es Salaam corridor with a particular emphasis on issues related to food security. Appendix B presents the performance assessment details for additional cargo types.

Figure 1.1. CDS Study Area



2. FastPath® Methodology

Conceptual Approach

A transport logistics chain is a system of links and nodes that represent transport legs and processes occurring along the chain (Figure 2.1). Depending on the corridor, the system may have many links and nodes (e.g., for cargo originating from or destined to landlocked regions or countries) or relatively few (e.g., international cargoes destined for domestic deliveries to areas near a port). In both cases, shippers can be "victims" of onerous procedures that delay domestic or cross-border shipments. On the port side, slow cargo loading or discharge rates extend a vessel's time in port, incurring an extraordinary cost that is passed on to shippers in higher freight rates.

Nathan Associates Inc. developed a *FastPath*® to apply to transport logistics chains to measure the current state of performance (in terms of time, cost, and reliability) and to identify bottlenecks and potential solutions[1]. We recognized through our projects and research that governments did not have the ability to measure corridor performance in the same way that supply chain managers measure costs of logistics services they seek to move freight. Supply chain managers, however, have no control over the infrastructure and institutional frameworks affecting their supply chains. Governments needed a way to define the problems in consistent terms and to identify potential solutions and their impacts. Nathan Associates Inc. developed *FastPath* in order to help transport ministries, port authority managers, and logistics industry interests establish priorities for resolving transport logistics problems.

FastPath's process also encourages discussion and consensus building between and among stakeholders and policymakers of transport and logistics chain problems and solutions to inefficiencies. *FastPath*'s tools constitute a screening system that (1) assesses and quantifies the relative importance of a problem in a logistics

FASTPATH® | improving transport logistics performance

[1] FastPath is a proprietary diagnostic tool developed in a partnership between USAID and Nathan Associates to analyze transport infrastructure and operational inefficiencies in the transport/logistics chains serving import and export traffic. FastPath provides a quantitative basis for monitoring corridor performance. The audit methodology consists of surveys and questionnaires to identify bottlenecks and appropriate improvements to freight corridors.

chain, and (2) helps users prioritize areas for improvement credibly and transparently so that all parties can participate in the analysis to arrive at a mutually acceptable result. Though *FastPath* facilitates decision making and analysis of the consequences of decisions, it does not make decisions. Rather, it provides the basis for making informed decisions over policy, investment, and institutional changes.

Box 1. FastPath® Diagnostic Tool

Developed in partnership between USAID and Nathan, *FastPath* is a diagnostic tool used to analyze transport infrastructure and operational inefficiencies in the transport/logistics chains serving import and export traffic. *FastPath* provides a quantitative basis for monitoring corridor performance. It can also provide a basis for aid agencies and developing country stakeholders and policymakers to agree on the relative importance of port and logistics chain inefficiencies and evaluate improvements to eliminate inefficiencies. The audit methodology consists of surveys and questionnaires to identify bottlenecks and appropriate improvements to freight corridors. Data are inputted into the software to generate time, cost, and reliability "scores", and to test the merits of proposed solutions. *FastPath* methodology constitute a screening system that (1) assesses and quantifies the relative importance of a problem in a logistics chain, and (2) helps users prioritize areas for improvement credibly and transparently so that all parties can participate in the analysis to arrive at a mutually acceptable result.

Deciding which initiatives will be most beneficial requires understanding how initiatives affect service quality. This differs from the traditional approach of measuring the economic efficiency of individual transport and cargo handling activities. Two examples illustrate this difference. The first is an investment in additional road capacity, the second an investment in container berth and gantry cranes.

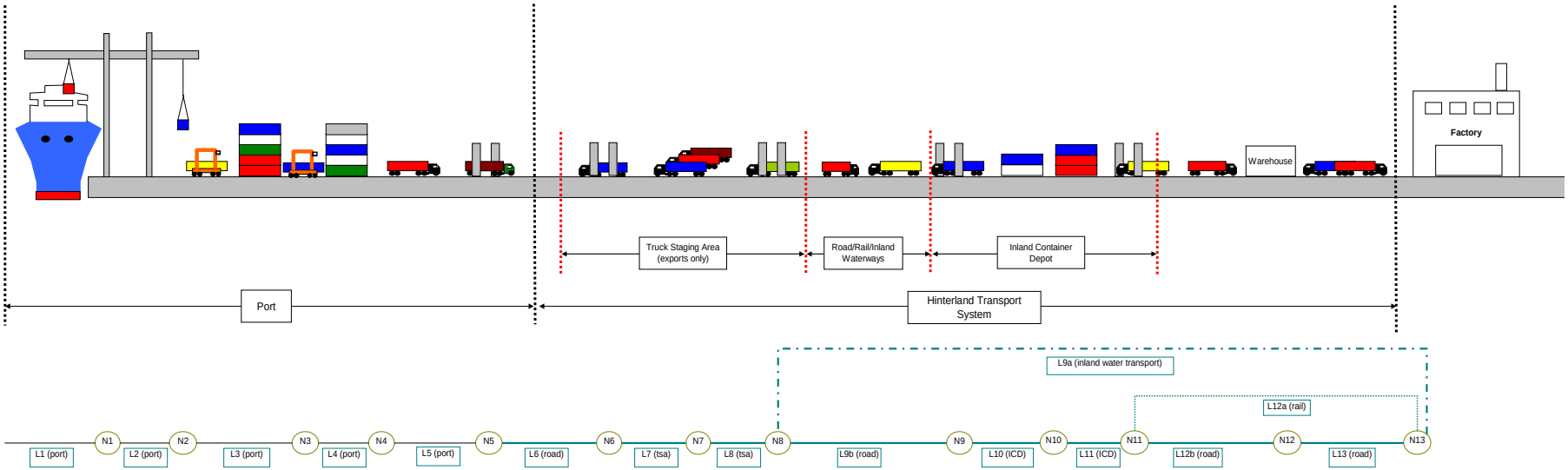
Widening a road link or constructing a new link will, by adding capacity, reduce congestion and average travel time thereby increasing the productivity of trucks and drivers. Road surface improvements also reduce truck maintenance costs. The savings in operating costs that result can be estimated to provide a measure of the benefits from the investment. But from the shippers' perspective, the only benefits are those realized in the form of lower tariffs, which will depend on the level of competition in the trucking sector. The increase in average velocity and reduction in variance of travel time as a result of less congestion will cut inventory carrying costs provided that these are transmitted through the supply chain and to reduce total transit time. More significant benefits could be realized if the road improvements allow the logistics providers to operate newer, larger trucks on longer routes and to increase the number of trips per day on their shorter routes. Shippers would also benefit from safer transport for larger shipments and more frequent service.

Investing in container berths and ship-to-shore gantry cranes provides faster turnaround of vessels at berth, which lowers berth occupancy and reduces vessel waiting time. The benefits from this investment are

calculated based on the estimate of average savings in ship time multiplied by the value of ship's time.2 But from the shippers' perspective, this benefit is realized only if it results in a reduction in freight rates. This rarely occurs quickly unless there is a congestion surcharge that is removed once congestion is eliminated. It will occur gradually, assuming sufficient competition. The shipper may realize a significant benefit if shorter port time translates into shorter transit time, but this is unlikely as most voyage patterns are designed to achieve

[2] This value is generally done as an accounting exercise rather than trying to understand the opportunity cost for ship's time. As a result, the benefits are overestimated when there is excess shipping capacity and underestimated when there is a shortage of ship capacity. Since the latter is a more common occurrence, the more likely error is an overestimate of the benefits.

Figure 2.1. Links and Nodes of the Transport Logistics Chain



Source: FastPath User's Manual

day-of-the-week service at ports of call. However, substantial benefits could accrue if the reduction in turnaround time and congestion allows the shipping lines to convert from an unscheduled or loosely scheduled service to a day-of-the week schedule.

Both the impact of changes in specific logistics activities and the overall effectiveness of supply chains can be measured using the same quality of service measures as the shippers and consignees use to determine the competitiveness of the underlying trade in goods. These are, aside from cost and quality of production, time and cost for delivery. Embedded in all these is the factor of reliability. Some common terms used for these measures are:

- Total delivered cost - cost of good delivered to the buyer including that for logistics
- Order cycle time - time from placing initial order to receipt of the goods ordered
- Order fulfillment - probability of receipt of the goods in the correct amount, in good condition in accordance with the agreed delivery schedule

The measurement of cost is generally stated as the total unit cost (i.e., the total cost for the delivered goods divided by the quantity of goods shipped). This may be specified as a percentage of the selling price for the goods at either the origin or the destination (e.g., 10 percent of FOB value) or as a cost per unit of weight, volume, or cargo unit (e.g., US$ per TEU, truckload, or wagonload).

The measurement of time is the average times for delivery of inputs from suppliers to a production/assembly process, for delivery of outputs from this process to the market, and for delivery of parts and after-sales technical support to the buyers. This may be the gross time between initiating and completing the shipment or the net time to complete the shipment after subtracting the time for discretionary activities (e.g., intermediate storage or delays requested by the buyer or the seller).

The measurement of reliability is more complex but can be expressed as a range (e.g. +two days, +10 percent, maximum 10 days - minimum six days), a standard deviation/coefficient of variance, or a confidence limit (e.g., 10 days or less for 95 percent of the shipments).

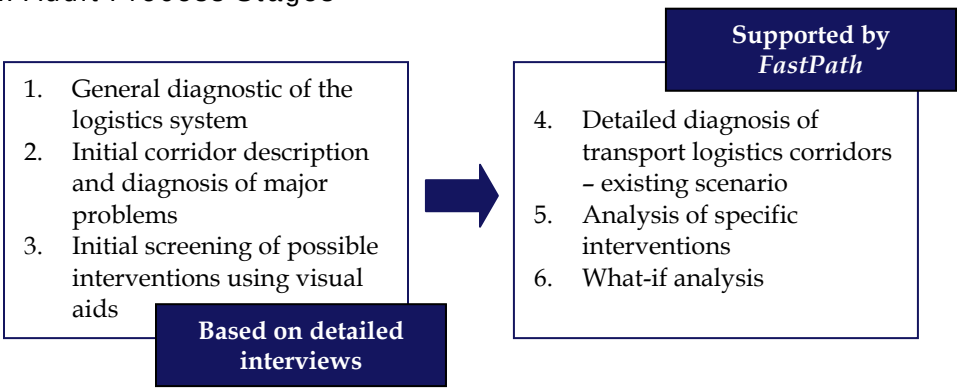
A reduction in time or cost for delivery or an increase in reliability in meeting delivery schedules will benefit all shippers. However, the value of these benefits to individual shippers will depend on the relative importance given to cost, time, and reliability. This, in turn, varies with the type of goods and the markets in which they are sold. For high-value goods and dynamic markets, there will be a premium on the order time. For inputs to a continuous production activity, the greatest concern will be reliability of delivery, whereas for the goods produced, the principal concern is likely to be the delivered cost. Even individual shippers will have different priorities depending on what is being shipped and to which market. Because of these differences, it is important that the logistics sector offer different combinations of cost, time, and reliability to meet the requirements of different shippers.

The *FastPath* methodology reflects a comprehensive understanding of shipper requirements as well as the policy, regulatory, institutional, and infrastructure insight that ultimately leads to optimal and consensus built solutions.

FastPath® Audit Stages

Diagnosing the problems in a transport logistics chain while working with stakeholders requires a detailed audit process that consists of six stages (Figure 2.2)

Figure 2.2. Audit Process Stages



The first three stages are diagnostic steps based on detailed interviews conducted with stakeholders and serve as a means to define the logistics issues on a sector basis. This is not computerized. The purpose of these stages is to develop a detailed understanding of the impact of problems on the competitiveness of the region's trade logistics system. This entails identifying and defining in detail the logistics problems in specific corridors and the related trade flows. Data collected cover the time and cost for each link and node of the typical shipment in each selected logistics chain and the principal sources of inefficiency and reliability problems. The relative sensitivity of these trade flows to the time it takes to respond to orders for logistics services and equipment and to the variation in transit times from one end of the logistics chain to the other is also examined. The following section describes the participants' selection process and how the interviews were conducted.

The second three stages serve as a detailed analysis of specific transport and logistics corridors and are supported by the *FastPath* software. The software application is used to (1) define the transport and logistics system; (2) record the specific performance of each component of the system in terms of cost, time, and reliability; (3) compare these performance measures with international norms; (4) add the performance measures for the total logistics chain and its subchains, and (5) report on the results in tabular and graphic forms.

Finally, to diagnose performance, one must compare actual performance to benchmarks. This can be done first for an entire corridor, then for each mode, and eventually for each process in

the transport logistics chain. Whatever the level, the methodology involves comparing actual or perceived performance to benchmarks or norms.

FastPath® Interviews

BACKGROUND

We assessed and analyzed all aspects related to the transport of goods along each corridor. A central element of the audit and diagnostic is the conduct of detailed interviews with stakeholders using sets of semi-structured questionnaires to guide the discussions. Information obtained in the interviews is validated by reviewing original documents and/or collaborated by discussions with others. Further confirmation is obtained by physically driving each corridor and its spurs up to the borders with neighboring countries.

Given the range of activities encompassed by logistics, the variety of problems that can affect the quality of services is immense. For the purposes of identifying and evaluating these problems, it is often necessary to group them into categories according to their source. The primary sources identified for this purpose are as follows:

- Physical operations and assets used in the transport, handling, and storage of goods.
- Transactions related to these operations that occur between shippers and logistics service providers as well as among third parties involved in a supply chain, including Customs.
- Government policy that regulates these operations and the underlying trade as well as safety and environment issues.
- Ancillary services such as financing and communications that contribute to the efficiency of these operations.

PHYSICAL OPERATIONS AND ASSETS

The principal source of problems, and the area most frequently analyzed, is the physical assets used for the transport, handling, and storage of goods moving through a supply chain. These assets are subdivided into infrastructure, equipment, and labor. Problems with the condition and capacity of infrastructure and equipment limit the throughput of these activities thereby increasing cost and time and reducing reliability. These problems are usually addressed by renewing existing assets or procuring new assets. Problems with labor, which are frequently more serious, affect not only time and costs but also the productivity of existing as well as new infrastructure and equipment. These problems are addressed by enhancing skills and, where necessary and in cases of overstaffing, by reducing the labor force.

An equally important problem affecting the use of the assets is management performance. Logistics service providers normally evolve from individual operators to small enterprises providing a single service (e.g., cargo clearance, truck transport, warehousing). Their planning, monitoring and communications are rudimentary and they rarely provide

complementary value-added services. As these enterprises grow, they may make small improvements in management capacity, but significant improvements do not occur until they interact with international logistics companies with modern management practices, including specialization and delegation. This enhancement can be accomplished through a correspondent or agency arrangement, a joint venture or direct competition where there is significant technology transfer.

TRANSACTIONS

Because supply chains are usually constructed from a number of separate logistics activities, the movement of goods through a supply chain requires a number of commercial transactions between logistics service providers and/or between them and the cargo owners. A large percentage of logistics problems are caused by difficulties with these transactions as they add costs, delays, and uncertainty to the movement of goods through the supply chain.

Another set of transactions that frequently cause problems are those between shippers or logistics providers and the public officials whose approvals are required to move goods through the supply chain. While transactions involving public officials are usually minimal for domestic trade, they can be problematic within the country where provincial governments regulate the movement of goods transiting their province. For international trade they have traditionally been identified as a major source of cost and delay.

These transactions can be distinguished between those that must be completed prior to an activity taking place and those which occur as part of an activity. For example, a customs declaration must be submitted prior to clearance of import cargo and a contract of affreightment as well as, where applicable, bond guarantees, prior to transport of cargo but the bill of lading is issued after the cargo is loaded and transferred to the consignee while the vessel is en-route. The more complex the supply chain, the greater the number of transactions and their associated costs and delays. The more complex these transactions, the greater the cost and delays incurred.

Two of the most effective mechanisms for reducing the cost and delays associated with these transactions have been to simplify the documentation and to eliminate redundant requests for information. For this purpose, forwarders have introduced combined bills of lading; customs officials have introduced Single Administrative Documents, and trucking organizations have acquired TIR carnets[3]. Efforts to simplify transactions allow for greater integration of logistics services but require a suitable environment. The government must reduce paperwork and the number of signatures required while reforming inefficient and corrupt practices. The private sector must adopt modern business practices, including increased transparency, more specialization of management functions, delegation of authority, and investment in information communication technology.

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[3] Formal in-transit documents for bonded cargo.

A third mechanism has been to automate data processing. While the procedures for storage and retrieval of data related to goods and their movement through a supply chain are well established, the use of this data to facilitate that movement is still evolving. Track and trace systems are a standard offering by the larger logistics service providers, especially those operating internationally, but are only now being offered by smaller providers. Similarly, while most forwarders offer warehousing only the international service providers and some large domestic providers offer inventory management systems. The ability to embed logistics information systems into the enterprise software of clients has become an important value-added service but relatively few fourth-party logistics providers/ advisors (4PLs) have this capability.

GOVERNMENT REGULATIONS AND POLICIES

The effect of government policies on logistics has received more attention because of the substantial economic benefits of deregulation and privatization. Economic regulations have created significant problems for logistics activities when they prevented pricing from adjusting to market conditions and when they increased barriers to entry for new providers entering existing markets and existing logistics providers entering new markets. These not only increased costs but also reduced the variety of time and cost combinations offered by three PLs. Safety and environmental regulations have also increased operating costs but often provided compensating public benefits.[4] However, they can cause problems for logistics service providers when they are enforced in an arbitrary or selective manner. The resulting loss of transparency discourages competition, thereby severely reducing any benefits that the regulation might have provided. These problems can be addressed through programs of reform and deregulation.

Regulation of international trade can also add time and costs to logistics activities. The imposition of duties and taxes on traded goods, restrictions on the types of goods traded (based on trade agreements and protection of domestic industries), and enforcement of safety, sanitary and phytosanitary standards increases the time and cost of moving goods across land borders or through international gateways, can be justified on political and economic grounds. Problems arise where these is a lack of diligence, consistency and transparency in enforcement of these regulations or where the procedures are inefficient thus introducing unnecessary costs, delays and uncertainty.

Another area of government policy that affects performance in the logistics sector is investment in public transport infrastructure assets. The role of the private sector in these investments has been the subject of considerable experimentation over the last two decades. This has led to an increase in the number of privately operated toll roads and rail track as well as port and airport terminal concessions. There are various models for allocating

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[4] These regulations can increase short-term freight rates, but reduce long-term costs to the shippers. For example, the introduction of a requirement for annual certification of roadworthiness can force trucks operators to renew their fleet thereby providing safer and more reliable transport of goods.

responsibility between the public and private sector but the principle criteria of success is whether they provide sufficient capacity in a timely manner, at reasonable cost, and with acceptable quality. Otherwise, they significantly increase the time and cost for the logistics activities that use this infrastructure.

A final area of government policy that affects logistics is taxation and subsidization. Excessive taxation of transport equipment can discourage investment while increasing transport costs. This problem is often sited with regard to imports of equipment, especially parts. Subsidization can be a problem especially when it is used to maintain inefficient transport services thereby lowering the returns to efficient transport or when it provides a competitive advantage to less efficient logistics service providers.

ANCILLARY ACTIVITIES

The remaining source of problems for the logistics sector are activities that facilitate logistics management, in particular, the acquisition of assets, the coordination of transactions and compliance with government regulations. Of particular concern is the lack of access to modern financial and communications services.

The role of the government in financing public infrastructure has already been discussed. Of equal importance is the availability of commercial financing for both capital investment and working capital. This is a significant problem for the logistics sector. In many countries, banks are reluctant to lend to transport service providers for the procurement of equipment unless the loan is securitized with property or other fixed assets. This has led to extensive use of leasing arrangements in some countries, but in others, it has left transport service providers dependent on savings of families and friends to acquire new equipment.

Logistics service providers who act as forwarders but do not own transport equipment or other significant fixed assets still a need working capital. The amount can be significant where transport companies and other logistics service providers require payment from forwarders on less favorable terms then the forwarders can obtain from the shippers. Producers and traders also require working capital. This is often financed against firm orders or buyers' Letters of Credit. Difficulties in obtaining this finance not only limit the amount of competition in the logistics sector but also prevent existing providers from expanding into new markets and increasing their market share.

The introduction of automatic debit systems has simplified transactions especially between logistics service providers and public agencies. These not only reduce the time required to complete transactions but improve transparency and eliminate the number of money exchanges between private parties and public officials.

Modern communications has been an essential part of logistics management. Email has replaced the telephone and fax as primary mode of communication, though internet-based

transactions are usually limited either because electronic signatures are not legally recognized or because supporting financial services are not available.

Electronic data interchange (EDI) has also transformed transactions between the public and private logistics service providers. EDI allows supply chain participants to share information in a format that also supports data processing. While EDI has become essential in international transport and logistics, domestic providers have been slow to make the necessary investment. The public sector has often delayed the introduction of EDI because of difficulties in selecting a standard format (EDIFACT, XML/EDI, Rosetta.net, ebXML), method of access (VAN, VPN, or Internet), or, more commonly, right of access. Some government agencies have tried to discourage the use of EDI by restricting access, requiring hardcopy backup, and assigning strict liability for the data transmitted, but these actions are generally part of a broader effort to discourage transparency. At the same time, EDI has become essential for international trade and lack of it constitutes a competitive disadvantage.

In the section below, we discuss the types of organizations targeted for CDS diagnostic interviews that were conducted to complete the first three stages of the *FastPath* analysis.

COMBINING TYPES AND SOURCES OF PROBLEMS

The sources of problems discussed above can be linked to the general problems of inefficiency, competition, complexity, and compatibility as shown in Table 3. Problems with physical operations and assets generally result in inefficiency and incompatible interfaces. Problems due to excessive or complex transactions not only reduce efficiency but are symptomatic of complex supply chains. Difficulties associated with public regulation commonly lead to the complementary problems of inefficiency and lack of competition. Public policies related to international trade frequently lead to problems with compatibility at the borders and gateways. Limitations on ancillary activities constrain the growth of the logistics industry thereby maintaining the existing complexity of supply chains.

Table 2.1. Relationship between Type and Source of Problems

Problems	Inefficiency	Competition	Complexity	Compatibility
ASSETS AND OPERATIONS				
Infrastructure	√√	√		√
Equipment	√√			√
Labor	√√	√	√	√
Management	√√		√√	√
TRANSACTIONS				
Between private logistics service providers	√	√	√√	√√
With public officials	√√		√√	
Data processing	√√		√√	√√
PUBLIC POLICY				
Economic regulation	√√	√√		
Regulation of trade	√	√		√√
Regulation of operations		√		√
Enforcement of regulations	√√	√		√√
Taxation and subsidization	√	√		
ANCILLARY ACTIVITIES				
Public finance for capital investment		√√	√	
Commercial finance for capital investment	√	√√		
Working capital	√	√√	√√	√
Data communications	√√		√√	√√
EDI	√√		√√	

TYPES OF ORGANIZATIONS TARGETED FOR DIAGNOSTIC INTERVIEWS

Because of the diversity of logistics services and the large number of service providers, interviews were targeted for groups representing specific sectors rather than individual companies or agencies[5], as follows:

- **Shippers** — traders, manufacturers, and retailers
- **Transport service providers**—ports, shipping lines, inland container depots, truckers, railways and pipeline operators
- **Freight forwarders** — freight forwarders, clearing agents, insurance companies
- **Government ministries and agencies**—transport ministries, customs agencies, regulatory entities and multinational or regional government entities

[5] In some cases, participants could be classified in more than one group of organization; however, for purposes of this methodological note, they have been only counted once and placed in the organization group that is believed to correspond to their primary interest.

Shippers

Cargo owners – importers and exporters – are not necessarily bound by the same rules. Large companies can be small importers and exporters in terms of volume, and small companies can often use large transport service providers. Large companies involved in manufacturing and distribution will often have their own in house transport and logistics division with their own transport fleet, or alternatively, use the services of a large three or four PL logistics company. Many large companies have in-house transport and top it up with private operators. Others give annual contracts to established companies and top it up as needed. One typical scenario within the region is for a trader to make frequent flights to Dubai (or China, or Nairobi) to purchase own goods of less than a full container load, and to use small transport and logistics service providers in order to save money.

Transport Service Providers

The logical observation and general rule is that the larger service providers are more resourceful and are able to provide better and faster service. The large trucking companies and logistics companies generally have influential owners and shareholders, and are less prone to being harassed at police road blocks and having to pay bribes. The smaller trucking companies are less likely to have a back up service in the event of a breakdown, and their transit times will be less predictable/ reliable than the larger companies. They may drive longer hours and in fact have shorter times. With a smaller customer profile, the smaller companies are less likely to be able to pick up a return load, and their profit margins will be lower.

Freight Forwarders

Similarly for clearing agents, freight forwarders and ship agents, the smaller companies generally have longer clearance times and lower service levels than the large companies, but with lower prices, and their customer base will tend to be smaller companies where the price is more important than the quality of the service. The general rule for transport service providers is that the smaller the company, the worse the service levels, the lower the price, and the lower the profit margin. Of the very many small independent operators, only a few well managed companies, operated by previous employees of the larger companies, have prospects for growth. Improving service levels by tighter regulation will likely lead to a reduction in the number of smaller companies. In case of servicing transit traffic or traffic moving in bond, the bigger companies have capacity to organize guarantees for higher value bonds compared to smaller companies. Therefore bigger companies are in better position to handle transit traffic with higher value and bigger volume traffic.

Government Ministries and Agencies

For public officials, it is important to interview those responsible for regulation of logistics services and for the provision of public infrastructure. Responsibility for regulation of logistics services is generally distributed among a number of ministries. While the extent of regulation of the logistics services sector is usually limited, these same ministries are

responsible for public policies that affect the structure of the industry. As such, it is important that they be interviewed as a group. Responsibility for organizing this group should be given to this senior ministry involved, which is often the Ministry of Finance. For international trade, it is necessary to interview the Customs officials and the customs clearance agents. These could be done as separate interviews with the latter interviewed together with the freight forwarders.

Definition of Small Organization or Entities

In identifying organizations to be interviewed, care was taken to include both large and small entities so as to obtain a balanced perspective of the issues, concerns and performance of the corridors. For purposes of the study, it was necessary to identify some general criteria as to what constitutes a small organization or entity.

For the CDS freight scenarios, small is defined as a small importer or exporter, typically less than 500 TEUs or 10,000 tons per year often less than a full container, using small trucking company with less than 20 trucks, and using small clearing agent with less than 25 employees. All government entities were classified as large entities.

PROCESS FOR IDENTIFYING PARTICIPANTS

A multifaceted approach was used to identify participants to be included in the diagnostic interviews. This approach included the following elements:

1. Discussing with senior officials of the two corridor authorities (NCTTCA and CCTTFA) regarding the objectives of the interviews and seeking suggestions and contact information for organizations and participants.
2. Contacting associations relevant to the transport and logistics sector, including main shippers and consignee organizations, clearing and forwarding agencies, shipping lines' agencies, shipper's councils, chambers of commerce, association of exporters, association of transporters and product association of main commodities.
3. With the help of the associations, we identified a representative group of shippers and consignees to provide detailed data on the steps involved when exporting and importing their products along each corridor. We placed special attention in selecting a representative group of companies to ensure that the sample adequately characterize different size of companies and degrees of participation for specific products.
4. Contacting transport service providers directly from our prior experience and contacts in the region including the railroads, shipping lines, port operators and inland container depot operators.
5. Discussing with senior officials of relevant national ministries and government agencies the objectives of the interviews and seeking suggestions of government officials to include in the interviews.
6. Reviewing list of organizations and participants in regional workshops and conferences dealing with the transport sector.

7. Reviewing lists of organizations and participants contacted by prior regional transport and logistics studies.
8. Identifying new organizations and participants for a fresh look at sector issues by asking those interviewed to recommend additional candidates.

NUMBER OF CDS INTERVIEWS TARGETED AND CONDUCTED

The sections below discuss the organizations and participants targeted for interview, those that were actually interviewed, and the representativeness of the interviews conducted.

CDS Interviews Targeted

Table 2.2 shows a breakdown of the 336 interviews that were targeted for the CDS by type and size of organization and country. The target set of interviews included more than 100 transport service providers, 100 government entities, more than 70 shippers and more than 50 freight forwarders.

In terms of size, 266 interviews were targeted with large organizations and 70 interviews with small organizations. Excluding interviews targeted with government entities, the 70 interviews with small organizations represents 30 percent of the total.

Table 2.2 CDS Interviews Targeted by Type of Organization and Country

Type and Size of Organization	Burundi	Kenya	Rwanda	Tanzania	Uganda	Total
Large Organizations						
Freight Forwarders	6	4	9	4	1	24
Transport Service Providers	-	47	3	33	5	88
Shippers	4	12	6	16	16	54
Government Entities	15	26	12	23	24	100
Subtotal	25	89	30	76	46	266
Small Organizations						
Freight Forwarders	4	7	8	5	5	29
Transport Service Providers	3	9	3	7	2	24
Shippers	3	1	4	2	7	17
Government Entities	-	-	-	-	-	-
Subtotal	10	17	15	14	14	70
All Organizations						
Freight Forwarders	10	11	17	9	6	53
Transport Service Providers	3	56	6	40	7	112
Shippers	7	13	10	18	23	71
Government Entities	15	26	12	23	24	100
Subtotal	35	106	45	90	60	336

Source: Nathan Associates

In terms of countries, the target of 336 interviews was distributed as follows: Kenya, 106 interviews (32 percent); Tanzania, 90 interviews (27 percent); Uganda, 60 interviews (18 percent); Burundi, 35 interviews (10 percent); and Rwanda, 45 interviews (13 percent).

INTERVIEWS CONDUCTED

Table 2.3 shows a breakdown of the 236 interviews that were conducted by type of and size of organization and country. Interviews were conducted with 91 transport service providers, 71 government entities, 39 shippers and 35 freight forwarders.

In terms of size, 189 interviews were conducted with large organizations and 47 interviews with small organizations. Excluding interviews targeted with government entities, the 47 interviews with small organizations represents 28 percent of the total.

Table 2.3. CDS Interviews Conducted by Type of Organization and Country

Type and Size of Organization	Burundi	Kenya	Rwanda	Tanzania	Uganda	Total
Large Organizations						
Freight Forwarders	3	3	7	2	-	15
Transport Service Providers	-	38	3	31	3	75
Shippers	3	9	3	10	3	28
Government Entities	11	22	10	13	15	71
Subtotal	17	72	23	56	21	189
Small Organizations						
Freight Forwarders	4	7	2	5	2	20
Transport Service Providers	3	7	3	3	-	16
Shippers	3	1	1	2	4	11
Government Entities	-	-	-	-	-	-
Subtotal	10	15	6	10	6	47
All Organizations						
Freight Forwarders	7	10	9	7	2	35
Transport Service Providers	3	45	6	34	3	91
Shippers	6	10	4	12	7	39
Government Entities	11	22	10	13	15	71
Subtotal	27	87	29	66	27	236

Source: Nathan Associates

In terms of countries, the 236 interviews conducted were distributed as follows: Kenya, 95 interviews (40 percent); Tanzania, 67 interviews (27 percent); Uganda, 27 interviews (10 percent); Burundi, 27 interviews (10 percent); and Rwanda, 29 interviews (13 percent).

The percent of CDS interviews conducted of those targeted is shown in Table 2.4 Overall 70 percent of the interviews targeted were actually conducted. In some instances, the persons targeted for the interview were not available due to other commitments or illness. In many instances, the CDS team was able to interview a knowledgeable colleague or associate of the person not available. The interview rate of 70 percent is considered acceptable and is above that achieved by other recent regional transport studies.

Table 2.4. Percent of CDS Interviews Targeted that were Conducted by Type of Organization and Country

Type and Size of Organization	Burundi	Kenya	Rwanda	Tanzania	Uganda	Total
Large Organizations						
Freight Forwarders	50	75	78	50	-	63
Transport Service Providers	0	81	100	94	60	85
Shippers	75	75	50	63	19	52
Government Entities	73	85	83	57	63	71
Subtotal	68	81	77	74	46	71
Small Organizations						
Freight Forwarders	100	100	25	100	40	69
Transport Service Providers	100	78	100	43	-	67
Shippers	100	100	25	100	57	65
Government Entities	-	-	-	-	-	-
Subtotal	100	88	40	71	43	67
All Organizations						
Freight Forwarders	70	91	53	78	33	66
Transport Service Providers	100	80	100	85	43	81
Shippers	86	77	40	67	30	55
Government Entities	73	85	83	57	63	71
Subtotal	77	82	64	73	45	70

Source: Nathan Associates

REPRESENTATIVENESS OF CDS INTERVIEWS CONDUCTED

Overall, a credible distribution of interviews by organization type, size and country was obtained relative to the CDS information requirements. For example, the number of interviews conducted allowed information needed for the *FastPath* methodology from different organizations to be compared and contrasted and for a both a high and low range of values to be defined as well as average or typical values. The number of interviews also permitted the analysis to probe further into subsequent issues that may have been only briefly mentioned in an earlier interview. Finally, the distribution of interviews conducted is generally representative of the size and complexity of each organization type in the five study countries. The percentage of small entities interviewed at 28 percent of non-government interviews, is consistent with the target rate of 30 percent and provided ample information and data on the particular issues, concerns, and logistics performance encountered by small entities.

The CDS interviews included organizations that deal with principal cargo types and commodities transported on the Northern and Central Corridors. This includes imports, exports and transit cargoes shipped in heavy and light containers, dry bulk and liquid bulk, and break-bulk. Interviews included those with institutions involved in shipments via road, rail, pipeline, maritime and lake ports. Principal commodities that were addressed in the interviews include manufactured goods, coffee, tea, cereals and milled products, sugar,

vegetable oil, clinker and stones, cement, fertilizer, steel and steel products, project cargo and petroleum and petroleum products. These products represent more than 80 percent of the commodities transported along the corridors.

Finally, the information obtained during the CDS interviews has been cross-checked with available information from actual invoices, published tariffs, and with discussions with unbiased third parties. The information will be further checked in the series of validation workshops that will be conducted in each country.

ADMINISTRATION OF THE CDS INTERVIEWS

Generally, interviews were conducted as open-ended group discussions organized as follows:

- Introductions
- Background discussion
- Major issues and problems
- Detailed discussion on specific areas
- Prioritization of concerns
- Planned and potential initiatives

During the interviews we addressed issues associated with trade competitiveness or the lack of it, quality of logistics services and logistics industry structure, management of supply chains, facilitation of trade and transport, transport services quality and exiting fleet capabilities and capacities, transport services variety and efficiency, regulation and enforcement of transport services, ongoing planned and proposed initiatives, among others. Data was collected and analyzed on transport logistics practices, behavior, and requirements, data on export and import transactions, identification of cost, time and reliability, cargo volumes, operational reports, and others. Detailed notes of the interviews were recorded and these notes have been entered into *FastPath* to derive estimates of time, cost and reliability of each corridor's performance by type of cargo, significance of the shipment by size, origin and destination pairs, and mode(s) of transport used.

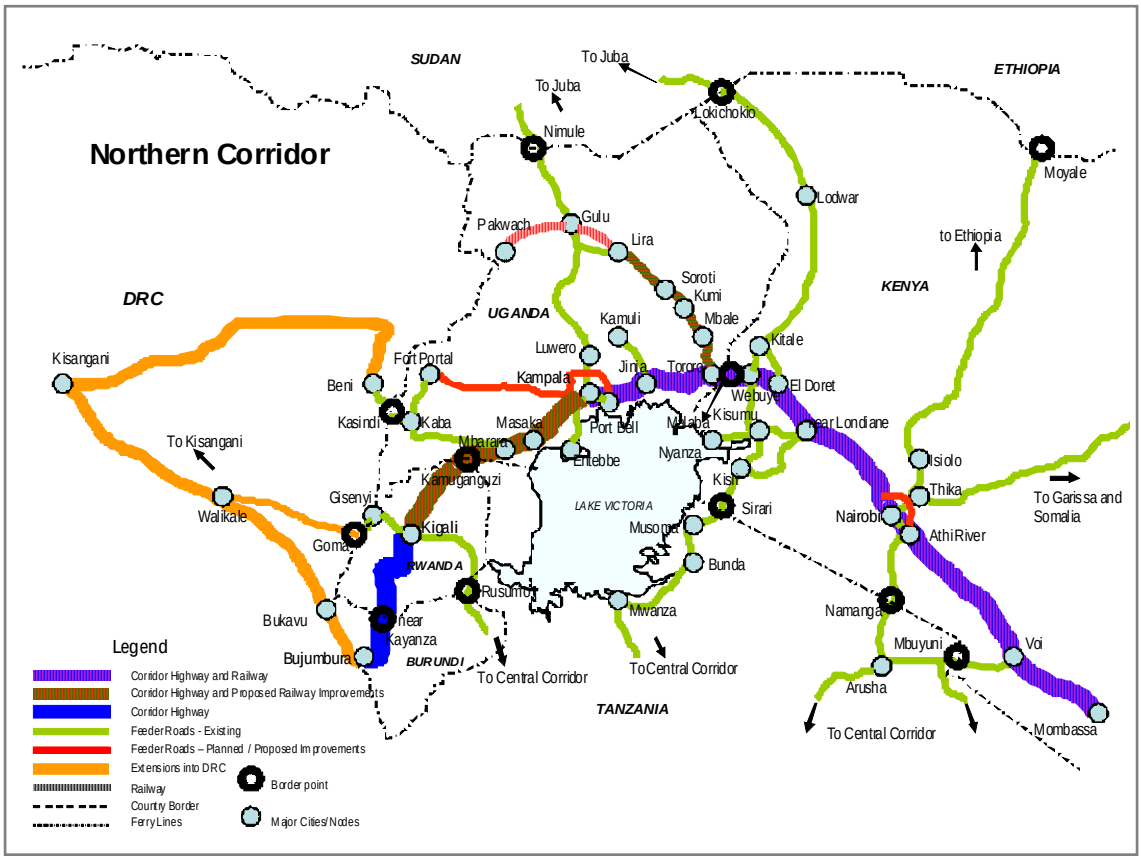
3. Corridor Infrastructure

This chapter presents the analysis of the existing conditions of the Northern and the Central Corridors that was conducted from November 2009 through September 2010.

