



**ADDIS ABABA UNIVERSITY ADDIS ABABA
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**ETHIOPIAN RAILWAY CORPORATION
AS A MULTIMODAL OPERATOR**

*A Thesis Submitted to the Graduate School of Addis Ababa University in
partial fulfillment of the requirement for the Degree of Masters of Science*

In Railway Mechanical Engineering

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Abstract

Multimodal freight transport can facilitate the economic development of Operators. The Study shows particularly in freight transportation, there is developing the single mode of transport in to multimodal operation system, the characteristics of multimodal travel today in Ethiopia and assesses its future potential in Railway Corporation, the factors required to implement the multimodal operating system and make Railway will be competitive rather than shipping line.

Multimodal transport requires new organizational and financial arrangements between all actors involved. Transporting freight plays a major role in the country and Ethiopian railway will start to work in the route of Addis Ababa-Djibouti in a single mode of transport. this type of transport is not sufficient to return the loan of railway in short period of time and in the sake of increasing socio- economic benefit.

In this study by interviewing the groups of professional from Governmental agencies and private sector the information which is necessary for this paper is collected and the required data for this particular investigation purpose is taking from concerned sectors especially ESLSE . The previous research which is related to this title is used as a base for the theoretical and empirical framework of the study. Additionally, computerized search strategy was selected.

Finally implementing multimodal operation requires solving the transportation cost, transportation time, transportation capacity constraints, and transportation allocation problem and also transporting in multimodal makes to saving 62.2USD/ton or transporting in unimodal is 1.24times that of multimodal cost and Operating Multimodal transport is 7.07 times greater profit than operating single mode of transport. Therefore By Considering enough performance of railway and its profitability implement Operating Multimodal transport is essential. Hence Ethiopian Railway use multimodal operator for their better economic efficiency and social effectiveness,

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Abbreviation

BBK: Transported in Break Bulk

CDE: Djibouti-Ethiopian Railway Corporation

DDP: Djibouti Dry Port

ECA: Ethiopian Custom Authority

ERC: Ethiopian Railway Corporation

ESLE: Ethiopian Shipping Line and Logistics Enterprise

ESL: Ethiopian Shipping Line

IT: Information Technology

MTO: Multimodal Transport Operator

MT: Multimodal Transport

MTSE: Maritime and Transit Service Enterprise

NBE: National Bank of Ethiopia

OECD: Organization for Economic Co-operation and Development

TEU: Twenty foot Equivalent Unit (standard Iso container 20'long)

THC: Terminal Handling Charge

UNCTAD: United Nation Conference on Trade and Development

Chapter 1: Introduction

1.1 Background

Multimodal transport is an important part of the dynamic transport industry and new issues are addressed and new solutions to problems are found all the time.

The developments in the multimodal transport industry are regarded as of critical interest to the future development of the freight transport industry in Ethiopia.

International multimodal transport covers the door-to-door movement of goods under the responsibility of a single transport operator. The concept of multimodal transport was developed with the container revolution initiated in the late 1950s. The coming of the container technology and the multimodal transport concept facilitated international trade. Trade and transport are inextricably linked i.e., efficient transport services are a pre-requisite to successful trading.

International transport generally implies the use of various modes of transport and interfaces, each mode and interface corresponding to a transfer, storage or transport operation either in the country of origin, in a transit country or in the country of the final destination. Considering the variety of cultures, languages and commercial practices at both ends of a trade and the resulting complexities of assembling such an international transport operation, it would appear reasonable to a trader to let one qualified operator organize and be responsible and accountable for the entire chain of transport.

Multimodal transport implies the safe and efficient movement of goods where the multimodal operator accepts the corresponding responsibility from door to door. With technological development of transport operations, as well as communications, coupled with liberalization in the provision of services, more and more transport operators are now able to provide safe and efficient transport. Against this background and as proposed by a study made by moving towards this advance system of operation is considered imperative.

In our country such type of transportation is until now not developed specially in railway transportation. The study covers the multimodal transportation in the route of Addis Ababa to Djibouti. The characteristics of Ethiopian railway multimodal mobility

today, the future potential of multimodal travelling and the profitability of railway when implementing the multimodal in its mode of transport are found in this research.

1.2 Statement of the Problem

Many problem of the statement would be raised but I select the basic statement of the problem that is solved by the study.

In Ethiopia, currently the railway transport system is on the way to start operation in single mode of transport, this type of transport is not sufficient to return the loan of railway in short period of time. Additionally it is not enough technological developments of international trade market for our country and the socio- economic benefit of ERC Is not increasing as required . Hence Ethiopian Railway Corporation strongly require multimodal operator in its freight transport system. Multimodal operator in Ethiopia is found only in Ethiopian shipping line. For more computation, it is requires other transporting modes especially Ethiopian railway implement a multimodal operation.

1.3 Objective

1.3.1 General Objective

The general objective of the study is to assess the requirement and benefit of applying multimodal transport operation system in Ethiopian Railway Corporation in the corridor of Addis Ababa to Djibouti.

1.3.2 Specific Objective

The specific objective of the study is:

- To define multimodal transport operation requirement in ERC.
- To identify the benefits of multimodal transport system over unimodal in ERC.
- To investigate operation of unimodal and multimodal in ERC
- To compare the transportation cost of unimodal and multimodal in ERC
- To recommend the use of multimodal transport operation system in ERC

1.4 Scope of the study

In the new Ethiopian Railway Corporation the current program of transportation is

unimodal or single mode of transport. So the scope of the study is focus Railway Corporation to implement the multimodal system of transportation in the route of Addis Ababa to Djibouti because 75% of freight is exported and Imported in this corridor.

1.5 Research Methodology

Different researchers use different type of research methodology in order to meet their objectives. In this particular study the method which is scientific methodology is uses

- By interviewing the groups of professional from Governmental agencies and private sector the information which is necessary for this paper is collected and the required data for this particular investigation purpose is taking from concerned sectors especially ESLSE .
- The previous research which is related to this title is used as a base for the theoretical and empirical framework of the study.
- Additionally, computerized search strategy was selected in order to detect recent publications in multimodal freight transport and a separate search was performed of electronic journals from concerning transportation.

1.5.1 Data collection

The methods of data collection are going to use: surveys, interviews and observation. The data would be collected from Governmental agencies and private sector. Governmental agencies such as Customs, National Bank of Ethiopian, Ethiopian Shipping and Logistics Service Enterprise and Ethiopian Railway Corporation. The private sectors are Importer of spare part and Exporter of Coffee.

Primary as well as secondary data which is needed for the study are collected using different data collection techniques. These are:

- Observing the routes of the rail way to predetermine what transportation could exist. The first stage of the research involved an empirical investigation into transport usage and the factors affecting the selection of transport mode.
- By interviewing concerned bodies, research utilized a survey, consulting advisors and discussing with friends modeling.
- To examine the question of international freight transport practices to and from Addis Ababa Djibouti and multimodal transport corridors.

1.5.3 Survey description

When I examine and report on the condition of multimodal operation for the new railway the following some survey would be seen:

In Ethiopian shipping Line & Logistics service Enterprise is the first implementing of multimodal for our country. Hence it is helpful to my study by collecting the material by Interview of professional groups and by taking the data required to the study.

When interviewing they said that implementing multimodal operation in shipping line there is so many advantages in company side & users such as:-

- The customer no need of any contact without their company this indicates that minimizing the customer time & cost.
- There is 8days free of storage cost in Djibouti port.
- Their profit increased by multiple times.
- Minimizing hard currency so beneficial to the economic development of the country
- Reduces freight cost, time of delivery, unnecessary operation delay, accident & loss of cargo in transit.
- Planned and organized transportation system of the freight.

In the unimodal transportation system the customer needs a contact of the agents in every transition port this is exposed to extra cost, extra time, delay in transition, loss of the freight &etc. In the unimodal the waiting day &time in the Djibouti port is a paid for storage. In shipping line there is an equal service for both of multimodal & unimodal system and in some case if the multimodal operation is failed they used unimodal transportation system.

The shipping line there is some problem when they are implementing multimodal operation

- There is no well-organized information technology
- There is no well-organized staff member
- No well controlling mechanism
- No good transfer mechanism
- Shortage of Trucking system & car-carrier

There is an exceptional transportation for multimodal operation in shipping line, greater than 3tonnage car and bulk freights such as fertilizer, sugar, wheat & other

construction materials. Also the Export goods are transporting by unimodal not by multimodal up to now.

The professional in shipping line said that the railway has the backbone of shipping line & for their multimodal transport. When Railway starts to operation: minimize transit time, efficient, safe, and economical also it has enough cargo for transporting bulk quantity of goods.

1.6 Challenges

There were many difficulties involved in the search for relevant data with regard to freight transport in Addis Ababa to Djibouti. These difficulties include out-of-date data, incomplete data sets, ambiguous data values and complete lack of data in some cases. The political situation in some of the Organization involved in the study also created many barriers to data collection, as many governmental agencies were reluctant to disclose their operating procedures and practices.

Data collected from private enterprises were also quite difficult to obtain, as many of the data required for this research are considered commercially sensitive access to data had to be negotiated on every level.

1.7 Organization of the thesis

The organization of the thesis can be separated into seven chapters. The contents of each chapter are presented below:

- Chapter 1 begins with a general background related to the research then problem of the statements, general & specific objective of the study, the scope of the study, research strategy and methods used in the study and the structure of the thesis are presented.
- Chapter 2 Reviews the literature relating to International freight transport corridors, International multimodal transport and its competitiveness, this review is to provide a perspective on previous publications and studies that have been conducted as well as to illustrate relevant research areas and finally presents the challenges found in international freight transport.
- Chapter 3 Introduce the concept of Fright transport in Ethiopia. It begins with introduction of fright transport in Ethiopia then fright transport in roadway, railway, and shipping line. Finally the chapter ends with challenges and problems of

transportation system.

- Chapter 4 this chapter covers: the Freight transport in Ethiopian Railway Corporation, Feasibility study, future direction of the transportation and finally the challenges of the railway in freight transport.
- Chapter 5 discusses Development of multimodal operation in Ethiopia, the application of the system in railway, the working principles, social and economic benefit of multimodal operation. Presents the findings related to international freight transport practices and attitudes towards the selection of transport modes in Ethio-Djibouti. These findings are derived from an analysis of transport usage and attitudes towards transport modes in Ethiopia. Finally, the chapter ends implementation requirement of the system.
- Chapter 6 concludes the thesis with a summary of the research and a discussion drawn from the study's main findings. In addition, this chapter presents the limitations and applicability of the research. Finally, chapter closes with suggestions for future research.

Chapter 2 Literature review

2.1 Introduction

The thesis was initiated by a literature review and for each article presented in this thesis, as well as whenever a previously uncharted area of interest arose, additional literature searches were performed, not limited to the articles or search terms described below. A literature review is often performed to gain a basic understanding of a research area, to identify gaps in existing research or to compile what has been scrutinized by previous research.

As previously stated, several additional literature searches have been performed during the research project. Thus, the selection of articles presented below represents but a small part of the theory studied and used as a foundation for this thesis. My study is the only research that is found in Ethiopia regardless of railway has a multimodal operator. Hence, by considering the new railway and other mode of transportation solve the problem of the freight transportation in the route Addis Ababa to Djibouti.

2.2 International freight transportation

Modern transport and freight distribution system all over the world are tending towards the adoption of best practices that are reliable, timely and cost-effective. For their study evaluates the potentials of integrating rail-road system for port-hinterland freight in Nigeria. Much of the primary data was obtained through the administration of a questionnaire specifically designed to gather information on the cost involved, distanced covered, areal coverage, and time taken to deliver cargoes to consignees.

The respondents that were sampled systematically for this study were truck drivers who were interviewed at the point of loading in Lagos and Port Harcourt port complexes. In all, 302 truck drivers were interviewed. Secondary data sources were from records of Nigerian Ports Plc. and Nigerian Railway Corporation. The data was analyzed using frequency distribution, Student's *t*-test, and Geometric Mean analysis. The indications of these findings are that integrating the various modes of transport for port-hinterland freight distribution would make the nation's transportation system to be faster and more cost-effective.[3]

In order to inform the repositioning of South Africa's freight transport industry, a segmentation model for total freight was developed that enabled the categorization of the billion tons of freight that are transported in South Africa every year. This categorization, in turn, informs the optimal modal split, facilitates policy development and enables appropriate investment.[2]

A major factor underlying this transformation of freight transport is due to changes in the scale, in the composition and in the structure of the American and global economies. The demand for transportation has grown in response to the generally brisk performance of the US and global economies during this period. The US economy is dominantly becoming service oriented, and shifting from mass manufacturing to high value added custom manufacturing. The resulting combination of increasing information content and decreasing material intensity of goods changes the character and value of goods being moved.

Further, the US and other Organization for Economic Cooperation and Development (OECD) countries have created global and regional free trade regimes, and globally organized production systems and value chains, which require speedy and timely movement of goods. These flows of goods are coordinated across national and global transport nodes and links in order to support the smooth functioning of the global economy.

Technological changes in the transport sector in the US occurred in form of Interstate Highway System, the jet aircraft, the container and container ships, container stacking in rail, roll-on/roll-off vessels, and a variety of micro infrastructure to facilitate operations at seaports and airports. The use of information technology (IT) greatly enhances transport operator and system efficiency, offering not only speedier goods transport at declining costs but also the ability to integrate goods supply chains regionally and globally while maintaining lean inventories.

Business logistics service systems, aimed at minimizing total logistics cost (transportation, warehousing and inventories, insurance, administration and so on) by freight transport companies add value to the operation of their customers conferring strategic competitive advantage on US firms operating in the global market.[8]

2.3 Challenges found in international freight transport

There are some shortcomings existing in the domestic and foreign documents all above about the multimodal transportation modes selection; the main problem is that the impact of transportation cost and time selection on multimodal transportation modes was considered in the past; only a single target situation for multimodal transportation mode optimal selection failed to consider other factors in the problems. But, in the actual decision process selection in multimodal transportation modes, in order to ensure the continuity and safety, we need to consider transportation safety and transportation risk factors comprehensively; only in this way we can meet the actual needs of transportation.

South Africa's national freight transport challenges, describe the research methodology, focusing on the market segmentation approach and key rail economic principles that support a modal shift; and show the results of the market segmentation exercise as well as their application to key rail economic principles and resultant cost-saving opportunities. South Africa's freight-flow challenges, amid the imperative for urgent large-scale infrastructure investments, require innovative, mature approaches.

Given the country's high logistics costs, dense long-distance road corridors and significant growth forecasted in freight flows, a restructuring of the freight transport system and related investment is critical. The research illustrates clear opportunities for intermodal solutions where both road and rail can benefit, allowing South Africa to move closer to its growth ideals.[2]

According to Europe experienced to decline in rail transport while highways were developed and markets were liberalized. The authors provide a detailed analysis of the underlying reasons for this decline. The key exogenous reasons proposed are a shift in demand patterns (for example, from high stock levels to just-in-time delivery, and from low-value/high-volume to high-value/low-volume freight), as well as policies and investments that favor road over rail.

The endogenous reasons that they put forward relate to various aspects of rail service delivery. The inefficiency and poor performance of the railways in led to reform. Apart from institutional structure challenges "under-pricing" of especially the road mode as a

major driver of rail's demise. What has in fact happened is that the road mode is supported by regulation, because of its ability to serve the market better. The a priori reason for rail's decline is therefore poor understanding of shifting demand or an inability to adapt. [2]

The multi-period multimodal container shipment planning problem in the hinterland of China is studied in this article. A planning horizon is divided into several time periods and goods can be carried in a time period within its due date. Generally, railroad is the first choice for container transportation, but there are also several other modes to be considered. The other modes of transportation should be adopted if there is not enough rail capacity or not enough containers to be carried.

The problem is formulated as a large-scale programming model, which maximizes the total profit generated by all freight bookings accepted in a multi-period planning horizon subject to the limited capacities. Two heuristic algorithms are proposed to get approximate optimal solutions of the problem and numerical experiments are conducted to demonstrate the proposed formulation and heuristic algorithms. The results of numerical experiments indicated that the two proposed heuristic algorithms are effective for time critical tactical or operations level decisions, where an approximate optimal solution is acceptable and fast computation is more important than guaranteeing optimal value.

2.4 International Multimodal transportation

Multimodal transportation is defined as completing the transportation process by using at least two transportation tools to connect and transport together; it is a kind of transportation organization form which uses optimum efficiency as the goal. There are no new transportation channels and tools in the multimodal transportation process; it is a combination of modern organization means and single transportation mode.

It has important and realistic meaning for saving transportation costs and transportation time and improving transportation service quality by researching the decision of multimodal transportation scheme in the process of transportation.

The European Union is seeking to integrate the transportation systems of member countries by identifying more than 400 billion of investments in transportation improvements. These include the construction of high-speed rail infrastructure as well

as road improvements to connect rail lines with other land air, and water transportation systems. The ports of Rotterdam, Antwerp, Hamburg and Bremerhaven are quickly becoming multimodal hubs that combine deep-sea line haul facilities with rail, inland waterway, and road transport systems linkages.

The Port of Rotterdam in The Netherlands is expanding its combined intermodal transportation and logistics services centers to connect maritime shipping facilities with truck, barge, and rail systems. These transshipment centers cluster firms providing information and communications technology, storage, repacking, labeling, assembling, and container loading services, and are linked by highways to nearby rail, air, and inland water transportation infrastructure.[4]

Multimodal transportation is a kind of holistic and integrated operation process about the mutual coordination and cooperation between multimodal transportation network nodes, node enterprises lines, social economic conditions, and natural environment factors. Risk factors existed in several aspects of the multimodal transportation network, including multimodal transportation enterprises, transportation channels, external economic, social environment, and natural factors; these risk factors are not only the necessary conditions for the formation of multimodal transportation network risk but also an important prerequisite for the existence of multimodal transportation network risk.

They suppose that a company has a batch of goods to transport from origin point O to destination point D through a multimodal transportation network. A plurality of hub nodes composed the multimodal transportation network several transportation modes can be chosen between two arbitrary adjacent nodes. Each node is a transit hub for different transportation modes when they switched the goods from one mode to another mode, they need to spend some time and cost, but total transportation time cannot exceed the scope of delivery time. They hoped to deliver the goods safely, economically, and conveniently through the proper choice of the transportation modes during the agreed period.[5]

2.5 Freight transportation in Ethiopia

Ethiopia is one of the landlocked developing countries in the world. Being a landlocked country, Ethiopia depends on transit trade. For facilitating its transit trade, Ethiopia has concluded Port Utilization Agreement with Djibouti and Sudan. However, nowadays Ethiopia mainly uses the port of Djibouti. Road transport plays a significant role in the transit transport. For which, Ethiopia has concluded Road Transport Agreements with Djibouti and Sudan.