Northern Corridor Existing Infrastructure and Condition

The Northern Corridor connects the Port of Mombasa to markets in Kenya, Uganda, Rwanda and Burundi as well as southern Sudan, eastern DRC and parts of northern Tanzania (see Figure 3-1). As such, it connects the entire East African Community to a major regional port and for intra-regional trade and personal mobility. The road connects four of the five East African Community (EAC) countries and is one of the six identified strategic corridors for the EAC. It also links the EAC to states on its periphery: Sudan, DRC and Ethiopia. It is strategic because of the importance of the Port of Mombasa to the region. Despite its centrality in regional development, there are still many facilitation problems.

Figure 3.1. Northern Corridor Network



Source: Nathan Associates Inc.

OVERALL NORTHERN CORRIDOR TRAFFIC

As presented in Table 3.1 in 2009 is estimated that 21.5 million tons were shipped via the Northern Corridor. Kenyan overseas trade accounted for 58 percent of the total corridor traffic with transit traffic next at 28 percent and regional trade at 14 percent.

Table 3.1. Northern Corridor Traffic by Type and Mode 2009 (000 tons)

Corridor and Type of Traffic	Road	Rail	Total	Rail Share (%)
Northern				
Transit	5,509	417	5,926	7
Regional	2,974	151	3,125	5
Domestic	11,817	622	12,439	5
Total	**20,300**	**1,190**	**21,490**	**6**

Source: Nathan Associates Inc.

Historically, the landlocked countries of Burundi, (Eastern) DR Congo, Rwanda and Uganda divide their overseas imports and exports between the Northern and Central Corridors, while Southern Sudan and Ethiopia only use the Northern Corridor.

MOMBASA PORT

As a multipurpose port, Mombasa handles containerized cargo, general cargo, dry bulk, and liquid bulk. In 2009 the total throughput of the port was 19.1 million tons; throughput has been growing at an average annual rate of 8.8 percent from 2002-2009. The predominant traffic of the port is imports, which represent 86.6 percent of the total traffic. For imports, 38.9 percent is liquid bulk, 28.1 percent is dry bulk, 24.7 percent is containerized cargo and only 8.2 percent is general cargo.

Table 3.2. Mombasa Port Traffic, 2002-2009 (000s tons)

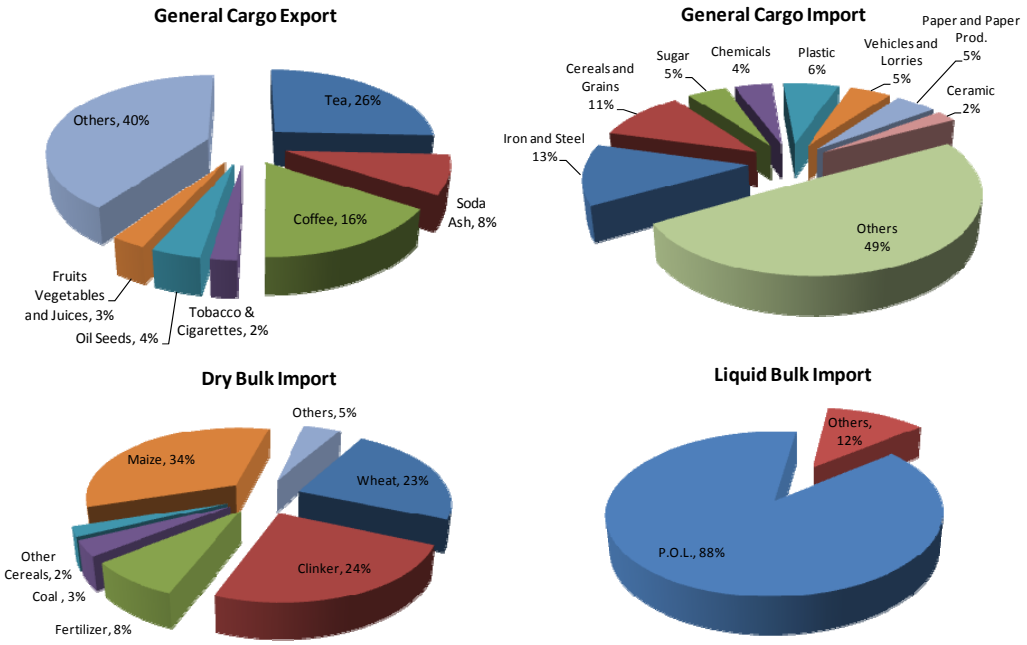
Type of Cargo	2002	2003	2004	2005	2006	2007	2008	2009	AAGR 2002-2009
Imports									
Containerized Cargo	1,624	2,228	2,599	2,645	2,970	3,761	3,959	4,086	14.1%
General Cargo	1,196	1,209	1,236	1,009	1,129	1,105	1,020	1,349	1.7%
Dry Bulk	1,098	1,404	1,588	2,128	2,344	2,722	2,891	4,641	22.9%
Liquid Bulk	3,926	4,491	4,595	4,918	5,403	5,474	5,441	6,431	7.3%
Total	7,844	9,332	10,018	10,700	11,846	13,062	13,311	16,507	11.2%
Transit Cargo[1]	1,875	2,186	2,590	3,202	3,473	4,042	4,471	4,612	13.7%
Exports									
Containerized Cargo	1,466	1,135	1,669	1,680	1,625	1,934	1,996	1,952	4.2%
General Cargo	241	208	198	139	185	168	299	269	1.6%
Dry Bulk	464	380	381	286	313	205	200	62	-25.0%
Liquid Bulk	209	271	246	173	132	167	190	167	-3.2%
Total	2,380	1,994	2,494	2,278	2,255	2,474	2,685	2,450	0.4%
Transit Cargo	340	266	300	334	335	381	404	368	1.1%
Total Imports and Exports	**10,224**	**11,326**	**12,512**	**12,978**	**14,101**	**15,536**	**15,996**	**18,957**	9.2%
Transhipment	340	605	409	303	318	426	419	105	-15.5%
Total Traffic	**10,564**	**11,931**	**12,921**	**13,281**	**14,419**	**15,962**	**16,415**	**19,062**	8.8%
Container Traffic (TEU's)	305,427	380,353	438,597	436,671	479,355	585,367	615,733	618,816	10.6%

Note 1: Included as part of total cargo

Source Kenya Ports Authority

Exports through the Port of Mombasa have been stagnant during the 2002-2009 period showing an average annual increase of 0.4 percent. Transshipment represents a minimal portion of the port traffic with only 0.5 percent participation in 2009; moreover the volumes of this type of cargo have been shrinking markedly in the last five years.

Figure 3.2. Mombasa Port Traffic Composition by Commodity, 2009

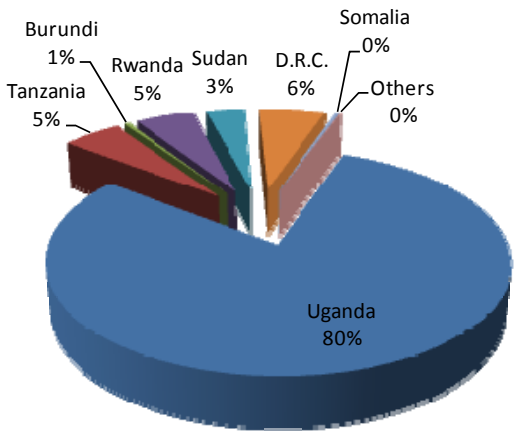


Source: Kenya Port Authority.

The main export commodities handled at the port are coffee, tea and soda ash accounting for about 50 percent of the total general cargo exports. In terms of general cargo imports, the most important commodities are iron and steel followed by plastic, rice, vehicles, sugar, paper and chemicals with similar participations between seven and four percent. Dry bulk imports are clearly dominated by maize, clinker and wheat, which account for 81 percent of the dry bulk imports total. Finally, petroleum, oil and lubricants represent 88 percent of liquid bulk imports.

Almost five million tons of transit cargo were moved through the port in 2009. By far, the most important origin / destination of transit cargo moved through Mombasa is Uganda, followed by D.R.C., Tanzania and Rwanda. Inbound and outbound transit flows with Tanzania have shrunken; imports towards Burundi and Somalia and exports from Rwanda have also decreased.

Figure 3.3. Mombasa Port Transit Traffic, 2009 (percent)



Source: Kenya Port Authority

The current layout of Mombasa Port is presented in Figure 3.4, and the characteristics of the port are presented in Table 3.3. The main physical constraint at the port is the access channel, which is narrow (200 m) and shallow (approximately 13.7 m). Nevertheless, there are plans to widen and deepen the channel, to construct an additional new container terminal at Kipevu West and to establish a petroleum terminal just down the coast where the water is deeper and to relocate the tank farm further from the city with safety and environmental benefits. Funds have already been secured for the new container terminal which will have three berths of 900 meters and 100 hectares of yard space.

Figure 3.4. Current Layout of Mombasa Port

Table 3.3. Characteristics of Mombasa Port

Item	Description
Natural Catchment Area	Kenya, Uganda, Sudan, Great Lakes region and Southern Ethiopia
Vol of freight – total, import, export mtpa	19 mtpa in 2009
No of berths, depths	16, 10.0m
Container Berths	5, total length 964m
Container Equipment , Capacity	4 x 40t gantry cranes, full capacity
Container Vols - total, Imp, Exp - TEUs	619,000 in 2009
Bulk berths & equipment	17 cranes, 5t to 20t
Marine Access	Channel 15km long, 13.7m deep, tide 2.5 to 4m
Road Access	Poor, congested
Rail Access	Via RVR
Current Operational Status	Fully operational, congested, only port serving Kenya
Specific Problems / Issues	Container dwell time, port congestion, recently improved.
Planned Developments	70-% of all cargo containerized – planned expansion of container terminal, improved road and rail access. Possible additional port at Lamu
Intervention / Assistance Required	No plans yet for container terminal privatization

Source: Nathan Associates Inc.

Container Facilities

Containers are handled in Mombasa in two types of facilities: (1) specialized container terminals and (2) conventional terminals. The conventional terminals also handle other, non–container cargoes. The specialized terminals handle about 70–80 percent of the total container throughput. Containers are not handled by direct delivery. The containers are first stored in container yards, stay several days inside the terminals and only then, are usually released.

Mombasa's specialized container terminal (Kipevu West), Berths 16–18, consists of:

- 650 m of marginal berthage with –10.2 m depth CD alongside and about 15 ha of backup area
- Four gantry, STS cranes
- RTG based container yard
- Back of terminal intermodal yard with two RMGs

The conventional terminal in Mombasa includes Berths 11–14 with a total of about 800 m of berthing length and a depth alongside of about –10 meters. This terminal also handles general

cargoes. Berths 13–14 are used exclusively for containers, mostly those of one shipping line (Maersk). All container handling in Mombasa's conventional terminal is by ship's gear. Mombasa has only one mobile harbor crane, but it is not presently used for ship handling.

Traffic of containerized cargo reached 619 thousand TEU in 2009 (Table 3.4). Preliminary data indicate that container traffic increased by 13 percent in 2010. The handling of empty containers is significant; it represents 34.6 of the total TEU handled at the port. This is a reflection of the imbalance between imports and exports flowing through the port.

Table 3.4. Mombasa Port Container Traffic, 2003-2009 (TEU)

Type	2003	2004	2005	2006	2007	2008	2009	AAGR 2003-2009
Imports								
Full	159.0	190.0	193.2	217.9	277.8	292.3	301.5	7.7%
Empty	14.0	14.0	14.6	11.6	4.2	5.1	6.4	-12.8%
Exports								
Full	78.0	91.0	94.1	86.3	101.3	102.9	95.8	0.3%
Empty	79.0	110.0	107.5	132.2	165.5	181.0	205.6	11.4%
Transhipment								
Full	44.0	29.0	22.3	21.8	30.5	30.3	7.4	-16.8%
Empty	6.0	5.0	5.0	9.5	6.0	4.2	2.1	-13.3%
Total								
Full	281.0	310.0	309.7	326.0	409.6	425.5	404.7	4.6%
Empty	99.0	129.0	127.0	153.3	175.8	190.2	214.1	9.1%
Grand Total	**380.0**	**439.0**	**436.7**	**479.4**	**585.4**	**615.7**	**618.8**	6.0%

Source: Kenya Port Authority

Mombasa container terminal is not designed according to the specifications of modern container terminals. The width is about 250 m, while modern terminals' width is usually 400–500 m. As a result, the backup area is limited. Moreover, there is no practical way of expanding the terminal areas since the marine port facilities are cordoned by the city or other private facilities. The small backup area provides for relatively small container yard. The resulting shortage in container yard currently is the main source of terminal congestion in the port.

A related and even more severe problem is traffic congestion inside and outside the terminal. The container yard seems to have difficulties in serving ship and gate traffic at the same time. During our visits at the terminal we observed long waiting lines of trucks inside the terminal and at both out and in gate. The result is that the STS cranes often wait for yard tractors, a major factor for the low crane productivity and subsequently low berth productivity.

CFS (or ICDs) were first permitted in Mombasa in 2007. At present, Mombasa has 17 CFS, about half of them handle containers. However, it is understood that only seven are presently handling import boxes.

NORTHERN CORRIDOR ROAD SYSTEM

The trunk road network of the Northern Corridor that stretches from Mombasa to Bujumbura via Malaba is 1,970 km and to Goma is 1,846 km. An assessment of the Northern Corridor road network was carried out by Aurecon for the East African Transport Strategy and Regional Road Sector Development Program conducted for the EAC in 2010. This assessment consisted of two major elements: road capacity and road condition.

Road Capacity and Other Characteristics

The evaluation of road capacity was based on level of service standards defined in Aurecon's First Order Network Assessment (FONA) model developed based on the Highway Capacity Manual (Transportation Research Board, 2000). Level of service (LOS) with indices ranging from A (best operating conditions) to F (worst operating conditions). The best operating conditions entail free flow high (design) average speeds and able to overtake easily. The road capacity of the Northern Corridor in terms of LOS is presented in Table 3.5. Approximately 22 percent of the trunk road is rated at a LOS of C or better; 38 percent of the road was rated at a LOS of D, while 45 percent of the road was rated poor at a LOS of E or F.

Table 3.5. Characteristics of the Northern Corridor Road Network

Corridor Name	Northern Corridor								Corridor Length (km)	1898 km	
Corridor Description	Mombasa Voi Eldoret Bigiri Kamala Masaka Kigali Kibuye Kayanza Bujumbura										
Lanes	1	2	Travel Speed	70km/h	80km/h	90km/h	Road Reserve			10.6m	17.6m
Length	1738 km	161 km	Length	852 km	890 km	158 km	Length			1738 km	161 km
	91.5%	8.5%		45%	47%	9%				92%	9%
Terrain	Level	Rolling	Mountain	Land-use	Urban	Rural	Surface			Paved	Unpaved
Length	131 km	1718 km	50 km	Length	329 km	1570 km	Length			1896 km	3 km
	7%	91%	3%		18%	83%				100%	1%
Number of Accesses / km	0 Accesses		1 Access		2 Accesses		3 Accesses			≥ 4 Accesses	
Length	1634 km		121 km		88 km		57 km			0 km	
	87%		7%		5%		3%			0%	
Traffic Volumes*	0-50	51-100	101-200	201-300	301-400	401-500	501-750	751-1000	1001-1500	1501-2000	
Length	55 km	106 km	784 km	466 km	326 km	38 km	52 km	70 km	5 km	0 km	
	3%	6%	42%	25%	18%	2%	3%	4%	1%	0%	
Corridor Performance (Level of Service)				A	B	C	D	E	F		
				Very Good	Good	Acceptable	Acceptable	Poor	Very Poor		
2010 (Base Year) Scenario				111 km	148 km	138 km	711 km	812 km	19 km		
				6%	8%	8%	38%	43%	2%		

Note: Traffic volumes are for the 30th highest hourly volume per direction.
Source: Aurecon, East African Transport Strategy and Regional Road Sector Development Program, 2010.

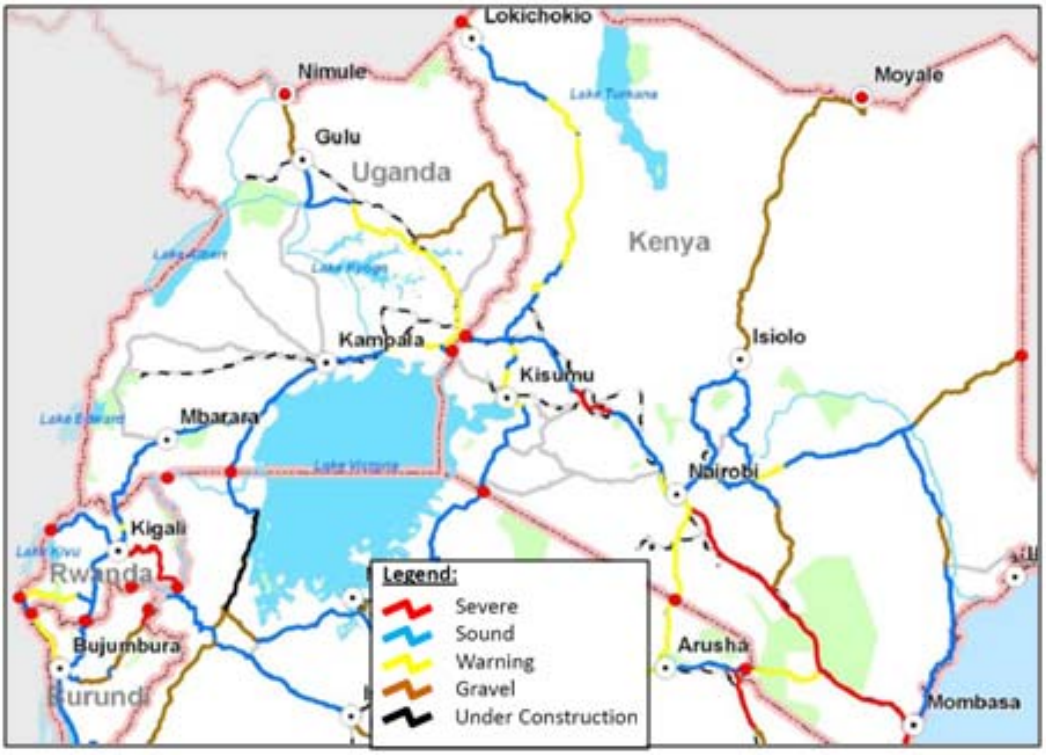
Road Conditions

Data obtained from the Primary and Secondary sources were used to determine the current condition status of the pavement structures of this EAC corridor (Table 3.5). The first and foremost indicator of the pavements' condition was pavement roughness, also referred to as riding quality. This objective measurement describes the distortion of the pavement surface

which contributes to an undesirable or uncomfortable ride. The unit for roughness is the International Roughness Index (IRI) ranging between 0 (Good) to 20 (Very Poor).

- Paved roads are typically maintained at roughness levels between 2 and 6 IRI. These roads require no immediate remedial action and are considered to be in a sound state.
- Paved roads that are approaching a severe state have typical roughness levels between 6 and 10 IRI. These roads are in warning state.
- Paved roads in a severe condition, requiring immediate remedial action have typical roughness levels above 10 IRI.

Figure 3.5. Condition Assessment of Northern Corridors Roads



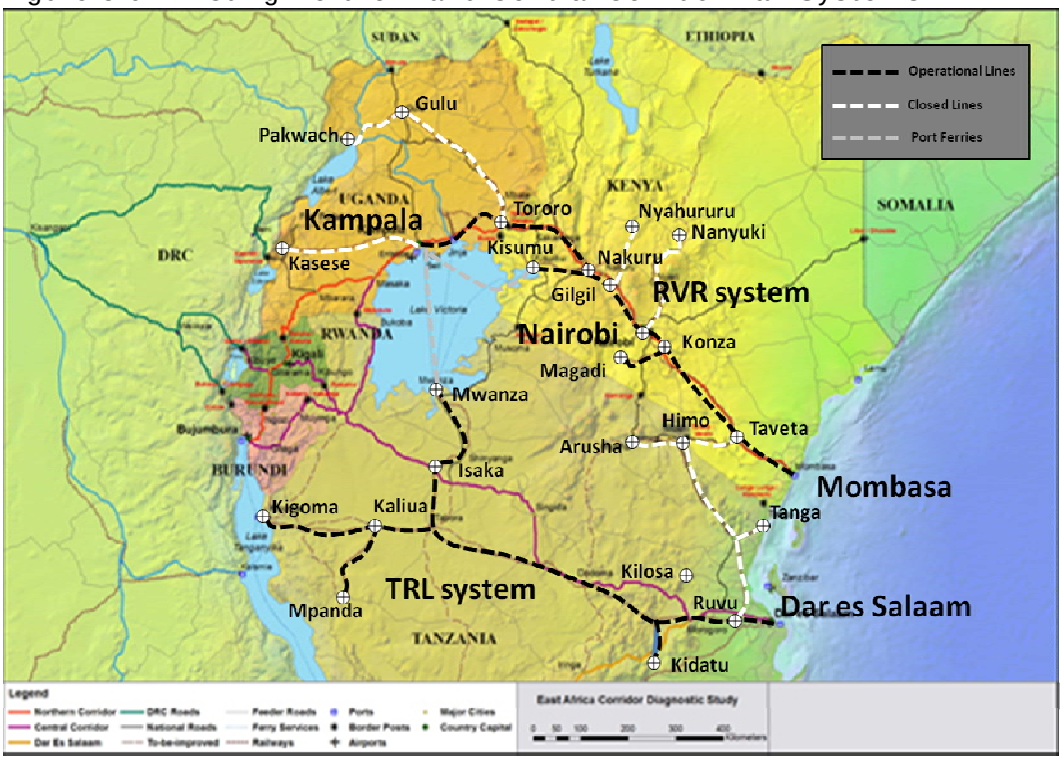
Source: Aurecon, East African Transport Strategy and Regional Road Sector Development Program, 2010.

RAIL SYSTEM

The Northern Corridor rail system (Figure 3.6) operates within Kenya and Uganda as a narrow gauge (1,000 mm) system, compatible with the Tanzania Railway Limited (TRL) system on the central corridor in Tanzania. The line extends from the port of Mombasa to Nairobi, and further to Malaba, connecting to the Ugandan rail system serving Kampala and on to Kasese close to the DRC border. There are several spurs, the most important being the line to Kisumu on Lake Victoria, and the spur to Magadi Soda south of Nairobi. The rail link to Tanzania is closed, because of low traffic demand. This is also the case for the line between Kampala and Kasese, and the northern Ugandan line from Tororo through Gulu to Pakwach

on Lake Albert, which has a road /rail bridge across the Nile. Rebel activity is also partly responsible for closure of this line, which was built as recently as the 1960s.

Figure 3.6. Existing Northern and Central Corridor Rail Systems



Source: Prepared by Nathan Associates Inc.

The condition of the Northern Corridor railway track is presented in Table 3.6. The poor condition of the track has lead to imposition of temporary speed restrictions on many sections across the track, resulting in about 20 derailments per day and unpredictable transit times.

Table 3.6. Condition of Northern Corridor Railways Tracks

Section	Length (km)	Condition of the track and rail weight	Needed intervention
KENYA			
Mombasa-Nairobi	530	Good/Fair: 95 lb/yard	Spot Rehabilitation Replacement of rails and slippers
Nairobi-Malaba	550	Good/Fair: 80 lb/yard	Replacement of rails and slippers Reconstruction of culverts
Nakuru-Kisumu	217	Fair/poor: 80 lb/yard (60 km) and 60 lb/yard (160 km)	Improvement of track of 160 km Reconstruction of culverts and viaducts
UGANDA			
Malaba-Kampala	250	Fair/poor	Rehabilitation of the line including bridges
Port Bell-Kampala	10	Good	
Kampala-Kasese	332	Poor	Rehabilitation

Source: NCIMPS, Interim Report.

RVR inherited thirty-nine mainline (Class 93/94) diesel electric locomotives from KRC, which form the core of the mainline fleet. These locomotives are North American GE U26Cs, fitted with 2,600hp engines. A total of twenty-six were built in 1977 and the remainder in 1987 or later. The bulk of the mainline fleet is therefore thirty-seven years old, but continues to remain serviceable and suitable for rehabilitation and upgrading. In southern Africa, many of the mainline locomotives still in service are more than fifty years old, and continue to be serviceable.

On the RVR Uganda section between Malaba and Kampala, the mainline locomotives are much smaller, similar to those used on the TRL system in Tanzania, 1200hp. During the 1980's the Nalukolongo railway workshop near Kampala was equipped and upgraded through a €40 million program by KfW, and it is well qualified to carry out full refurbishment of the Uganda locomotives, subject to financing being available. The longer term objective would be to replace the Uganda locomotives with larger units similar to those operated in Kenya, to allow for seamless railway operations.

LAKE TRANSPORT

A description and assessment of the lake ports and transport on Lakes Tanganyika and Victoria that serves both corridors is presented in Chapter 3 on the Central Corridor.

BORDER CROSSINGS

Border crossings within the region are characterized by poor infrastructure, inadequate coordination and congestion. The busiest and most congested border on the route is at Malaba between Kenya and Uganda. One stop border post (OSBP) operations are being introduced on all the Northern Corridor borders with support from the World Bank and African Development Bank as part of the East Africa Trade and Transport Facilitation Project. Under this project, the World Bank is supporting new border facilities at Malaba and Gatuna/Katuna on the Uganda/Rwanda border and the African Development Bank is supporting feasibility studies for OSBP at Akinyaru/Kinyaru Haut on the Rwanda/Burundi border, Gisenyi/Goma on the Rwanda/DRC border and Mpondwe/Kasindi on the Uganda/DRC border. The regional OSBP legal framework being developed by the East Africa Community with support from JICA provides the legal jurisdiction and structure, operating principles and methods of coordination. The approval process has involved all border agencies as has the joint planning for the new OSBP border facilities. Continuing support for this coordination is critical.

Cargo clearance can be done at the border, but in most cases is done at inland clearance centers, most in capital cities. Where clearances are not done at the border, the border clearance is generally done in a few hours. Nevertheless, the process is not done and the 1-3 day final clearance should be seen as part of the overall process. In the following discussion of corridor performance, the term border is used to describe the cost and time spent at the

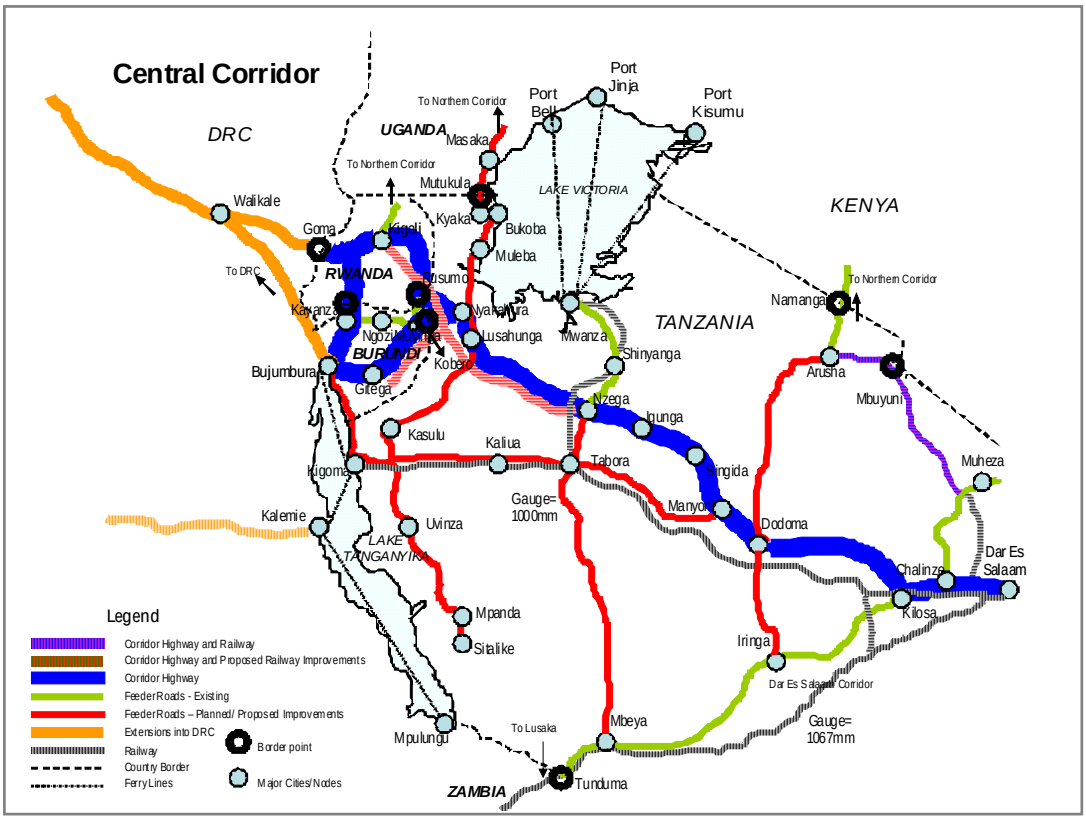
border plus the average time at the final inland clearance point. In terms of improving facilitation on the Northern Corridor, both control points are important.

Most of the trucks operating on the route are Kenyan-owned since it is easier for them to arrange cargo from the port and then seek return hauls in the other countries. Nevertheless, the cargo is significantly imbalanced in favor of imports and many return hauls are empty. The Kenyan road transporters have a very active association, the Kenya Transport Association, which represents their interests at the port and with government agencies concerning the regulations that affect their operations. Freight forwarders are represented with national and regional associations. These associations will be important "drivers" for more effective transport facilitation measures on the Corridor.

Central Corridor Existing Infrastructure and Condition

The Central Corridor connects the Port of Dar es Salaam to markets in Tanzania, Burundi, Rwanda, Uganda and DRC (See Figure 3.7). It connects the entire East Africa Community to a major regional port for overseas trade and connects the EAC partner states and DRC for intra-regional trade and personal mobility. The Central Corridor connects all of central and northern Tanzania itself with branches to Burundi, Rwanda and Uganda and through them to DRC. Several road sections have just been paved within the last four years, making it a recent option for competitive cross border trade using the Port of Dar es Salaam. The rail network is also extensive, though in need of some rehabilitation. The railway goes to Mwanza on the southern shore of Lake Victoria where rail ferries make an 18 hour connection to Port Bell and nearby Kampala in Uganda or to Kisumu in Kenya. The railway also connects to Lake Tanganyika at Kigoma Port, for vessel connections to Bujumbura Port, Burundi and Kalemie and Uvira Port in DRC. These were previously major multimodal routes and, with better rail service, would be important again. Much of the road from Dodoma to Kigoma is not paved. Tanroads has begun construction of this part of the Central Corridor to make it a road and rail route. There are no rail connections to Burundi and Rwanda, but several feasibility studies have been carried out to determine the feasibility of an extension to Kigali and to the nickel deposit area of western Tanzania and eastern Burundi. The Central Corridor offers Burundi, Rwanda and the Goma/Bakavu area of DRC a shorter route to a major port. Despite its importance to the region, there are still many facilitation issues to be addressed. Competition between the Central and Northern Corridor for the traffic of the Great Lakes should improve performance on both Corridors.

Figure 3.7. Central Corridor Network



Source: Nathan Associates Inc.

Overall Central Corridor Traffic

The total traffic on the Central Corridors in 2009 is estimated at 7.1 million tons. More than 83 percent of the traffic on the Central Corridor was domestic, that is, Tanzanian trade to overseas countries. Regional trade and transit traffic accounted for 10 percent and 7 percent, respectively of the remaining Central Corridor traffic.

Table 3.7. Central Corridor Traffic by Type and Mode 2009 (000 tons)

Corridor and Type of Traffic	Road	Rail	Total	Rail Share (%)
Central				
Transit	357	111	468	24
Regional	658	32	690	5
Domestic	5,617	296	5,913	5
Total	**6,632**	**439**	**7,071**	**6**

Source: Nathan Associates Inc.

Historically, the landlocked countries of Burundi, (Eastern) DR Congo, Rwanda and Uganda divide their overseas imports and exports between the Northern and Central Corridors, while Southern Sudan and Ethiopia only use the Northern Corridor.

PORT OF DAR ES SALAAM

The Port of Dar es Salaam has been increasing its overall vessel traffic by 3.9 percent per year and overall cargo traffic by 8.6 percent between 2000 and 2009. Total traffic through the port was 8.1 million tons in 2009. Container traffic in TEUs has been increasing at 12.3 percent per annum from 2000 - 2009 and reached 373,548 TEUs in 2009. The container terminal at the Port of Dar es Salaam was given in concession in 2000 and realized a considerable improvement in handling and dwell times. The container terminal, however, is constrained by space limitations and increased traffic through the port led to congestion that caused deterioration in port performance indicators. It is now using container freight stations (ICDs) to move cargo out of the port for all clearance procedures and alleviate the congestion at the Container Terminal and at the gate.

Table 3.8. Dar Es Salaam Port Traffic ('000 Tons)

Type of Cargo	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	AAGR 2000-2009
Imports											
Containerised	727.2	849.7	895.9	1,024.1	1,265.2	1,372.0	1,347.2	1,915.7	2,171.7	2,056.0	12.2%
General Cargo	699.6	585.6	586.7	500.3	652.9	548.1	701.7	557.0	588.8	657.9	-0.7%
Dry Bulk	376.9	503.1	544.8	719.1	839.1	972.3	1,115.9	1,129.4	904.3	1,270.1	14.5%
Liquid Bulk	1,254.2	1,573.8	1,603.4	1,798.3	2,006.4	1,936.6	2,060.7	2,074.4	2,142.3	2,645.6	8.6%
Total	3,057.9	3,512.2	3,630.7	4,041.8	4,763.5	4,829.0	5,225.4	5,676.5	5,807.2	6,629.6	9.0%
Exports											
Containerised	458.9	458.7	459.5	604.0	673.3	801.2	757.0	987.4	1,068.1	1,067.4	9.8%
General Cargo	219.9	168.4	211.2	238.0	187.4	172.8	205.6	282.4	122.0	148.2	-4.3%
Liquid Bulk	66.3	38.6	53.6	39.5	54.3	77.2	41.4	47.2	52.6	43.8	-4.5%
Total	745.1	665.8	724.3	881.4	914.9	1,051.2	1,004.0	1,317.0	1,242.7	1,259.4	6.0%
Imports and Exports	**3,803.0**	**4,177.9**	**4,355.1**	**4,923.2**	**5,678.5**	**5,880.2**	**6,229.4**	**6,993.5**	**7,049.9**	**7,889.0**	**8.4%**
Transhipment	31.5	93.4	168.7	245.8	375.6	404.9	428.1	433.8	354.5	213.0	23.6%
Bunkers	1.6	0.3	0.7	-	-	-	-	-	16.8	0.9	-5.7%
Total Traffic	**3,836**	**4,272**	**4,525**	**5,169**	**6,054**	**6,285**	**6,657**	**7,427**	**7,421**	**8,103**	**8.7%**
Container TEU's	124.6	141.7	141.4	167.7	199.3	228.7	240.6	334.0	373.5	353.7	12.3%

Source: TPA.

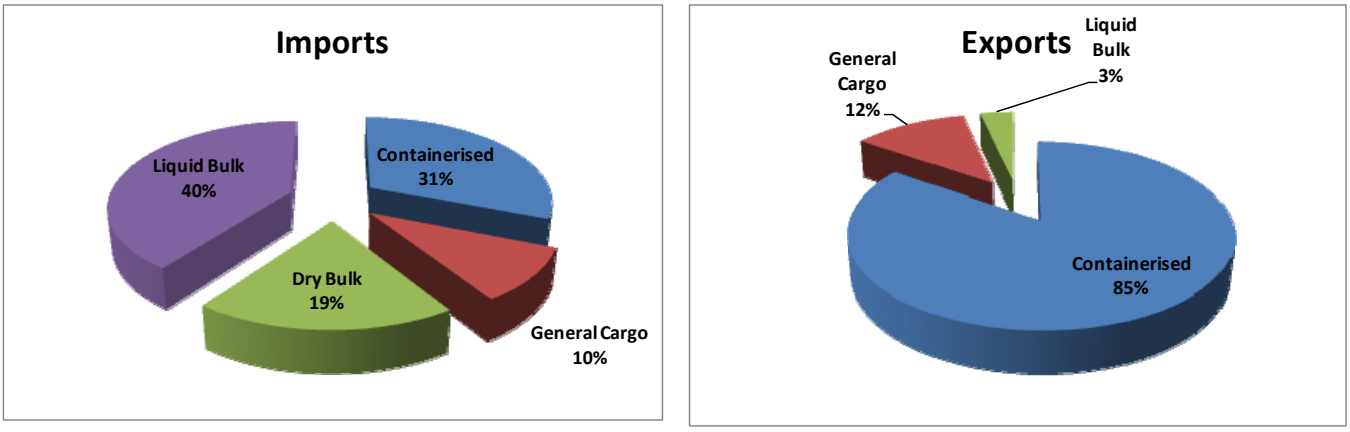
Figure 3.8 illustrates the current design and usage of the port terminals. Current container operation is at Berth 8-11, operated by the concessionaire Tanzania International Container Terminal Services Ltd (TICTS). The rapid growth of containerized traffic has meant that Berth 8 was added to the container terminal operated by TICTS and Tanzania Ports Authority has handled some containers at Berth 7 and Berth 4. In addition, the container yard has also occupied some of the storage behind the break bulk terminal. These factors have led to the plan for an additional container terminal at Berth 13 – 14. The liquid bulk terminal is currently upstream of TICTS, and also operating well over capacity. The construction of a new single point mooring, to replace the old one which is no longer functioning, will help to alleviate this problem.