There is a rail transport along the Ethio-Djibouti corridor. As it is not good enough to facilitate transit trade, the role of rail transport is insignificant. The use of rail transport is mainly to transport passengers and small parcels of goods in the corridor. The current transit transport system between Ethiopia and its transit countries, in particular Djibouti. This transport system makes Ethiopian importers to receive their imported goods at the port of Djibouti through their agents and Ethiopian Exporters to send their cargoes to the port of Djibouti for being stuffed in containers at Djibouti Port.

As both Ethiopia and its neighboring transit countries, (Djibouti and Sudan,) are developing countries, the constraints of transit trade that exist in other landlocked and transit developing countries are also common problem of Ethiopia and its neighboring transit countries.

2.5.1 Road Transport

Despite huge investments in port development, the landside and infrastructure is somewhat neglected. Unfortunately it was not possible for the Consultant to drive from the port area to the border. However, discussion with truck drivers learned that large parts of the highway to the border are not resurfaced for more than a decade and that the highway is in poor condition due to the heavy traffic. A World Bank report emphasized the importance of road maintenance especially when pavement starts to crack up. It is well established that rehabilitation after the asphalt pavement has failed can cost at least three to five times more than timely application of overlays.

The aforementioned World Bank report indicated that truck traffic from Djibouti port to Ethiopia was in 2011 about 1,200 loaded trucks a day. Of these trucks, 17% carried oil, 20-30% containers and cars, while the remainder carried goods imported in bulk or freight stripped from containers in Djibouti port. Overloaded trucks exceeding the axle

weight are a heavy burden for the roads and as far as the Consultant understood, there is no control or road regulator to avoid these situations.

The competition between trucking companies from Djibouti and Ethiopia are in favor of the latter. According to the same report there are about 200 – 250 trucks in Djibouti and 6,000 – 8,000 trucks in Ethiopia in competition for the same transport haul. Due to a serious shortage in truck capacity you may expect more collaboration between the two countries or between trucking companies, but this seems to be limited.

The competition is for Djiboutian truckers more difficult as:

- Ethiopian trucking tariffs are subsidized and/or controlled by the government;
- Ethiopian state-owned truck companies does not have to include depreciation and financing cost in the calculation of transport rates, which cover only fuel, labor and maintenance;
- Fuel prices are cheaper in Ethiopia;
- Ethiopian drivers and repair mechanics are considered as better skilled;
- Payments in Birr create problems as the Ethiopian currency isn't convertible.

A major problem, which is applicable to both Djiboutian and Ethiopian truckers, is the difficulty to find return cargo due to the imbalance of import and export cargo. To avoid a fully congested town with trucks parking everywhere, Djibouti has a central truck parking area, where truckers can wait for a next transport order.

Although the area is under construction and the parking area is still Draft unpaved, it is a good concept. That said from truckers' viewpoint the situation is poor. They have to pay for an unstructured area, where trucks are parked crisscross and without any facility. At least there should be a canteen with washing rooms and sleeping accommodation. Also a truck service point and a fuel station will make the area more professional.

To ease communication with truckers it is advisable to create a (central) desk, where gate passes and transport documents are handed over or where traffic management is coordinated. The roads in the city and to port areas are in good condition and the same can be said about the main road corridors on Ethiopian side of the border.

2.5.2 Railway

In the past there was a railway connection between Addis Ababa and the port of Djibouti with one railroad and narrow gauge. It was a long haul with steep gradient up from sea level to the Ethiopian highlands (2,300m). In 2007 the rail traffic was 250,000 tons per annum. The line is jointly owned by the governments of Ethiopia and Djibouti and managed by the Djibouti-Ethiopia Railway Corporation (CDE). The whole railway passes through 32 cities between Addis Ababa and Djibouti, with totally 34 stations, among which Addis Ababa Station, Dire Dawa Station and Djibouti Station are the main stations.

The minimum radius of curve of the line is 150m and the maximum longitudinal slope is 27 ‰, with 19 locomotives in internal combustion traction. The Addis Ababa-Dire Dawa section, due to the serious subgrade subsidence, steel rail deformed as well as being buried by road pavement in certain sections, is dilapidated and out of operation. Despite these defects like aging equipment, poor management, insufficient transport capacity and heavy losses, Dire Dawa - Djibouti section continues to operate but suffers heavy loss.

Therefore the road is still the only mode of transport to reach the hinterland, but in a number of years rail will be a second option again. The Ethiopian government develops a rail network through the country based on standard gauge (143.5cm), including one to Djibouti. Agreements are signed between ERC (Ethiopian Railway Corporation) and Chinese and Turkish constructors.

The railway should also connect in the north to Port Sudan, while a rail connection with the port of Lamu is under construction. Ethiopia is keen to reduce its dependence on the port of Djibouti. The Ethiopian Railways Corporation is a newly established railway freight service provider. The corporation is in the process of planning the development of modern standard gauge (1435mm) railways system along the corridors and trunk lines of the country with a first priority given to Addis Ababa-Djibouti corridor.

The construction of the Djibouti line is already started in September 2011 and is expected to commence operation within the coming four to five years. The new corporation will be a significant factor in future corridor transportation and the development of railway network throughout the country. The share of the new railway

of the corridor traffic could easily be up to 75% of foreign trade which will be incorporated in the second phase of the ten year plan period. The ERC report (2010) says that single height container freight train wagons may be used.

When the railway Addis Ababa – Djibouti is up and running it will provide a dilemma for ESLSE. The shortage in truck capacity asked for expansion of the trucking fleet. However, the effect of rail on road transport cannot be wiped out especially for the long haul. Figure 4 provides an indicative overview of the cost difference between rail and road transport. ESLSE should develop road and rail as a complementing system. The challenge is hidden in the purchasing policy of trucks. Road and rail has to be balanced to avoid overcapacity at a later stage.

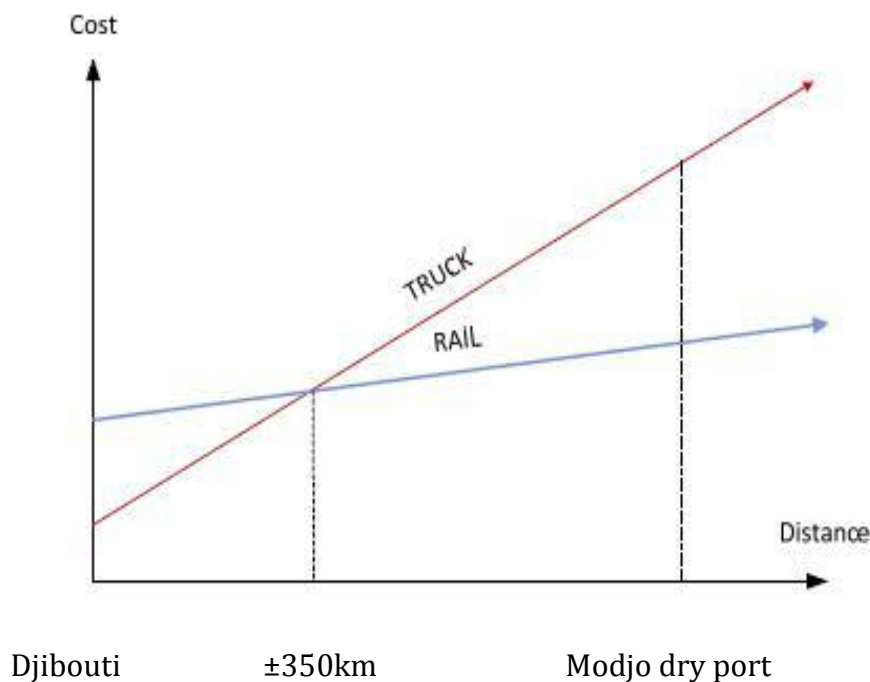


Figure 1: Indicative costs of rail versus road transport

2.5.3 Shipping Line

Ethiopia is an inland country; its maritime transportation service plays a key part in connecting Ethiopia and places around the world. The company engaged in maritime transportation is mainly Ethiopian Shipping Lines S.C. Djibouti Harbour (using 90% of its throughput) and Berbera Harbour became the main port for importing and exporting

goods. Its transport services begin at Red Sea and stretch to northern mainland, Mediterranean Sea, the Far East and the Gulf region.

Presently, the main imported materials like petroleum oil, grains, fertilizers and other industrial products are transited at Djibouti Harbour. In recent years, the amount of imported materials is about 600×10⁴t, which are transported to various regions by roads.

This describes infrastructure and logistics arrangements wherein ESLSE operates. ESLSE is involved from the moment import cargoes land in Djibouti till these cargoes arrive at one of the dry ports or, directly, to consignees' premises. For export cargoes it is the other way round.

The shipping company has been established to carry nation's traffic. The first service, launched in 1966, was between Europe and Ethiopia and provided by three vessels of 5,000 DWT. They were replaced in the mid-1980s by six tween deckers of 15,000 DWT each with about 350 TEU capacities. In the second half of 1990s a service was launched to the Far East and in 2006-2007 two new build multipurpose ships were added to the fleet of six. These were the SHEBELLE and the GIBE, both 27,400 DWT with a container capacity of 1,377 TEU each. The 1980s built vessels are currently in the process of being replaced by seven new multipurpose vessels of around 28,000 DWT each and a capacity for 1,690 TEU.

ESLSE's Shipping Sector today offers semi-liner break-bulk services to Ethiopia (through the port of Djibouti), from the Arabian Gulf/Indian Sub-Continent, Far East (China, Korea, Japan, Singapore) and the Mediterranean (Turkey/Black Sea). By the end of 2013 the company expects to dispose of a fleet of thirteen multipurpose vessels and two product tankers. ESLSE will then have a total general cargo carrying capacity of 312,550 DWT/16,330 TEU and a tanker deadweight capacity of 84,340 dwt. The seven multipurpose new buildings, of which the remaining two to be delivered in September and December 2013, were bought as replacement of the ageing fleet and the older units may be sold in due course.

After disposal of the older units, ESLSE's fleet will count nine owned multipurpose vessels (seven built in 2012/2013 and two dating from 2006/2007) plus two product tankers (2013), offering a general cargo capacity of about 250,900 DWT/14,630 TEU

and 84,300 DWT for liquids. The multipurpose vessel fleet is supported by a 5,392 TEU container box fleet, of which some 3,834 TEU owned and the remainder leased.

In 2012/13, the owned vessels, carrying break bulk, project cargoes and containers, lifted about 19% of the total of all ESLSE controlled cargoes. ESLSE carries out the third party container transportation through carrier agreements with a number of major container carriers. Organizationally, ESLSE labels this as “slot operation”. This “slot operation”, i.e. third party carriage activity has grown to account for nearly 81% of all fiscal 2011/2012 ESLSE imports.

2.5.4 Challenges and problems

The importance of freight transport for the functioning of both local and global economy is clear but transport volumes are ever growing and the problems of accommodating the freight flows in an efficient and sustainable way is real a challenge. Traffic congestion is rapidly growing; the quality of freight transport couldn't satisfy the ever increasing demand of customers; environmental deterioration, inefficient use of resources, space restrictions and traffic accidents are increasingly acknowledged as serious problems. In light of these problems, there is a great challenge to achieve a breakthrough in the performance of freight transport systems.

The Addis Ababa - Djibouti Corridor is a transport corridor where sea and road modes of transport operation are carried out. Imports and exports from and to Djibouti are transported using long haul trucks. The entry of Ethiopian Shipping Lines (ESL) and Maritime and Transit Services Enterprise (MTSE) into the business will make the activity a multimodal operation with ESL and MTSE as multimodal transport operators.

The ESL will transport commodities from their point of origin by sea and then unload them at an intermediate transshipment point before delivery at the final destination. The intermediate transshipment point in this case will be the port of Djibouti. The final destination will be the Comet- bonded warehouse. The document for taking delivery of the cargo will be the Bill of Lading issued by ESL at the port of loading. In this example, customs formalities at the intermediate points of transshipment could perhaps be avoided, thereby saving time for the inland carrier.

Truck delays are experienced during loading and unloading of goods, particularly at the port of Djibouti, where the truck parking area is inconveniently located away from the cargo stacking port area. The source of the problem is administrative. It is poor cargo traffic management and the low level of the shippers' awareness of the carriers' problem which affects truck productivity.

In general, trucks and tankers operate at low load factors (60 percent for trucks and 50 percent for tankers) due to the foreign trade structure (for dry cargo trucks) and due to the nature of the activity (for tankers). In the case of dry cargo trucks, the fact that the volume of import largely exceeds the volume of export, forces vehicles to travel empty in most of their out bound trips to the port. In the case of tankers, the special nature of the activity makes one-way empty haulage unavoidable.

Some Important Challenges in Road Transport

There is no visible preparedness, in view of Ethiopia's possible World Trade Organization Accession Agreement (in terms of freight transport, maintenance and repair services, storage and warehousing, etc.); and there is an absence of, or inadequate, freight forwarding and cargo consolidation services at strategically located centers. Some important challenges have been identified in the recently completed studies as follows:

Poor Vehicle Productivity

Poor vehicle productivity, which is reduced by the poor road system, enforced traffic delays for customs and other purposes, and the age of the fleet. The system of transport associations reduces competition and vehicle utilization.

Poor Safety

The road safety situation is serious and will become more so. Ethiopia has one of the highest accidents rates, per vehicle-km, in the world. More than half of those killed in roads accidents each year are pedestrians.

Increasing Air Pollution

Pollution is a growing problem in Addis Ababa. Reducing the sulphur content in diesel fuel would follow world trends and is needed to benefit from the more modern and cleaner engine technology in the recently imported vehicles. A project is needed to ensure such change goes smoothly. Looking further ahead, the use of domestic electricity, biomass or natural gas for transport needs to be investigated and implemented over time as opportunities arise.

Need to Consider Transport Fuels for the Future

Petrol (gasoline) and diesel fuel are imported. Ethiopia has no refinery and imports petroleum products from Sudan and from the Middle East through Djibouti. In the next 20 years the price of such products can be expected to continue to rise, either steadily or in step changes. Ethiopia has three opportunities to reduce dependence on oil for transport:

(i) Use the electricity that should become available after 2011 to electrify the main Transport corridors, e.g., trolleybuses, light rail or metro systems in Addis Ababa and other towns, railway electrification when sufficient traffic is being carried to justify this, an urban metro system in the future, etc.

(ii) Use biomass from (for example) the bagasse that is a by-product of sugar production to produce ethanol. This could substitute for up to perhaps 20 percent of petroleum fuels without requiring expensive vehicle modifications.

(iii) Use natural gas, if produced later in the Ogaden (Somali Region) or other regions. Gas could be piped to Addis Ababa and compressed there for use as a transport fuel. A first step could be the introduction of trolleybuses, trams or light rail transit in Addis Ababa.

As there is no transit regime in Djibouti, Ethiopian Customs is clearing cargo directly in Djibouti with inconvenience for Ethiopian small scale companies without sufficient Resources to pay customs duties upfront, resulting in long period before customs clearance. The counterpart result is however a best practice on Djibouti Corridor that there is no road blocks along the corridor meaning that cargo cleared in Djibouti will reach the final destination without any other inspection formality.

2.6 Operation of multimodal and unimodal

2.6.1 Multimodal operation

A multimodal transport operator (MTO) acts as a principal and therefore as a “carrier”, because the MTO contracts with the shipper to carry goods by one or more modes of transport as may be necessary. The MTO has accepted total responsibility and liability to perform the transport contract; it has become the sole interface point for the shipper’s transport function.

1) Components of a multimodal transport system

Origin/Supplier-----Destination/Customer

Physical Base:

Depot, Road/Rail, Terminal, Sea Trunk/Leg, Terminal, Road/Rail, Depot

Commercial System:

Cost & Delivery, Pack, Inland Movement, Papers, Port to Port, Papers, Inland Movement, Unpack, Cost & Delivery

Management & Co-ordination:

Packing, Container Positioning, Inland Movement, Terminal Operations, Ship Stowage, Route Scheduling

Flow of Information:

Booking, Waybill, Invoice, Manifest, Delivery, Instructions, Release of Cargo

Liability Network:

Forwarder, Road, Rail, Terminals, Sea, Forwarder

2) List of typical transport considerations in multimodal

a) Shippers

- 1) Inland Transport complications
- 2) Transit time to terminal
- 3) Transit costs to terminal
- 4) Terminal charges
- 5) Frequency of service of main transport leg
- 6) Transit time of main transport leg
- 7) Costs of main transport leg

b) Consignees

- 1) Terminal charges
- 2) Delay in obtaining inward clearance
- 3) Costs of bonds, etc. at inward clearance point
- 4) Transit costs from terminal to destination
- 5) Transit time from terminal to final destination
- 6) Border delays

Source: Derived from UNCTAD

These two tables actually represent the minimum considerations that must be taken into account by both shippers and consignees, when exporting or importing. By using a MTO, shippers and/or consignees do not have to worry about their cargo as that burden has shifted to the service provider.

3) Typical steps in multimodal transport chain



Figure2. Multimodal Transport chain

4) Relevant Document for multimodal port and customs clearance service operation

Source: ESLSE

- Original bill of lading/5 copies each
- Original commercial invoice/5 copies
- Original packing list/5 copies/
- Original certificate of origin/5 copies/
- Original bank permit/5 copies/
- Insurance /5 copies/
- Endorsed bill/if vessel is not Ethiopian shipping line/5 copie
- Customs clearing agency agreement Signed and Stamped /2copies/

- Freight Payment Request/5 copies/
- Freight Settlement/5 copies/
- Bank Advice /5 copies/
- Forwarding instruction /specified details of service required/2 copies
- Tin, VAT and Trade License certificate/2 copies each/
- Letter from respective Government organization /1 original and 3 copies/

2.6.2 Unimodal Operation

The World Bank measures the time and cost (excluding tariffs, time and cost for sea transport) associated with exporting or importing a standard shipment of goods per sea transport, and the number of documents necessary to complete the transaction. According to the World Bank, it includes procedural requirements such as documentation requirements and procedures at customs authority and other regulatory agencies as well as at the port. They also cover trade logistics, including the time and cost of inland transport to Addis Ababa as the country's largest city.

The import trade involves the movement of materials and finished inventories through a chain of logistical activities. These logistical activities, performed in the course of importing, can be simply viewed in five consecutive stages.