Figure 3.8. Layout of Dar es Salaam Port

Source: Tanzania Port Master Plan.

In 2009, imports constituted 82 percent of the total traffic through the port. Of imports, 40 percent is liquid bulk, 31 percent is containerized cargo, 19 percent is dry bulk and 10 percent is general cargo. Exports constituting 18 percent of total traffic through the port, were 85 percent containerized. Additionally, 3 percent is liquid bulk and 12 percent is general cargo.

Figure 3.9. Dar Es Salaam Traffic by Cargo Type, 2009

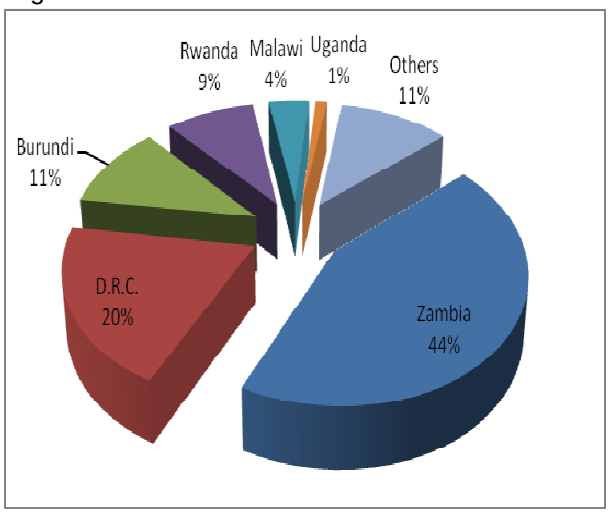


Source: TPA.

About 40 percent of the cargo through the port of Dar es Salaam is transit traffic, hence a significant part of port business. The port of Dar es Salaam serves two major corridors, the Central Corridor already defined and the Dar es Salaam Corridor which serves southwestern Tanzania, Zambia Malawi and DRC. It is one of the major outlets for the copper belt handling export of copper, cobalt and other minerals and import of equipment, parts and supplies for the mines, in addition to meeting the demand of this region for consumer goods. As illustrated, currently 64 percent of the transit traffic is on the Dar es Salaam Corridor, while

about 36 percent is on the Central Corridor. Different parts of DRC use both routes for overseas traffic, making this percentage approximate. Both catchment areas for the port rely on several corridors making for a competitive transport environment. The percentages reflect the distance from the port. Of the other EAC partners, Burundi is the closest and Uganda the farthest.

Figure 3.10. Transit Traffic Distribution 2009



Source: TPA.

Table 3.9 provides basic data on the port of Dar es Salaam the size, equipment, access and current operational features and plans. A major problem is the depth of the harbor which restricts the vessel size and adds the turnaround time for vessels and reduces berth usage. Part of the port development plan is to dredge the channel and terminal to allow the port to achieve economies of scale from larger vessels. Access for both road and rail is poor and needs to be addressed. Port congestion has been a major problem affecting wait time to enter the channel, time to unload and load, and dwell time in the port. The introduction of ICDs to act as extensions of the port in clearing domestic imports has reduced all these performance indicators, but as the following section will illustrate the port still needs to address the time factors. Dwell time has been reduced to 12 days, but should still be reduced substantially.

Table 3.9. Characteristics of the Dar es Salaam Port

Item	Description
Natural Catchment Area	All Tanzania, Great Lakes region, Uganda, Zambia, DRC, Malawi
Volume of freight – total, import, export mtpa	8.1 mtpa in 2009
No of berths, depths	11, up to 10.1m, total length 550m
Container Berths	3 – 12Ha, operated by TICTS / Hutchinson
Container Equipment , Capacity	250 000, congested, 3x40t gantries, 13 rubber tired cranes, 14 front end loaders, 13 forklifts
Container Vols - total, Imp, Exp - TEUs	350,000, mostly imports
Bulk berths & equipment	Bulk grain, including grain bagging facilities, no mineral berths
Marine Access	Via 2 km channel
Road Access	Road condition and access poor at port, congested
Rail Access	Via TAZARA and TRL – poor service and access
Current Operational Status	Fully operational, congested, delays, import dwell time 12 days, ship waiting 10 day before, now zero
Specific Problems / Issues	Congestion in port and city, 11 inland terminals licensed, 6 operational, road and rail access poor
Planned Developments	Container terminal to be extended berths 13 &14, maintenance and capital dredging required. Additional Inland Container Freight Station being planned
Intervention / Assistance Required	Assistance with operational planning and systems, funding required. Port master plan completed in 2008

Source: Tanzania Port Master Plan.

Container Facilities

Containers are handled in Dar es Salaam in two types of facilities: (1) Specialized Container Terminals and (2) Conventional Terminals. Once containers are unloaded they are moved to stacks, originally all within the container terminal. Due to congestion and the use of ICDs to extend the capacity of the port, by 2008 only about 37 percent of containers were actually kept in the TICTS container yard, while 32 percent were kept at the ICDs during clearing and the remainder elsewhere in the port. The specialized terminal handles up to its capacity and then off-loading is scheduled with TPA. In interviews with one of the shipping lines, he indicated a preference for waiting for TICTS rather than using a conventional berth because of the greater efficiency. Table 3.10 below shows the continuous growth in containerized imports with an average growth rate between 2000 and 2009 of 12.7 percent and of exports of 10.4 percent. It also indicates the volume of empties handle by the port. Interview indicated that there was sufficient depot storage for empties at the port of Dar es Salaam.

Table 3.10. Dar es Salaam Container Traffic 2000-2009 ('000 TEUs)

Type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	AAGR 2000-2009
Imports											
Full	56.7	60.3	68.6	86.1	99.6	108.8	121.6	147.0	161.4	165.9	12.7%
Empty	5.5	5.3	4.5	4.0	5.9	5.6	3.2	0.7	0.6	1.7	-12.4%
Exports											
Full	26.1	27.7	28.3	39.2	43.9	53.3	49.1	54.3	58.7	63.7	10.4%
Empty	34.4	38.9	40.0	38.4	49.8	59.8	68.8	81.0	95.7	106.0	13.3%
Transhipment											
Full	2.0	6.3	24.8	36.6	55.6	61.0	60.4	56.8	38.2	16.4	26.5%
Empty	-	-	-	-	-	-	-	-	-	-	-
Total											
Full	84.7	94.3	121.7	162.0	199.2	223.0	231.1	258.1	258.3	246.1	12.6%
Empty	39.9	44.1	44.5	42.5	55.7	65.3	72.0	81.8	96.3	107.7	11.7%
Grand Total	**124.6**	**138.4**	**166.2**	**204.4**	**254.9**	**288.4**	**303.1**	**339.9**	**354.6**	**353.7**	12.3%

Source: TPA.

Presently, Dar es Salaam has six licensed ICDs, with five additional ICDs under development. We visited two ICDs, TRH and Azam. TRH is the largest of Dar es Salaam's ICDs and closest to the port, located about 2 km away. This ICD began operations in 2007 with 17 ha and has the potential to grow to 35 ha. In comparison, Dar es Salaam's specialized container terminal only has about 13 ha. The main ICD's facilities include a large container yard based on concrete pavers, modern reachstackers (RS), warehouses, Customs inspection shed and administration building, which also has offices for Customs and TPA. The complex is surrounded by security fence with steel gates and around-the-clock security. Azam is relatively small ICD, with a total area of about 4 ha, located about 7 km away from the port. Like TRH, the facilities, including container yard, sheds and offices are new and well maintained. Both ICDs have short access roads connecting them to the main highway leading to the port. Interestingly, both access roads are unpaved, with deep potholes, which turn muddy during rainy days. These roads also often get congested. Both ICDs declared their desire to finance the improvement of these roads but are not allowed by the City. Both ICDs are well kept.

CENTRAL CORRIDOR ROAD SYSTEM

The Central Corridor was originally a combination of paved and gravel road links. The Central Corridor Road Project, which is nearing completion, involved rehabilitation (517 km), construction (527 km) and routine maintenance (200 km). Construction is planned and managed by TanRoads, which also designs and manages the weighbridges to control overloading on the route. When weighbridges where placed in the newly constructed/rebuilt Central Corridor in 2006, TanRoads envisioned about 7 weighbridges at points where additional traffic enters the corridor. There are now 7 fixed and 3 mobile weighbridges on the route, as well as customs and police checkpoints. All of these affect the flow of traffic on the

route. Transport demand has been increasing rapidly and the choice of a fully paved route to the Port of Dar es Salaam offers a shorter route for Rwanda and Burundi than the Northern Corridor to Mombasa. Assuming good road, rail and port performance, it interjects competition between the Central and Northern Corridors that should drive cost down and facilitate improvements.

An assessment of Central Corridor road network was carried out by Aurecon for the East African Transport Strategy and Regional Road Sector Development Program conducted for the EAC in 2010. This assessment consisted of two major elements: road capacity and road condition.

Road Capacity and Other Characteristics

The evaluation of road capacity was based on level of service standards defined in the Highway Capacity Manual (see Table 3.11). Level of service with indices ranging from A (best operating conditions) to F (worst operating conditions). The best operating conditions entail free flow high (design) average speeds and able to overtake easily.

Table 3.11. Characteristics of the Central Corridor Road Network

Corridor Name	Central Corridor								Corridor Length (km)	3100 km
Corridor Description	Dar es Salaam – Morogoro – Dodoma – Singida – Nzega – Nyakanazi – Kigali - Gisenyi									
Lanes	1	2	Travel Speed	70km/h	80km/h	90km/h	Road Reserve	10.6m	17.6m	
Length	3026 km	74 km	Length	152 km	1419 km	1529 km	Length	3026 km	74 km	
	97.7%	2.3%		5%	46%	50%		98%	3%	
Terrain	Level	Rolling	Mountain	Land-use	Urban	Rural	Surface	Paved	Unpaved	
Length	1506 km	1594 km	0 km	Length	125 km	2975 km	Length	2651 km	449 km	
	49%	52%	0%		5%	96%		86%	15%	
Number of Accesses / km	0 Accesses	1 Access	2 Accesses	3 Accesses	≥ 4 Accesses					
Length	2382 km	428 km	164 km	86 km	41 km					
	77%	14%	6%	3%	2%					
Traffic Volumes*	0-50	51-100	101-200	201-300	301-400	401-500	501-750	751-1000	1001-1500	1501-2000
Length	2413 km	397 km	0 km	160 km	0 km	83 km	24 km	9 km	11 km	6 km
	78%	13%	0%	6%	0%	3%	1%	1%	1%	1%
Corridor Performance (Level of Service)	A	B	C	D	E	F				
	Very Good	*Good*	*Acceptable*	*Acceptable*	*Poor*	*Very Poor*				
2010 (Base Year) Scenario	0 km	67 km	142 km	144 km	9 km	0 km				
	0%	3%	5%	5%	1%	0%				
2020 5% Traffic Growth Scenario	0 km	67 km	142 km	108 km	43 km	3 km				
	0%	3%	5%	4%	2%	1%				
2020 8% Traffic Growth Scenario	0 km	67 km	142 km	106 km	39 km	9 km				
	0%	3%	5%	4%	2%	1%				

Note: Traffic volumes are for the 30th highest hourly volume per direction.
Source: Aurecon, East African Transport Strategy and Regional Road Sector Development Program, 2010.

Road Conditions

Data obtained from the Primary and Secondary sources were used to determine the current condition status of the pavement structures of the EAC corridor. The first and foremost indicator of the pavements' condition was pavement roughness, also referred to as riding quality (see Figure 3.11). This objective measurement describes the distortion of the pavement

surface which contributes to an undesirable or uncomfortable ride. The unit for roughness is the International Roughness Index (IRI) ranging between 0 (Good) to 20 (Very Poor).

- Paved roads are typically maintained at roughness levels between 2 and 6 IRI. These roads require no immediate remedial action and are considered to be in a sound state.
- Paved roads that are approaching a severe state have typical roughness levels between 6 and 10 IRI. These roads are in warning state.
- Paved roads in a severe condition, requiring immediate remedial action have typical roughness levels above 10 IRI.

The second indicator of pavement condition was an overall condition index, also referred to as the Visual Condition Index (VCI). Visual assessments are a cost effective method of gathering information to describe the functional and structural condition of a road's pavement.

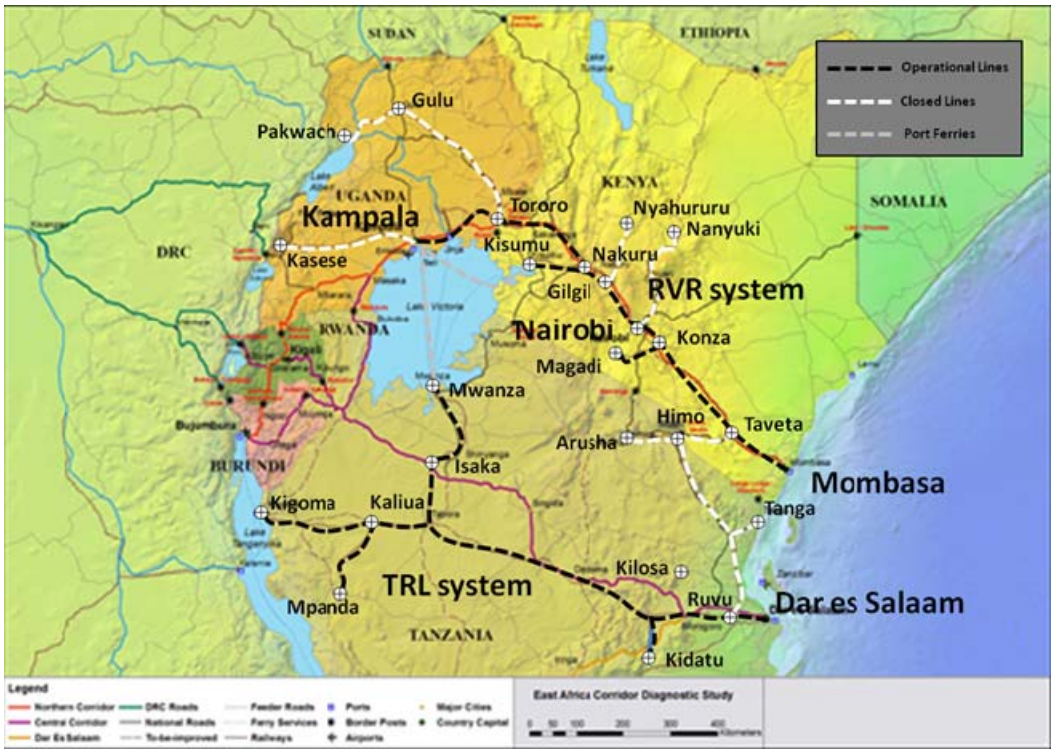
Figure 3.11. Condition Assessment of Central Corridors Roads

Source: Aurecon, East African Transport Strategy and Regional Road Sector Development Program, 2010.

RAIL SYSTEM

The Central Corridor railway system operates within Tanzania as the Tanzania Railways Limited, (TRL). The concession operator was Rites from India and railway assets are controlled by RAHCO, which is a state owned company. The system consists of about 2600 km of 1000 mm gauge track, generally light 30 kg/m rail with 15-ton axle loads. Some sections have gradually been upgraded to 45 kg/m and 18-ton axle loads. The condition of the equipment fleet of 109 locomotives and 1,670 wagons is uncertain, given the operating cash flow problems since it was given in concession. Due to the poor condition of the track, speed restrictions of between 13 km/hr and 50 km/hr are imposed on many sections. Train turnaround time between Dar es Salaam and Mwanza or Kigoma is typically 18 days, rather than the scheduled 10 days, with the consequent increase in operating costs.

Figure 3.12. Existing Central Corridor Rail System



Source: Nathan Associates Inc.

LAKE TRANSPORT

Lake Victoria ferries serve to provide another connection between Kenya, Uganda and Tanzania. Ferries link through the port of Kisumu (Kenya) to Kenya's railway and road network, through Mwanza (Tanzania) to the Central Corridor and Tanzania's railway system, and through Port Bell and Jinja (Uganda) to the Northern Corridor and Uganda's road network.

The system is currently suffering from outdated ports, lack of equipment at the ports and an extremely old fleet of small ferries. The current system is based on rail ferries which can handle 22 wagons on a roll on-roll off basis at Kisumu and Port Bell (15 minutes from Kampala). It was previously use to carry fuel and other goods to Kampala to overcome the necessity of locomotive and train reconfiguration at the Uganda border. Kenya has put its ferry back into commission and Uganda is rehabilitating their two ferries to revive this service and the one to Tanzania. There is also active private vessel haulage among the ports on Lake Victoria.

Maritime and port operations on Lakes Tanganyika and Victoria have a significantly different structure and modus operandi. Lake Victoria has a much more modern and viable merchant fleet particularly with respect to passenger and RoRo ferry operations. They also have a more

energetic private sector operating both shipping and port facilities. The public rail and port sector, however, lags well behind the private sector in developing its facilities and providing modern port services to the merchant fleet and shipping community. Paradoxically, on Lake Tanganyika with the exception of a few new constructions the shipping fleet is very old and antiquated while the ports, particularly Bujumbura, are reasonably well developed and have been investing in their infrastructure to upgrade their facilities.

Vessels

The "Integrated Transport Strategy – Lakes Tanganyika and Victoria" study developed by Marine Logistics Ltd. (MLL) for the Central Development Corridor (CDC) Spatial Development Initiative (SDI) project, February 2009 identified 23 vessels operating on Lake Tanganyika of which 56.5 percent were 50 years or older and six were laid up or inoperable. There were only three operating tugs on the lake, one in the Port of Kigoma and two in the Port of Bujumbura. Of the eight dry cargo barges in the fleet, only two have a total cargo capacity of 1,014 tons. In addition, only three general cargo vessels with a total capacity of 1,500 tons and three combo carriers with a total capacity of 74 TEUs were available for handling general or container cargo. Bujumbura was the sole port that had the capacity for handling LoLo containers in the northern part of the lake. Most of its recent container traffic was coming from Zambia due to the four months closure of the rail service to Kigoma. By May 2010, the Port of Kigoma was expecting a new mobile harbor crane capable of handling containers in September. However, the design and age of the wharf will limit its effective use to less than 100 m of the quay.

On Lake Victoria the situation is a little different. The vessels are not nearly as ancient as those on Lake Tanganyika (with the oldest dating to 1938). However, according to the MLL study, of the 42 vessels that were listed ten were laid up. There were 13 operating passenger/general cargo vessels, and seven relatively new car ferries that were oriented primarily to the local markets. There were only two general cargo vessels of less than 200 GRT and three small tankers serving the transit markets.

Port Facilities

Since most of the main Lake Victoria ports 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. Five of these vessels were built between 1964 and 1979 of which one has sunk, two are laid up (Uganda), one has been reconditioned and waiting for Lloyds Certification (Kenya) and one is in operation (Tanzania). They are capable of carrying 19 rail wagons each (equivalent to 38 TEUs). During the first semester of 2010, the Tanzanian ferry has not been in operation because of repairs to the mainline rail track between Dar es Salaam and Dodoma.

Of the six ports only Bujumbura has made a major investment in the port infrastructure in the last two decades. The main quay, which was built between 1939 and 1957, was rehabilitated in 1990 in which the 100 m wide apron was resurfaced in concrete and new crane rails and

bollards were installed. In addition, the 50 year old rail mounted derrick cranes were rehabilitated in 2001. The only other infrastructure project under way is the dredging of the Port of Kigoma and the rehabilitation of its slip ways.

With the exception of Bujumbura, the ports have some serious infrastructure problems. The Ports of Kigoma and Mwanza have bi-level pile supported quays in which the bottom water side level is only six meter wide. The top level, which is approximately one meter higher, was added in response to a rise in water level by simply adding a facing wall on top of the old deck and filling in dirt and gravel behind it. The Port of Kisumu essentially did the same thing but topped the entire original apron so that the quay is at one level, albeit surfaced with gravel. In all cases the original quays or piers, as in the case of Port Bell and Jinja, were built between 1920 and 1930. Consequently there are serious questions regarding their weight bearing capacity and suitability for supporting heavier cranes. On Lake Victoria, the rail links at each of the ports are relatively well maintained except for Jinja which has deteriorated to the point of being unusable.

Equipment

Bujumbura is the best equipped of all the ports with four operating 5 ton rail mounted shore cranes, one fixed and one mobile container crane of 50 ton capacity, two 25 ton and twelve 4.5 ton forklifts, one yard tractor and one 80 ton weigh bridge. Kigoma is also relatively well equipped; it has two of three 60 year old rail mounted derrick cranes working and a 105 m wide rail mounted bridge crane of 35 tons operating in the container yard, three working yard tractors, and ten working forklifts.

With regards to the four ports on Lake Victoria, all are inadequately equipped. In Mwanza the two 5 ton jetty cranes were manufactured in 1929 and only one is still operational at a max of three tons. They have only one operating forklift which is used in the warehouse. All ship shore operations are primarily done using manual labor. There is one farm tractor used for shunting the rail cars on and off the wagon ferry. They also have two relative new floating dry docks that are fully functional. The largest is 100m x 24m with a lifting capacity of 2,100 tons while the smallest is 70m x 13m with a lifting capacity of 860 tons. However, the machine and repair shops are rather limited in scope and equipment.

Kisumu, Port Bell and Jinja do not have any working cargo handling equipment at all and consequently do not handle containers unless they are on a rail wagon. When a crane is needed it has to be rented from the associated towns. Kisumu, however, does have a built in functional dry dock 100m x 30m with a 6m draft. It is equipped with a swinging gate that is opened and shut using a 250 horse power tug built in 1958. The facility also includes one slipway under rehabilitation and one that is beyond use. It also has the most fully equipped machine, carpentry, and fabrication shops of the ports that were visited. The Port of Kisumu is also associated with a dry port operated by the KPA that is approximately three kilometers from the port.

BORDER CROSSINGS

Border crossings within the region are characterized by poor infrastructure, inadequate coordination and congestion. The East African Community has committed to introducing one stop border post (OSBP) operations at all its main internal borders and is also introducing OSBP at borders with countries outside the EAC. The regional OSBP legal framework being developed by the East Africa Community with support from JICA provides OSBP legal jurisdiction and structure, operating principles and methods of coordination. Through this framework, common practices will be introduced and harmonized throughout the Community. The OSBP Act approval process has involved all border agencies as has the joint planning for the new OSBP border facilities. Continuing support for this coordination is critical.

On the Central Corridor borders, support is being given by several cooperating partners. On the border between Tanzania and Rwanda at Rusumo, there is need for a new bridge to replace the single lane one, which is there and not built to handle the maximum allowable weights on the route. JICA is supporting the construction of a two-lane bridge and new OSBP facilities at this border. From Kigali, the Central Corridor continues to DRC. The African Development Bank as part of the East Africa Trade and Transport Facilitation Project is financing a feasibility studies for OSBP at Gisenyi/Goma on the Rwanda/DRC border. The border between Tanzania and Burundi at Kabanga/Kobero is also planned as an OSBP and TradeMark East Africa is planning a feasibility study for this border. There is at present no commitment regarding the borders between Burundi and DRC, where traffic is relatively light. New OSBP border facilities at Mutukula between Tanzania and Uganda are funded by the World Bank also under the East Africa Trade and Transport Facilitation Project. JICA is taking the lead under the Infrastructure Consortium for Africa in coordinating support for the development and implementation of OSBP.

Cargo clearance can be done at the border, but in most cases is done at inland clearance centers, mostly in capital cities. Where clearances are not done at the border, the border clearance is generally done in a few hours. Nevertheless, the process is not completed and the 1-3 day final clearance should be seen as part of the overall process. In the following discussion of corridor performance, the term border is used to describe both the cost and time spent at the border plus the average time at the final inland clearance point. In terms of improving facilitation on the Central Corridor, both control points are important, as well as control of vehicle movement on the Corridor.

Most of the trucks operating on the route are Tanzanian-owned since it is easier for them to arrange cargo from the port and then seek return hauls in the other countries. Road transporters from the land-locked countries generally have an office or a partner that arranges for return haulage, mostly to their own country. The cargo is significantly imbalanced in favor of imports and many return hauls are empty. The Tanzanian road transporters have a very active association, the Tanzanian Truck Owners Association (TATOA), which represents their interests at the port and with government agencies concerning the regulations that affect their

operations. Freight forwarders are represented with national and regional associations. These associations will be important "drivers" for more effective transport facilitation measures on the Corridor.

4. Corridor Performance

The performance assessment provides a framework for the detailed analysis conducted through the use of our logistics toolbox, FastPath. This is done based on three variables that define the performance of transportation networks: price (as experienced by the shippers of cargo - producers and importers), time and the reliability of completing the shipment.

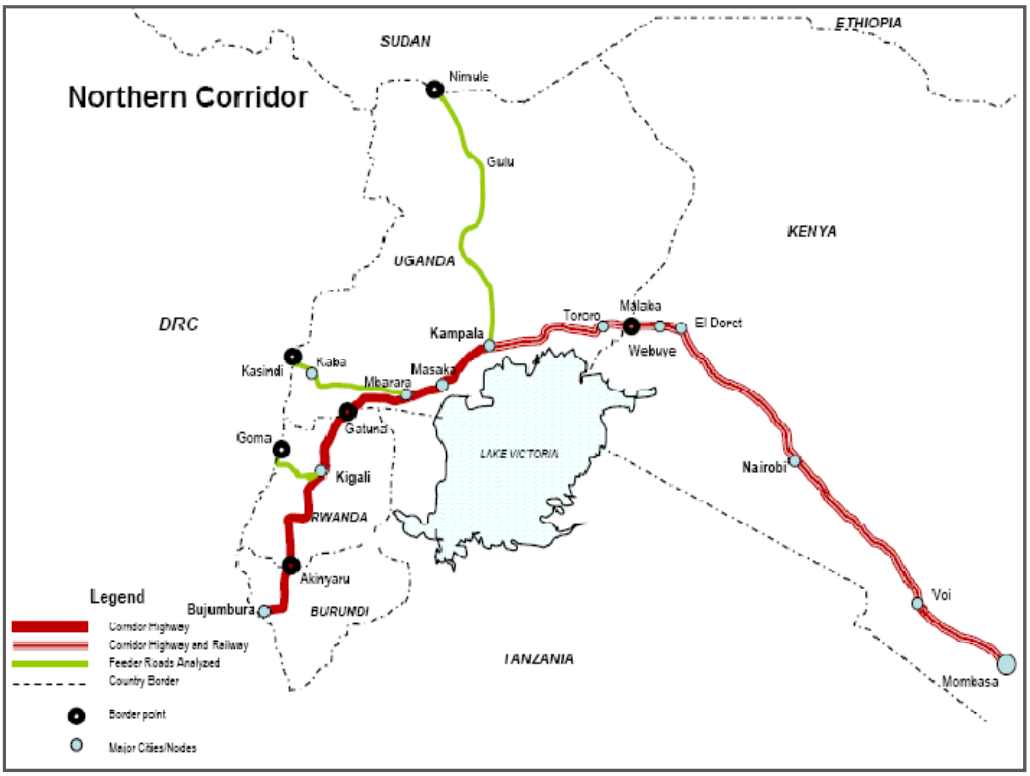
First, we present a comparative assessment of the performance of the Northern and Central Corridors. First, we compare the two corridors performance to common destinations or origins served for imports and exports, respectively. This is followed by a comparison of the overall performance of the Northern and Central Corridors to other African and Asian corridors.

Detailed Northern Corridor Performance Data by Component

For analysis purposes the Northern Corridor has been defined according to Figure 4.1 shown below. The main origins/destinations of cargo are the port of Mombasa, Nairobi, Kampala, Kigali and Bujumbura along the main corridor. Additional origins/destinations are Goma and Kasindi (access to eastern DRC) and Nimule (access to southern Sudan). These origins/destinations were selected based on their importance as population and industrial centers as well as consolidation and redistribution centers.

The transport network is divided into nodes and links each representing different physical and operational characteristics. The nodes represent the port, ICDs, border posts, lake ports and regular nodes that are necessary to separate links with different characteristics. The port node contains information regarding five elements within the ports: the channel, the berth, the yard, customs clearance and the gate. Other nodes contain information specific to their physical characteristics and their operations. The links represent road, rail and maritime segments with unique characteristics. They contain modal information on capacity, topography, price and travel time that defines its performance.

Figure 4.1. Links and Nodes Schematics of the Northern Corridor



Source: Prepared by Nathan Associates Inc.

In order to organize and verify the information that will be introduced to the FastPath model a series of tables were prepared with the information required to simulate the different elements of the logistics chain. As mentioned previously, the logistics chain is organized in nodes and links that represent all the relevant elements.

The nodes that will be analyzed for the project are the port, ICD, border posts, lake ports and inland clearance. The links that will be analyzed are road, rail and lake segments.

Generally discussions are made on the performance of the logistics chain for 20 foot light containers as indicative of the processes. A discussion of the performance of other commodities is presented in the Overview of Corridor Performance. Whenever relevant, specific comments will be made on different performance for other commodities.

PORTS

There are several elements that are considered within the port node. They represent several stages of the cargo processing that are commonly found in a port. These elements are the port channel, the berth, storage-yard, customs, terminal handling and the gate. Understanding that several activities take place at the same time and not sequentially, we have distributed the cost and time among these elements such that the totals match what was reported. The information is consolidated to represent the three variables used to assess performance price, time and reliability (measured as the range of time in which an activity can be completed).

Table 4.1 shows the input information for the import and export of 20 ft light containers. For example, it costs US$ 297 and it usually takes 217 hours to complete the process to import a light container at the port of Mombasa. The process could be completed in as little as 73 hours or as much as 362 hours. When looking at the individual elements it can be seen that the terminal handling costs US$ 162, takes 24 hours to complete and this time has a range between 4 and 48 hours.

Table 4.1. Port Input for the Import and Export of Transit 20 ft Light Containers

Mombasa	Price per Unit (US$)		Average Time (hours)		Max. Time (hours)		Min. Time (hours)	
	Import	Export	Import	Export	Import	Export	Import	Export
Port Channel	--	--	48	--	72	--	--	--
Berth	60	60	48	48	72	72	24	24
Storage - Yard	--	--	48	192	72	648	24	72
Customs and Agents	75	75	48	48	96	72	24	24
Terminal Handling	162	125	24	24	48	48	--	--
Gate	--	--	1	1	2	2	1	1
Total	**297**	**260**	**217**	**313**	**362**	**842**	**73**	**121**

Source: Prepared by Nathan Associates Inc.

ICD IMPORTS (DOMESTIC CFS)

The container imports for the domestic market are transferred from the port to a Container Freight Station (CFS). FastPath has an Inland Container Depot type node that was used to model the processing of containers at the CFS. Table 4.2 shows the five elements considered for the ICD type nodes. The information is organized in similar fashion to the information discussed for the port above.

Table 4.2. Nairobi ICD Input for 20ft Light Containers

Nairobi ICD	Price per Trip (US$)	Average Time (hours)	Max. Time (hours)	Min. Time (hours)
Transfer	150	3	5	1
Customs	300	192	400	48
ICD Handling	110	200	48	48
Storage Costs	--	--	--	--
Gate	--	1	2	1
Total	560	396	455	98

Source: Prepared by Nathan Associates Inc.

BORDER POST

The border posts are another important node along the logistics chain. Customs clearance at the border can represent significant delays. There are two components that are analyzed

within a border post: immigration and customs. In the case of Malaba border post, 25 of the 26 hours of the cargo waiting time are related to customs procedures.

Table 4.3. Border Post Input for 20ft Light Containers

Malaba	Price per Trip (US$)	Average Time (hours)	Max. Time (hours)	Min. Time (hours)
Immigration	--	1	1.5	1
Customs	--	25	30	1
Total	--	26	32	1

Source: Prepared by Nathan Associates Inc.

ROAD

Each road link contains information pertaining to the physical characteristics of the road segment as well as price, time and reliability. The physical information relates to its distance, the type of terrain (flat, rolling, hilly and mountainous), surface condition (good, fair and bad) as well as congestion level (congested and not congested). This information is used to estimate a factor that is used to provide a weight to distribute the cost among the road links for each road transport alternative. The performance information includes the cost as a total for the link or per km, total time in the link (including wait time), wait time (including rest stops), and the maximum and minimum speeds and wait times.

Table 4.4 shows the road link information between Mombasa and Kigali for import of 20ft light containers. The table shows that the most expensive road segment is between Nairobi and Eldoret which is the result of a combination of difficult terrain and congestion.

Table 4.4. Road Input for 20ft Light Containers

Segment	Distance (km.)	Terrain	Condition	Congestion	Cost (TEU/km)	Ave. Trip Time (hours)	Ave. Wait Time (hours)	Max. Speed (km/hr)	Min. Speed (km/hr)	Max. Wait Time (hours)	Min. Wait Time (hours)
Mombasa-Nairobi	480	F to H	F	H	2.42	25	13	60	30	19.5	0
Nairobi-Eldoret	327	H to M	F	H	3.05	18	10	60	30	15	8
Eldoret-Webuye	67	H	F	H	2.63	3	1	60	30	1.5	0
Webuye-Malaba	67	H	F	H	2.63	13	11	60	30	16.5	8
Malaba-Tororo	20	H	F	H	2.63	1.1	0.5	60	30	0.75	0
Tororo-Kampala	219	F	F	H	2.10	20	14	60	30	21	0
Kampala-Gatuna	411	H	F	M	1.16	23	12	60	30	18	8
Gatuna-Kigali	70	H to M	F	M	1.47	2	0	60	30	0	0
Total	**1661**					**132.1**	**61.5**				

Source: Prepared by Nathan Associates Inc.

RAIL

Similarly to the road links, the rail links contain information pertaining to the physical characteristics of the rail segment as well as price, time and reliability. The physical information relates to its distance, the type of terrain (flat, rolling, hilly and mountainous),

and track condition (good, fair and bad) as well as number of tracks. This information is used to estimate a factor that is used to provide a weight to distribute the cost among the links for each road transport alternative. The performance information includes the cost as a total for the link or per km, total time in the link (including wait time), wait time (including rest stops), and the maximum and minimum speeds and wait times.

Table 4.5 shows the rail link information between Mombasa and Nairobi for import of 20ft light containers. The table shows that the most difficult terrain is between Voi and Nairobi.

Table 4.5. Rail Input for 20ft Light Containers

Segment	Distance (km.)	Terrain	Condition	No. Tracks	Cost (TEU/km)	Ave. Trip Time (hours)	Ave. Wait Time (hours)	Max. Speed (km/hr)	Min. Speed (km/hr)	Max. Wait Time (hours)	Min. Wait Time (hours)
Mombasa-Voi	155	F	P	1	1.21	30	22	40	10	76	6
Voi-Nairobi	334	H	P	1	1.21	66	48	40	10	164	14
Total	**489**					**96**	**70**				

Source: Prepared by Nathan Associates Inc.

Overview of Northern Corridor Performance

Once all the information is introduced and all checks are completed the FastPath model produces summaries of the corridor level performance which can be drilled down for further analysis. The summaries are produced for imports and exports for each of the commodity types and transport alternatives analyzed.

IMPORTS

Table 4.6 shows the price, time and reliability of each of the destinations from the port of Mombasa for imports of different handling types of cargo served by road. The reliability indicator reflects the range of variations in time with respect to the average time it takes to complete each stage of the logistics chain. A higher value for the reliability indicator signifies a greater variation and more likelyhood of long delays.

Information on Table 4.6 shows, for example, that for dry bulk going to Bujumbura the total price is US$ 8,511 per truck (US$ 360 at the port), it takes 364 hours to complete the trip (170 hours at the port) and has a reliability indicator of an average 200 percent (424 percent at the port). Generally, the price for heavy containers, dry and liquid bulk is similar. As expected, Table 4.6 shows that the price goes up with distance (lowest rate per km is to Kampala at US$ 1.78/km for light containers). But it also shows that there are destinations with higher rates due to dangerous conditions (Nimule at US$ 3.53/km for light containers) and destinations with extensive delays to clear customs while the cargo remains loaded in the truck (Bujumbura, Goma and Kasindi at US$ 2.60, US$ 2.66 a US$ 2.97/km respectively).