I. Process for ordering goods: concluding sale contracts on CIF/FOB basis, obtaining letter of credit, placing order with the seller and similar functions.

II. Seller firm's activities: receipt of order goods, planning, producing/procuring the goods, storing, obtaining export clearance, land transport and delivery to the carrier.

III. Sea Transport: cargo loading at port of origin, carriage and discharging at destination port.

IV. Port transit: cargo transfer to the warehouse, de-consolidation, inspection and transfer to land transport modes.

V. Inland transit: transport, inspections, storage, customs clearance and delivery.

1) The generale transport chain in unimodal

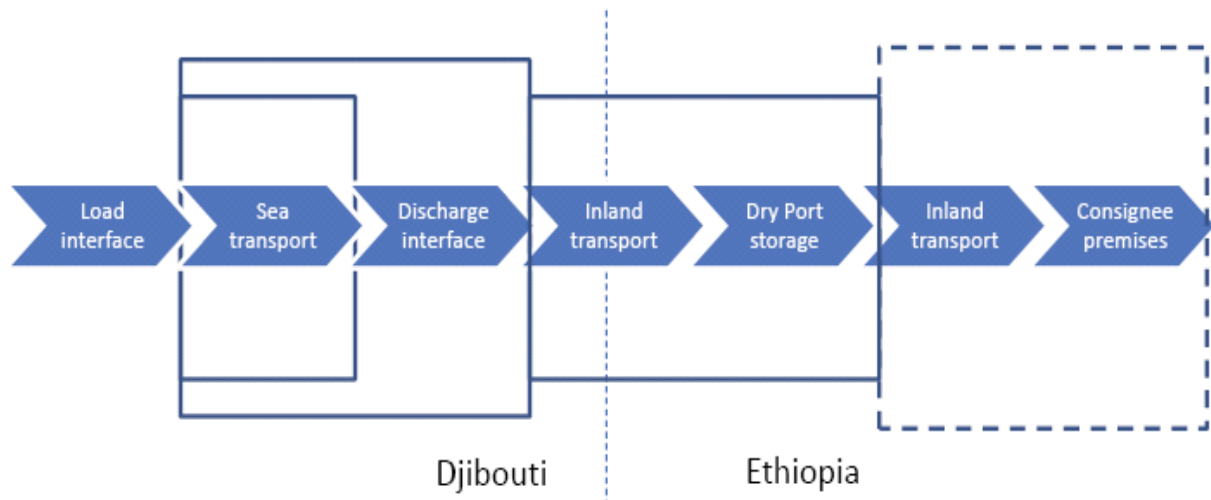


Figure3: Transport chain in unimodal

There are physical as well as non-physical activities in the chain. The physical aspects incorporate warehouses, production facilities, transport modes and cargo handling equipment whereas the non-physical aspects embrace activities such as information flow, administration, management, customs service and related support functions.

2) Document for import operation

Source: ESLSE

- Forwarding instruction /specified details of service required/2 copies
- Original commercial invoice/5 copies
- Original packing list/5 copies/
- 2 Original bill of lading/5 copies each
- Indorsed bill/if vessel is not Ethiopian shipping line/5 copies
- Original bank permit/5 copies/
- Original certificate of origin/5 copies
- Insurance debit note/if not CIP/5 copies/
- Freight invoice & Request /if freight collect/5 copies/
- Settlement/5 copies/
- Debit advice/5 copies/
- Tin Certificate /Tax identification number/2 copies
- Trade license/2 copies/
- VAT registration certificate/2 copies/

- Duty free letter/if applicable/5 copies/
- Donation certificate/if applicable /5 copies/
- Customs clearing agency agreement/2 copies/
- Entry license from road transport authority

3) Documents for export operation

Source: ESLSE

- 5 Original Shipping Instruction(specified details of service required)
- 2 Original invoice for coffee and for others
- Original packing list only for cereals
- Ethiopian standard certificate (For cereals & oil seeds)
- Original bank permit(custom copy)
- copy of bank permit
- copy of TIN certificate /Tax identification number/
- Copy of Trade license/back & front/
- Copy of VAT registration certificate
- Animal guarantee certificate /For livestock & livestock products/ optional
- Certificate of cleanliness /for agricultural products/
- Customs clearing agency agreement

2.7 Benefit

Transport is a critical element of Urban system which in the present scenario is generating a huge pressure on the travel demand and hence, mass transit system is required as effective means for providing better, advanced, efficient and effective mass transit services; However, the efficiency of an effective shall depend on availability of various modes at city and regional level, location and design of nodes, pedestrian flow at transfer station, network structure, line density, stop density, frequency of services and bus routes .

The importance of measuring customer satisfaction for public transport service is apparent, even beyond the more immediate marketing processes; the overall satisfaction levels for the service and its frequency of use seem not correlated for

multimodal travelers; Satisfaction numbers are highest in smaller towns and lower in metropolitan cities.

Connectivity plays a crucial role in multimodal public transit and defines the level of coordination of the transit routes, coverage, schedule, speed, operational capacity, urban form characteristics and is an influential element of the image of any transit network. Access and egress determine importantly the availability of public transportation and should travelers face unrealistic access and egress times public transport trips will be excluded as an alternative compared to unimodal transport alternatives.(7)

Containerized multimodal transportation is the transportation of containerized goods under a single contract but performed with several different modes of transportation (*e.g.* rail, sea, river, air and road), which was developed in the middle of the last century. When considered in terms of ton-kilometers hauled per unit of consumed energy, rail container transportation is more efficient than other means of transportation, especially when hauled over 500 kilometers. Recently, rail container transport has been rapidly developed in China because of its advantage of being energy efficient in long-haul transportation and the environmental benefits that it would bring.

Demands for rail container throughput have been increasing as China seeks to revitalize its northeast and invigorate the vast western region. Opportunities abound in hinterland multimodal container transportation, but nothing there will be easy. Inadequate rail capacity is the main obstacle to setting up a nation-wide integrated multimodal transportation network in China. Both the capacity and management of rail container transportation in China should be upgraded for the development of an efficient nation-wide multimodal transportation system.[1]

2.8 Output of the literature review

- Integrating the various modes of transport for land locked country freight distribution would make the nation's transportation system to be faster and more cost-effective.
- The flows of goods are coordinated across national and global transport nodes and links in order to support the smooth functioning of the global economy.

- The multimodal operator centers cluster firms providing information and communications technology, storage, repacking, labeling, assembling, and container loading services, and are linked by highways to nearby rail, air, and inland water transportation infrastructure.
- Each node found in the route is a transit hub for different transportation modes when it switched the goods from one mode to another mode, it need to spend some time and cost, but total transportation time cannot exceed the scope of delivery time. It hoped to deliver the goods safely, economically, and conveniently through the proper choice of the transportation modes during the agreed period.
- The MTO contracts with the shipper to carry goods by one or more modes of transport as may be necessary. The MTO has accepted total responsibility and liability to perform the transport contract; it has become the sole interface point for the shipper's transport function.
- Components of a multimodal transport system with typical steps in multimodal transport chain and document for import - export operation for multimodal and unimodal.
- Connectivity plays a crucial role in multimodal public transit and defines the level of coordination of the transit routes, coverage, schedule, speed, operational capacity, urban form characteristics and is an influential element of the image of any transit network.
- Recently, rail container transport has been rapidly developed in China because of its advantage of being energy efficient in long-haul transportation and the environmental benefits that it would bring.

Chapter 3 Freight transport in Ethiopian Railway Corporation

3.1 Introduction

In past, Ethiopia has only one narrow-gauge (gauge is 1000mm) railway connecting Addis Ababa and Djibouti Harbour, with the total length of 850km—681km within Ethiopia. The line is jointly owned by the governments of Ethiopia and Djibouti and managed by the Djibouti-Ethiopia Railway Corporation (CDE). The whole railway passes through 32 cities between Addis Ababa and Djibouti, with totally 34 stations, among which Addis Ababa Station, Dire Dawa Station and Djibouti Station are the main stations. The minimum radius of curve of the line is 150m and the maximum longitudinal slope is 27 ‰, with 19 locomotives in internal combustion traction.

The Addis Ababa-Dire Dawa section, due to the serious subgrade subsidence, steel rail deformed as well as being buried by road pavement in certain sections, is dilapidated and out of operation. Despite these defects like aging equipment, poor management, insufficient transport capacity and heavy losses, Dire Dawa - Djibouti section continues to operate but suffers heavy loss.

The proposed project is a railway connecting Addis Ababa and Djibouti, which is the main corridor for passenger and freight transport, and for rapid transport of imported goods from Doharre new port to interior areas. Addis Ababa ~ Djibouti railway is an east-west main trunk railway for the East Africa railway network, which plays an active instructive and illustrative role for building national railway network of Djibouti and Ethiopia and facilitating their railway network. It is shown that the construction scheme of the line is technically feasible, economic and reasonable, and the line should be implemented as soon as possible.

3.2 Feasibility study

The feasibility study proposed for project is a railway connecting Addis Ababa and Djibouti, which is the main corridor for passenger and freight transport, for imported goods from Doharre new port to be quickly sent to interior areas. Addis Ababa-Djibouti railway is an east-west main trunk railway for building the East Africa railway network, which is an active instructive and illustrative for formation of national railway network for Djibouti and Ethiopia and facilitating the railway network of two countries.

The study shows that, with the construction scheme of Addis Ababa-Djibouti railway, the technique is feasible and economic condition is reasonable. It is suggested that the Addis Ababa-Djibouti railway shall be constructed as soon as possible.

Traffic Volumes Design

Based on the predicted results of freight traffic volumes, the designed freight traffic volumes for Initial stage of this line are summarized as follows:

Forecast Fright Traffic volume for Initial stage		
Section	Direction	Fright flow in(tons)
Indode -Adama	up-Direction	410×10^4
	down-Direction	142×10^4
Adama-Awash	up-Direction	439×10^4
	down-Direction	136×10^4
Awash-Diredawa	up-Direction	456×10^4
	down-Direction	144×10^4
Diredawa-Djibouti	up-Direction	479×10^4
	down-Direction	148×10^4

Table 1: Forecast initial freight volume

Note: The up direction of freight transportation (Djibouti -Addis Ababa) is the direction of loaded cars.

Source: Feasibility study

3.3 Discussion of feasibility study

The feasibility study covers most of the requirement designed for new railway in the route of Addis Ababa-Djibouti but the study was not consider the transportation method that is needed by railway and customer. The basic required transportation in the selected route is the multimodal transport system.

Most of the study covers as follow:

Major technical standards of the designed railway would be seen. Based on the predicted results of freight traffic volumes, the designed freight traffic volumes for initial stage, short stage and long stage is stated. Pick-up and drop trains shall be organized to digest local freight transportation along the line. Freight trains shall adopt electric-power dual-locomotive traction, with a traction mass of 3500t. If traffic demand

further increases, it can be considered to build a second line along the single track section, using automatic block for the whole line. The passing capacity of the railway will be largely increased, which can satisfy 2 to 3 times of the anticipated traffic demand in long-term stage.

20 new stations and a port marshaling yard shall be constructed along the whole line in the initial stage. 1passenger station, 1harbor station, 1frontier checkpoint, 10intermediate stations, 7passing stations are included. Locomotive configuration is according to the designed locomotive routing and transport demand of this line. SS4 type electric locomotive are used for freight locomotive. They are equipped in INDODE locomotive depot, 32 sets in the initial stage, increased by 14 sets in short term and increased by 54 sets in long term (than short term).

Type of Freight vehicles are mainly box car, gondola car, tank car and container flat car, which are equipped with 1100 sets in the initial stage, increased by 900 sets in the short term and 2300 sets in the long term (than short term). Communication is based on capacity selection of communication line and selection of main communication equipment. The signaling system of Sebeta-Nagad Railway includes blocking system and computer interlocking system.

The freight transport management system is designed according to center-station two-level system. Set freight transport management information system center-level equipment in dispatching center and set freight transport management information system station terminal equipment at each freight transport station along the freight transport operating line. Transportation price rate due to the lacking of market investigation for freight price of Ethiopian roads and railways, the evaluation follows the condition of Ethiopian Railway cooperation and the local fact, the financial evaluation is calculated at basic freight price of 0.046 USD /ton-km.

3.4 Future direction

In the future there is not a transportation problem because the new railway start to operate in single mode of transport, in the next, railway will operator of multimodal transportation, therefor problem of transport is eliminate and users initiate to Importing and Exporting Goods.

In the future Railway has not a problem of implementing Multimodal transport system because the customer is already knows the advantage of it as mentioned before in ESLSE. The estimated freight in table 4 states that market is available in the coming 5 years, also the feasibility study describe that most of the requirements to implement multimodal operation is fulfilled. Therefore with in some additional requirement, implementing the operation of multimodal is not difficult. In this study multimodal operation is include both Importing and exporting goods.

Estimated freight in the coming 15 years

Railway			
Year`	Estimated freight(Mil tons)	Domestic freight (50%)	Total Freight
2015	4.68	2.34	7.02
2018	7.58	3.79	11.37
2020	10.44	5.22	15.66
2025	14.23	7.11	21.34
2030	19.8	9.9	29.7

Table 2: Estimated freight

Source: Salient Features and Technical Specification

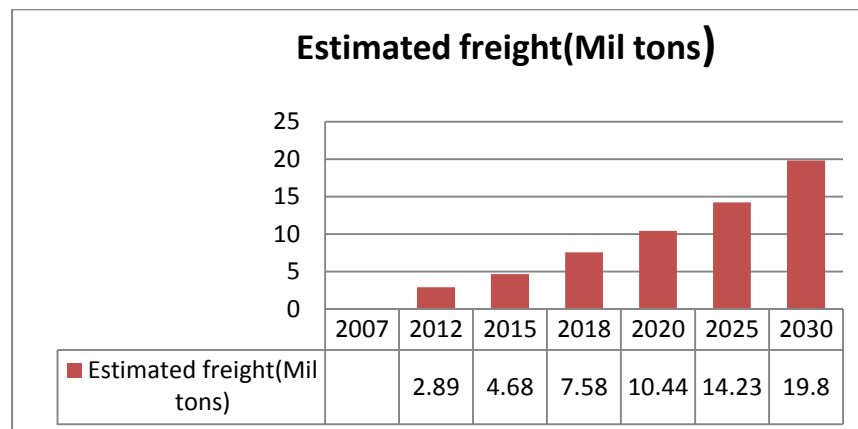


Figure 4: Estimated freight in coming 15years

The feasibility study describe that, the parameters even in the initial stage is fulfill to implement multimodal operation for Railway Corporation. Let see one of the method to indicate performance of the railway and its market availability.

Example

The data is taken from feasibility study

Given

Initial stage of Import Goods = $479 \times 10^4 \text{t}$ (Table 3)

Initial stage of Export Goods =148x10⁴t (Table 3)

The traction power of the freight train =3500t

Freight vehicles in initial stage =1100sets

Wagon capacity =40t

Assumption

Transportation days =360days/year

The traction power of the freight train (75% of 3500)=2625t

Where: t=tone

Solution

Import goods per day:

$$(479 \times 10^4 / 360) = \mathbf{13305.5t/day}$$

Export goods per day

$$(148 \times 10^4 / 360) = \mathbf{4111t/day}$$

Total freight transport = **17416.6t/day**

The trips required to take the import goods (9972t/day)

$$=13305.5/2625$$

5trips/day is required

The trips required to take the Export goods (3083t/day)

$$=3083/2625$$

2trip/day is required

The wagon required for one trip is:

$$=2625/40$$

66wagon/trip

Daily wagon requirement will be:

$$\text{Import } 5 \times 66 = \mathbf{330}$$

$$\text{Export } 2 \times 66 = \mathbf{132}$$

Total =462wagons/day

In the feasibility study type of Freight vehicles are box car, gondola car, tank car and container flat car, which are equipped with 1100 sets in the initial stage.

Out of 1100wagons, 462wagons are daily required to take the goods as indicated above. Therefore neither ERC uses the multimodal transport system nor unimodal transport system initially 462wagons/day requires. But in future Railway is enough performance to implementing the multimodal operation because 638 wagons will be as a reserve.

Chapter 4: Development of the Multimodal Transport Industry in Ethiopia

4.1 Introduction

The developments in the multimodal transport industry are regarded as of critical interest to the future development of the freight road transport industry in Ethiopia. Without a full understanding of these multimodal developments, it would be difficult to make a detailed program for the development of the international road freight transport industry.

International multimodal transport covers the door-to-door movement of goods under the responsibility of a single transport operator. The concept of multimodal transport was developed with the container revolution initiated in the late 1950s. The coming of the container technology and the multimodal transport concept facilitated international trade. Trade and transport are inextricably linked i.e., efficient transport services are a pre-requisite to successful trading.

International transport generally implies the use of various modes of transport and interfaces, each mode and interface corresponding to a transfer, storage or transport operation either in the country of origin, in a transit country or in the country of the final destination. This situation has created a number of problems over the years, as more and more shippers realize that this new concept involves the effective participation of various modes of transport operators, but it does not always make clear as to who is responsible for delivering cargo at destinations in a safe condition, according to agreed schedules.

Considering the variety of cultures, languages and commercial practices at both ends of a trade and the resulting complexities of assembling such an international transport operation, it would appear reasonable to a trader to let one qualified operator organize and be responsible and accountable for the entire chain of transport.

Multimodal transport implies the safe and efficient movement of goods where the multimodal operator accepts the corresponding responsibility from door to door. With technological development of transport operations, as well as communications, coupled with liberalization in the provision of services, more and more transport operators are now able to provide safe and efficient transport. Against this background and as

proposed by a study made by the Ministry of Transport and Communications, moving towards this advance system of operation is considered imperative.

Main Issues are Ethiopia's main transport route is between Addis Ababa and Djibouti via Adama and Awash. There are also secondary goods flows from Djibouti to other main centers such as Kombolcha and Mekele, and between Addis Ababa and other main towns.

4.2 Implementation of multimodal in ESLSE

The multimodal regime (Proclamation N.548/2007), or FOB directive, makes it easier to transport cargo from the seaport to a dry port in Ethiopia or vice versa. Ethiopian shippers and consignees are obliged by law to make use of a MTO (multi transport operator), which is ESLSE. The directive is applicable to containers and vehicles up to 3 tons and guarantees ESLSE a continuous flow of shipments.

As a rule of thumb the more aggregate the cargo flows, the more options are available in developing smart logistics. Whilst on the tariff side it is easier to become competitive. Nevertheless in general terms multimodal transport is the movement of one unit load from origin to destination by more than one mode of transport under one document without breaking up the unit load. Whether this document is through bill of lading or a multimodal bill of lading is not completely clear.