Table 4.6. Northern Corridor Performance for Imports by Cargo Type and Destination, 2010 (via road)

Destination	Distance km.	Price (US$)				Time (hours)			Reliability Indicator (%)		
		Containers		Bulk		Containers	Bulk		Containers	Bulk	
		Light	Heavy	Dry	Liquid	Light/ Heavy	Dry	Liquid	Light/ Heavy	Dry	Liquid
Nairobi	480	1,396	1,895	1,530	1,365	396	181	145	158	377	359
Kampala	1,180	2,099	3,448	3,511	3,316	323	276	240	194	262	217
Kigali	1,661	3,901	6,595	6,658	6,463	376	329	293	167	220	178
Bujumbura	1,903	4,950	8,448	8,511	8,316	411	364	328	153	200	160
Nimule	1,526	5,383	7,697	7,760	7,565	381	334	274	165	217	190
Kasindi	1,623	4,825	9,635	9,698	9,503	372	325	289	168	223	180
Goma	1,811	4,822	8,137	8,200	8,005	537	490	454	131	162	135
Port Node*											
Mombasa - Domestic		315	315	330	165	217	170	134	287	400	386
Mombasa - Transit		297	297	360	165	217	170	134	287	424	386

Note: Port values are included in the totals shown for each destination.

Source: Nathan Associates

Total travel time varies by destination depending on the number of border crossing and the delays experienced at final clearance. The time at the port for containers is longer than for bulk because the bulk is generally loaded into trucks at the quay, cleared customs and taken out of the port immediately. Regarding the average travel speed for the shipment from the port to the destination (excluding the time spent in the port) the route to Kampala is the fastest (one border post) followed by Kigali and Kasindi (two border posts). Bujumbura (three border posts) and Nimule (two border posts) have slower border posts and inland clearance. The slowest trip is to Goma (three border posts) where cargo has to wait about two weeks to be cleared.

In terms of reliability, the port has the greatest range of variation in time in the logistics chain hence the most unreliable. Generally, road transport is the most reliable element of the transport logistics chain. As a result, the longer the travel distance the lower is the overall reliability indicator since the relative weight of the road transport reliability index increases.

Table 4.7 presents similar performance results of imports that use rail along the Northern Corriodor. The average cost per km to Kampala (US$ 1.72/km for a 20 ft light container) is slightly cheaper than to Nairobi (US$ 1.91/km). The rail rate to Kampala is slightly lower than the road rate (difference of US$ 0.06 per km) which confirms RVR strategy to maximize revenue of cargo they can effectively carry (given the current infrastructure and equipment constraints) by setting their rates slightly lower than the road transport. In terms of time, the time by road is faster for both Nairobi and Kampala.

Table 4.7. Northern Corridor Performance for Imports by Cargo Type and Destination, 2010 (via rail)

Destination	Distance km.	Price (US$)				Time (hours)				Reliability Indicator (%)			
		Containers		Bulk		Containers		Bulk		Containers		Bulk	
		Light	Heavy	Dry	Liquid	Light	Heavy	Dry	Liquid	Light	Heavy	Dry	Liquid
Nairobi	489	935	1,479	1,494	1,329	316	316	269	233	202	202	257	229
Kampala	1,200	2,059	3,369	3,432	3,237	462	281	415	379	138	222	177	141
Port Node*										0	0	0	0
Mombasa - Domestic		315	315	330	165	217	217	170	134	287	287	400	386
Mombasa - Transit		297	297	360	165	217	217	170	134	287	287	424	386

Note: Port values are included in the totals shown for each destination.

Source: Nathan Associates Inc.

EXPORTS

For exports, similar tables have been prepared. Table 4.8 shows that for the export flows via road the cheapest rates are also for Kampala (US$ 1.75/km) and then Nairobi (US$ 2.02/km). These are the shortest and involve fewer delays because they only experience one border post (Malaba). The most expensive are Kasindi and Nimule that involve dangerous conditions and delays in clearance. In terms of time to complete the shipment Kasindi, Bujumbura, Nimule and Goma take about the same time. Considering the distances traveled Nimule and Kasindi are the most inefficient considering road conditions and border delays. The reliability indicator shows that the shortest trips are the most unreliable given that the impact of the port unreliability is more significant. Variations in reliability of border crossing are also reflected in the results.

Table 4.8. Northern Corridor Performance for Exports by Cargo Type and Origin, 2010 (via road)

Origin	Distance km.	Price (US$)		Time (hours)	Reliability Indicator (%)	
		Containers			Containers	
		Light	Heavy		Light	Heavy
Nairobi	480	971	1,500	324	326	343
Kampala	1180	2,062	3,441	395	267	353
Kigali	1661	3,864	6,588	422	250	261
Bujumbura	1903	4,913	8,441	433	244	255
Nimule	1526	5,346	7,690	431	245	256
Kasindi	1623	7,291	9,628	436	242	253
Goma	1811	4,785	8,113	429	246	257
Port Node*						
Mombasa - Domestic		270	300	313	336	354
Mombasa - Transit		260	290	313	336	351

Note: Port values are included in the totals shown for each origin.

Source: Nathan Associates Inc.

For exports via rail, Table 4.9 shows that the transport rate for Kampala (US$ 1.69/km for a light container) is slightly lower than for Nairobi (US$ 1.82/km). In terms of average speed (total travel time excluding the time in the port), they are quite similar with Narobi slightly faster (US$ 4.95 km/hr) but overall quite slow. The shipment takes almost three times longer via rail than via road to Kampala and is only six cents cheaper per kilometer.

Table 4.9. Northern Corridor Performance for Exports by Cargo Type and Origin, 2010 (via rail)

Origin	Distance km.	Price (US$)		Time (hours)		Reliability Indicator (%)	
		Containers		Containers		Containers	
		Light	Heavy	Light	Heavy	Light	Heavy
Nairobi	489	890	1,464	412	390	258	286
Kampala	1,200	2,022	3,362	558	605	191	260
Port Node*							
Mombasa - Domestic		270	300	313	313	336	354
Mombasa - Transit		260	290	313	361	336	434

Note: Port values are included in the totals shown for each origin.

Source: Nathan Associates Inc.

When comparing imports to exports, it can be seen for example that light container exports from Nairobi by road are 30 percent cheaper and 18 percent faster. In contrast, exports by rail are 5 percent cheaper and 40 percent slower. The port charges are lower for exports (14 percent) while the processing time is longer (44 percent).

Northern Corridor Cost and Time Comparison by Transport Alternatives

This section presents the results of the performance assessment for light containers which are generally indicative of results for other cargo types. The results are presented for imports/exports for the selected transport alternatives connecting each origin/destination and the port of Mombasa. The figures show the participation of each component (links and nodes) in the total costs and time for respective transport alternative[6].

IMPORTS

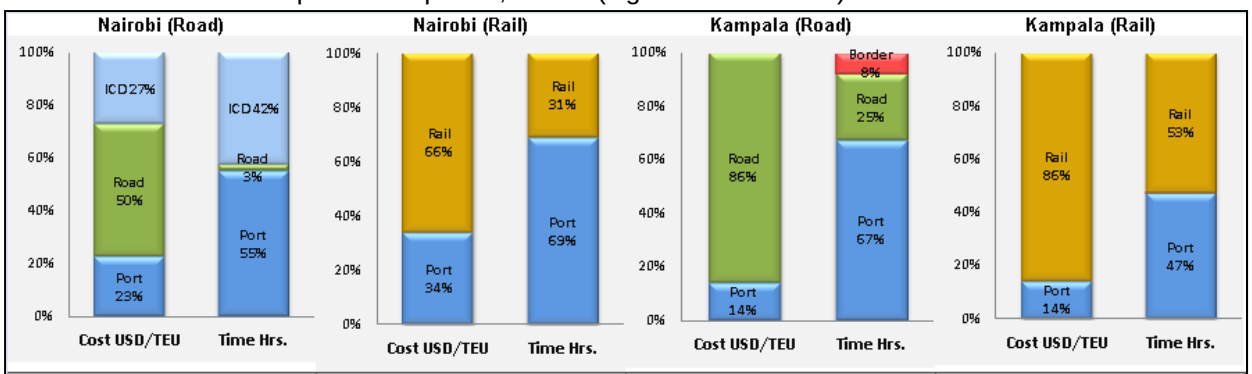
Two transport alternatives were considered for the segments between Mombasa and **Nairobi**, one via road and one via rail. Figure 4.2 shows that the rail alternative is less expensive and

[6] The tables present the actual values of each component and include the estimated facilitation and extra inventory costs. The extra inventory cost is the estimated value of additional goods that corridor users have to move through the system, in order to maintain an uninterrupted supply / provision for their regular operations. All percentages in the figures are based on transport costs only.

faster than the road alternative. This is mostly due to how the customs clearance at the port is handled. The containers that will be transported by rail are identified when offloading from the ship and immediately transported to the rail yard for loading into a train along with the manifest. Customs is cleared at the ICD in Nairobi given KRA allows direct bill of lading to the ICD (it may be considered highly secure given that the ICD is operated by KPA and containers are more secure than on trucks). In terms of total cost (including freight forwarding and extra inventory costs) the rail connection to Nairobi is 19 percent lower than the road and in terms of time rail is 20 percent quicker that the road. The combination of port and ICD costs account for 50 percent in the road option and 34 percent in the rail option; the remaining costs of both alternatives are related entirely to the surface transport cost. Time at the port and ICD for containers transported by road is 97 percent of the total time, while via rail is 69 percent.

There are also two transport alternatives between Mombasa and Kampala, one via road and one via rail. The rail connection is slightly less expensive despite the higher extra inventory cost associated to the unreliability of the rail service. In terms of time, the rail alternative takes 43 percent longer than the road alternative. In terms of distribution of cost and time, the port's share of the total cost is reduced compared to that shown above for Nairobi. The port now represents 14 percent of the cost for the road connection and 14 percent for the rail. With respect to time, the port represents 67 percent and the Malaba border post 8 percent for the road connection while the port represents 47 percent for the rail connection. This is due to the increased cost and time taken up by the longer land transport component to Kampala.

Figure 4.2. Cost and Time for Northern Corridor Destinations Served by Road and Rail Transport – Imports, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.
Port	315	217
Road	701	11
Border	-	-
Rail	-	-
ICD	380	168
Transport	1,396	396
Freight Fwd. Fe	300	-
Extra Inventory	619	-
Total	2,315	396

Elements	Cost USD/TL	Time Hrs.
Port	315	217
Road	-	-
Border	-	-
Rail	620	99
Lake	-	-
Transport	935	316
Freight Fwd. Fe	300	-
Extra Inventory	632	-
Total	1,867	316

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	1,801	80
Border	-	26
Rail	-	-
Lake	-	-
Transport	2,098	323
Freight Fwd. Fe	300	-
Extra Inventory	621	-
Total	3,019	323

Elements	Cost USD/TL	Time Hrs.
Port	297	217
Road	-	-
Border	-	2
Rail	1,762	243
Lake	-	-
Transport	2,059	462
Freight Fwd. Fe	300	-
Extra Inventory	632	-
Total	2,991	462

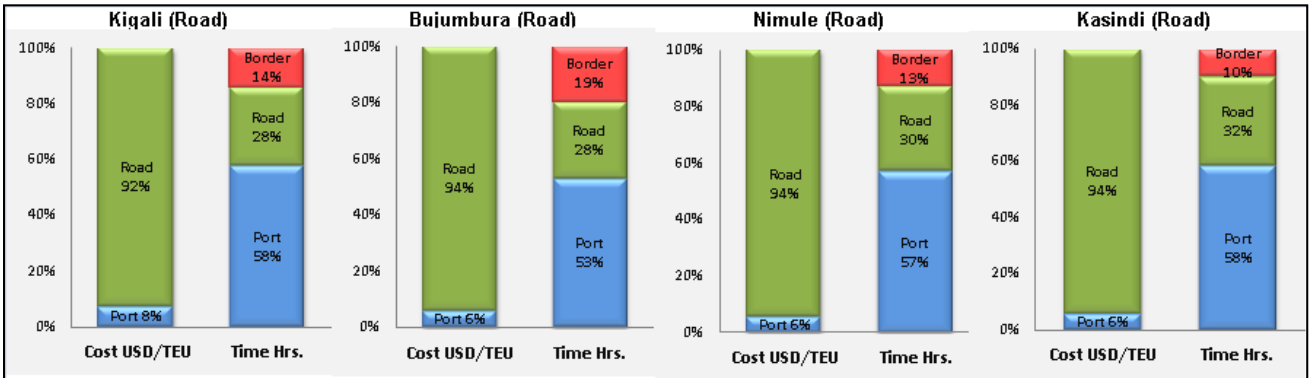
Source: Nathan Associates Inc.

Figure 4.3 presents the results for destinations served only by road. When looking at the total cost, the most expensive destination is **Nimule** due to higher rates to account for security risks

between Nimule and southern Sudan. Other expensive destinations are **Goma** and **Bujumbura** where trucks are required to wait while the cargo is cleared for up to a week.

For the Mombasa – **Kigali** pair, Figure 4.3 shows that the port only represents 8 percent of the transport cost while still taking up most of the time with a 58 percent share. This cost distribution is very similar for Bujumbura, Nimule, Kasindi and Goma. In terms of time, the port share decreases in cases where the border and inland clearance is large. Thus the port share of total transport time to Bujumbura is 53 percent, Nimule (57 percent) and Goma (40 percent). Long inland clearance times at Goma and Bujumbura are due to delays of up to a week to clear the cargo. The delays also have significant cost implications because the trucks are required to remain loaded while the clearance is completed. On the graph border represents both the time spent at the border and at the inland clearance office.

Figure 4.3. Cost and Time for Northern Corridor Destinations Served Only by Road Transport - Imports, 2010 (light containers)

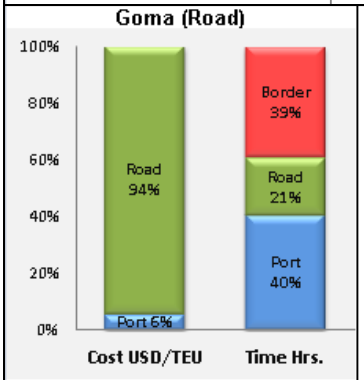


Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	3,604	105
Border	-	54
Rail	-	-
ICD	-	-
Transport	3,901	376
Freight Fwd. Fe	300	-
Extra Inventory	622	-
Total	4,823	376

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	4,653	114
Border	-	80
Rail	-	-
ICD	-	-
Transport	4,950	411
Freight Fwd. Fe	300	-
Extra Inventory	623	-
Total	5,873	411

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	5,087	114
Border	-	50
Rail	-	-
Lake	-	-
Transport	5,384	381
Freight Fwd. Fe	300	-
Extra Inventory	623	-
Total	6,307	381

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	4,522	119
Border	5	36
Rail	-	-
Lake	-	-
Transport	4,824	372
Freight Fwd. Fe	300	-
Extra Inventory	618	-
Total	5,742	372



Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	4,519	110
Border	5	210
Rail	-	-
Lake	-	-
Transport	4,821	537
Freight Fwd. Fe	300	-
Extra Inventory	697	-
Total	5,818	537

Source: Nathan Associates Inc.

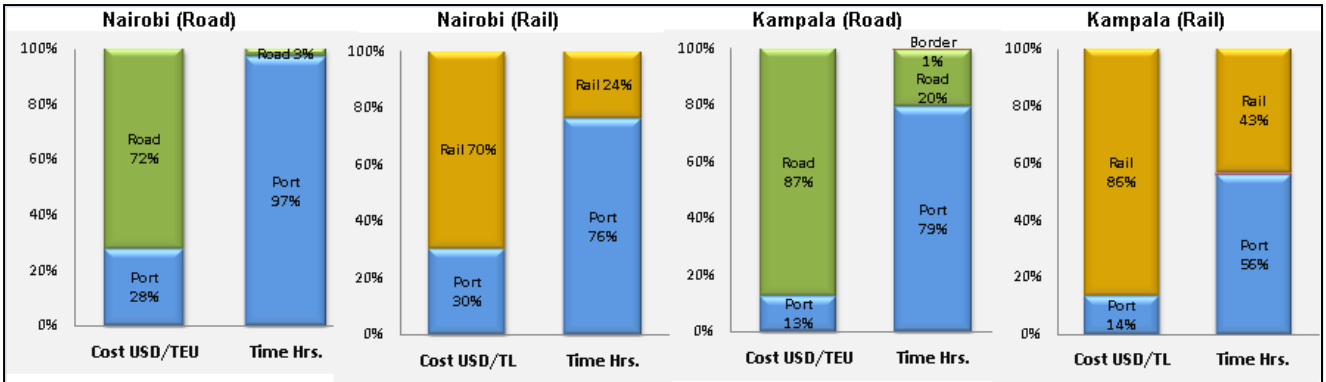
EXPORTS

Figure 4.4 presents the cost and time distribution for export flows. It can be seen that the rail alternative to export containers from Nairobi is slightly less expensive (3 percent) and slower (27 percent). In terms of the cost and time distribution, the port has a similar share for road and rail alternatives with 28 and 30 percent, respectively. Land transport makes up the

remaining shares. In terms of time, the port takes up 97 percent of the total time for the road alternative while it takes 76 percent for rail.

Similarly for the export of containers from Kampala, the rail connection is less expensive (5 percent) and slower (41 percent). As a result of the longer distances, the cost distribution changes with the port taking 13 and 14 percent for road and rail alternatives, respectively. The port share of the time also is reduced although it still is quite significant at 79 percent for road alternative and 56 percent for rail.

Figure 4.4.Cost and Time for Northern Corridor Origins Served by Road and Rail Transport Alternatives - Exports, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.
Port	270	313
Road	701	11
Border	-	-
Rail	-	-
ICD	-	-
Transport	971	324
Freight Fwd. Fe	300	-
Extra Inventory	1,044	-
Total	2,315	324

Elements	Cost USD/TL	Time Hrs.
Port	270	313
Road	-	-
Border	-	-
Rail	620	99
Lake	-	-
Transport	890	412
Freight Fwd. Fe	300	-
Extra Inventory	1,052	-
Total	2,242	412

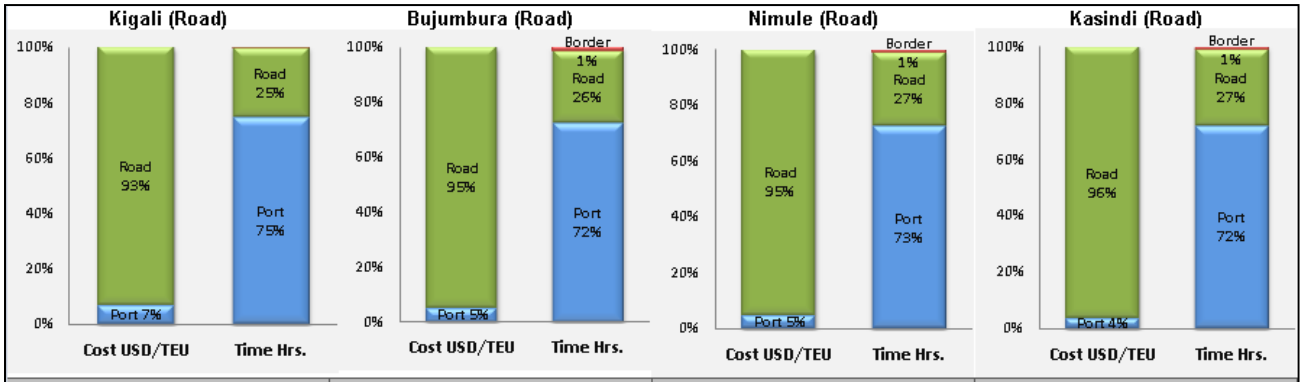
Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	1,801	80
Border	-	2
Rail	-	-
ICD	-	-
Transport	2,061	395
Freight Fwd. Fe	300	-
Extra Inventory	1,044	-
Total	3,405	395

Elements	Cost USD/TL	Time Hrs.
Port	260	313
Road	-	-
Border	-	1
Rail	1,612	241
Lake	-	-
Transport	1,872	555
Freight Fwd. Fe	300	-
Extra Inventory	1,056	-
Total	3,228	555

Source: Nathan Associates Inc.

Figure 4.5 shows the results for origins served only by road for exports. When looking at the total cost, the most expensive origins are Kasindi due to low volumes and Nimule due to higher rates to account for security risks. Other less expensive origins are Goma and Bujumbura due to their distance from the port and with Kigali being the lowest.

Figure 4.5. Cost and Time for Selected Northern Corridor Origins Served by Road Transport - Exports, 2010 (light containers)

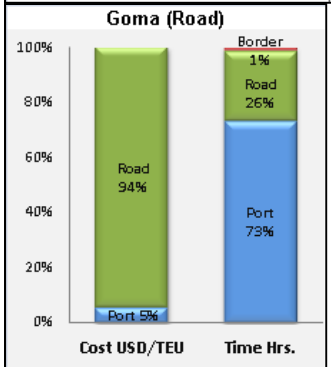


Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	3,604	105
Border	-	2
Rail	-	-
ICD	-	-
Transport	3,864	420
Freight Fwd. Fe	300	-
Extra Inventory	1,045	-
Total	5,209	420

Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	4,653	114
Border	-	6
Rail	-	-
ICD	-	-
Transport	4,913	433
Freight Fwd. Fe	300	-
Extra Inventory	1,046	-
Total	6,259	433

Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	5,087	114
Border	-	4
Rail	-	-
ICD	-	-
Transport	5,347	431
Freight Fwd. Fe	300	-
Extra Inventory	1,046	-
Total	6,693	431

Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	7,025	119
Border	5	4
Rail	-	-
ICD	-	-
Transport	7,290	436
Freight Fwd. Fe	300	-
Extra Inventory	1,044	-
Total	8,634	436



Elements	Cost USD/TEU	Time Hrs.
Port	260	313
Road	4,519	110
Border	5	6
Rail	-	-
ICD	-	-
Transport	4,784	429
Freight Fwd. Fe	300	-
Extra Inventory	1,046	-
Total	6,130	429

Source: Nathan Associates Inc.

For the Kigali- Mombasa pair, Figure 4.5 shows that the port only represents 7 percent of the transport cost while still taking up most of the time with a 75 percent share. This cost distribution is very similar for the Bujumbura, Nimule, Kasindi and Goma. In terms of time the port share is also very similar for all origins because the impact of the border and inland clearance is minimal.

Interpretation of Results for the Northern Corridor

PORT OF MOMBASA

The analysis of all the different transport alternatives between the selected origins and destinations for the exports and imports along the Northern Corridor show consistently that the greatest share of the time is spent at the port of Mombasa.

Table 4.10 presents a further breakdown of the diagnostic assessment of the different components of the port node for both imports and exports. The results for imports show that containerized cargo spends most of the time in the yard and this component is also the most expensive. The components with the next share in time are the channel, the berth and customs clearance. For exports, the yard is also the most significant component followed by the berth and customs.

Table 4.10. Mombasa Port Performance (light containers)

	Imports – Light Containers			Exports – Light Containers		
Component	Price (US$)	Time (hrs)	Reliability (%)	Price (US$)	Time (hrs)	Reliability (%)
Mombasa Port	**297**	**217**	**287**	**260**	**313**	**336**
Channel	0	48	150	0	0	0
Berth	60	48	100	60	48	100
Yard	162	72	133	125	216	289
Customs	75	48	150	75	48	100
Gate	0	1	100	0	1	100

Source: Nathan Associates Inc.

Ship waiting in Mombasa is often three to four days. Crane productivity at the specialized terminal was about 10 moves/crane–hour. Since ships were mostly served by one crane, this also was the berth productivity. Larger ships, with 1,500 moves/call, are served part of the time by two cranes, reaching berth productivity of 15 moves/berth–hour. Berth productivity at the conventional terminal was not much different than that at the specialized terminal, since ships worked with their onboard cranes, usually three or four cranes at the same time, each achieving about four moves/hour. The resulting berth productivity was 13–14 moves/berth–hour[7]. The reasons for the low productivity indicated by Mombasa lines are yard congestion, traffic jam inside the terminal, equipment breakdown, shortage of equipment, lack of modern Terminal Operating System (TOS) and labor motivation [8].

[7] More recent observations, in October 2010, indicated berth productivity as low as 10 moves/hour.
[8] A more detailed description of the current port performance in the CDS Technical Paper E. on Integration of Ports and ICDs.

LAND TRANSPORT

There are potential cost and time advantages for using the rail alternative where it is available. However, poor performance and inadequate rail capacity has led to most shippers (over 90 percent) using road. There is urgent need to rebuild and further develop rail capacity not only to provide effective competition with road but to increase use of rail with a view to reducing the region's total transport and trade cost.

Table 4.11 summarizes the price, time and reliability information for all the segments that make up the Mombasa to Kigali road transport alternative and for all the cargo types analyzed. The table shows that the prices for all road segments are the same for heavy containers and dry and liquid bulk. The charges for light containers are lower because the trucks are not fully loaded when transporting them. However, the price distribution across all segments remains the same for all commodities. The time and reliability are the same for all commodities because the trucks experience the same delays and congestion as they move through the corridor. The only exception would be for fuel trucks that have priority for clearance at the border posts given their dangerous cargo. The table also shows the performance of two border posts that are in the alternative: Malaba and Gatuna.

The port performance is also reported in Table 4.11 to indicate the relevance of the port as it takes a significant share of the time. The port performance data also shows its variation in price and time by cargo type. It shows that offloading liquid bulk has the lowest price and fastest time of the cargo types.

Table 4.11. Road and Border Post Performance, Imports

Segment	Distance (km.)	Price (US$)					Time (hours)			Reliability Indicator (%)			
		Containers			Bulk		Container	Bulk		Containers		Bulk	
		Light	Light/km.	Heavy	Dry	Liquid	Light	Dry	Liquid	Light	Heavy	Dry	Liquid
Mombasa to Kigali	**1,661**	**3,901**	**2.35**	**6,595**	**6,658**	**6,463**	**376**	**329**	**293**	**167**	**167**	**220**	**178**
Mombasa - Nairobi	480	1,162	2.42	2,030	2,030	2,030	25	25	25	110	110	110	110
Nairobi - Eldoret	327	997	3.05	1,743	1,743	1,743	18	18	18	21	21	21	21
Eldoret - Webuye	67	176	2.63	308	308	308	3	3	3	2	2	2	2
Webuye - Malaba BP	67	176	2.63	308	308	308	13	13	13	14	14	14	14
Malaba Border Post	n.a.	0		0	0	0	26	26	26	141	141	141	141
Malaba BP - Tororo	20	53	2.65	92	92	92	1	1	1	0	0	0	0
Tororo - Kampala	219	460	2.10	806	806	806	20	20	20	74	74	74	74
Kampala - Gatuna	411	477	1.16	830	830	830	23	23	23	45	45	45	45
Gatuna Border Post	n.a.	0		0	0	0	28	28	28	156	141	141	141
Gatuna - Kigali	70	103	1.47	180	180	180	2	2	2	1	1	1	1
Port Node													
Mombasa - Kigali		297		297	360	165	217	170	134	287	287	424	386

Source: Nathan Associates

Table 4.12 summarizes the price, time and reliability information for all the segments that make up the Mombasa to Kampala rail transport alternative and for all the cargo types analyzed. The table shows that the prices for all rail segments are the same for heavy containers and dry and liquid bulk. The charges for light containers are lower because the wagons are not fully loaded when transporting them. However, the price distribution across

all segments remains the same for all commodities. The time and reliability are the same for all commodities because the rail experiences the same delays and inefficiencies as they move through the corridor. The only exception would be for fuel wagons that have priority and are normally transported in unitary trains. The table also shows that border posts clearance is quick fast for trains since the risk associated to cargo deviation is minimal.

The port performance is also reported in Table 4.12 to indicate the relevance of the port as it takes a significant share of the time. The port performance data also shows its variation in price and time by cargo type. It shows that offloading liquid bulk has the lowest price and fastest time of the cargo types.

Table 4.12. Rail and Border Post Performance, Imports

Segment	Distance (km.)	Price (US$)					Time (hours)			Reliability Indicator (%)			
		Containers			Bulk		Containers	Bulk		Containers		Bulk	
		Light	Light/km.	Heavy	Dry	Liquid	Light/Heavy	Dry	Liquid	Light	Heavy	Dry	Liquid
Mombasa to Kampala	**1,200**	**2,059**	**1.72**	**3,369**	**3,432**	**3,237**	**462**	**415**	**379**	**138**	**222**	**177**	**141**
Mombasa - Voi	155	172	1.11	312	312	312	31	31	31	300	11	300	300
Voi - Nairobi	334	438	1.31	794	794	794	67	67	67	1,297	39	1,297	1,297
Nairobi - Malaba BP	470	712	1.51	1,290	1,290	1,290	95	95	95	2,604	78	2,604	2,604
Malaba Border Post		0		0	0	0	2	2	2	100	100	100	100
Malaba BP - Tororo	30	45	1.50	82	82	82	6	6	6	7	0	7	7
Tororo - Kampala	211	245	1.16	444	444	444	42	42	42	486	13	486	486
Port Node													
Mombasa - Kampala		297		297	360	165	217	170	134	287	287	424	386

Source: Nathan Associates

Table 4.13 and Table 4.14 show similar information as above but related to exports. The only significant differences are observed at border posts where customs clearance procedures are minimal and for the port where the process is different and the wait time before loading into the ships are longer because shippers tend to send their goods ahead of time to account for any possible delays.

Table 4.13. Road and Border Post Performance, Exports

Segment	Distance (km.)	Price (US$)					Time (hours)			Reliability Indicator (%)			
		Containers			Bulk		Container	Bulk		Containers		Bulk	
		Light	Light/km.	Heavy	Dry	Liquid	Light	Dry	Liquid	Light	Heavy	Dry	Liquid
Mombasa to Kigali	**1,661**	**3,901**	**2.35**	**6,595**	**6,658**	**6,463**	**376**	**329**	**293**	**167**	**167**	**220**	**178**
Mombasa - Nairobi	480	1,162	2.42	2,030	2,030	2,030	25	25	25	110	110	110	110
Nairobi - Eldoret	327	997	3.05	1,743	1,743	1,743	18	18	18	21	21	21	21
Eldoret - Webuye	67	176	2.63	308	308	308	3	3	3	2	2	2	2
Webuye - Malaba BP	67	176	2.63	308	308	308	13	13	13	14	14	14	14
Malaba Border Post	n.a.	0		0	0	0	26	26	26	141	141	141	141
Malaba BP - Tororo	20	53	2.65	92	92	92	1	1	1	0	0	0	0
Tororo - Kampala	219	460	2.10	806	806	806	20	20	20	74	74	74	74
Kampala - Gatuna	411	477	1.16	830	830	830	23	23	23	45	45	45	45
Gatuna Border Post	n.a.	0		0	0	0	28	28	28	156	141	141	141
Gatuna - Kigali	70	103	1.47	180	180	180	2	2	2	1	1	1	1
Port Node													
Mombasa - Kigali		297		297	360	165	217	170	134	287	287	424	386

Source: Nathan Associates

Table 4.14. Rail and Border Post Performance, Exports

Segment	Distance (km.)	Price (US$)			Time (hours)		Reliability Indicator (%)	
		Light	Light/ km.	Heavy	Light	Heavy	Light	Heavy
Kampala to Mombasa	**1,200**	**2,022**	**1.69**	**3,362**	**558**	**605**	**191**	**260**
Kampala - Tororo	211	245	1.16	444	42	42	486	486
Tororo - Malaba BP	30	45	1.50	82	6	6	7	7
Malaba Border Post	n.a.	0	n.a.	0	1	1	100	100
Malaba BP - Nairobi	470	712	1.51	1290	95	95	2,604	2,604
Nairobi - Voi	334	438	1.31	794	68	67	1,408	1,297
Voi - Mombasa	155	172	1.11	312	31	31	300	300
Port Node								
Mombasa - Kampala		260		290	313	361	336	434

Source: Nathan Associates

OTHER CAUSES OF INEFFICIENCY

As highlighted in this diagnostic assessment the performance of the Northern and Central Corridors is affected by numerous operational, policy, procedural, and administrative issues.

- In Kenya, vehicles licensed for transit cannot carry domestic cargo and must use prescribed transit routes. This has the effect of many return trips being empty. Similarly in Tanzania, the Revenue Authority licenses trucks for transit or domestic with the same effect.
- Domestic road transport policies in all states are aimed at deregulating market access, which has had some positive effects, but the lack of qualitative regulation has also had several undesirable consequences. These include low entry barriers leading to cut throat competition, low safety levels and poor service quality.
- Existing overloading control strategy is aimed at achieving 100 percent inspection of all commercial vehicles. There is no targeted risk management approach and no incentive to encourage truckers to self-regulate. The high intensity of checking increases journey times and provides an added incentive for corruption. Differences in national limits complicate

cross-border operations. There is also no regional consistency in terms of the frequency of checks as some states (Burundi, Rwanda) have no existing weighbridge infrastructure.

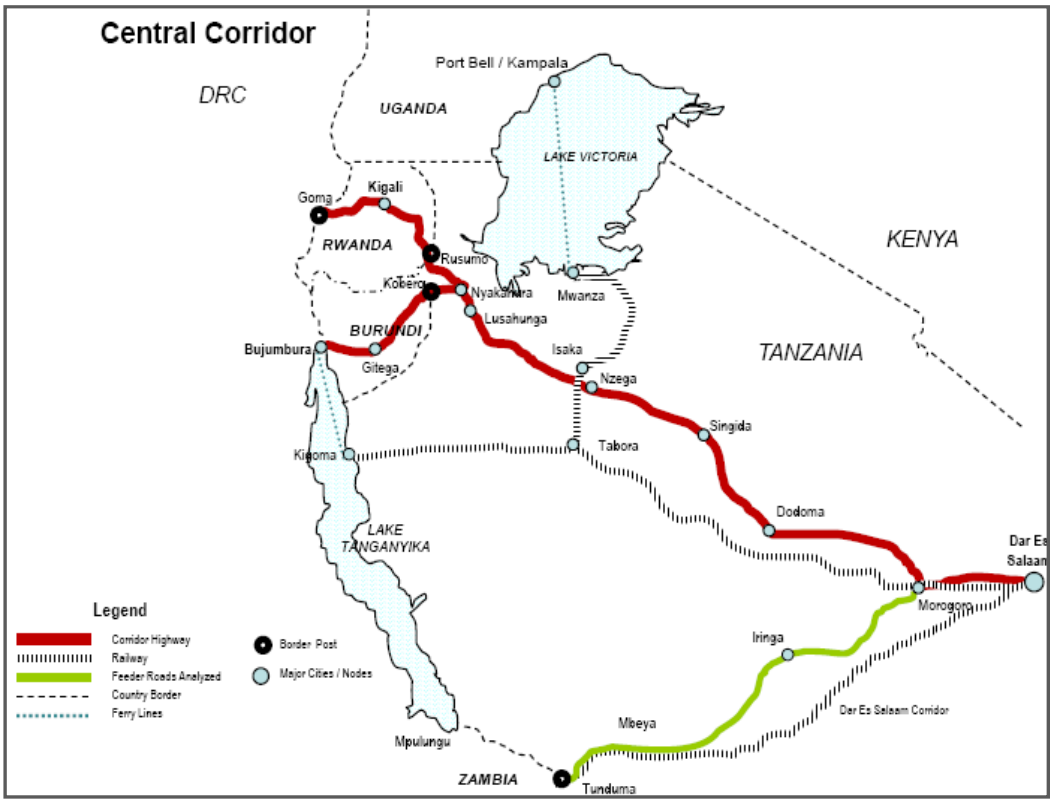
- The Northern Corridor, as is the case for Central Corridor, suffers from serious delays caused by informal stops and check points on the route. Some are officially sanctioned and some are created to collect payments to police, transit authorities and local communities. Without sufficient law enforcement vehicles, stationary control points to check for driving licenses, vehicle registration, vehicle road worthiness certificates and to inspect vehicles for contraband and trafficking are essential. Nevertheless, unofficial stops delay transit transport and add cost to transport which is passed on to the shipper. In other cases, they are payments to avoid regulatory control, such as payments especially on the Northern Corridor to avoid overloading regulation.
- Insufficient use is made of customs tools to expedite processing. Clearance modernization is being implemented at the national level and the extent of implementation is varied. Tools include risk management, accredited economic operators, customs bonds and control points, preclearance and so forth.
- Failure to implement an effective transit regime impedes transit movement in terms of cost, time and reliability. Many aspects of a transit regime exist, but have not been fully implemented. Common vehicle regulations have been issued, but not fully implemented and there are current efforts to change again. Road worthiness standards have been promoted, but there is lack of trust in the systems of other EAC partner states. Customs declaration have been simplified and harmonized, but each country still requires its own form under national insignia.

Central Corridor Detailed Performance Data by Component

For the analysis purposes the Central Corridor has been defined according to Figure 4.6 shown below. The main origins/destinations of cargo are the port of Dar es Salaam, Kampala (Uganda), Bujumbura (Burundi), Kigali (Rwanda) along the main corridor. Additional origins/destinations are Mwanza (Tanzania), Goma (Rwanda connection to DRC). These origins/destinations were selected based on their importance as population and industrial centers as well as consolidation and redistribution centers.

The transport network is divided in nodes and links each representing different physical and operational characteristics. The nodes are marine ports, ICDs, border posts, and lake ports that are necessary to connect links with different characteristics. The port node contains information regarding five elements within the ports: the channel, the berth, the yard, customs clearance and the gate. Other nodes contain information specific to their physical characteristics and their operations. The links represent road, rail and lake segments with unique characteristics. They contain modal information on capacity, topography, price and travel time that defines its performance.

Figure 4.6. Links and Node Schematic of the Central Corridor



Source: Nathan Associates Inc.

Similarly to the Northern Corridor, for the purpose of organizing and verifying the information that will be introduced to the FastPath model a series of tables were prepared with the information required to simulate the different elements of the logistics chain.

The nodes that will be analyzed for the project are the port, border posts, lake ports and inland clearance. The links that will be analyzed are road, rail and lake segments.

General discussions are made on the performance of the logistics chain for 20 foot light containers as indicative of the processes. A discussion of the performance of other commodities is presented in the Overview of Corridor Performance. Whenever relevant, specific comments will be made on different performance for other commodities.

PORTS

There are several elements that are considered within the port node. They represent different stages of the cargo processing that are commonly found in a port. These elements are the port channel, the berth, storage-yard, customs, terminal handling and the gate. Understanding that some of the activities take place at the same time and not sequentially, we have distributed the cost and time among these elements such that the totals match what was reported. The information is consolidated to represent the three variables used to assess performance price, time and reliability (measured as the range of time in which an activity can be completed).

Table 4.15 shows the input information for the import and export of 20 ft light containers in the por4t of Dar es Salaam. For example, it costs US$ 297 and it usually takes 217 hours to complete the process to import a light container at the port of Mombasa. The process could be completed in as little as 73 hours or as much as 266 hours. When looking at the individual elements it can be seen that the terminal handling costs US$ 162, takes 24 hours to complete and this time has a range between 4 and 48 hours.

Table 4.15. Port Input for the Import and Export of Transit 20 ft Light Containers

Dar es Salaam	Price per Unit (US$)	Average Time (hours)		Max. Time (hours)		Min. Time (hours)	
	Import / Export	Import	Export	Import	Export	Import	Export
Port Channel	0	48	0	72	0	24	0
Berth	90	48	48	72	72	24	24
Storage - Yard	0	96	216	146	720	48	72
Customs and Agents	79	72	24	144	72	48	24
Terminal Handling	150	24	36	48	48	12	24
Gate	0	3	1	4	3	1	1
Total	**319**	**291**	**325**	**486**	**915**	**157**	**145**

Source: Prepared by Nathan Associates Inc.

BORDER POST

The border posts are another important node along the logistics chain. Customs clearance at the border can represent significant delays. There are two components that are analyzed within a border post: immigration and customs. In the case of Rusumo border post four hours of the cargo waiting time are due to customs procedures.

Table 4.16. Border Post Input for 20ft Light Containers

Rusumo	Price per Trip (US$)	Average Time (hours)	Max. Time (hours)	Min. Time (hours)
Immigration	0	0.1	--	--
Customs	0	4.0	8	1
Total	**0**	**4**	**8**	**1**

Source: Prepared by Nathan Associates Inc.

ROAD

Each road link contains information pertaining to the physical characteristics of the road segment as well as price, time and reliability. The physical information relates to its distance, the type of terrain (flat, rolling, hilly and mountainous), surface condition (good, fair and bad) as well as congestion level (congested and not congested). This information is used to estimate a factor that is used to provide a weight to distribute the cost among the road links for each road transport alternative. The performance information includes the cost as a total

for the link or per km, total time in the link (including wait time), wait time (including rest stops), and the maximum and minimum speeds and wait times.

Table 4.17 shows the road link information between Mombasa and Kigali for import of 20ft light containers. The table shows that the most expensive road segment is between Gitega and Bujumbura.

Table 4.17. Road Input for 20ft Light Containers

Segment	Distance (km.)	Terrain	Condition	Congestion	Cost (TEU/km)	Ave. Trip Time (hours)	Ave. Wait Time (hours)	Max. Speed (km/hr)	Min. Speed (km/hr)	Max. Wait Time (hours)	Min. Wait Time (hours)
Dar-es-Salam-Morogoro	195	FH	F	L	2.36	17.5	12	60	30	18	8
Morogoro-Dodoma	274	H	P	L	2.75	9.5	2	60	30	3	0
Dodoma-Singida	227	FH	F	L	2.36	18	12	60	30	18	8
Singida-Nzega	214	H	F	L	2.55	8	2	60	30	3	0
Nzega-Lusahunga	318	FH	F	L	2.36	21	12	60	30	18	0
Lusahunga-Nyakahura	39	H	F	L	2.55	1.3	0	60	30	0	8
Nyakahura-Kobero	103	H	F	L	2.55	15.5	12	60	30	18	0
Kobero-Gitega	109	HM	F	L	2.95	3.9	0.3	60	30	0.45	0
Gitega-Bujumbura	88	M	F	L	3.64	3.5	0	60	30	0	0
Total	**1567**					**154.2**	**52.3**				

Source: Prepared by Nathan Associates Inc.

RAIL

Similarly to the road links, the rail links contain information pertaining to the physical characteristics of the rail segment as well as price, time and reliability. The physical information relates to its distance, the type of terrain (flat, rolling, hilly and mountainous), and track condition (good, fair and bad) as well as number of tracks. This information is used to estimate a factor that is used to provide a weight to distribute the cost among the links for each road transport alternative. The performance information includes the cost as a total for the link or per km, total time in the link (including wait time), wait time (including rest stops), and the maximum and minimum speeds and wait times.

Table 4.18 shows the rail link information between Dar es Salaam and Mwanza for import of 20ft light containers. The table shows that the track condition in the whole segment is poor.

Table 4.18. Rail Input for 20ft Light Containers

Segment	Distance (km.)	Terrain	Condition	No. Tracks	Cost (TEU/km)	Ave. Trip Time (hours)	Ave. Wait Time (hours)	Max. Speed (km/hr)	Min. Speed (km/hr)	Max. Wait Time (hours)	Min. Wait Time (hours)
Dar-Tabora	840	F	P	1	1.2	82	49	40	10	164	33
Tabora-Isaka	159	F	P	1	1.2	16	9	40	10	31	6
Isaka-Mwanza	230	F	P	1	1.2	22	13	40	10	45	9
Total	**1229**					**120.0**	**72.0**			**240**	**48**

Source: Prepared by Nathan Associates Inc.

Overview of Central Corridor Performance

IMPORTS

Table 4.19 shows the price, time and reliability of each of the destinations from the port of Mombasa for imports of different type of cargo by handling served by road. The information listed includes all costs and process times experienced by the shipments at they proceed through the transport networks including ports, ICDs, border posts, inland customs clearance (at capital cities), facilitation costs at weighbridges and check points and rest stops.

The port related charges and times (included in the information by destination) are specifically listed at the bottom of the tables because it makes it easier to assess their significant contribution to the delays experienced and also to observe that in terms of price the land transport represents the highest proportion.

Table 4.19. Central Corridor Performance for Imports by Cargo Type and Destination, 2010 (via road)

Destination	Distance (km.)	Price (US$ TEU)			Time (hours)			Reliability Indicator (%)			
		Containers (TEU)		Bulk (TL)	Containers	Bulk		Containers		Bulk	
		Light	Heavy	Dry/Liquid	Light/Heavy	Dry	Liquid	Light	Heavy	Dry	Liquid
Mwanza	1129	1,618	2,765	2,511	362	467	371	198	215	186	177
Goma	1640	3,618	5,418	5,161	565	670	574	135	145	144	136
Kigali	1495	3,314	4,918	4,661	420	525	429	171	186	166	155
Bujumbura	1567	4,369	6,961	6,704	440	545	449	163	177	159	147
Port Node*											
Dar Es Salaam		319	319	62	291	396	300	245	266	217	217

Note: Port values are included in the total shown for each destination.

Source: Nathan Associates Inc.

Table 4.19 shows the price, time and reliability of each of the destinations served by road from the port of Dar es Salaam for imports of different types of cargo by handling. For example, heavy containers going to Bujumbura are subject to a total cost US$ 6,961 per TEU, of which US$ 319 are port costs; it takes 149 hours to reach Bujumbura after staying at the port for291 hours, thus the total time of the segment is 440 hours; the reliability of the segment indicates that the expected delays are within 177 percent range above or under the average time. Generally, the price for heavy containers, dry and liquid bulk is similar. The table shows that the price goes up with distance (lowest rate per km is to Mwanza at US$ 1.43/km for light containers). There are destinations with higher rates that account for longer delays to clear customs, while the cargo remains loaded in the truck; this is the case of Bujumbura at US$ 2.70/km and Goma at US$ 2.21/km.

Total travel time varies by destination depending on the number of border crossing and the delays experienced at final clearance. The time at the port for containers is longer than for bulk because the bulk is generally loaded into trucks at the berth, cleared customs and released from the port immediately. If we calculate the average travel speed (excluding the time at the port) we see that the route to Mwanza is the fastest (no border post) followed by

Kigali and Bujumbura (one border posts). The slowest trip is to Goma where cargo has to wait about one week to be cleared after having crossed two border posts.

The reliability indicator reflects the range of variations in time with respect to the average time it takes to complete each stage of the logistics chain. A higher value for the reliability indicator signifies a greater variation and more likelihood of long delays. The port has the greatest range of variation in time in the logistics chain hence the most unreliable. Generally, road transport is the most reliable element of the transport logistics chain. As a result, the longer the travel distance the lower is the overall reliability indicator since the relative weight of the road transport reliability index increases.

Table 4.20 presents similar performance results for imports that use rail along the Central Corridor. The average cost per km to Mwanza (US$ 1.46/km for a container) is less costly than to Kampala (US$ 1.59/km) and Bujumbura (US$ 1.66/per km).

Table 4.20. Central Corridor Performance for Imports by Cargo Type and Destination (via rail or rail and lake)

Segment	Distance (km.)	Price (US$ TEU)		Time (hours)		Time Variation (%)	
		Containers	Bulk	Containers	Bulk	Containers	Bulk
		Light/ Heavy	Dry/ Liquid	Light/ Heavy	Dry/ Liquid	Light/ Heavy	Dry/ Liquid
Kampala	1,568	2,507	2,250	530	539	150	152
Mwanza	1,229	1,794	1,537	411	420	192	193
Bujumbura	1,446	2,403	2,146	524	533	152	154
Port Node*							
Mwanza Port - Port Bell		132	132	48	48	150	150
Dar Es Salaam		319	62	291	300	266	266

Note: Port values are included in the total shown for each destination.

Source: Nathan Associates Inc.

EXPORTS

For exports, similar tables have been prepared. Table 4.21 shows that for export flows via road the cheapest rates are also for Mwanza (US$ 1.43/km). This is the shortest segment and involves fewer delays because it has no border post. The most expensive segment is Bujumbura with a cost of US$ 2.78/km for light containers and US$ 4.44/km for heavy containers. In terms of average speed of the segments (without considering the time spent at the port) Mwanza is the fastest segment followed by Bujumbura, and Kigali. The reliability indicator show similar levels of reliability along all the segments of the corridor. In general, the shortest trips are the most unreliable given that the impact of the port unreliability is more significant. Variations in reliability of border crossing are also reflected in the results.

Table 4.21. Central Corridor Performance for Exports by Cargo Type and Origin (via road)

Source: Nathan Associates Inc.

Origin	Distance (km.)	Price (US$ TEU)		Time (hours)	Reliability Indicator %	
		Light	Heavy		Light	Heavy
Mwanza	1,129	1,618	2,768	396	283	260
Goma	1,640	3,618	5,418	599	200	186
Kigali	1,281	3,314	4,918	454	248	228
Bujumbura	1,567	4,369	6,961	480	234	217
Port Node*						
Dar Es Salaam		319	319	325	344	316

Note: Port values are included in the total shown for each destination.

For the exports flows transported via rail, Table 4.22 shows that the transport rate per kilometer are similar; for Mwanza (US$ 1.45/km for all containerized cargo) is lower than Kampala (US$ 1.59/km) and Bujumbura (US$ 1.66/km). In terms of average speed (time of travel discounting the port time), the results are quite different with Mwanza being significantly faster (17.07 km/hr) compared with 8.2 km/hr and 7.7 km/hr for Kampala and Bujumbura respectively. This is due to the speed of the lake portion of the segment that lowers the average of the segments from Kampala and Bujumbura.

Table 4.22. Central Corridor Performance for Exports by Cargo Type and Origin (via rail or rail / lake)

Origin	Distance (km.)	Price (US$ TEU)	Time (hours)	Reliability Indicator %
		Light / Heavy		Light / Heavy
Kampala (via rail/lake)	1,568	2,507	636	221
Mwanza (via rail)	1,229	1,794	517	271
Bujumbura (via rail/lake)	1,446	2,403	631	223
Port Node*				
Port Bell - Mwanza Port		132	48	150
Dar Es Salaam		319	397	351

Note: Port values are included in the total shown for each destination.

Source: Nathan Associates Inc.

When comparing imports to exports, it can be seen than moving containerized cargo has basically the same cost for import and export flows. This is explained by the tariff structure of the port of Dar es Salaam that charges the same prices for inbound and outbound containers. In terms of time containerized exports are subject to longer times at the port and the overall result for all segments indicates that exporting is slower than importing. The reason behind this is that containerized exports spend more time at the port than imports; the exporters are using the port as warehousing facility until the arrangement for the overseas transport of the cargo is made.

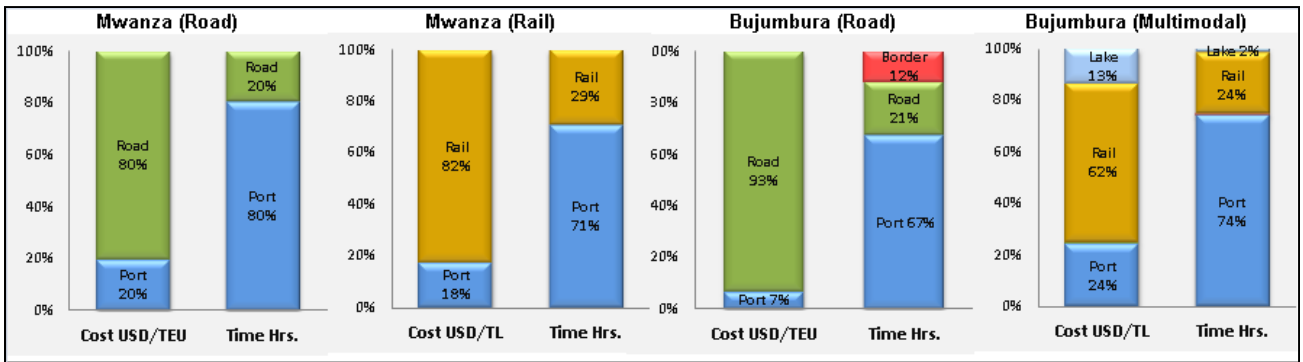
Central Corridor Cost and Time Comparison by Transport Alternative and Component

Following the analysis performed for the Northern Corridor, this section presents the results of the performance assessment for light containers. The results are presented for imports/exports for the selected transport alternatives connecting each origin /destination and the port of Dar Es Salaam. The figures show the participation of each component (links and nodes) in the total costs and time of the transport alternative.

IMPORTS

Two transport alternatives were considered for the segment between **Dar es Salaam** and **Mwanza**, one via road and one multimodal that combines rail and lake links. Figure 4.7 shows that the rail alternative is more expensive and slower than the road alternative. In terms of total costs (including facilitation and extra inventory) the rail connection exceeds by 9 percent the road and in terms of time rail exceeds the road mode by 14 percent. The difference in cost is explained by the higher price of rail surface transport and also in higher extra inventory cost.

Figure 4.7. Cost and Time for Central Corridor Destinations Served by Road and Rail/ Lake Transport Alternatives, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	1,300	71
Border	-	-
Rail	-	-
Lake	-	-
Transport	1,619	362
Freight Fwd. Fe	300	-
Extra Inventory	710	-
Total	2,629	362

Elements	Cost USD/TL	Time Hrs.
Port	319	291
Road	-	-
Border	-	-
Rail	1,475	120
Lake	-	-
Transport	1,794	411
Freight Fwd. Fe	300	-
Extra Inventory	781	-
Total	2,875	411

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	4,333	91
Border	-	50
Rail	-	-
Lake	-	-
Transport	4,652	432
Freight Fwd. Fe	300	-
Extra Inventory	711	-
Total	5,663	432

Elements	Cost USD/TL	Time Hrs.
Port	583	387
Road	12	0
Border	-	2
Rail	1,488	124
Lake	320	10
Transport	2,403	524
Freight Fwd. Fe	300	-
Extra Inventory	788	-
Total	3,491	524

Source: Nathan Associates Inc.

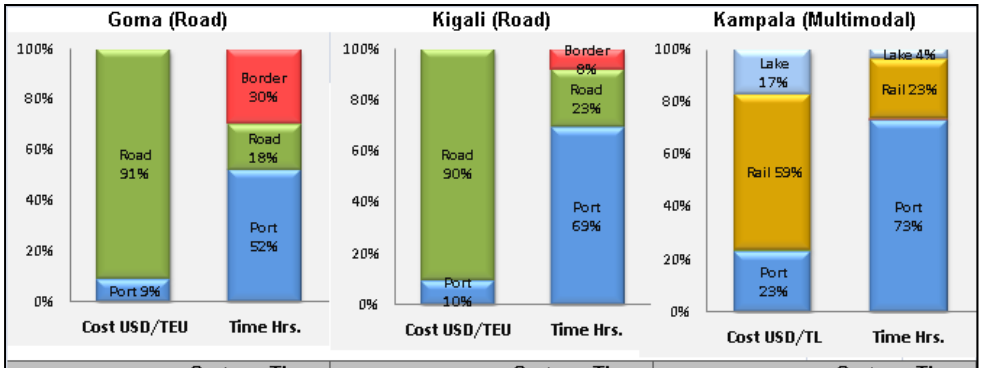
The time that the cargo spends at the port is identical; therefore, total time difference is explained entirely by the longer time required to complete the movement of the cargo between the port and Mwanza via rail. The participation of port related costs and times in the total for both modes is similar; port costs account for 20 percent in the road option and 18 percent in the rail option; the remaining costs of both alternatives are related entirely to the

surface transport cost. Time at the port for containers transported by road is 80 percent of the total time, while via rail is 71 percent.

Similarly to the previous segment, a road and a rail / lake alternatives were analyzed for the **Dar es Salaam** and **Bujumbura** segment. The rail / lake option is less expensive and slower than the road option, as would be expected. This alternative was the historic favorite for the shippers in Bujumbura and the one they are very interested in seeing improved. The cost of the multimodal option (including facilitation and extra inventory) is 38 percent less than the road; road surface transport costs almost triple rail surface transport costs. As for the port related costs these are higher for the rail / lake because cargo goes through three port nodes, Dar es Salaam, port of Kigoma and the port at Bujumbura. The time for the rail / lake alternative is higher by 21 percent than for the road. This is caused by the poor port infrastructure and inefficiencies of the rail and the lake ports which hamper the intermodal transfer. Understandably, most of the costs for imports moved by road are related to surface transportation; in the multimodal option rail transport costs are the most relevant part with a 62 percent share of the total. In regards to time, the port is the most important component for both alternatives, accounting for 67 percent and 74 percent respectively (the last number includes the time at Kigoma and Bujumbura lake ports).

The road alternatives between **Dar es Salaam** and **Goma** and **Dar es Salaam** and **Kigali** (Figure 4.8) present a similar distribution of times and costs. Road related costs are the prevailing component with 91 and 90 percent of the share of the total respectively. In terms of time, port is the most significant element for both destinations; additionally, in the case of Goma, containerized cargo spends around seven days clearing border post procedures, therefore there is a significant participation of border post related time, which accounts for 30 percent of the total time of the segment.

Figure 4.8. Cost and Time for Central Corridor Destinations Served by Single Transport Alternatives Road or Rail/ Lake, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	319	291	Port	319	291	Port	583	387
Road	3,298	104	Road	2,995	97	Road	7	0
Border	-	170	Border	-	32	Border	-	2
Rail	-	-	Rail	-	-	Rail	1,487	121
Lake	-	-	Lake	-	-	Lake	430	20
Transport	3,617	565	Transport	3,314	420	Transport	2,507	530
Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-
Extra Inventory	755	-	Extra Inventory	711	-	Extra Inventory	787	-
Total	4,672	565	Total	4,325	420	Total	3,594	530

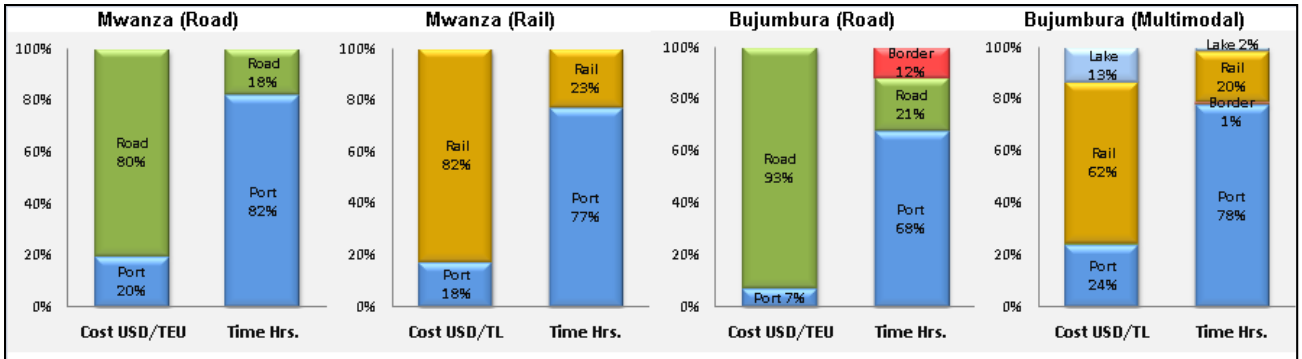
Source: Nathan Associates Inc.

The multimodal alternative from **Dar es Salaam** to **Kampala** integrates rail and lake links; rail costs represent the main share of the overall cost (59 percent). Time at the port has the highest participation in the overall time accounting for 73 percent of the total. Port costs and time for this transport alternative include the values for Dar es Salaam, port of Mwanza and Port Bell. This option is currently not very competitive when compared to the transport alternatives along the Northern Corridor due to the lack of scheduled ferry services and inefficiencies in the operation of TRL. Anecdotal information suggests that at the peak of operation of the East Africa Railway, the cost and time were very competitive which suggests that if the services are improved, this could be a viable transport alternative.

EXPORTS

The transport alternatives considered for exports correspond exactly to the ones presented for imports. Containerized exports flowing between **Mwanza** and **Dar es Salaam (**Figure 4.9) are subject to higher cost and longer time if they use the rail option instead of the road alternative.

Figure 4.9. Cost and Time for Central Corridor Origins Served by Road, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	319	325	Port	319	397	Port	319	325	Port	583	493
Road	1,300	71	Road	-	-	Road	4,050	99	Road	12	0
Border	-	-	Border	-	-	Border	-	56	Border	-	4
Rail	-	-	Rail	1,475	120	Rail	-	-	Rail	1,488	124
Lake	-	-	Lake	-	-	Lake	-	-	Lake	320	11
Transport	1,619	396	Transport	1,794	517	Transport	4,369	480	Transport	2,403	633
Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-
Extra Inventory	1,109	-	Extra Inventory	1,387	-	Extra Inventory	1,113	-	Extra Inventory	1,391	-
Total	3,028	396	Total	3,481	517	Total	5,782	480	Total	4,094	633

Source: Nathan Associates Inc.

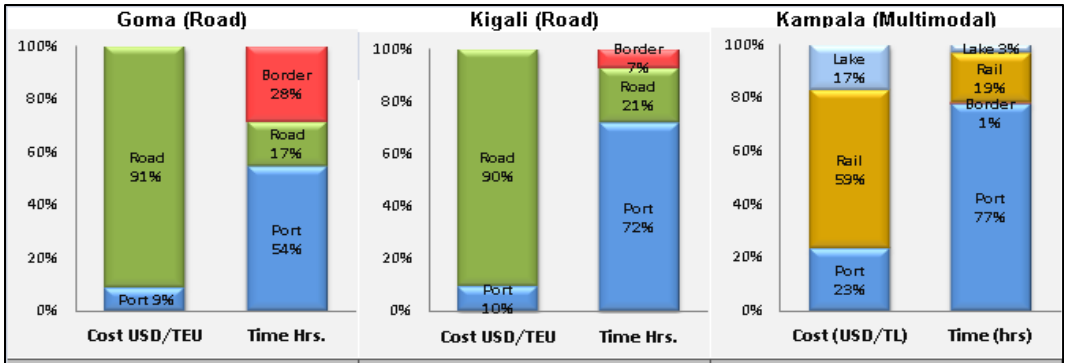
The rail total cost exceeds the road cost by 15 percent, while the time difference is 31 percent. The difference in cost is due to higher rail surface transport costs and also higher extra inventory cost. The participation of port related costs and times in the total for both modes is similar; port costs account for 20 percent in the road option and 18 percent in the rail option; the remaining costs of both alternatives are related entirely to the surface transport cost. Time at the port for containers transported by road is 82 percent of the total time, while via rail is 77 percent.

The total cost of the connection between **Bujumbura** and **Dar es Salaam** via road is 29 percent higher than the rail cost. Even though the port and the extra inventory costs of the rail alternative exceed those corresponding to the road mode, the US$ 2,230 difference in higher road surface transport costs makes the road alternative more expensive. The participation of port costs in the rail/lake alternative is 24 percent versus only 7 percent in the road alternative. Also the participation of port time is higher in the rail/lake scenario by 10 percent. This higher participation is again explained because the port value for the lake/rail alternative aggregates costs and times for the three port nodes of the segment, Dar es Salaam, port of Kigoma and the port at Bujumbura.

The results in Figure 4.10 show that the road alternatives for exports between **Dar es Salaam** and **Goma** and **Dar es Salaam** and **Kigali** present a similar distribution of costs between port and road surface cost. Road related costs are the prevailing component with 91 and 90 percent of the share of the total respectively. In terms of time, port is the most significant element for both destinations; additionally, in the case of Goma, containerized cargo spends around seven

days clearing border post procedures, therefore there is a significant participation of border post related time, which accounts for 28 percent of the total time of the segment.

Figure 4.10. Cost and Time for Central Corridor Origins served by a Single Transport Alternative, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	319	325	Port	319	325	Port	583	493
Road	3,298	104	Road	2,995	97	Road	7	0
Border	-	170	Border	-	32	Border	-	4
Rail	-	-	Rail	-	-	Rail	1,487	120
Lake	-	-	Lake	-	-	Lake	430	20
Transport	3,617	599	Transport	3,314	454	Transport	2,507	638
Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-
Extra Inventory	1,185	-	Extra Inventory	1,114	-	Extra Inventory	1,388	-
Total	5,102	599	Total	4,728	454	Total	4,195	638

Source: Nathan Associates Inc.

For the multimodal alternative from **Dar es Salaam** to **Kampala** the rail costs represent the main share of the overall cost (59 percent). Time at the port has the highest participation in the overall time accounting for 77 percent of the total. Port costs and time for this transport alternative include the values for Dar es Salaam, port of Mwanza and Port bell.

Interpretation of Results for the Central Corridor

DAR ES SALAAM PORT PERFORMANCE

The analysis of all the different alternatives between the selected destinations / origins for exports and imports along the Central Corridor show consistently that the greatest share of the time is spent at the port of Dar es Salaam.

Table 4.23 summarizes the assessment of the specific components of the port node. The results show that containerized cargo spends most of the time in the yard, which understandably, presents also the lower logistics score of the node components. The next component with a mayor share in time is the berth and accordingly its logistics score is the second lower. Gate operations occur generally in an efficient and fluid manner, being this element the best ranked according to the port nodes logistics scores.

Table 4.23. Dar es Salaam Port Performance (light containers)

Component	Imports			Exports		
	Price (USD)	Time (hrs)	Reliability Indicator (%)	Price (US$)	Time (hrs)	Reliability Indicator (%)
Dar es Salaam Port	319	291	245	319	325	344
Channel	0	48	100	0	0	0
Berth	90	48	100	90	48	100
Yard	150	120	112	150	252	243
Customs	79	72	133	79	24	100
Gate	0	3	112	0	1	200

Source: Nathan Associates Inc.

Shipping lines have indicated that the productivity in handling smaller ships at Dar es Salaam, with about 500 moves (in/out), was 10 moves/crane–hour. Since smaller ships were usually assigned only one crane, this also was the berth productivity. Accordingly, the berth time for handling these ships was about two days. For larger ships, handling 800–1,200 moves/call, productivity did reach higher levels of about 13 moves/crane–hour. Since these ships work part of the time with two cranes, the overall berth productivity was 15 moves/berth–hour. At this handling rate, these ships spent three to four days at berth. Participants in our Dar es Salaam workshop in October 2010 observed that recently TICTS has been reaching 20 moves/berth-hour, presumably following the commissioning of the new STS gantry cranes.

The reason for the low productivity, according to the shipping lines, was first and foremost yard congestion. The shore cranes spent much of their time waiting for yard tractors, while these tractors, in turn, were waiting for RTGs. The congestion and waiting of shore cranes is attributed to the simultaneous handling of RTGs yard tractors and outside trucks of shippers and consignees. These trucks compete with yard tractors on RTG services and also queue inside the stacks. Moreover, handling import boxes to outside trucks often requires shuffling of boxes, which sometimes may require additional five moves (TICTS operates with one over five RTGs). Another reason for the low productivity is frequent breakdowns of handling equipment, especially the 25 year old gantry cranes. Shipping lines also complained that there was a shortage in all types of handling equipment: shore cranes, RTGs, RSs and yard tractors. For example, the lines claimed that ships with 500 moves should be assigned two shore cranes and those with 1,000 moves even three cranes (depending on stowage plan).

The productivity data provided by the terminal operators was somewhat higher than that claimed by lines. TICTS claimed that crane productivity has recently increased reaching 12 moves/crane-hour. TICTS agreed that the main reason for the low productivity is congestion; in the pre–congestion period, they claim that productivity was +20 moves/crane–hour.

TPA claimed that their MHCs' productivity was 12–14 moves/crane–hour. Accordingly, while typically working with two MHCs, berth productivity was at times 24–28 moves/berth–hour. This productivity was similar or perhaps even exceeding that of TICTS, which explains why lines preferred directing their ships to the conventional container terminal when the container terminal was occupied.

Ships' waiting time, according to shipping lines, ranged two to four days, which was a great improvement compared to up to 12 days previously. As seen above, berth time at TICTS for small ships was two days and for large ships three to four days. Hence, the total port time ranged from five to seven days.

No data on truck turnaround times was available. The lines indicated that it was probably six to eight hours. The long time was required due to the pre–gate, out–gate and RTG waiting along with waiting for the scanning process. Even longer waiting times were required in case of Customs verification (physical inspection). It should be noted that all containers, including those transferring to the ICDs, are required to be scanned at the port.

LAND TRANSPORT

There are potential cost and time advantages for using the rail plus lake alternatives where they are available. However, poor performance, inadequate infrastructure and low capacity has led most shippers (over 90 percent) using the road. Historically, the rail plus lake transport alternative had been the preferred option for shippers from Bujumbura and for shippers from Kampala to access the port of Dar es Salaam. There is an urgent need to rebuild and further develop rail and lake capacity not only to provide effective competition with road but to increase the use of rail with a view to reducing the region's total transport and trade costs. A sizable and steady demand for their services would allow TRL and lake service operators to provide for scheduled and frequent services at competitive costs (reduced when compared to current road transport costs).

Table 4.24 summarizes the price, time and reliability information for all the segments that make up the Dar es Salaam to Kigali road transport alternative and for all the cargo types analyzed. The table shows that the prices for all road segments are the same for heavy containers and dry and liquid bulk. The charges for light containers are lower because the trucks are not fully loaded when transporting them. However, the price distribution across all segments remains the same for all commodities. The time and reliability are the same for all commodities because the trucks experience the same delays and congestion as they move through the corridor. The only exception would be for fuel trucks that have priority for clearance at the border posts given their dangerous cargo. The table also shows the performance of the Rusumo border post.

The port performance is also reported in Table 4.24 to indicate the relevance of the port as it takes a significant share of the time. The port performance data also shows its variation in price and time by cargo type. It shows that offloading bulk cargoes has the lowest price, while the fastest time corresponds to offloading containers.

Table 4.24. Road and Border Post Performance, Imports

Segment	Distance (km.)	Price (US$)				Time (hours)			Reliability Indicator (%)			
		Containers			Bulk	Container	Bulk		Containers		Bulk	
		Light	Light/ km.	Heavy	Dry/ Liquid	Light/ Heavy	Dry	Liquid	Light	Heavy	Dry	Liquid
Dar es Salaam to Kigali	1,495	3,314	2.22	4,918	4,661	420	525	429	171	186	166	155
Dar Es Salaam - Morogoro	195	349	1.79	536	536	18	18	18	154	154	154	27
Morogoro - Dodoma	274	573	2.09	880	880	10	10	10	19	19	16	19
Dodoma - Singida	227	406	1.79	624	624	18	18	18	123	123	26	123
Singida - Nzega	214	415	1.94	638	638	8	8	8	12	14	14	14
Nzega - Lusahunga	318	569	1.79	875	875	21	21	21	82	172	82	172
Lusahunga - Rusumu	107	240	2.24	368	368	16	16	16	25	25	25	285
Rusumu Border Post	n.a.	0	n.a.	0	0	32	32	32	150	120	250	250
Rusumu -Kigali	160	443	2.77	678	678	7	7	7	11	16	16	16
Port Node												
Dar Es Salaam Port		319		319	62	291	396	300	245	266	217	217

Source: Nathan Associates Inc.

Table 4.25 summarizes the price, time and reliability information for all the segments that make up the Dar es Salaam to Bujumbura rail transport alternative and for all the cargo types analyzed. The table shows that the prices for all rail segments are the same for heavy containers and dry and liquid bulk. However, the price distribution across all segments remains the same for all commodities. The time and reliability are the same for all commodities because the rail experiences the same delays and inefficiencies as they move through the corridor. The only exception would be for fuel wagons that have priority and are normally transported in unitary trains. The table also shows that border posts clearance is quick fast for trains since the risk associated to cargo deviation is minimal.

The port performance is also reported in Table 4.25 to indicate the relevance of the port as it takes a significant share of the time. The port performance data also shows its variation in price and time by cargo type. It shows that offloading liquid bulk has the lowest price and fastest time of the cargo types.

Table 4.25. Rail and Border Post Performance, Imports

Segment	Distance	Price (US$)			Time (hours)		Reliability Indicator (%)	
		Containers	Container/ km.	Bulk	Containers	Bulk	Containers	Bulk
Dar es Salaam to Bujumbura	1,446	2,403	1.66	2,146	524	533	152	154
Dar Es Salaam - Tabora	840	991	1.18	991	83	83	3,772	3,772
Tabora - Kigoma BP	411	485	1.18	485	41	41	884	884
Kigoma Border Post	n.a.	0	n.a.	0	1	1	100	100
Kigoma BP - Kigoma	10	12	1.20	12	0	0	0	0
Kigoma - Bujumbura Port	175	320	1.83	320	10	10	107	107
Bujumbura Port - Bujumbura BP	5	6	1.20	6	0	0	0	0
Bujumbura Border Post	n.a.	0	n.a.	0	1	1	100	100
Bujumbura BP - Bujumbura	5	6	1.20	6	0	0	0	0
Port Node								
Bujumbura Port - Bujumbura		132		132	48	48	150	150
Kigoma Port - Bujumbura		132		132	48	48	150	150
Dar Es Salaam Port - Bujumbura		319		62	291	300	266	266

Source: Nathan Associates Inc.

Tables 4.26 and 4.27 show similar information as above but related to exports. The only significant differences are observed at border posts where customs clearance procedures are minimal and for the port where the process is different and the wait time before loading into the ships are longer because shippers tend to send their goods ahead of time to account for any possible delays.

Table 4.26. Road and Border Post Performance, Exports

Segment	Distance (km.)	Price (US$)			Time (hours)	Reliability Indicator (%)	
		Light	Light/km.	Heavy	Light/ Heavy	Light	Heavy
Kigali to Dar es Salaam	**1,281**	**3,314**	**2.59**	**4,918**	**454**	**248**	**228**
Kigali - Rusumu	160	443	2.77	678	7	17	17
Rusumu Border Post	n.a	0	n.a	0	32	190	250
Rusumu - Lusahunga	107	240	2.24	368	16	25	285
Lusahunga - Nzega	318	569	1.79	875	21	172	172
Nzega - Singida	214	415	1.94	624	18	14	123
Singida - Dodoma	227	406	1.79	880	10	123	16
Dodoma - Morogoro	274	573	2.09	536	18	19	154
Morogoro - Dar Es Salaam	195	349	1.79	0	0	154	0
Port Node							
Dar Es Salaam Port - Kigali		319		319	325	344	316

Source: Nathan Associates Inc.

Table 4.27. Road and Border Post Performance, Exports

Segment	Distance (km.)	Price (US$)		Time (hours)	Reliability Indicator (%)
		Light/ Heavy	Container / km.	Light/ Heavy	Light/ Heavy
Bujumbura to Dar es Salaam	**1,446**	**2,403**	**1.66**	**631**	**223**
Bujumbura - Bujumbura Port	5	6	1.20	0	0
Bujumbura Port - Kigoma	175	320	1.83	11	126
Kigoma - Kigoma BP	10	12	1.20	0	0
Kigoma Border Post	n.a.	0	n.a.	1	100
Kigoma BP - Tabora	411	485	1.18	41	884
Tabora - Dar Es Salaam	840	991	1.18	83	3,772
Port Node					
Bujumbura Port - Bujumbura		132		48	150
Kigoma Port - Bujumbura		132		48	150
Dar Es Salaam Port - Bujumbura		319		397	351

Source: Nathan Associates Inc.