A "multimodal transport bill of lading" is a bill of lading involving both sea and other transport modes but, with different carriers involved at each stage, e.g. another shipping company, a road haulier, a railway company, an air transport company, an inland shipping company, etc. The multimodal transport bill of lading is issued by the sea carrier and he states that he will be responsible for the goods during the entire period of transport. However, when containers are shipped by a third party container carrier, then ESLSE is not the sea carrier.

The through bill of lading is virtually identical to the multimodal transport bill of lading with one major difference: the MTO takes responsibility during the entire transport. The through bill of lading is issued by the sea carrier, but only takes responsibility for that part of the transport he takes care of, thus the sea leg. The multimodal transport bill of

lading is send directly to the final place of destination of the goods and can be issued as a negotiable bill of lading or as a non-negotiable bill of lading.

Naturally there also issues, which are not in favor for a multimodal transport bill of lading. For instance shippers/ or consignees do not have much control over what is happening in the transport chain and with that one contact, they may get information at a later stage especially when problems occur.

ESLSE does not offer door-to-door services, which is covered by a combined transport bill of lading. Door-to-door services are usually used by liner companies, like APL, Maersk and NYK, with the aim to strengthen business relationships by offering a full service to their customers and to penetrate into land logistics. Combined transport is the combination of at least two types of transport in a uniform transport chain that does not involve the changing of transport units thus containers. Door-door services are known as carrier haulage, where the container carrier is responsible for either the pre-carriage before the sea transport, or on-carriage after the sea transport, or both.

The goods are either discharged or loaded at the consignee or shipper premises under control of the container carrier. Now goods are claimed or delivered at a dry port, while the consignee or shipper is responsible for the leg between its premises and the dry port. The last leg can be of interest for ESLSE. This service can be offered as a forwarding activity. The last leg is of importance for ESLSE as it opens opportunities to combine transports and to reduce empty mileage. As a landlocked developing country the number of containers being imported exceeds the number of containers being exported.

The imbalance in trade is at the disadvantage of trucks because of the empty leg to Djibouti. Empty legs give a price increase. Although there a continuous flow of trucks driving up and down between Djibouti and, mainly, Modjo Dry Port, any extra trip along this line will generate extra income for ESLSE. Additional services like warehousing and distribution increase the chance to develop transport. Also the development of industrial corridors along the main transport routes to Djibouti, Sudan, and Kenya may help to get an increase in domestic transport activities.

For Five years Imported Goods in shipping line by container in TEU transported by multimodal & unimodal.

year	Transporting with shipping	Transporting with multimodal	Transporting with unimodal
2002	97,931	12,337	85,594
2003	93,091	12,216	80,875
2004	128,476	27,084	101,392
2005	117,238	67,389	49,849
2006	130,638	88,559	42,079

Table3: Amount of Multimodal & unimodal transport.

Source: ESLSE

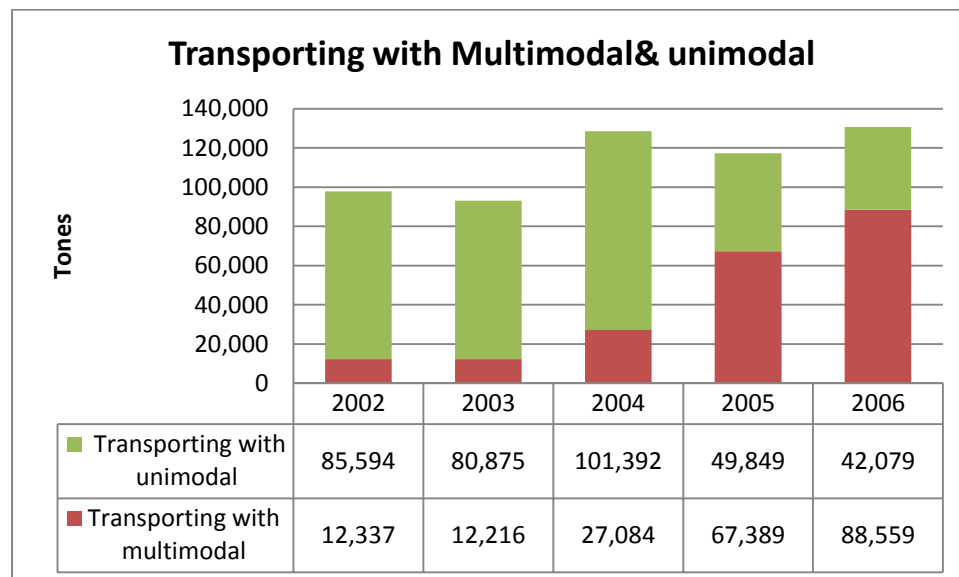


Figure 5: Transporting with Multimodal & unimodal

For five year amount of Imported Goods in shipping line transported by container in multimodal & unimodal, shows in Table2. In 2002 & 2003 the imported goods by multimodal is 13%, then in 2004 increased by 8% and reaches 21%. In 2005 & 2006 there is radically change and reaches 58% & 68% respectively. Therefore the Imported Goods for the past five year indicates that the multimodal operation awareness by customer is increased and also the profitability of the operator is increased as well. Especially, the past three year selection of multimodal operator over uni-modal is increased.

Major Import and Export Goods in the past 5 year

Major Imported & Exported Goods	Year	2008/09	2009/10	2010/11	2011/12	2012/13
Major Imported	Value(Birr)	131,730,182.55	168,077,608.05	196,594,767.15	295,208,390.40	302,705,435.78
	Quantity (metric tons)	6,418,566	7,237,466	4,529,345	6,940,603	5,553,814
Major Exported	Value(Birr)	11,413,314.68	19,586,479.43	33,394,173.75	40,871,075.48	42,092,693.78
	Quantity (metric tons)	563,615.64	745,717.61	834,269.93	893,040.23	935,657.33

Table 4: Major import & Export Goods Value and quantity

Source: National Bank of Ethiopian

In the National bank my survey is basically gain the value & quantity of total imported & exported Goods in the route of Addis Ababa to Djibouti. Even though the data in the bank having of the total sum of imported & exported Goods found in all ports of Ethiopia. Most of the Goods imported & exported in the port of Djibouti in average of 75%. So I took the 75% of all imported & exported goods for the past five year.

4.3 Choosing Multimodal transport over unimodal transport

Choosing multimodal transport over uni-modal transport has some very practical advantages. Not only does it in some situations save time and minimize transportation days by multimodal ship and transcontinental rail carriage, as opposed to all water route it may also save money and the environment. On the whole multimodal transport costs less, offers the opportunity to incorporate less polluting modes of transport into the transport chain and may save time.

Taylor claims that multimodal carriage, also known as intermodal carriage, is the key to increasing the productivity and competitiveness of the freight transport industry as a whole, while maintaining the environmental balance. This is because effective multimodal transport ensures the use of the most efficient mode of transport at each stage, thus reducing congestion, energy expenditure and pollution. In addition to these practical benefits however, there are also several legal reasons that can be named as to

why a shipper or a freight forwarder would conclude a multimodal carriage contract instead of contracting with separate carriers for each transport stage.

Firstly, contracting separately means more separate arrangements have to be made. Secondly, the shipper then has to arrange for the goods to be at the right place and at the right time for each of the contracted transport stages himself or by means of an ancillary. Thirdly, he has to arrange for the goods to be stored between the different segments of the transport if the segments do not fit seamlessly together. Under a multimodal transport contract it is the multimodal carrier who provides for the storage between stages. Since the multimodal carrier has more pull in these circles, is often better connected than the shipper and is able to influence the transport itinerary it is likely that the storage will thus be cheaper and more efficient. A fourth argument is that every carrier issues his own type of transport document. Whereas a bill of lading issued for a sea carriage segment is generally negotiable, the consignment notes issued by road carriers are not.

These differences tend to create difficulties for the buyer of the cargo when he attempts to acquire a documentary credit from a bank. And the fifth and last reason mentioned here is that the pool of individual counterparties the shipper has to deal with in unimodal carriage may cause difficulties in case the cargo is damaged en route. Especially if it proves impossible to discover at which stage of the transport the damage occurred. In such a case each carrier will be tempted to decline liability if he can, and the claimant or his insurer could well be left to bear the loss.

It is therefore useful to contract with a single multimodal carrier, since even if the exact stage where the loss occurred cannot be identified, at least it is clear which party can be held responsible under the contract of carriage. Considering the variety of cultures, languages and commercial practices at both ends of a trade transaction and the resulting complexity of assembling such an international transport operation, it is likely to appear reasonable to a trader to let one qualified operator organize and be responsible and accountable for the entire transport chain. The carriers in turn have developed transport systems over the years in order to fulfill their customers' requirements, offering competitive services.

They endeavor to make trade more efficient by offering multimodal transport services to their clients. At present the carriage business seems to be a buyer's market; the form in which carriage contracts are molded is evidently dominated by the demands of the shipper. But not only had the carriers seen themselves obligated to provide their customers with a different sort of contract, freight forwarders found themselves in the same position. The trend to provide a single contract for carriage by several transport modes coincides with the introduction of documents by freight forwarders which burdened them with the more onerous liability of a carrier instead of the liability of a freight forwarder. Market demands simply put more and more pressure on them to accept carrier liability for their services.