OTHER CAUSES OF INEFFICIENCY

Other causes if corridor inefficiencies that are common to the Northern and Central Corridors are described at the end of the Northern Corridor section.

Comparative Analysis of the Northern and Central Corridors Performance

In this section we present a performance comparison for the transport alternatives on the Northern and Central Corridors serving common origins or destinations by cargo type. In the tables that are presented, the best result for each destination in terms of price, time and reliability is highlighted with a box.

IMPORTS

As shown in Table 4.28, there are three transport alternatives into **Kampala**, one for road and one for rail on the Northern Corridor and one on lake+rail on the Central Corridor. The rail alternative on the Northern Corridor offers the lowest price and the best reliability for light containers and liquid bulk. The fastest time for all types of cargo is offered by the road alternative on the Northern Corridor. In terms of price, the Northern Corridor road option is the least expensive for light containers and liquid bulk; the Central (Rail+Lake) option is the least expensive only for dry bulk. Results are consistent with results on other destinations.

Table 4.28. Performance Comparison of Destinations Served by Both the Northern and Central Corridors, 2010 (imports)

Destination and Corridor	Mode	Distance km.	Light Containers			Dry Bulk			Liquid Bulk		
			Price (US$)	Time (hours)	Reliability Indicator (%)	Price (US$)	Time (hours)	Reliability Indicator (%)	Price (US$)	Time (hours)	Reliability Indicator (%)
Kampala											
Northern	Road	1,180	2,099	323	194	3,511	276	262	3,316	240	217
Northern	Rail	1,200	2,059	462	138	3,432	415	177	3,237	379	141
Central	Rail+Lake	1,568	2,507	530	150	2,250	539	152			
Kigali											
Northern	Road	1,661	3,901	376	167	6,658	329	220	6,463	293	178
Central	Road	1,495	3,314	420	171	4,661	525	166	4,661	429	155
Bujumbura											
Northern	Road	1,903	4,950	411	153	8,511	364	200	8,316	328	160
Central	Road	1,567	4,369	440	163	6,704	545	159	6,704	449	147
Central	Rail+Lake	1,446	2,403	524	152	2,146	533	154	2,146	533	154
Goma											
Northern	Road	1,811	4,822	537	131	8,200	490	162	8,005	454	135
Central	Road	1,640	3,618	565	135	5,161	670	144	5,161	574	136
Port Node*											
Mombasa Transit			297	217	287	360	170	424	165	134	386
Dar Transit			319	291	245	62	396	217	62	300	217

Note: Port values are included in the totals shown for each destination.

Source: Nathan Associates Inc.

The case of **Kigali** shows that the road alternative on the Central Corridor offers the lowest price (US$ 587 less) while not the fastest time which is offered by the road alternative on the Northern Corridor (44 hours faster). This relationship is held over the other cargo types analyzed. Additionally, it's worth to note that this matches the perception that while the distance from Kigali and Bujumbura are shorter to the port of Dar es Salaam (hence the lowest prices to ship through Dar), the faster service is offered by the alternatives through the port of Mombasa (given its faster processing time). The road transport alternatives to **Goma** show similar results with the lowest price on the Central Corridor and the fastest alternative on the Northern Corridor.

For **Bujumbura** different transport alternatives have the lowest price (rail+lake alternative on the Central Corridor) and the fastest time (road alternative on the Northern Corridor) for transporting light containers. The rates for rail and lake transport are generally the lowest and coupled with a shorter distance combine to make this alternative the one with the lowest time. On the other hand, rail and lake are also the slowest and most unreliable with together with the fact that Dar es Salaam is slower than Mombasa by 74 hours explain why the fastest alternative is by road on the Northern Corridor. The performance comparison of transport alternatives for other cargo types shows similar results.

EXPORTS

Table 4.29 presents a performance comparison for the transport alternatives on the Northern and Central Corridors serving common export origins by cargo type. For **Kigali** and **Goma**, there are two road transport alternatives. As with imports, the road alternative on the Central Corridor has the lowest price while the fastest is the one on the Northern Corridor. This is true for light and heavy containers.

For exports from **Bujumbura** there are three transport alternatives. The lowest price is observed in the shortest alternative that additionally uses the least expensive modes (rail+lake). The fastest alternative is by road on the Northern Corridor.

Finally for **Kampala**, the lowest price for light containers is by rail on the Northern Corridor and the fastest in on the same corridor but by road. The results for heavy containers indicate that the lowest price is on the Central Corridor by rail+lake even though this alternative is the longest. The information provided by TRL indicates no differentiated transport rates for light and heavy containers. On the other hand, RVR indicates that the common business practice is to charge higher tariffs for heavy containers. Since that differentiation was not reported by TRL, the tariffs for the central corridor are the same for light and heavy containers and less expensive that on the Northern Corridor for heavy containers.

Table 4.29. Performance Comparison of Origins Served by Both the Northern and Central Corridors, 2010 (exports)

Origin and Corridor	Mode	Distance km.	Light Containers			Heavy Containers		
			Price (US$)	Time (hours)	Reliability Indicator (%)	Price (US$)	Time (hours)	Reliability Indicator (%)
Kampala								
Northern	Road	1,180	2,062	395	267	3,441	395	353
Northern	Rail	1,200	2,022	558	191	3,362	558	260
Central	Rail+Lake	1,568	2,507	636	221	2,507	636	221
Kigali								
Northern	Road	1,661	3,864	422	250	6,588	422	261
Central	Road	1,281	3,314	454	248	4,918	454	228
Bujumbura								
Northern	Road	1,903	4,913	433	244	8,441	433	255
Central	Road	1,567	4,369	480	234	6,961	480	217
Central	Rail+Lake	1,446	2,403	631	223	2,403	631	223
Goma								
Northern	Road	1,811	4,785	429	246	8,113	429	257
Central	Road	1,640	3,618	599	200	5,418	599	186
Port Node*								
Mombasa - Transit			260	313	336	290	313	351
Dar - Transit			319	325	344	319	325	316

Note: Port values are included in the totals shown for each origin.

Source: Nathan Associates Inc.

Comparisons of Northern and Central Corridor Performance to Other African and Asian Corridors

In order to assess the overall performance of the Northern and Central Corridors it is useful to compare their performance with that of other corridors in Africa and elsewhere. The FastPath methodology used for CDS has been applied to several other African and Asian corridors and provides an appropriate basis for comparison.

In addition to the above indicators for price, time and reliability, FastPath calculates "logistics scores" for each transport/logistics chain, segment and component. The *logistics score* is computed by comparing the performance of a component of the transport/logistics chain and rating it as good, fair, poor or very poor, according to international standards. This rating is then converted to a numeric score (61-80 if good, 41-60 if fair, 21-40 if poor and 1-20 if very poor). Then the scores for price, time and reliability are averaged to get the total score for a component. The scores for nodes and links are then given a time-weighted average to compute the segment total. If there is more than one segment corridor in a corridor, their scores are combined to compute their volume-weighted average for the total chain.

A *logistics score* between 70 and 80 indicate that time, cost and reliability in the total supply chain is efficient and competitive according to global standards. These scores are computed only for containerized cargo.

Table 4.3 presents a comparison of FastPath logistics scores by corridor and segment. The overall score is shown as well as the component scores for port, road rail and border posts. For the Northern Corridor, imports to Nairobi, Kampala and Kigali by road currently are all rated as "Good" albeit at the bottom of the Good scale. Other Northern Corridor destinations are currently rated in the upper range of the "Fair" category. Mombasa Port is considered as "Fair". Road segments to Nairobi, Kampala and Kigali as scored as "Good" while other destinations have a "Fair" rating. The rail component is also rated as "Fair". All of the border posts in Northern Corridor are rated as "Good" with the exception of Nimule which is rate "Fair".

For the Central Corridor the overall score to all destinations is "Good" except for Bujumbura which is rate "Poor" due to the performance of the road. The Port of dare s Salaam is rated as "Fair"and is scored a few points below the Port of Mombasa. All of the border posts in the Central Corridor are rated as "Good".

The overall performance of the two corridors is considered fair and is comparable to the performance of the other African and Asian corridors shown in Table 4.3. However the goal should be to reach a Good rating for all components.

Table 4.30. Comparison of FastPath Logistics Scores by Corridor and Segment

Corridor and Segment	Logistics Score				
	Overall	Port	Road	Rail[1]	Border Post[2]
Northern Corridor (from Mombasa port)					
Nairobi (via road)	61	57	73	--	--
Nairobi (via rail)	50	57	--	47	--
Kampala (via road)	64	57	64	--	67
Kampala (via rail)	53	57	--	49	77
Bujumbura (via road)	57	54	54	--	71
Kigali (via road)	61	54	60	--	68
Nimule(via road)	54	54	52	--	57
Kasindi (via road)	56	54	55	--	62
Goma (via road)	52	54	48	--	67
Central Corridor (from Dar es Salaam)					
Mwanza (via road)	50	52	50	--	--
Mwanza (via rail)	51	55	--	50	--
Bujumbura (via road)	36	52	30	--	70
Bujumbura (via rail)	54	55	60	48	80
Kampala (via rail)	56	55	60	51	80
Kigali (via road)	59	52	58	--	72
Goma (via road)	45	52	41	--	70
Other Road Corridors in Africa					
Tema - Ouagadougou (2008)	51	55	55	--	46
Durban - Nelspruit (2007)	63	60	65	--	73
Maputo - Nelspruit (2007)	62	51	51	--	--
Road Corridors in Asia					
Laem Chabang -Vientiane (2006)	64	49	70	--	65
Dacca Chittagong (2006)	59	60	58	--	--

Note 1: Rail score aggregates the results for segments combining rail and lake links.

Note 2: Border post score is the average score of all border posts in the segment.

Source: Nathan Associates Inc.

Good	61-80
Fair	41-60
Poor	21-40
Very Poor	1-20

5. Summary and Impact

In this section we present a summary of the proposed infrastructure and operational projects their funding requirements and the impact that implementation of the proposed projects would have on corridor performance.

Proposed Projects

The 27 transport infrastructure projects that have been proposed for consideration in the Action Plan are presented by mode in Table 5-1. These projects, which are to be implemented within the next five years, have a total cost of US$ 4.1 billion. It is anticipated that 21 of the 27 projects could be implemented under a PPP arrangement with varying degrees of private sector participation. Of the 27 infrastructure projects, 13 projects are in the Central Corridor and have a total cost of US$ 2.1 billion. There are 14 proposed projects for the Northern Corridor with a total cost of US$ 2.0 billion.

There are nine proposed infrastructure projects for the rail sector with a total capital cost of US$ 1.3 billion. Eight of the proposed rail infrastructure projects are suitable for PPP financing. The one that is not is the short-term revival of TRL that is anticipated to require public sector and donor financing in the next two years. After that, proposed investments for TRL could be provided under a PPP arrangement.

The six proposed road infrastructure projects have a total capital cost of US$1.7 billion of which US$0.9 billion are for the Central Corridor and US$0.8 billion for the Northern Corridor. Except for a few specific road segments in urban areas or on the Corridor trunk roads with the highest traffic, these projects are not considered as likely candidates for PPP financing.

Table 5.1. Proposed Infrastructure Projects by Mode

Name	Cost (US$ mil.)	Corr.	Estimated Impact on Peformance			EIRR (%)	PPP Potential
			Price	Time	Reliability		
Port Projects							
Mombasa Short-term Container Handling Capacity Enhancement with ICDs	35.0	NC	-4	-13	-23	165	Yes
Dar es Salaam Short-term Container Handling Capacity	26.0	CC	-2	-16	-7	226	Yes
Mombasa New Container Terminal – Kipevu West	342.5	NC	-3	-11	-23	37	Yes
Dar es Salaam Container Terminal (Berth 13 &14)	500.0	CC	-1	-15	-7	35	Yes
Mombasa New Petroleum Facility	55.8	NC	-5	-12	-13	35	Yes
Mombasa Dry Bulk and General Cargo Facilities	1.7	NC	-3	-6	-10	25	Yes
Dar es Salaam Dry Bulk and Break Bulk Facilities	5.0	CC	-2	-5	-8	25	Yes
Dar es Salaam Single Point Mooring	68.5	CC	-5	-12	-13	35	Yes
Lamu Corridor New Port and Associated Infrastructure	7.0	NC	n.a.	n.a.	n.a.	30	Yes
Subtotal	1,041.5						
Rail Projects							
TRL Revival Infrastructure, Rolling Stock and Working Capital and Isaka ICD	185.0	CC	-15	-11	-19	38	No
TRL Track Infrastructure Upgrade 3-5 years	350.0	CC	-4	-3	-5	27	Yes
RVR Infrastructure Upgrade 1 - 3 years	250.0	NC	-2	-6	-9	22	Yes
RVR Locomotive Rehabilitation -3 years	20.0	NC	-4	-11	-15	22	Yes
RVR Infrastructure Upgrade 3 - 5 years	150.0	NC	-2	-5	-6	22	Yes
RVR Mombasa Intermodal Yard and Equipment	20.0	NC	-1	-2	-3	26	Yes
RVR Kampala ICD Development	10.0	NC	-1	-2	-3	21	Yes
Reconstruction of Tororo-Gulu- Pachwach Railway	325.0	NC	n.a.	n.a.	n.a.	24	Yes
Dar es Salaam CFS Site Selection Design and Project	2.0	CC	-1	-1	-1	n.a.	Yes
Subtotal	1,312.0						
Road Projects							
Central Corridor Capacity Upgrades	61.7	CC	-1	-2	-2	n.a.	No
Central Corridor Road Rehabilitation	331.0	CC	-2	-3	-1	n.a.	No
Central Corridor Upgrade to Paved	543.8	CC	-3	-6	-1	n.a.	No
Northern Corridor Capacity Upgrades	234.5	NC	-2	-3	-6	n.a.	No
Northern Corridor Road Rehabilitation	362.9	NC	-10	-8	-7	n.a.	No
Northern Corridor Upgrade to Paved	143.7	NC	-5	-7	-3	n.a.	No
Subtotal	1,677.6						
Lake Transport Projects							
Lake Ports Rehabilitation, Dredging and Siltation Protection	14.0	CC	-2	-2	-8	34	No
Provision of RoRo Services on Lakes Tanganyika and	15.4	CC	-1	-1	-5	28	Yes
Restructuring Wagon Ferries to Carry MAFI Trailers	7.0	CC	-1	-1	-2	28	Yes
Subtotal	36.4						
Total All Infrastructure Projects	4,067.5						

Source: Prepared by Nathan Associates Inc.

There are nine port infrastructure project proposed with a total investment of US$ 1.0 billion. Two of the projects, the new container terminals in Dar es Salaam and Mombasa account for 80 percent of the proposed port sector investment. With the exception of several small dry bulk projects, all of the proposed port infrastructure improvements can be financed with a high-level of private sector participation.

The three infrastructure projects proposed for lake transport have a total investment of US$ 36 million. It is envisioned that the dredging and port rehabilitation project will require public and donor financing while the provision of RoRo services and restructuring of wagon ferries can be completed with private sector funding.

Proposed operational projects are presented by sector in Table 5-2. The 18 proposed projects have a total cost of US$ 22.8 million of all which would require public sector or donor funding. Nine of the projects are categorized as transit facilitation interventions, whereas the road sector has three operational projects. The rail and lake transport and ports sector each have two operational projects proposed.

Table 5.2. Proposed Operations Projects by Sector

Name	Sector	Cost (US$ mil.)
Develop Northern Corridor Road Maintenance Contracting System	Road	1.0
Develop Central Corridor Road Maintenance Contracting System	Road	1.0
Improved Vehicle Overload Control System	Road	1.8
Procure and Retain TRL Management Team	Rail	2.0
Establish a Regional Railway Safety Regulator	Rail	0.4
Develop Vessel Maintenance Capacity on Lake Tanganyika	Lake	2.0
Enhance Safe Navigation	Lake	3.0
Enhancing Mombasa Port Operations with ICT Applications	Ports	2.5
Enhancing Dar es Salaam Port Operations with ICT Applications	Ports	2.5
Liberalize Transit Requirements	Transit	0.4
Maximize Customs Union Implementation Benefits	Transit	0.3
Streamline Customs Clearances	Transit	0.9
OSBP Implementation	Transit	1.5
Reduce Stops and Informal Payments on Corridors	Transit	0.9
Implement an Effective Transit Regime	Transit	0.9
Integration of National &Regional Transport Policies	Transit	1.1
Leadership by NCTTCA	Transit	0.3
Leadership by CCTTFA	Transit	0.3
Total All Operations Projects		22.8

Source: Prepared by Nathan Associates Inc.

Impact of Proposed Projects

The implementation of the proposed Action Plan projects will have a substantial impact on the performance of the Northern Corridor and Central Corridors. The improvement in performance is presented in this section in terms of price, time and reliability for light container imports and exports which are considered indicative of the performance experienced by other cargo types.

NORTHERN CORRIDOR

Table 5-3 presents the estimated improvement in Northern Corridor performance to selected destinations of light container imports. Generally, the price to serve Northern Corridor destination by road decrease by 25 percent and those destination served by rail by 11-14 percent. In terms of time, the destinations served by rail enjoy an average reduction of 53 percent in shipment time, while destinations served by road have a reduction in time ranging from 21-33 percent.

Table 5.3. Improvement in Northern Corridor Performance for Imports with Proposed Action Plan Projects, 2015 (light containers)

Destination	Distance (km.)	Containers (TEU)								
		Price (US$)			Time (hours)			Reliability Indicator (%)		
		2010	2015	Var. %	2010	2015	Var. %	2010	2015	Var. %
Kampala (road)	1,180	2,099	1,563	-26	323	216	-33	194	61	-69
Kigali (road)	1,661	3,901	2,918	-25	376	262	-30	167	53	-68
Bujumbura (road)	1,903	4,950	3,820	-23	411	297	-28	153	50	-67
Nimule (road)	1,526	5,383	4,276	-21	381	280	-27	165	52	-68
Kasindi (road)	1,623	4,825	3,671	-24	372	259	-30	168	51	-70
Goma (road)	1,811	4,822	3,634	-25	537	422	-21	131	83	-37
Nairobi (road)	480	1,396	1,139	-18	396	308	-22	158	45	-72
Kampala (rail)	1,200	2,059	1,828	-11	462	198	-57	138	65	-53
Nairobi (rail)	489	935	801	-14	316	164	-48	202	77	-62
Port Node*										
Mombasa		297	227	-24	217	133	-39	287	94	-67

Note: Port values are included in the total shown for each destination.

Source: Nathan Associates Inc.

The proposed road projects are concentrated on the Northern Corridor (and not on its feeder roads) and are expected to reduce significantly price and time as well as the variation in time (reliability). The higher savings on road transport are due to the implementation of projects that increase the road capacity and rehabilitate the road surface which reduce congestion and vehicle operating costs.

The proposed rail rehabilitation projects, as indicated by RVR representatives, are expected to mainly have an impact on time and its variation. The projects are expected to concentrate in the reduction of derailments (improve safety) and improve reliability of locomotives. The impact of port improvements on road and rail alternatives is also important, although its impact is greater when considering the time due to its larger share of it (with port accounting for about 70 percent of the total time).

The proposed port projects (integrated ICDs, new port terminal, etc.) are expected to reduce the port costs by 24 percent and more importantly reduce port time by 39 percent. The proposed projects have an even greater impact on reliability with gains in reliability of more than 60 percent. This significant improvement in the overall reliability of the road and rail transport is the result of the reduction in variations of time caused by congestion and potential accidents on the road and the improvement of rail operations and reductions in the number of derailments and locomotive breakdowns.

Table 5-4 presents the improvement in performance for Northern Corridor exports of light containers. The changes in terms of reduction in price are similar to those described above for imports. In terms of time, the percent reduction for exports is slightly higher than those estimated for imports. Gains in reliability are substantial and average around a 62 percent improvement in reliability.

Table 5.4. Improvement in Northern Corridor Performance for Exports with Proposed Action Plan Projects, 2015 (light containers)

Origin	Distance (km.)	Containers (TEU)								
		Price (US$)			Time (hours)			Reliability Indicator (%)		
		2010	2015	Var. %	2010	2015	Var. %	2010	2015	Var. %
Kampala (road)	1,180	2,062	1,535	-26	395	255	-35	267	94	-65
Kigali (road)	1,661	3,864	2,890	-25	422	273	-35	250	87	-65
Bujumbura (road)	1,903	4,913	3,792	-23	433	285	-34	244	84	-66
Nimule (road)	1,526	5,346	4,248	-21	431	297	-31	245	82	-67
Kasindi (road)	1,623	5,491	4,003	-27	436	290	-33	242	82	-66
Goma (road)	1,811	4,785	3,606	-25	429	281	-34	246	85	-65
Nairobi (road)	480	971	720	-26	324	203	-37	326	117	-64
Kampala (rail)	1,200	2,022	1,801	-11	558	260	-53	191	92	-52
Nairobi (rail)	489	890	767	-14	412	227	-45	258	105	-59
Port Node*										
Mombasa		260	199	-23	313	196	-37	336	121	-64

Note: Port values are included in the total shown for each origin.

Source: Nathan Associates Inc.

CENTRAL CORRIDOR

Table 5-5 presents the estimated improvement in Central Corridor performance to selected destinations of light container imports. The reduction in price for destinations served by road are generally between 9-11 percent, while destinations served by rail or rail/ lake are estimated to have reduction in price between 30-36 percent. The percent reduction in time is generally in the range of 40-50 percent.

Table 5.5. Improvement in Central Corridor Performance for Imports with Proposed Action Plan Projects, 2015 (light containers)

Destination	Distance (km.)	Containers (TEU)								
		Price (US$)			Time (hours)			Reliability Indicator (%)		
		2010	2015	Var. %	2010	2015	Var. %	2010	2015	Var. %
Mwanza (via road)	1129	1,618	1,446	-11	362	190	-48	198	163	-18
Goma (via road)	1640	3,618	3,291	-9	565	350	-38	135	106	-21
Kigali (via road)	1495	3,314	2,980	-10	420	233	-44	171	134	-22
Bujumbura (via road)	1567	4,369	3,964	-9	440	253	-43	163	123	-25
Kampala (via rail/lake)	1,568	2,507	1,750	-30	530	312	-41	150	85	-43
Mwanza (via rail)	1,229	1,794	1,150	-36	411	195	-53	192	126	-34
Bujumbura (via rail/lake	1,446	2,403	1,654	-31	524	304	-42	152	88	-42
Port Node*										
Dar Es Salaam		319	199	-38	291	125	-57	245	193	-21

Note: Port values are included in the total shown for each destination.

Source: Nathan Associates Inc.

The proposed road projects on the Central Corridor are distributed between the main corridor and its feeder roads and are expected to have a modest impact on price, time and variation in time (reliability), mainly because the main spine of the network is relatively new, having been upgraded or improved in recent years. The savings on road transport are due to the implementation of projects that increase the road capacity and rehabilitate the road surface which reduce congestion and vehicle operating costs.

The proposed rail rehabilitation projects for TRL are expected to mainly have an impact on time and its variation. The projects are expected to concentrate in the reduction of derailments (improve safety) and improve reliability of locomotives, as is being done by RVR on the Northern Corridor.

The impact of port improvements on road and rail alternatives is also important, although its impact is greater when considering the time due to its larger share of it (with port accounting for about 70 percent of the total time). The proposed port projects (integrated ICDs, new port terminal, etc.) are expected to reduce the port costs by 38 percent and more importantly reduce port time by 57 percent.

Table 5-6 presents the improvement in performance for Central Corridor exports of light containers. The changes in terms of reduction in price are similar to those described above for imports.

Table 5.6. Improvement in Central Corridor Performance for Exports with Proposed Action Plan Projects, 2015 (light containers)

Origin	Distance (km.)	Containers (TEU)								
		Price (US$)			Time (hours)			Reliability Indicator (%)		
		2010	2015	Var. %	2010	2015	Var. %	2010	2015	Var. %
Mwanza (via road)	1129	1,618	1,446	-11	396	207	-48	283	238	-16
Goma (via road)	1640	3,618	3,292	-9	599	367	-39	200	163	-19
Kigali (via road)	1495	3,314	2,981	-10	454	250	-45	248	198	-20
Bujumbura (via road)	1567	4,369	3,965	-9	480	275	-43	234	180	-23
Kampala (via rail/lake)	1,568	2,507	1,751	-30	638	331	-48	220	113	-49
Mwanza (via rail)	1,229	1,794	1,150	-36	517	212	-59	271	169	-38
Bujumbura (via rail/lake	1,446	2,403	1,833	-24	633	324	-49	222	115	-48
Port Node*										
Dar Es Salaam (rail)		319	199	-38	397	143	-64	351	251	-28
Dar Es Salaam		319	199	-38	325	143	-56	326	256	-21

Note: Port values are included in the total shown for each origin.
Source: Nathan Associates Inc.

OVERALL TRANSPORT COST SAVINGS

The total impact of the proposed improvements on the performance of the Northern and Central Corridors in terms of reduced transport costs is shown in Table 5-7. Overall, annual transport cost savings by 2015 are estimated at US$ 1.9 billion, corresponding to an average reduction in transport costs of 28 percent. Due to the larger volumes and longer average distances, the Northern Corridor accounts for about three-quarters of the total transport cost savings with cost reduction of US$ 1.4 billion. The Central Corridor has annual transport cost savings of US$ 0.4 billion by 2015.

Table 5.7. Annual Transport Cost Savings from Proposed Corridor Improvement Projects, 2015

Item	Northern	Central	Total
Traffic (mt)	35.3	17.3	52.6
Transport cost under Status Quo (US$ million)	5,295.0	1,339.2	6,634.2
Transport costs with proposed improvements (US$ million)	3,874.0	908.56	4,782.6
Transport cost savings (US$ million)	1,421.0	430.7	1,851.7
Percent reduction	26.8%	32.2%	27.9%
Transport cost savings per ton (US$)	40.25	24.90	35.20

Source: Nathan Associates Inc.

In terms of percent reduction in transport costs, the savings on the Central Corridor represent a reduction of 32 percent as compared to a reduction of 27 percent for the Northern Corridor. On a per ton basis, the average reduction is US$ 40.25 per ton on the Northern Corridor and US$ 24.90 per ton on the Central Corridor.

IMPACT ON TRADE FLOWS

Trade flows are expected to increase even without a significant improvement in corridor performance, but could increase substantially with performance improvements as noted in above. These increases are related to the percentage decreases in price, transit time, and variation in transit time (unreliability) for each trade flow. The elasticity indicating the relationship between traffic and generalized cost was calculated using a gravity model. In this model, the total trade between pairs of trading partners is a function of the economic size of each country (GDP and population) and the disutility of shipping freight between them.[9] The results of the model indicate that the generalized cost has significant adverse effects on trade flows analyzed regionally (within East Africa) as well as with overseas partners.

The results shown in Table 5-8 for 2015 indicate an average potential increase in trade of 15 percent. The total potential trade increase 9.2 million tons is significant on top of the already substantial traffic growth forecasted for the Base Case. Thus total Northern and Central Corridor traffic would be 61.9 million tons by 2015. The largest potential increase in trade is shown for the Central Corridor with transit traffic increasing by 38 percent.

Table 5.8. Potential for Traffic Increases due to Improved Corridor

Corridor and Type of Traffic	Base Case	Potential Increase	Total	% Change
Northern Corridor				
Transit	10.0	1.6	11.6	14%
Regional	5.0	0.8	5.8	14%
Domestic	20.3	0.9	21.2	4%
Total	**35.3**	**3.3**	**38.6**	**9%**
Central Corridor				
Transit	3.2	2.0	5.2	38%
Regional	1.5	0.7	2.2	32%
Domestic	12.8	3.2	15.9	20%
Total	**17.5**	**5.9**	**23.4**	**25%**
Total	**52.8**	**9.2**	**61.9**	**15%**

Source: Nathan Associates Inc.

Performance, 2015 (million tons)

Table 5-9 presents the potential for increased traffic due to improved corridor performance for 2030. The impact is similar to that discussed above for 2015. Total Northern and Central Corridor traffic would reach 172 million tons by 2030. Of course, realizing these increases depends on the ability of the region to overcome very challenging capacity constraints at border posts, railways, and ports.

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[9] This disutility is assumed to be a combination of price, time, and reliability of these shipments and would be inversely related with trade output. Three elasticities were calculated: overseas trade for landlocked countries, overseas trade for coastal countries and trade between countries in the region.

Table 5.9. Potential for Traffic Increases due to Improved Corridor Performance, 2030 (million tons)

Corridor and Type of Traffic	Base Case	Potential Increase	Total	% Change
Northern Corridor				
Transit	24.7	3.9	28.6	14%
Regional	11.0	1.7	12.7	14%
Domestic	54.0	2.5	56.5	4%
Total	**89.6**	**8.2**	**97.7**	**8%**
Central Corridor				
Transit	12.1	7.8	19.9	39%
Regional	2.6	1.3	3.8	33%
Domestic	40.3	10.5	50.9	21%
Total	**55.0**	**19.6**	**74.6**	**26%**
Total	**144.6**	**27.8**	**172.3**	**16%**

Source: Nathan Associates Inc.

This analysis has shown that implementation of the recommended projects will bring major improvements in the cost, transit time and reliability of the logistic chain of the Northern and Central Corridors. These gains will promote and facilitate trade and economic growth to significantly contribute to the attainment of the region's leaders and people development aspirations.

WORST CASE SCENARIO

An additional alternative scenario was considered to assess the impact on projected corridor traffic if the proposed corridor improvements were not implemented. A "Worst Case Scenario" is evaluated, where it is assumed that none of the proposed projects are implemented and consequently corridor performance deteriorates as traffic volumes increase and the transport network gets increasingly congested. As increasing traffic challenges capacity leading to congestion; transport costs increase along with deteriorating quality of service along the corridor. Due to the deteriorating corridor performance, the forecast of traffic demand assumed for the Base Case Scenario will not materialize. This is due to the reduced competitiveness of the region's exports and the increased cost of imports. Also investment in new or expanded production facilities would be discouraged. Accordingly, this scenario would have a lower GDP growth than the Base Case. For the Worst Case Scenario we have assumed a worsening corridor performance in terms of a 25 percent increase in price, time as well as a 25 percent decrease in reliability coupled with the Low GDP Growth Scenario presented in Chapter 4 that assumed a 40 percent reduction of the Base Case Scenario annual GDP growth rate per country.

As a result of the Worst Case Scenario, the overall traffic in 2030 would decrease from 145 million tons to 116 million tons, a decrease of 20 percent from the Base Case scenario, as can be seen in Tables 9-10 and 9-11. In terms of types of traffic, the largest impact would be for transit traffic; 30 percent decrease from Base Case for the Northern Corridor and 35 percent for the Central Corridor by year 2030. Regional traffic would follow, with a 30 percent decrease for both corridors.

Table 5.10. Worst Case Scenario Traffic by Corridor and Mode 2015 (000 tons)

Corridor and Type of Traffic	Road	Rail	Total	AAGR (%) 2009-2015	Rail Share (%)
Northern					
Transit	5,254	2,401	7,655	4.4	31.4
Regional	3,642	154	3,797	3.3	4.1
Domestic	17,246	1,917	19,162	7.5	10.0
Total	26,142	4,472	30,614	6.1	14.6
Central					
Transit	1,175	1,045	2,220	28.1	47.1
Regional	1,068	43	1,111	8.3	3.9
Domestic	11,016	958	11,975	12.5	8.0
Total	13,259	2,046	15,305	13.6	13.4
Total	**39,401**	**6,518**	**45,919**	**8.2**	**14.2**

Source: Nathan Associates

Given the relatively short distances that domestic traffic (Tanzanian and Kenyan) travels, the impact of the worsening performance is less; around 12 percent. In terms of modal shares, different than the low growth only scenario, there is a change in the domestic rail traffic share compared to the Base Case. In the Northern Corridor, for year 2015 the domestic rail share is expected to increase from 5 percent to 10 percent in the worst case scenario. In year 2030, the share remains about the same. In the Central Corridor, the domestic rail share is expected to increase from 5 percent to 8 percent by 2015, while it increases from 6 percent to 11.3 percent in year 2030.

Table 5.11. Worst Case Scenario Traffic by Corridor and Mode 2030 (000 tons)

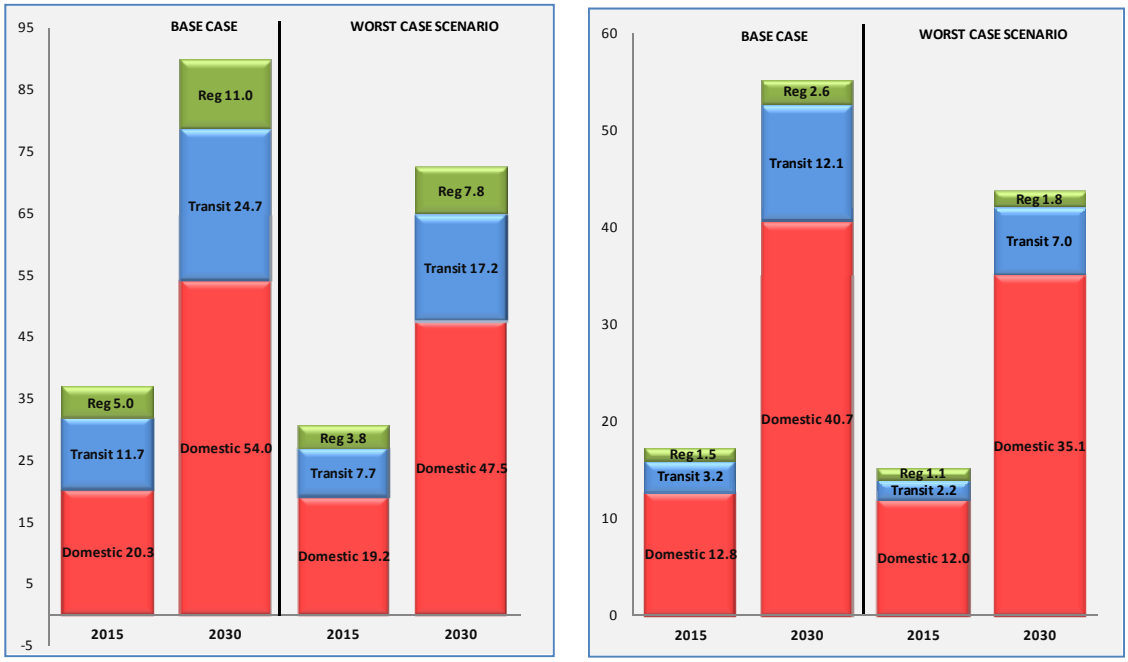
Corridor and Type of Traffic	Road	Rail	Total	AAGR (%) 2015-2030	Rail Share (%)
Northern					
Transit	11,622	5,572	17,194	5.5	32.4
Regional	7,516	314	7,831	4.9	4.0
Domestic	41,830	5,704	47,534	6.2	12.0
Total	60,968	11,590	72,558	5.9	16.0
Central					
Transit	4,137	2,843	6,981	7.9	40.7
Regional	1,740	62	1,802	3.3	3.4
Domestic	31,858	3,259	35,117	7.4	9.3
Total	37,736	6,164	43,900	7.3	14.0
Total	**98,704**	**17,754**	**116,458**	**6.4**	**15.2**

Source: Nathan Associates Inc.

A substantial decrease in traffic can be seen in Figure 5-1. The worsening performance results in a decrease of 19 percent. For Central Corridor the worsening performance results in a decrease in traffic of 21 percent. Compared to the Base Case scenario, total traffic in the Northern Corridor by 2030, would be estimated to decrease from 89.6 million tons to 72.6 million tons. In the Central Corridor, the traffic would decrease from 55.3 million tons to 43.9 million tons.

Figure 5.1.Comparison of Traffic Forecast in Base Case vs. Worst Case Scenario, 2015 and 2030 (million tons)

Northern Corridor **Central Corridor**



Source: Nathan Associates Inc.

Appendix A – Supplemental Diagnostic Assessment of the Dar es Salaam Corridor

Background

The sections below present the supplemental diagnostic assessment of the Dar es Salaam Corridor with a particular emphasis on issues related to food security requested. First an overview of the characteristics of the Dar es Salaam Corridor is presented followed by the assessment of how containers and dry bulk are transported in the corridor.

Dar es Salaam Corridor

Following the imposition of international sanctions against Rhodesia in 1965, Zambia re-directed its strategic imports and exports to the Benguela Railway, but with conflict growing in Angola also, it was necessary to look for an alternative and more sustainable route – particularly for the export of strategic minerals and for the import of fuel and food. This resulted in the improvement of the TANZAM road linking Zambia to the port of Dar es Salaam, the development of the TANZAMA oil pipeline, and the construction of the TAZARA railway. Zambia used the TANZAM/TAZARA integrated infrastructure to provide for its exports and its strategic imports – particularly fuel.

The Dar es Salaam Corridor comprises (1) the Port of Dar es Salaam; (2) the TAZARA rail line from the port to Kapiri Mposhi in Zambia where it joins Railway Services of Zambia (see Figure A-1), the concession, south to Lusaka and northwest to the Copper Belt and to the Democratic Republic of the Congo (DRC) where it connects to the Congolese Railway, SNCC; (3) the TANZAM road that follows much the same route as the TAZARA rail, and the road that runs from Mbeya into Malawi at Songwe, along the lakeshore from Karonga to Chiweta and inland to Lilongwe; (4) the TAZAMA oil pipeline, which runs from the Port of Dar es

Salaam to the Indeni Refinery at Ndola, Zambia; and (5) the road from Kasama to the Port of Mpulungu on Lake Tanganyika, providing for the transport of goods from Zambia to Rwanda, Burundi, and the eastern part of the DRC.

The corridor is supported by the border posts at Kasumulu/Songwe, Tunduma/Nakonde, and Kasumbulesa/DRC. Additionally, Malawi Cargo Centers operates dry port facilities at Dar es Salaam Port and Mbeya; and Zamcargo consolidates imports and exports for Zambia at Dar es Salaam Port.

DAR ES SALAAM CORRIDOR ROAD SYSTEM

Road Conditions and Other Characteristics

The Tanzanian side of the road was surfaced in the mid 1950s, and on the Zambian side in the mid-1970s – before then it was known as the 'hell run', referring to its poor and unpaved condition. The TANZAM road system therefore serves as a very strategic regional backbone, linking many population and economic centers.

The total distance from Kapiri Mposhi to Dar es Salaam is 1,768 km, of which 904 km is in Zambia and 864 km is in Tanzania. The road is maintained by the respective governments through budgetary provision, funded partly by a fuel levy and partly by road user fees paid at the border crossings. There are permanent and obligatory weighbridges in operation along the road, and although the max GVM is 56 t. Tanzania does not allow the use of 'Interlinks'.

Figure A-1. Existing TAZARA Rail Line

Source: TAZARA website.

The road within Zambia has fairly recently been resurfaced to a high standard and is in good condition apart from occasional pot holes. Within Tanzania, the standards and specifications are varying, having been rehabilitated in sections by different contractors and funding agencies, but well maintained. The road is generally in good condition except for some stretches along the Iringa escarpment in Tanzania. The road has suffered from intermittent maintenance problems over the years, but this has been improved through the establishment of Road Authorities and Roads Funds in the three Corridor countries (and some degree of harmonization in planning and revenue collection across the three), and through the development of weighbridges to control overloading.

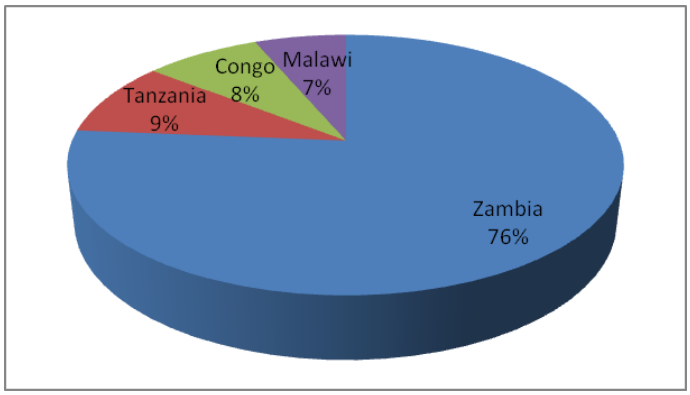
Traffic counts conducted by Aurecon in December of 2009 at Iringa indicate that the average daily traffic is 1,100 vehicles (34% were heavy trucks). Additionally, the capacity analysis conducted for the EAC Transport Strategy and Regional Roads Sector Development Program shows that within Tanzania most of the corridor operates at level of service (LOS) A with exception of the segment between Mbeya and Tunduma, which has LOS D.

RAIL SYSTEM

The TAZARA railway is jointly owned and managed by the Governments of Tanzania and Zambia. The 1860 km railway line from Dar es Salaam to Kapiri Mposhi in Zambia was funded and built by the Peoples Republic of China (PRC) in the period 1970 to 1976. The PRC has subsequently made additional interest-free loans for maintenance and training/management. TAZARA was built to handle 5 million tons annually, but at its peak in the early 1990's carried less than 1.5 million, largely made up of imports for regional drought relief. Current volumes are of the order of 0.5 mtpa, of which 91 percent is international traffic, mostly serving the DRC and Zambia copper belts (see Figure A-2). In the fiscal year ending in June 09, TAZARA transported 109,000 tons of fertilizer imports and 5,300 tons of containerized cargo imports. The following year, ending in June 2010, the railway transported 98,000 tons of fertilizer and 3,600 tons of containerized cargo which represented 19 percent and 1 percent of the total, respectively. Copper is the most significant commodity transported with 34 percent of the total traffic, followed by fertilized with 19 percent, fuel with 10 percent and cement with 8 percent.

The railway has struggled with overstaffing and insufficient operational locomotives and wagons, largely due to insufficient income to cover operating costs and maintenance. Locomotive and wagon failures are frequent, even considering that the equipment is relatively new and under-utilized. At a railway 'workshop' held in Ndola in 2008, the TAZARA management, which has seen frequent changes, stated that the operations could be profitable and sustainable, if traffic levels of 1.2 mtpa could be attained. The railway tariff from Kapiri Mposhi to Dar es Salaam is $123/t (6.6 US cents per tkm), which is competitive with road haulage – but is generally much slower than road, taking 5 to 10 days compared to 5 days maximum for road.

Figure A-2. TAZARA Cargo Distribution



Source: Nathan Associates Inc with information from TAZARA.

BORDER CROSSINGS

There are several border posts in the Dar es Salaam Corridor at Tunduma/Nakonde, Kasumbulesa/DRC and Kasumulu/Songwe. Additionally, the Malawi Cargo Centers operates dry port facilities at Dar es Salaam Port and Mbeya; and Zamcargo consolidates imports and exports for Zambia at Dar es Salaam Port.

Traffic levels in the Tundama border post are of the order of about 100 loaded trucks per day in each direction. It takes about 2 to 4 days to cross the border at Nakonde / Tunduma, making the transit time from Kapiri Mposhi to Dar es Salaam to take up to 5 days at average speeds of about 60 kph.

Border crossings within the region are characterized by poor infrastructure, inadequate coordination and congestion. The East African Community has committed to introducing one stop border post (OSBP) operations at all its main internal borders and is also introducing OSBP at borders with countries outside the EAC. The regional OSBP legal framework being developed by the East Africa Community with support from JICA provides OSBP legal jurisdiction and structure, operating principles and methods of coordination. Through this framework, common practices will be introduced and harmonized throughout the Community. The OSBP Act approval process has involved all border agencies as has the joint planning for the new OSBP border facilities. Continuing support for this coordination is critical.

Approach to Performance Assessment

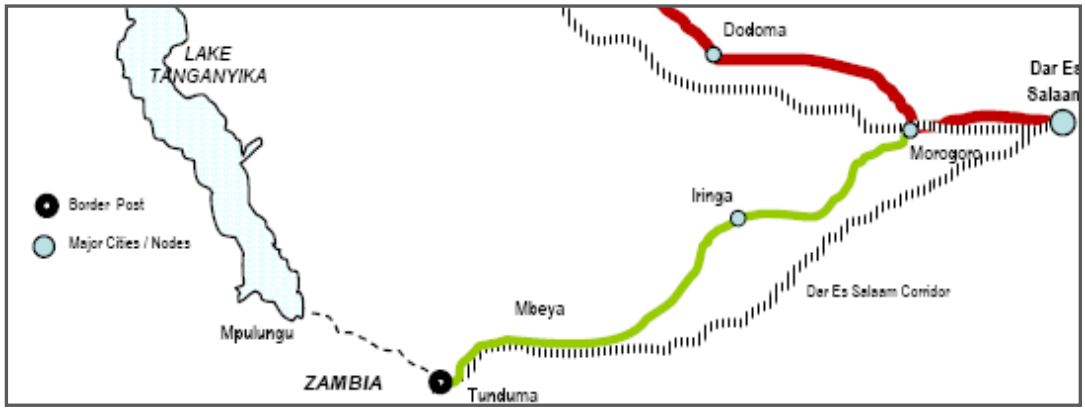
Agriculture in Tanzania accounts for half of the national income and represents three quarters of the exports. Southern Tanzania is an important agricultural area served by the Dar es Salaam Corridor. Considering that Zambia is also served by the corridor and has important production of millet, maize, rice and cassava, we included Mpika and Zambia's capital,

Lusaka, in the diagnostic analysis as a proxy for transport conditions to other production and consumption areas along the corridor within Zambia.

For the analysis purposes, the Dar es Salaam Corridor has been defined according to Figure A-3 shown below. The main origins/destinations of cargo are the port of Dar es Salaam, Mbeya (Tanzania), Mpika and Lusaka (Zambia) along the main corridor. These origins/destinations were selected based on their importance as population and agricultural centers as well as consolidation and redistribution centers.

The transport network is divided in nodes and links each representing different physical and operational characteristics. The nodes are marine ports, ICDs, border posts, and rail/road intermodal centers that are necessary to connect links with different characteristics. The port node contains information regarding five elements within the ports: the channel, the berth, the yard, customs clearance and the gate. Other nodes contain information specific to their physical characteristics and their operations. The links represent road and rail segments with unique characteristics. They contain modal information on capacity, topography, price and travel time that defines its performance.

Figure A-3. Links and Nodes of the Dar es Salaam Corridor in Tanzania



Source: Nathan Associates Inc.

For the purpose of organizing and verifying the information that will be introduced to the FastPath model a series of tables were prepared with the information required to simulate the different elements of the logistics chain. For samples of these input tables please refer to section 4 of this technical paper.

The nodes that will be analyzed for the project are the port, border posts, rail/road intermodal centers and inland clearance. The links that will be analyzed are road and rail segments.

General discussions are made on the performance of the logistics chain for 20 foot light containers and dry bulk as indicative of the processes. Most inputs and outputs related to food security move using these types of cargo handling.

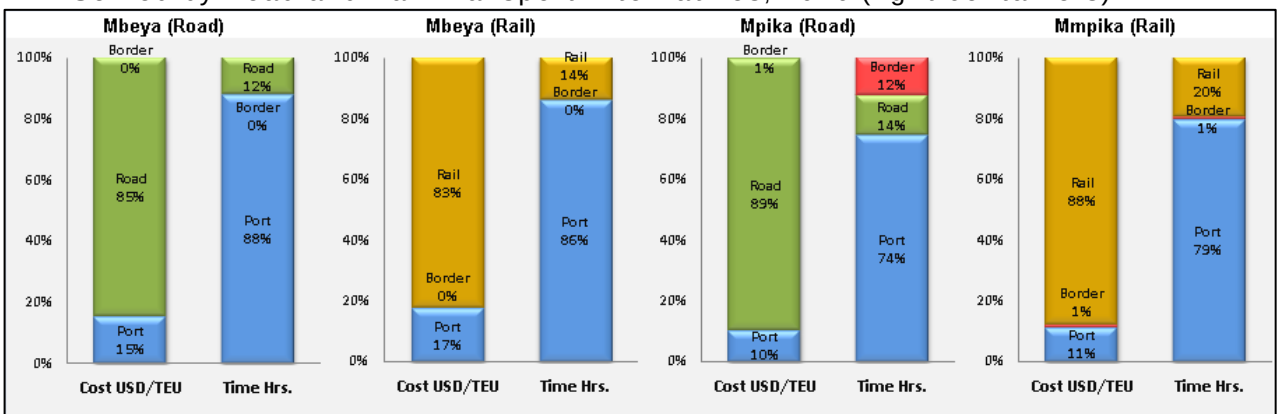
Dar es Salaam Corridor Cost and Time Comparison by Transport Alternative and Component

This section presents the results of the performance assessment for light containers and dry bulk. The results are presented for imports/exports for the selected transport alternatives connecting each origin /destination and the port of Dar Es Salaam. The figures show the participation of each component (links and nodes) in the total costs and time of the transport alternative.

IMPORTS – 20FT LIGHT CONTAINERS

Two transport alternatives were considered for the segment between **Dar es Salaam** and **Mbeya**, one via road and one via rail. Figure A-4 shows that the rail alternative is less expensive and slower than the road alternative. In terms of total costs (including facilitation and extra inventory) the rail alternative is 9 percent less expensive than the road alternative and in terms of time rail exceeds the road mode by 2 percent. The different cost is mostly due to the lower rates offered by the railway which could be even lower with higher usage of the assets.

Figure A-4. Cost and Time for Dar es Salaam Corridor Destinations Served by Road and Rail Transport Alternatives, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	1,778	41
Border	-	-
Rail	-	-
ICD	-	-
Transport	2,097	332
Freight Fwd. Fee	300	-
Extra Inventory	645	-
Total	3,042	332

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	-	-
Border	-	-
Rail	1,511	48
ICD	-	-
Transport	1,830	339
Freight Fwd. Fee	300	-
Extra Inventory	648	-
Total	2,778	339

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	2,710	53
Border	20	48
Rail	-	-
ICD	-	-
Transport	3,049	392
Freight Fwd. Fee	300	-
Extra Inventory	645	-
Total	3,994	392

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	-	-
Border	20	3
Rail	2,492	72
ICD	-	-
Transport	2,831	366
Freight Fwd. Fee	300	-
Extra Inventory	645	-
Total	3,776	366

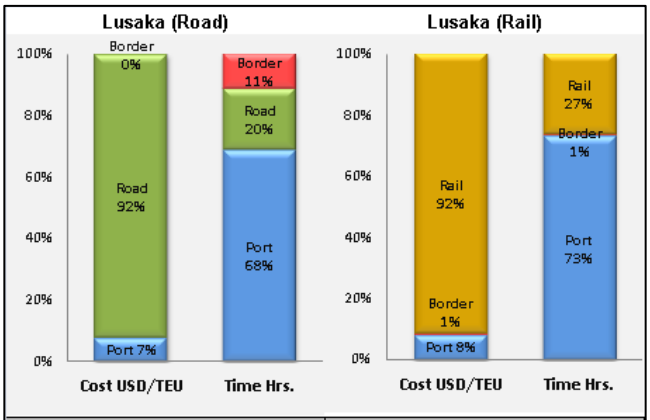
Source: Nathan Associates Inc.

The time that the cargo spends at the port is identical; therefore, total time difference is explained entirely by the longer time required to complete the movement of the cargo between the port and Mbeya via rail. The participation of port related costs and times in the total for both modes is similar; port costs account for 15 percent in the road option and 17

percent in the rail option; the remaining costs of both alternatives are related entirely to the surface transport cost. Time at the port for containers transported by road is 88 percent of the total time, while via rail is 86 percent.

Similarly to the previous segment, road and rail alternatives were analyzed for the **Dar es Salaam** and **Mpika** segment. The rail alternative is less expensive and faster than the road alternative. The cost of the rail alternative (including facilitation and extra inventory) is 5 percent less than the road (a difference of US$ 218 per container). The time for the rail alternative is higher by 2 percent than for the road. This is caused mostly by a faster clearance time at the border which offsets the inefficiencies of the rail operation which hamper the intermodal transfer, breakdowns, etc. Most of the costs for imports moved by road are related to surface transportation (89 percent); similarly, in the rail alternative transport costs are the most relevant part (88 percent). In regards to time, the port is the most important component for both alternatives, accounting for 74 percent and 79 percent respectively. The border post at Tunduma accounts for 12 percent of the time for the road alternative (48 hours) while only 1 percent for the rail alternative.

Figure A-5. Cost and Time for Dar es Salaam Corridor Serving Lusaka by Road and Rail Transport Alternatives, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.
Port	319	291	Port	319	291
Road	4,000	87	Road	-	-
Border	20	48	Border	20	3
Rail	-	-	Rail	3,660	106
ICD	-	-	ICD	-	-
Transport	4,339	426	Transport	3,999	400
Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-
Extra Inventory	647	-	Extra Inventory	646	-
Total	5,286	426	Total	4,945	400

Source: Nathan Associates Inc.

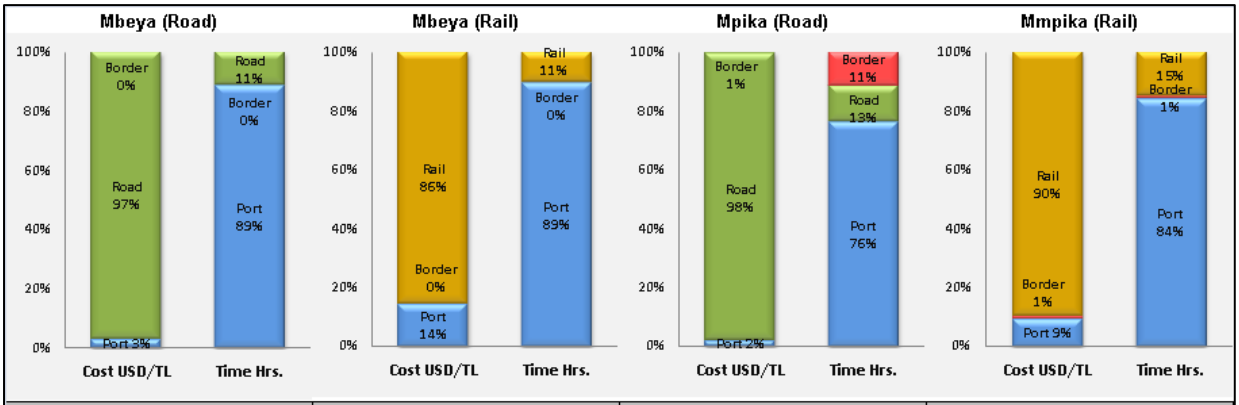
The road and rail alternatives between **Dar es Salaam** and **Lusaka** (Figure A-5) present a similar distribution of times and costs to what was observed for Mbeya and Mpika. Road related costs are the prevailing component with 92 percent of the share of the total for both alternatives. In terms of time, port is the most significant element for both destinations with 68 and 73 percent, respectively; additionally, in the case of the road alternative the border post

related time accounts for 11 percent of the total time compared to 1 percent for the rail alternative.

IMPORTS – DRY BULK

Figure A-6 shows that the rail alternative is significantly less expensive and slower than the road alternative. In terms of total costs (including facilitation and extra inventory) the rail alternative is 28 percent less expensive than the road alternative and in terms of time rail exceeds the road mode by 22 percent. The different cost is mostly due to the significantly discounted rates offered by the railway for the transport of dry bulk. The cost and time at the port is less for the road alternative because the trucks load straight at the ship side. The participation of port related costs is different with the port accounting for 3 percent for the road while for the rail it represents 14 percent. In terms of time the port share of the total for both modes is similar (89 percent).

Figure A-6. Cost and Time for Dar es Salaam Corridor Destinations served by Road and Rail Transport Alternatives, 2010 (dry bulk)



Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	65	324	Port	170	397	Port	65	324	Port	170	397
Road	2,313	41	Road	-	-	Road	3,522	53	Road	-	-
Border	-	-	Border	-	-	Border	20	48	Border	20	3
Rail	-	-	Rail	1,007	48	Rail	-	-	Rail	1,661	72
ICD	-	-	ICD	-	-	ICD	-	-	ICD	-	-
Transport	2,378	365	Transport	1,177	445	Transport	3,607	425	Transport	1,851	472
Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-
Extra Inventory	669	-	Extra Inventory	947	-	Extra Inventory	728	-	Extra Inventory	944	-
Total	3,347	365	Total	2,424	445	Total	4,635	425	Total	3,095	472

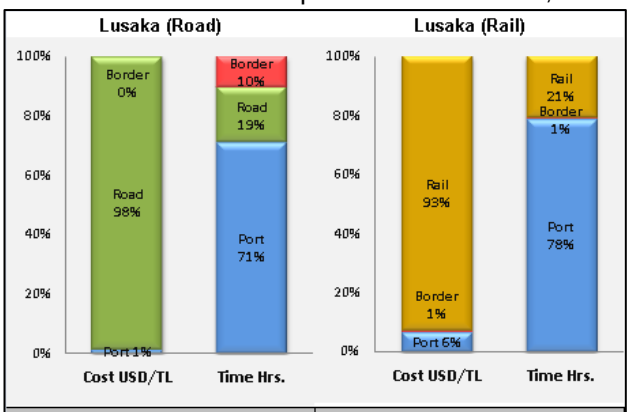
Source: Nathan Associates Inc.

For the **Dar es Salaam** and **Mpika** segment, the rail alternative is 33 percent less expensive and 11 percent slower than the road alternative (despite the faster rail clearance time at the border which offsets the inefficiencies of the rail operation). Most of the costs for imports moved by road are related to surface transportation (98 percent); similarly, in the rail alternative transport costs are the most relevant part (90 percent). In regards to time, the port is the most important component for both alternatives, accounting for 76 percent and 84

percent respectively. The border post at Tunduma accounts for 11 percent of the time for the road alternative (48 hours) while only 1 percent for the rail alternative.

For the **Dar es Salaam** and **Lusaka** segment (Figure A-7) present a similar distribution of times and costs to what was observed for Mpika. Land transport related costs are the prevailing component with 98 percent for the road and 93% for the rail alternatives. In terms of time, port is the most significant element for both destinations with 71 and 78 percent, respectively; additionally, in the case of the road alternative the border post related time accounts for 10 percent of the total time compared to 1 percent for the rail alternative.

Figure A-7. Cost and Time for Dar es Salaam Corridor Serving Lusaka by Road and Rail Transport Alternatives, 2010 (dry bulk)



Elements	Cost USD/TL	Time Hrs.
Port	65	324
Road	5,198	87
Border	20	48
Rail	-	-
ICD	-	-
Transport	5,283	459
Freight Fwd. Fee	300	-
Extra Inventory	722	-
Total	6,305	459

Elements	Cost USD/TL	Time Hrs.
Port	170	397
Road	-	-
Border	20	3
Rail	2,440	106
ICD	-	-
Transport	2,630	506
Freight Fwd. Fee	300	-
Extra Inventory	948	-
Total	3,878	506

Source: Nathan Associates Inc.

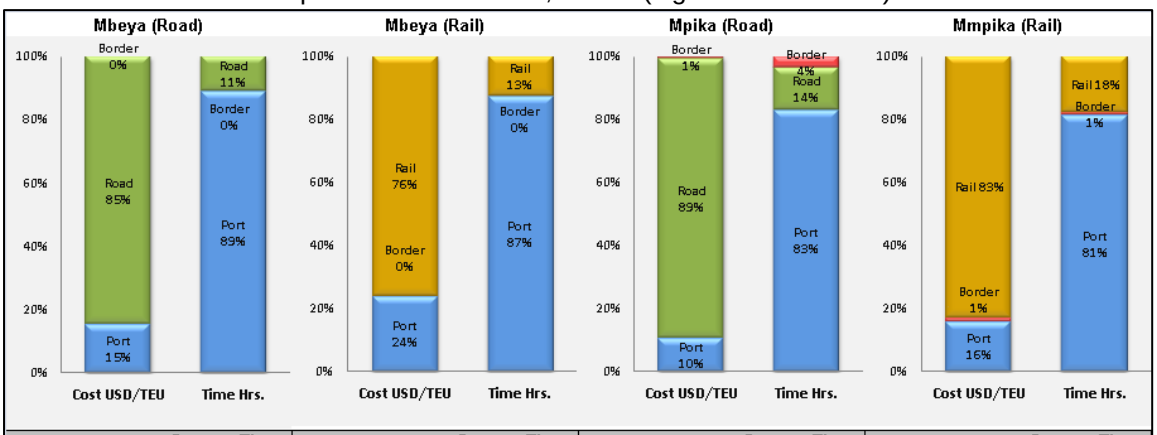
EXPORTS– 20FT LIGHT CONTAINERS

The transport alternatives considered for exports correspond exactly to the ones presented for imports. Containerized exports flowing between **Mbeya** and **Dar es Salaam (**Figure A-8) are subject to lower cost and longer time if they use the rail alternative instead of the road alternative. The rail alternative total cost is lower than the road cost by 21 percent, while the time difference is only 2 percent longer. The difference in cost is due to significantly lower rail tariffs. The participation of port related costs and times in the total for both modes is similar; port costs account for 15 percent in the road option and 24 percent in the rail option; the remaining costs of both alternatives are related entirely to the surface transport cost. Time at the port for containers transported by road is 89 percent of the total time and rail is 87 percent.

The total cost of the connection between **Mpika** and **Dar es Salaam** via road is 23 percent higher than the rail cost (due to significantly lower rail tariff). The participation of port costs in the rail alternative is 16 percent versus 10 percent in the road alternative. The participation of port time is higher in the road alternative by 2 percent while for the border post is higher by 3 percent.

The results in Figure A-9 show that the road and rail alternatives for exports between **Dar es Salaam** and **Lusaka** present a similar distribution of costs between port and road surface cost. Land transport related costs are the prevailing component with 92 and 88 percent of the share of the total respectively. In terms of time, port is the most significant element for both alternatives (76 and 75 percent, respectively).

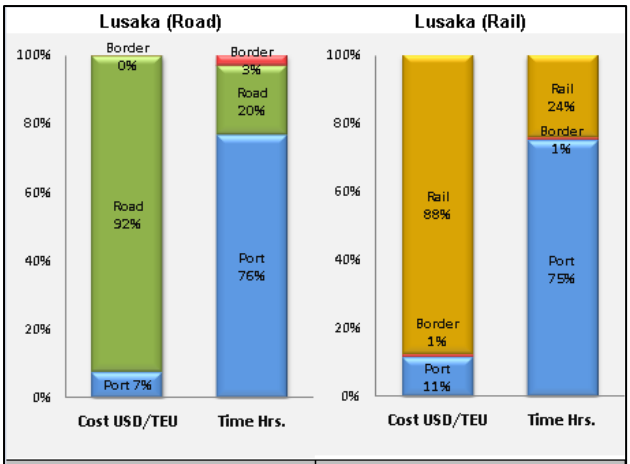
Figure A-8. Cost and Time for Dar es Salaam Corridor Origins served by Road and Rail Transport Alternatives, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.
Port	319	325	Port	319	325	Port	319	325	Port	319	325
Road	1,778	41	Road	-	-	Road	2,710	53	Road	-	-
Border	-	-	Border	-	-	Border	20	14	Border	20	3
Rail	-	-	Rail	1,007	48	Rail	-	-	Rail	1,661	72
ICD	-	-	ICD	-	-	ICD	-	-	ICD	-	-
Transport	2,097	366	Transport	1,326	373	Transport	3,049	392	Transport	2,000	400
Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-
Extra Inventory	1,291	-	Extra Inventory	1,292	-	Extra Inventory	1,293	-	Extra Inventory	1,292	-
Total	3,688	366	Total	2,918	373	Total	4,642	392	Total	3,592	400

Source: Nathan Associates Inc.

Figure A-9. Cost and Time for Dar es Salaam Corridor serving Lusaka by Road and Rail Transport Alternatives, 2010 (light containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	4,000	87
Border	20	14
Rail	-	-
ICD	-	-
Transport	4,339	426
Freight Fwd. Fee	300	-
Extra Inventory	1,294	-
Total	5,933	426

Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	-	-
Border	20	3
Rail	2,440	106
ICD	-	-
Transport	2,779	434
Freight Fwd. Fee	300	-
Extra Inventory	1,294	-
Total	4,373	434

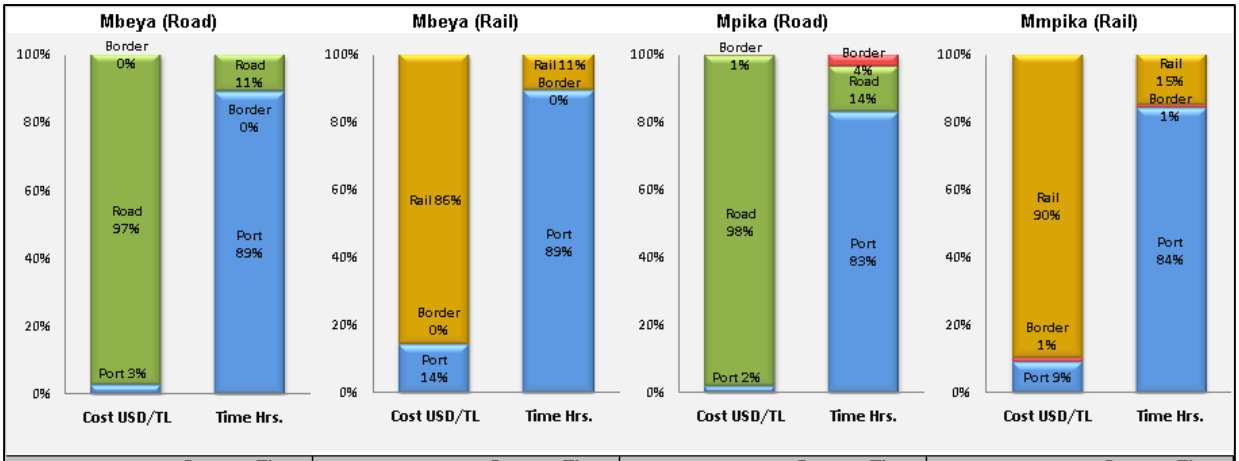
Source: Nathan Associates Inc.

EXPORTS– DRY BULK

Dry bulk exports traveling between **Mbeya** and **Dar es Salaam (**Figure A-10) using the rail alternative have to lower cost (29 percent) and longer time (21 percent) than if they use the road alternative. The difference in cost is due to significantly lower rail tariffs. The participation of port related costs and times in the total for both modes is different; port costs account for 3 percent in the road option and 14 percent in the rail option; the remaining costs of both alternatives are related entirely to the surface transport cost. Time at the port for both alternatives is similar (89 percent of the total time).

The total cost between **Mpika** and **Dar es Salaam** via road is 33 percent higher than the rail cost (due to significantly lower rail tariff) and 20 percent faster. The participation of port costs in the rail alternative is 9 percent versus 2 percent in the road alternative. The participation of port time is similar for both alternatives (83 and 84 percent respectively) with the border post 3 percent higher for the road alternative.

Figure A-10. Cost and Time for Dar es Salaam Corridor Origins served by Road and Rail Transport Alternatives, 2010 (dry bulk)

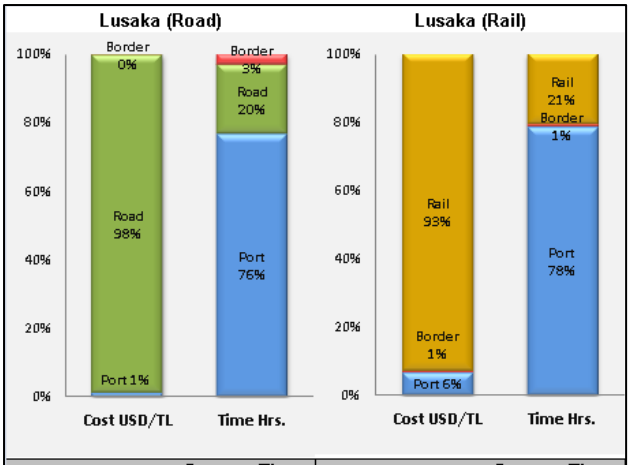


Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	65	325	Port	170	397	Port	65	325	Port	170	397
Road	2,313	41	Road	-	-	Road	3,522	53	Road	-	-
Border	-	-	Border	-	-	Border	20	14	Border	20	3
Rail	-	-	Rail	1,007	48	Rail	-	-	Rail	1,661	72
ICD	-	-	ICD	-	-	ICD	-	-	ICD	-	-
Transport	2,378	366	Transport	1,177	445	Transport	3,607	392	Transport	1,851	472
Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-
Extra Inventory	743	-	Extra Inventory	947	-	Extra Inventory	745	-	Extra Inventory	944	-
Total	3,421	366	Total	2,424	445	Total	4,652	392	Total	3,095	472

Source: Nathan Associates Inc.

Figure A-11 shows that the road alternative for exports between **Dar es Salaam** and **Lusaka** is higher by 39 percent present and faster by 19 percent than the rail alternative. The distribution of costs is different between port and road surface cost (the port accounts for 6 percent of the rail cost while for the road alternative it only accounts for 1 percent). Land transport related costs are the prevailing component with 98 and 93 percent of the share of the total respectively. In terms of time, port is the most significant element for both alternatives (76 and 78 percent, respectively).

Figure A-11. Cost and Time for Dar es Salaam Corridor serving Lusaka by Road and Rail Transport Alternatives, 2010 (dry bulk)

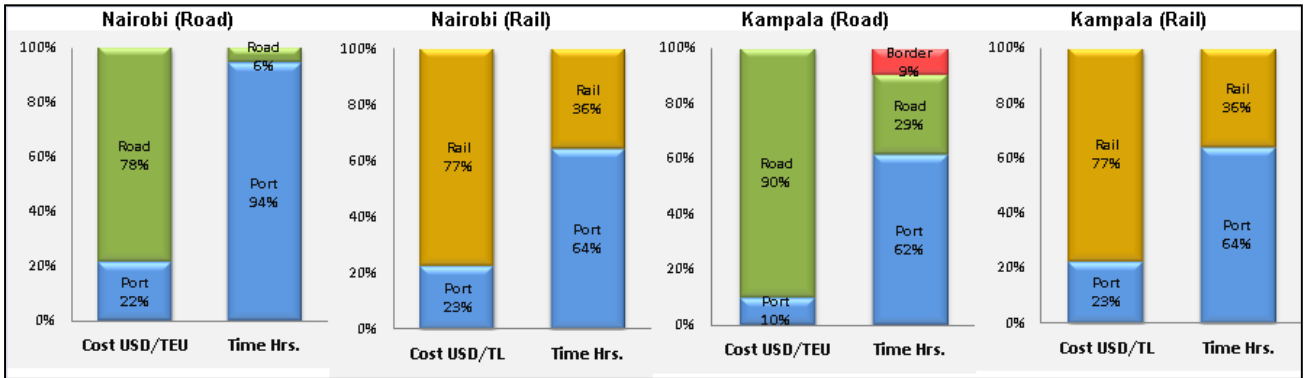


Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	65	325	Port	170	397
Road	5,198	87	Road	-	-
Border	20	14	Border	20	3
Rail	-	-	Rail	2,440	106
ICD	-	-	ICD	-	-
Transport	5,283	426	Transport	2,630	506
Freight Fwd. Fee	300	-	Freight Fwd. Fee	300	-
Extra Inventory	746	-	Extra Inventory	948	-
Total	6,329	426	Total	3,878	506

Source: Nathan Associates Inc.

Appendix B. Performance Assessment of Additional Cargo Types

Figure B.1. Cost and Time for Northern Corridor Destinations Served by Road and Rail Transport – (Imports Dry Bulk)



Elements	Cost USD/TEU	Time Hrs.
Port	330	170
Road	1,200	11
Border	-	-
Rail	-	-
ICD	-	-
Transport	1,530	181
Freight Fwd. Fe	300	-
Extra Inventory	674	-
Total	2,504	181

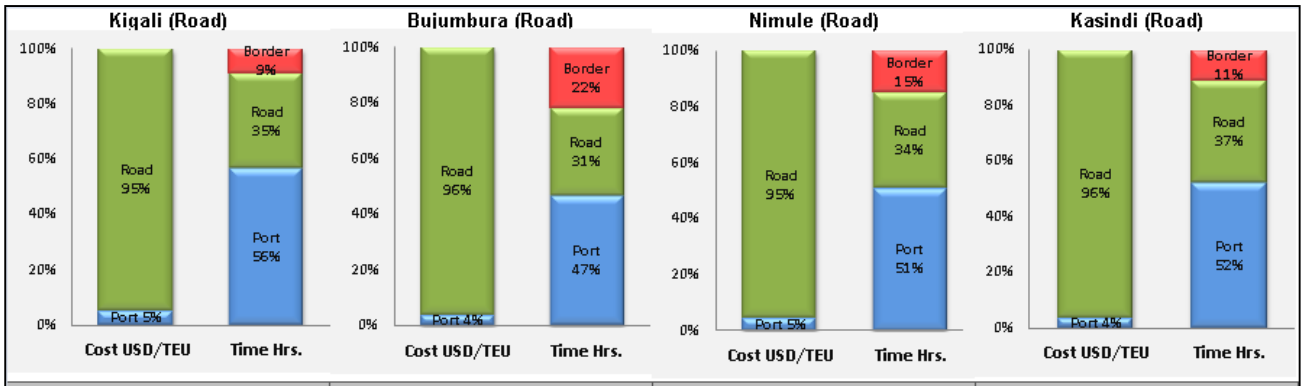
Elements	Cost USD/TL	Time Hrs.
Port	330	170
Road	-	-
Border	-	-
Rail	1,134	96
Lake	-	-
Transport	1,464	266
Freight Fwd. Fe	300	-
Extra Inventory	684	-
Total	2,448	266

Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	3,153	80
Border	-	26
Rail	-	-
Lake	-	-
Transport	3,513	276
Freight Fwd. Fe	300	-
Extra Inventory	716	-
Total	4,529	276

Elements	Cost USD/TL	Time Hrs.
Port	360	170
Road	-	-
Border	-	2
Rail	2,922	240
Lake	-	-
Transport	3,282	412
Freight Fwd. Fe	300	-
Extra Inventory	728	-
Total	4,310	412

Source: Nathan Associates Inc.

Figure B.2. Cost and Time for Northern Corridor Destinations Served Only by Road (Imports Dry Bulk)

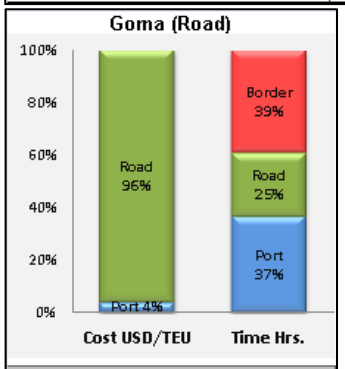


Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	6,297	105
Border	-	26
Rail	-	-
ICD	-	-
Transport	6,657	301
Freight Fwd. Fe	300	-
Extra Inventory	717	-
Total	7,674	301

Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	8,152	114
Border	-	80
Rail	-	-
ICD	-	-
Transport	8,512	364
Freight Fwd. Fe	300	-
Extra Inventory	721	-
Total	9,533	364

Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	7,402	114
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,762	334
Freight Fwd. Fe	300	-
Extra Inventory	718	-
Total	8,780	334

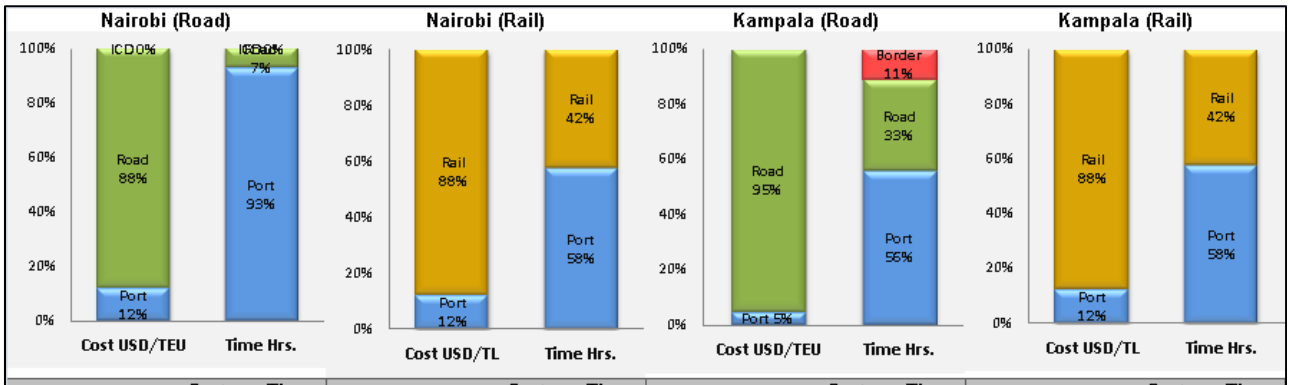
Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	9,333	119
Border	5	36
Rail	-	-
Lake	-	-
Transport	9,698	325
Freight Fwd. Fe	300	-
Extra Inventory	717	-
Total	10,715	325



Elements	Cost USD/TEU	Time Hrs.
Port	360	170
Road	8,150	114
Border	5	180
Rail	-	-
Lake	-	-
Transport	8,515	464
Freight Fwd. Fe	300	-
Extra Inventory	787	-
Total	9,602	464

Source: Nathan Associates Inc.

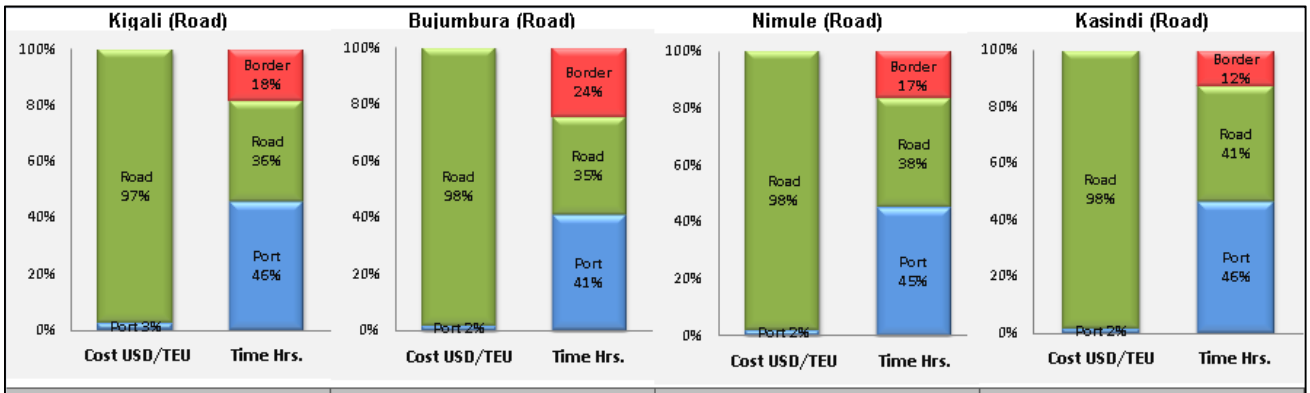
Figure B.3. Cost and Time for Northern Corridor Destinations Served by Road and Rail Transport – (Imports Liquid Bulk)



Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.	Elements	Cost USD/TEU	Time Hrs.	Elements	Cost USD/TL	Time Hrs.
Port	165	134	Port	165	134	Port	165	134	Port	165	134
Road	1,200	11	Road	-	-	Road	3,153	80	Road	-	-
Border	-	-	Border	-	-	Border	-	26	Border	-	2
Rail	-	-	Rail	1,164	99	Rail	-	-	Rail	3,072	243
ICD	-	-	Lake	-	-	Lake	-	-	Lake	-	-
Transport	1,365	145	Transport	1,329	233	Transport	3,318	240	Transport	3,237	379
Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-	Freight Fwd. Fe	300	-
Extra Inventory	514	-	Extra Inventory	528	-	Extra Inventory	516	-	Extra Inventory	530	-
Total	2,179	145	Total	2,157	233	Total	4,134	240	Total	4,067	379

Source: Nathan Associates Inc.

Figure B.4. Cost and Time for Northern Corridor Destinations Served Only by Road (Imports Liquid Bulk)

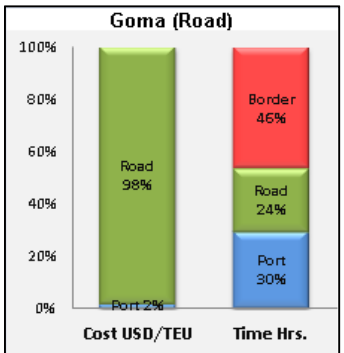


Elements	Cost USD/TEU	Time Hrs.
Port	165	134
Road	6,297	105
Border	-	54
Rail	-	-
ICD	-	-
Transport	6,462	293
Freight Fwd. Fe	300	-
Extra Inventory	517	-
Total	7,279	293

Elements	Cost USD/TEU	Time Hrs.
Port	165	134
Road	8,152	114
Border	-	80
Rail	-	-
ICD	-	-
Transport	8,317	328
Freight Fwd. Fe	300	-
Extra Inventory	520	-
Total	9,137	328

Elements	Cost USD/TEU	Time Hrs.
Port	165	134
Road	7,402	114
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,567	298
Freight Fwd. Fe	300	-
Extra Inventory	516	-
Total	8,383	298

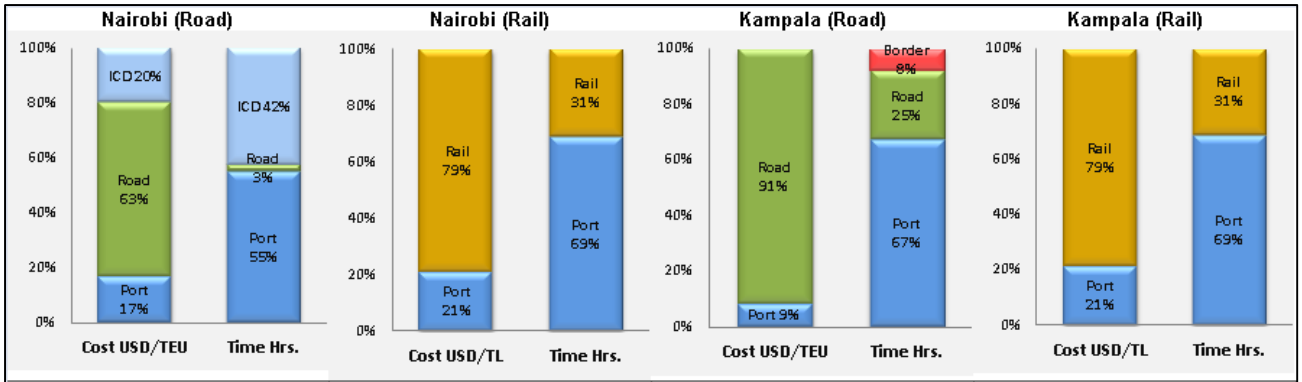
Elements	Cost USD/TEU	Time Hrs.
Port	165	134
Road	9,333	119
Border	5	36
Rail	-	-
Lake	-	-
Transport	9,503	289
Freight Fwd. Fe	300	-
Extra Inventory	515	-
Total	10,318	289



Elements	Cost USD/TEU	Time Hrs.
Port	165	134
Road	7,835	110
Border	5	210
Rail	-	-
Lake	-	-
Transport	8,005	454
Freight Fwd. Fe	300	-
Extra Inventory	607	-
Total	8,912	454

Source: Nathan Associates Inc.

Figure B.5. Cost and Time for Northern Corridor Destinations Served by Road and Rail Transport – (Imports Heavy Containers)



Elements	Cost USD/TEU	Time Hrs.
Port	315	217
Road	1,200	11
Border	-	-
Rail	-	-
ICD	380	168
Transport	1,895	396
Freight Fwd. Fe	300	-
Extra Inventory	619	-
Total	2,814	396

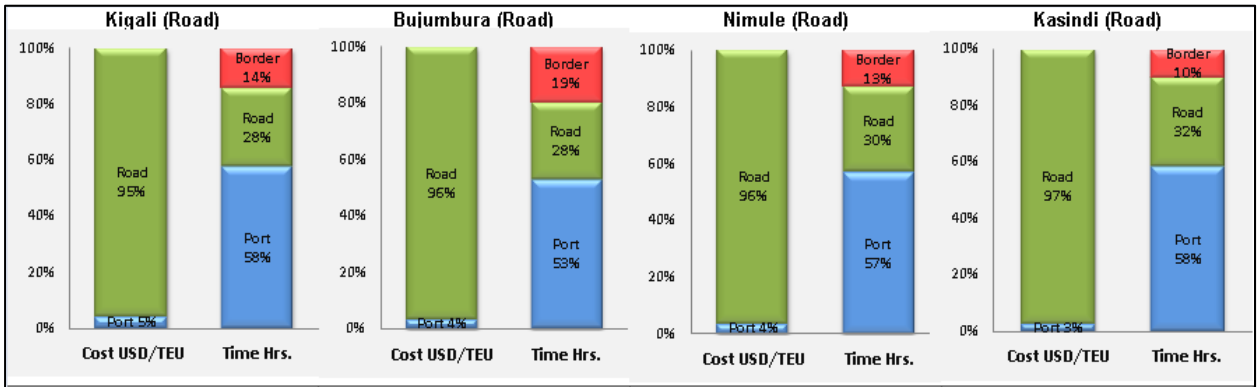
Elements	Cost USD/TL	Time Hrs.
Port	315	217
Road	-	-
Border	-	-
Rail	1,164	99
Lake	-	-
Transport	1,479	316
Freight Fwd. Fe	300	-
Extra Inventory	632	-
Total	2,411	316

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	3,153	80
Border	-	26
Rail	-	-
Lake	-	-
Transport	3,450	323
Freight Fwd. Fe	300	-
Extra Inventory	621	-
Total	4,371	323

Elements	Cost USD/TL	Time Hrs.
Port	297	217
Road	-	-
Border	-	2
Rail	3,072	62
Lake	-	-
Transport	3,369	281
Freight Fwd. Fe	300	-
Extra Inventory	618	-
Total	4,287	281

Source: Nathan Associates Inc.

Figure B.6. Cost and Time for Northern Corridor Destinations Served Only by Road (Imports Heavy Containers)

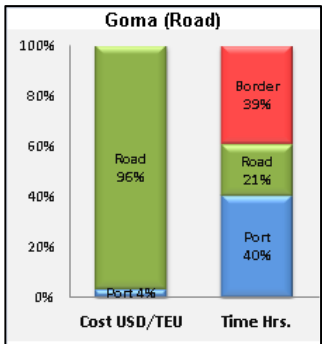


Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	6,297	105
Border	-	54
Rail	-	-
ICD	-	-
Transport	6,594	376
Freight Fwd. Fe	300	-
Extra Inventory	622	-
Total	7,516	376

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	8,152	114
Border	-	80
Rail	-	-
ICD	-	-
Transport	8,449	411
Freight Fwd. Fe	300	-
Extra Inventory	623	-
Total	9,372	411

Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	7,401	114
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,698	381
Freight Fwd. Fe	300	-
Extra Inventory	623	-
Total	8,621	381

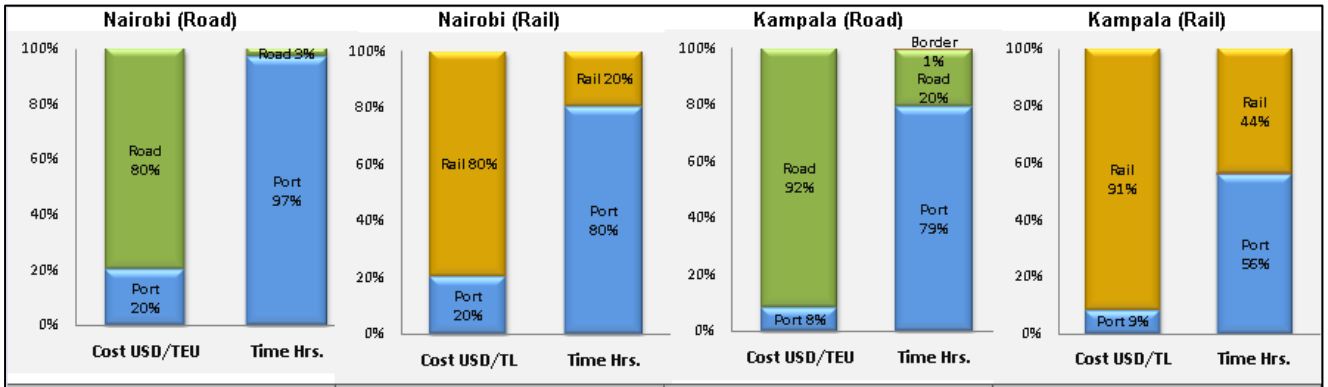
Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	9,333	119
Border	5	36
Rail	-	-
Lake	-	-
Transport	9,635	372
Freight Fwd. Fe	300	-
Extra Inventory	618	-
Total	10,553	372



Elements	Cost USD/TEU	Time Hrs.
Port	297	217
Road	7,835	110
Border	5	210
Rail	-	-
Lake	-	-
Transport	8,137	537
Freight Fwd. Fe	300	-
Extra Inventory	697	-
Total	9,134	537

Source: Nathan Associates Inc.

Figure B.7. Cost and Time for Northern Corridor Destinations Served by Road and Rail Transport – (Exports Heavy Containers)



Elements	Cost USD/TEU	Time Hrs.
Port	300	313
Road	1,200	11
Border	-	-
Rail	-	-
ICD	-	-
Transport	1,500	324
Freight Fwd. Fe	300	-
Extra Inventory	1,099	-
Total	2,899	324

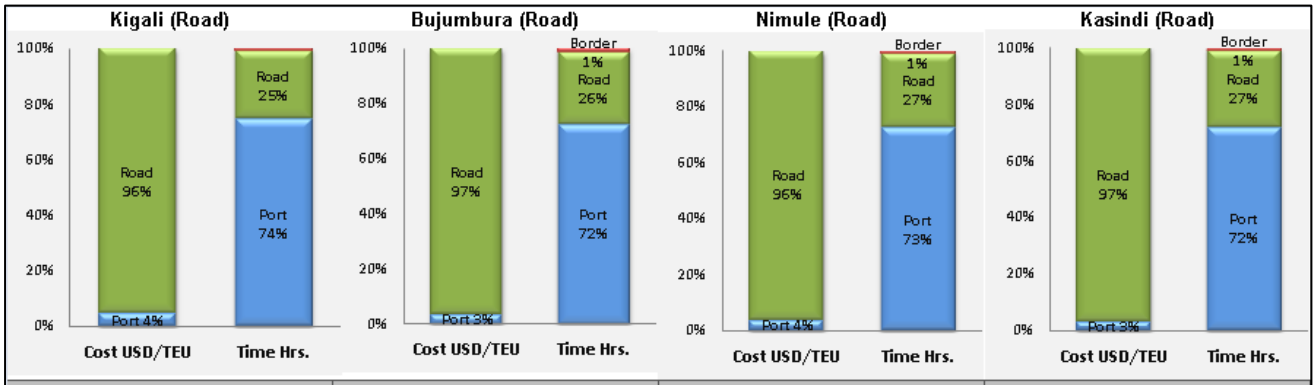
Elements	Cost USD/TL	Time Hrs.
Port	300	313
Road	-	-
Border	-	-
Rail	1,164	77
Lake	-	-
Transport	1,464	390
Freight Fwd. Fe	300	-
Extra Inventory	1,104	-
Total	2,868	390

Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	3,153	80
Border	-	2
Rail	-	-
ICD	-	-
Transport	3,443	395
Freight Fwd. Fe	300	-
Extra Inventory	1,097	-
Total	4,840	395

Elements	Cost USD/TL	Time Hrs.
Port	290	313
Road	-	-
Border	-	1
Rail	3,072	243
Lake	-	-
Transport	3,362	557
Freight Fwd. Fe	300	-
Extra Inventory	2,815	-
Total	6,477	557

Source: Nathan Associates Inc.

Figure B.8. Cost and Time for Northern Corridor Destinations Served Only by Road (Exports Heavy Containers)

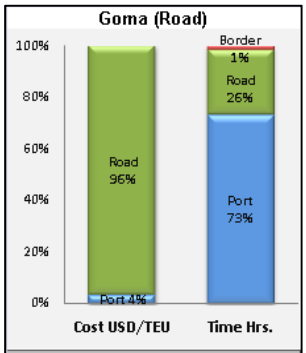


Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	6,297	105
Border	-	4
Rail	-	-
ICD	-	-
Transport	6,587	422
Freight Fwd. Fe	300	-
Extra Inventory	1,091	-
Total	7,978	422

Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	8,152	114
Border	-	6
Rail	-	-
ICD	-	-
Transport	8,442	433
Freight Fwd. Fe	300	-
Extra Inventory	1,093	-
Total	9,835	433

Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	7,402	114
Border	-	4
Rail	-	-
ICD	-	-
Transport	7,692	431
Freight Fwd. Fe	300	-
Extra Inventory	1,093	-
Total	9,085	431

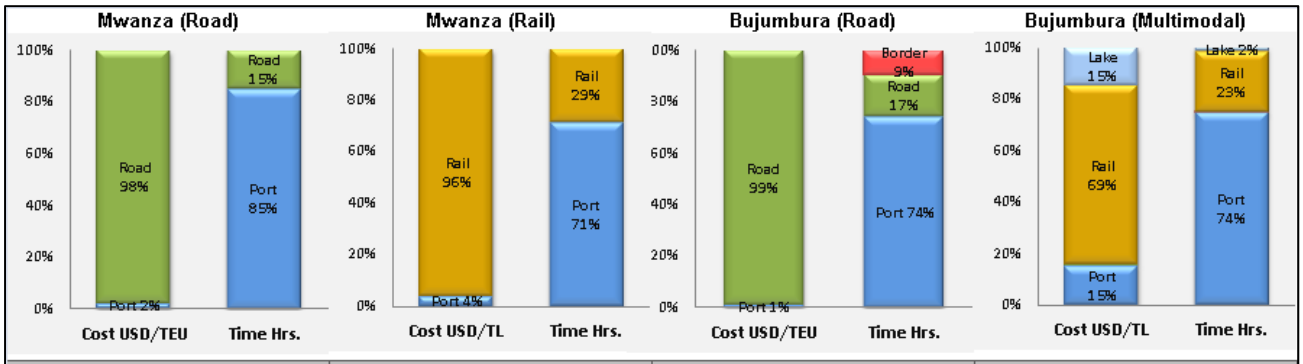
Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	9,333	119
Border	5	4
Rail	-	-
ICD	-	-
Transport	9,628	436
Freight Fwd. Fe	300	-
Extra Inventory	1,092	-
Total	11,020	436



Elements	Cost USD/TEU	Time Hrs.
Port	290	313
Road	7,817	110
Border	5	6
Rail	-	-
ICD	-	-
Transport	8,112	429
Freight Fwd. Fe	300	-
Extra Inventory	1,093	-
Total	9,505	429

Source: Nathan Associates Inc.

Figure B.9. Cost and Time for Central Corridor Destinations Served by Road or Rail / Lake Transport Alternative (Imports Dry Bulk)



Elements	Cost USD/TEU	Time Hrs.
Port	62	396
Road	2,449	71
Border	-	-
Rail	-	-
Lake	-	-
Transport	2,511	467
Freight Fwd. Fe	300	-
Extra Inventory	860	-
Total	3,671	467

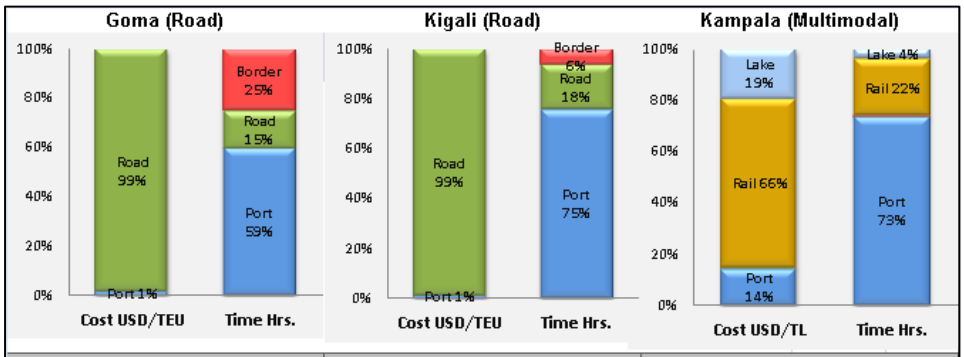
Elements	Cost USD/TL	Time Hrs.
Port	62	300
Road	-	-
Border	-	-
Rail	1,475	120
Lake	-	-
Transport	1,537	420
Freight Fwd. Fe	300	-
Extra Inventory	802	-
Total	2,639	420

Elements	Cost USD/TEU	Time Hrs.
Port	62	396
Road	7,107	91
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,169	537
Freight Fwd. Fe	300	-
Extra Inventory	859	-
Total	8,328	537

Elements	Cost USD/TL	Time Hrs.
Port	326	396
Road	12	0
Border	-	2
Rail	1,488	124
Lake	320	10
Transport	2,146	533
Freight Fwd. Fe	300	-
Extra Inventory	812	-
Total	3,258	533

Source: Nathan Associates Inc.

Figure B.10. Cost and Time for Central Corridor Destinations Served by Single Transport Alternative (Imports Dry Bulk)



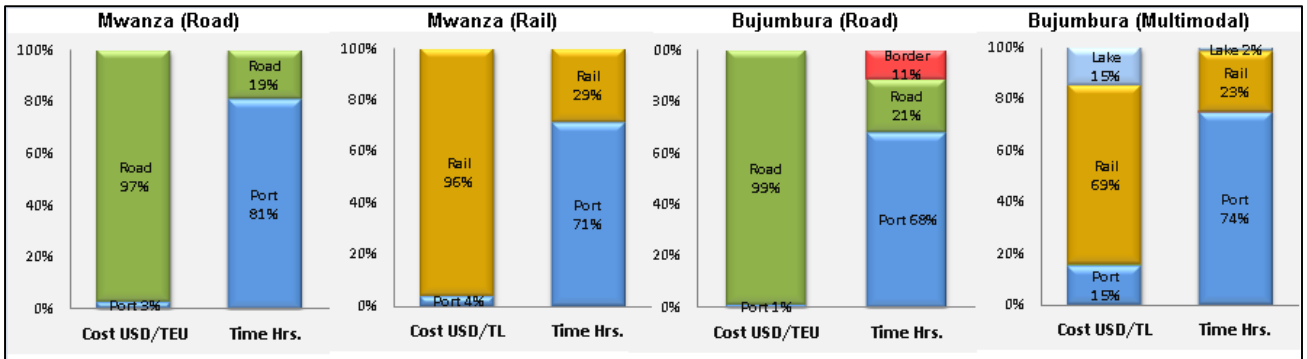
Elements	Cost USD/TEU	Time Hrs.
Port	62	396
Road	5,100	104
Border	-	170
Rail	-	-
Lake	-	-
Transport	5,162	670
Freight Fwd. Fe	300	-
Extra Inventory	955	-
Total	6,417	670

Elements	Cost USD/TEU	Time Hrs.
Port	62	396
Road	4,599	97
Border	-	32
Rail	-	-
Lake	-	-
Transport	4,661	525
Freight Fwd. Fe	300	-
Extra Inventory	862	-
Total	5,823	525

Elements	Cost USD/TL	Time Hrs.
Port	326	396
Road	7	0
Border	-	2
Rail	1,487	121
Lake	430	20
Transport	2,250	539
Freight Fwd. Fe	300	-
Extra Inventory	811	-
Total	3,361	539

Source: Nathan Associates Inc.

Figure B.11. Cost and Time for Central Corridor Destinations Served by Road or Rail / Lake Transport Alternative (Imports Liquid Bulk)



Elements	Cost USD/TEU	Time Hrs.
Port	65	300
Road	2,449	71
Border	-	-
Rail	-	-
Lake	-	-
Transport	2,514	371
Freight Fwd. Fe	300	-
Extra Inventory	650	-
Total	3,464	371

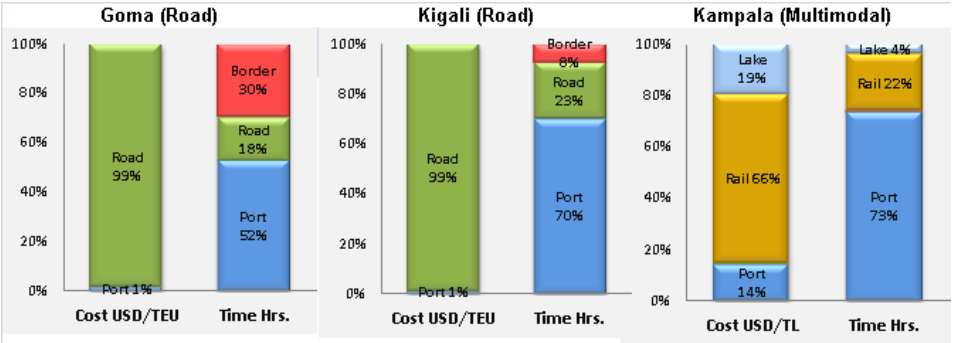
Elements	Cost USD/TL	Time Hrs.
Port	62	300
Road	-	-
Border	-	-
Rail	1,475	120
Lake	-	-
Transport	1,537	420
Freight Fwd. Fe	300	-
Extra Inventory	802	-
Total	2,639	420

Elements	Cost USD/TEU	Time Hrs.
Port	65	300
Road	7,107	91
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,172	441
Freight Fwd. Fe	300	-
Extra Inventory	654	-
Total	8,126	441

Elements	Cost USD/TL	Time Hrs.
Port	326	396
Road	12	0
Border	-	2
Rail	1,488	124
Lake	320	10
Transport	2,146	533
Freight Fwd. Fe	300	-
Extra Inventory	812	-
Total	3,258	533

Source: Nathan Associates Inc.

Figure B.12. Cost and Time for Central Corridor Destinations Served by Single Transport Alternative (Imports Liquid Bulk)



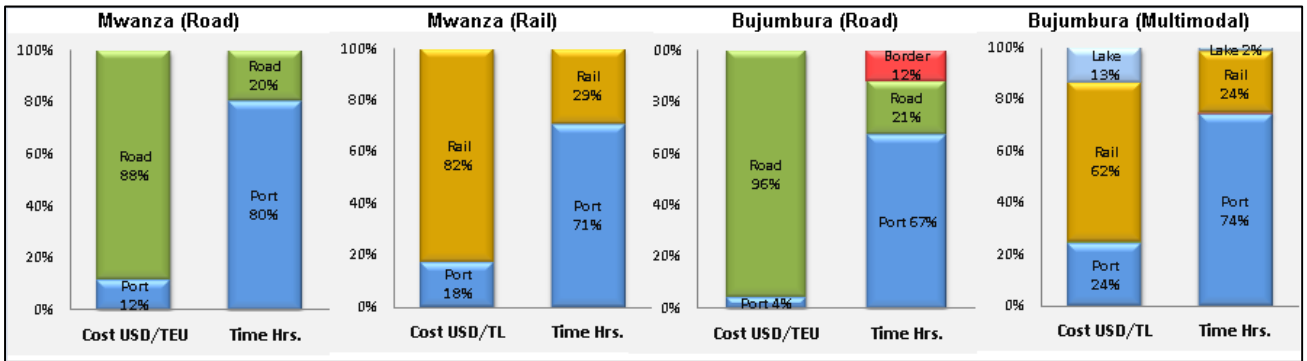
Elements	Cost USD/TEU	Time Hrs.
Port	65	300
Road	5,100	104
Border	-	170
Rail	-	-
Lake	-	-
Transport	5,165	574
Freight Fwd. Fe	300	-
Extra Inventory	772	-
Total	6,237	574

Elements	Cost USD/TEU	Time Hrs.
Port	65	300
Road	4,599	97
Border	-	32
Rail	-	-
Lake	-	-
Transport	4,664	429
Freight Fwd. Fe	300	-
Extra Inventory	658	-
Total	5,622	429

Elements	Cost USD/TL	Time Hrs.
Port	326	396
Road	7	0
Border	-	2
Rail	1,487	121
Lake	430	20
Transport	2,250	539
Freight Fwd. Fe	300	-
Extra Inventory	811	-
Total	3,361	539

Source: Nathan Associates Inc.

Figure B.13. Cost and Time for Central Corridor Destinations Served by Road or Rail / Lake Transport Alternative (Imports Heavy Containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	2,446	71
Border	-	-
Rail	-	-
Lake	-	-
Transport	2,765	362
Freight Fwd. Fe	300	-
Extra Inventory	771	-
Total	3,836	362

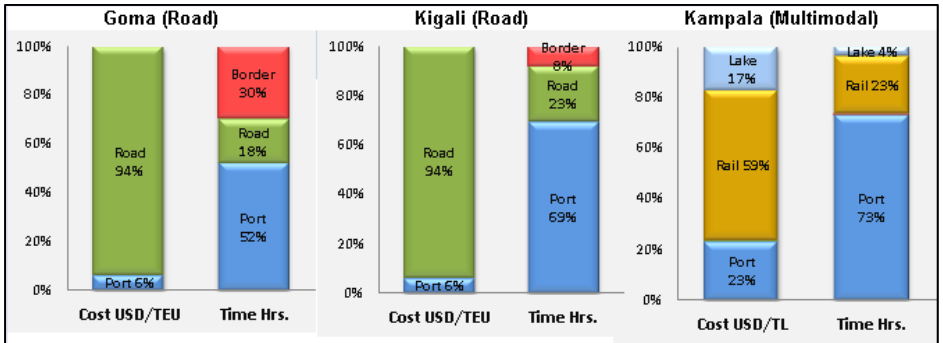
Elements	Cost USD/TL	Time Hrs.
Port	319	291
Road	-	-
Border	-	-
Rail	1,475	120
Lake	-	-
Transport	1,794	411
Freight Fwd. Fe	300	-
Extra Inventory	781	-
Total	2,875	411

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	7,107	91
Border	-	50
Rail	-	-
Lake	-	-
Transport	7,426	432
Freight Fwd. Fe	300	-
Extra Inventory	772	-
Total	8,498	432

Elements	Cost USD/TL	Time Hrs.
Port	583	387
Road	12	0
Border	-	2
Rail	1,488	124
Lake	320	10
Transport	2,403	524
Freight Fwd. Fe	300	-
Extra Inventory	788	-
Total	3,491	524

Source: Nathan Associates Inc.

Figure B.14. Cost and Time for Central Corridor Destinations Served by Single Transport Alternative (Imports Heavy Containers)



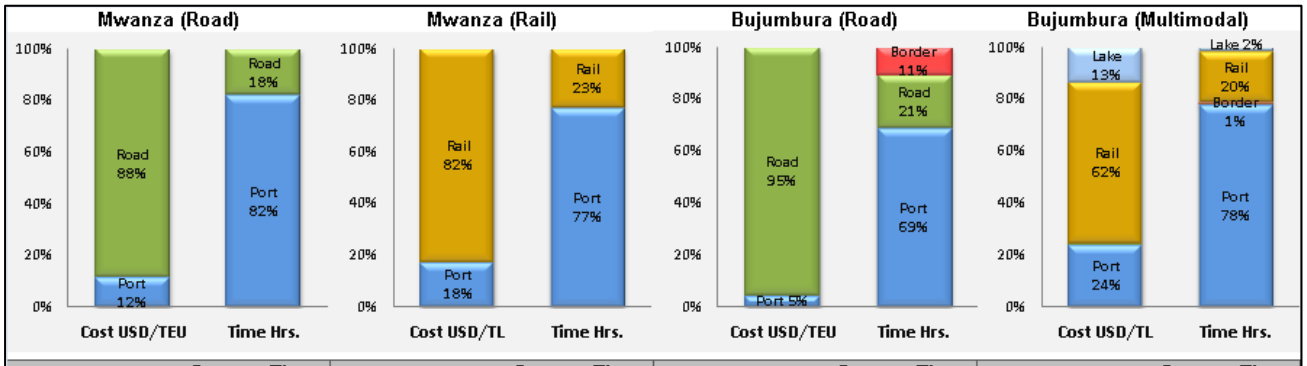
Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	5,100	104
Border	-	170
Rail	-	-
Lake	-	-
Transport	5,419	565
Freight Fwd. Fe	300	-
Extra Inventory	811	-
Total	6,530	565

Elements	Cost USD/TEU	Time Hrs.
Port	319	291
Road	4,599	97
Border	-	32
Rail	-	-
Lake	-	-
Transport	4,918	420
Freight Fwd. Fe	300	-
Extra Inventory	773	-
Total	5,991	420

Elements	Cost USD/TL	Time Hrs.
Port	583	387
Road	7	0
Border	-	2
Rail	1,487	121
Lake	430	20
Transport	2,507	530
Freight Fwd. Fe	300	-
Extra Inventory	787	-
Total	3,594	530

Source: Nathan Associates Inc.

Figure B.15. Cost and Time for Central Corridor Destinations Served by Road or Rail / Lake Transport Alternative (Exports Heavy Containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	2,449	71
Border	-	-
Rail	-	-
Lake	-	-
Transport	2,768	396
Freight Fwd. Fe	300	-
Extra Inventory	1,019	-
Total	4,087	396

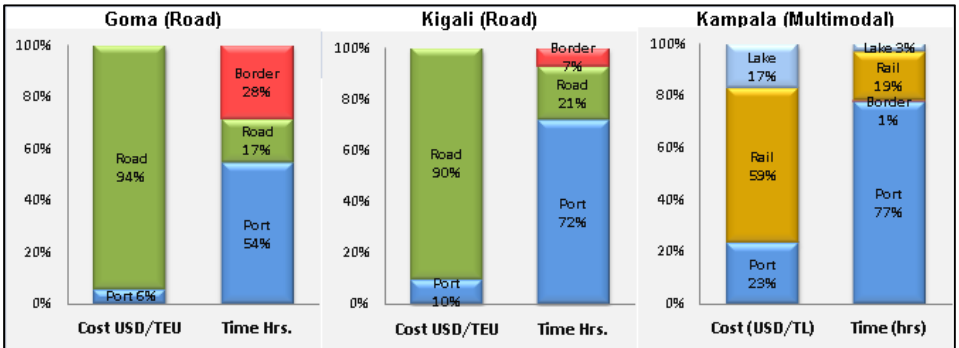
Elements	Cost USD/TL	Time Hrs.
Port	319	397
Road	-	-
Border	-	-
Rail	1,475	120
Lake	-	-
Transport	1,794	517
Freight Fwd. Fe	300	-
Extra Inventory	1,387	-
Total	3,481	517

Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	6,642	99
Border	-	50
Rail	-	-
Lake	-	-
Transport	6,961	474
Freight Fwd. Fe	300	-
Extra Inventory	1,019	-
Total	8,280	474

Elements	Cost USD/TL	Time Hrs.
Port	583	493
Road	12	0
Border	-	4
Rail	1,488	124
Lake	320	11
Transport	2,403	633
Freight Fwd. Fe	300	-
Extra Inventory	1,391	-
Total	4,094	633

Source: Nathan Associates Inc.

Figure B.16. Cost and Time for Central Corridor Destinations Served by Single Transport Alternative (Exports Heavy Containers)



Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	5,100	104
Border	-	170
Rail	-	-
Lake	-	-
Transport	5,419	599
Freight Fwd. Fe	300	-
Extra Inventory	1,102	-
Total	6,821	599

Elements	Cost USD/TEU	Time Hrs.
Port	319	325
Road	2,995	97
Border	-	32
Rail	-	-
Lake	-	-
Transport	3,314	454
Freight Fwd. Fe	300	-
Extra Inventory	1,024	-
Total	4,638	454

Elements	Cost USD/TL	Time Hrs.
Port	583	493
Road	7	0
Border	-	4
Rail	1,487	120
Lake	430	20
Transport	2,507	638
Freight Fwd. Fe	300	-
Extra Inventory	1,388	-
Total	4,195	638

Source: Nathan Associates Inc.