4.3.1 Characteristics of Unimodal and multimodal transportation Cost

1) PORT TRANSIT SERVICE

I. Ship-port interface

Cargo bound for Djibouti and destined for the Ethiopian hinterland can be broadly grouped into dry bulk, liquid bulk and general cargo. The general cargo is transported in break-bulk (BBK), mostly palletized, and in containers.

Terminal handling charges (THC) at loading ports that include costs for unloading cargo from the shippers' trucks, stowing in storage areas or warehouses, loading on to trucks or trailers and forwarding to shipside under-hook are to the account of the shippers. The THC at Djibouti that covers costs for transferring cargo from shipside to storage area/warehouse or container yard is also to the account of the consignees directly payable to the port. THC is separate from ocean freight at both ends.

II. Cargo Handling and Port Tariffs

Once the cargo has reached the port, various tariffs and handling costs begin to apply. The import transit general cargo handling activities and tariffs are grouped as following:

- Cargo manifests delivery
- Marine activities/charges
- Cargo/container discharge from hold to deck under hook
- Cargo/container transfer to alongside quay, truck or rail wagon
- Cargo/container transfer to stacking area within terminal, stacking and handing over
- Tallying of cargo
- Open/warehouse storage

- Un-stuffing/stripping of containers
- Inspection of cargo
- Transfer of cargo/containers to Djibouti Dry Port (DDP)
- Transfer of cargo to trucks for inland transport

The discharged containers and general cargo are transferred to terminal and storage areas, except for dangerous and hazardous cargo, which is delivered directly to trucks for inland transport. The direct delivery cargo accounts for much less than 1% of the imports. The containers and general cargo destined for Ethiopia are accorded a 30-day grace period (in 2005 the grace period has been reduced to 10 days only) within which storage charges are not applicable.

The port tariff for import transit cargo through Djibouti for 20" TEU is 10.235USD/unit or 0.9USD/ton/day.

III. Cargo Dwell Time

In this section, some questions relating to the turnover of import cargo through Djibouti will be raised. How long does the cargo stay in Djibouti before it is transited to its final destination? What factors govern its duration of stay in Djibouti? A sample of 465 consignments from imported general cargo lifted by MTSE during Quarter III of 2003/04 was randomly selected and an exercise performed to establish the port transit time. The findings are stated as follows:

- The average dwell time of consignments in Djibouti was 41.4 days with a standard deviation of 24 days.
- 42.6% of the consignments were lifted within the period of grace, which was less than 30 days.
- 57.4 % of the consignments were lifted after 30 days.
- Only 9% of the consignments were lifted within 10 days.

The results are representative of the dwell time of consignments in Djibouti Port.

The findings indicate that any general cargo consignment arriving in the port has a 57.4% probability to dwell for longer than 30 days. Furthermore, any cargo arriving in Djibouti over an extended period of time may not be transited from the port on average for more than 40 days.

There are a number of activities that take time and contribute to the extended dwell time of cargo in Djibouti. Such time taking activities include:

- Completing bank formalities and collection of documents by consignees

- Settling of freights with carriers
- Lodging documents with the Ethiopian Customs
- Obtaining transit permit from Ethiopian Customs
- Forwarding of transit permits to Djibouti
- Arranging transport and entering into contract with operators in Ethiopia
- Inspecting of cargo by the Ethiopian Customs in Djibouti
- Processing customs formalities to release cargo
- Stripping of containers
- Settling port dues and charges

Arrangements for direct delivery for certain cargo types, particularly dangerous goods, are in place but the quantity is very limited. The activities themselves are numerous and they are further slowed by a number of factors such as inefficiency, cumbersome procedures, excessive documentation, communication system power interruption in Djibouti and the dependence on manual methods of work.

2) INLAND TRANSIT SERVICE

I Transport Performance and Tariffs

The inland transport forms one of the important segments in the entire logistics chain necessary for the flow of the import trade. According to recent studies conducted under the sponsorship of the Ministry of Revenue of the FDRE (2003, p.4), 85 % of the cargo is destined for Addis Ababa and about 300 trucks enter the Ethiopian border on a daily basis through the border town of Galafi. The journey to Addis Ababa is 925 km by road through Galafi and 781 km by rail. A truck-trailer on average carries 30 tons of cargo and the Addis Ababa-Djibouti-Addis Ababa round trip takes a minimum of seven days. The passage time is three days each way with one-day waiting time. The drivers normally do not travel at night and rest sometime between 2000 and 4000 hours, and have to stop at a number of customs posts. The effective available travel time is, therefore, much less than 16 hours per day. The way to Addis Ababa is a tarmac road and passes through open plains except in a few locations where the terrain is winding and mountainous. More than two-thirds of the way is in an arid zone with temperatures ranging above thirty degrees centigrade. The roads leading to other destinations are of lower grade or patchy.

The working conditions of the drivers have an impact on the transport performance. One driver and an assistant are assigned for each truck in most cases. They have to obtain an entry permit and license from the Government of Djibouti, which as such is not difficult. The working hours of the truck drivers are not particularly strictly controlled by national law or otherwise. The dotted towns on the way provide few facilities due to the low development in the region and the drivers are not able to get adequate facilities where they can take a proper rest at affordable prices. They are seriously exposed to fatigue and weariness.

Availability of technical assistance in the event of a breakdown of the trucks during passage is not adequate either. The drivers are not equipped with the necessary training or tools and spare parts to take care of even simple forms of breakdowns, nor are mobile garages available/accessible to the drivers. In the event that breakdowns do occur, the drivers will have to wait until technical assistance is made available. When such breakdowns occur in the remote part of the Corridor, it may take days to avail the technical assistance.

II Customs Transit and Clearance Services

The Ethiopian Customs Authority has control over the import trade at three levels: at Djibouti, during inland transit and at destination. The Customs Branch office in Djibouti issues a transit permit upon receipt of a transit order from a relevant customs authority in Ethiopia for the cargo to be transported to an inland destination. According to a customs study paper on the application of through bill of lading the consignee's freight forwarder has to produce the documents listed below to the customs in order to initiate the release of the transit order to Djibouti Customs Branch.

- Customs declaration
- Commercial invoice
- Bank import permit
- Receipt for customs duty paid or deposited

The freight forwarder's counterpart in Djibouti will receive other document, such as cargo release notes from the carriers, and finalizes all the necessary formalities for the driver to load and depart. The clearance will then be completed when the freight forwarder arranges duty payment and submits a number of documents according to the Customs Manual

These are: Bill of lading, Commercial invoice, Ocean freight invoice, Invoice for insurance cover of cargo, Pre-shipment inspection certificate, Packing list, Certificate of origin, Bank CPO or receipt for duty payment

The entire clearance process on average takes up to five working days. The time taken to process the customs clearance of goods plays a significant part in the overall efficiency of any logistics chain. Speedy customs clearance of goods facilitates the flow of the import trade. This is the major reason why there have been innovations to apply new technology to cut customs delays.

III. Inland Warehousing and Tariffs

The holding costs refer to the cost of tied-up capital in goods and the storage charges refer to warehousing/storage service costs.

Inland Warehouse tariffs

Items	Unit	Unit price
Storage service	1-10 days	1.33USD/ton/day
	11-20 days	2.66USD/ton/day
	21-30 days	3.97USD/ton/day
	>30 days	5.33USD/ton/day
Labour charge	Ton	5.33USD/ton
Infrastructure charge	Ton	0.13USD
Marking	Consignment	2.67USD

Table 5: Inland Warehouse tariffs

Source: Custom, Warehouse tariffs

There is also an insurance cost and 15% VAT added to the tariffs given in Table above. The average storage time depends on the efficiency of the customs clearance process.

3) Total cost

I. In-transit Inventory Cost in Port(h1u and h1m)

The general cargo import trade is facilitated mainly through outbound logistics in the supply chain. Identification of the in-transit inventory costs in the nodes and link of the Corridor becomes necessary in order to establish whether competitive advantages or disadvantages are created to the importers.

The import trade is financed through lending arrangements by Ethiopian National banks. The banks finance up to 70% of the cost of the seaborne import trade conducted through approved sale contracts. According to the National Bank of Ethiopia (2003/04),

the average market lending interest rate for the period in review was 10.5%. The useful lifetime of the product determines the depreciation cost and in Ethiopia the straight-line depreciation method, with rates varying from 5% to 20%, is widely used but for this purpose an average depreciation rate of 10% with zero residual value is considered.

Take the assumption of the current Weight, value and unit price by increasing before 10 years data in 20%. The Table below gives the major origins of total metric tons of general cargo and a price of USD in million and forms by volume and value of the total imported seaborne trade within the six months period.

The Volume and value of major Country and origins for Ethiopia

Origin	Weight (tons)	Weight increased by 20%	Value (M USD)	value increased by 20%	Average Unit Price (USD/ton)	Unit Price increased by 20%
India	98762	118514	74.42	89.304	753.5	904.2
China	84036	100843	168.43	202.116	2004.3	2405.16
EU	70598	84717.6	231	277.2	3272	3926.4
USA	68641	82369.2	47.73	57.276	695.3	834.36
Turkey	68997	82796.4	41.5	49.8	601.3	721.56
ASEAN	61144	73372.8	51.81	62.172	847.3	1016.76
South Korea	25371	30445.2	25.42	30.504	1001.7	1202.04
Saudi Arabia	17168	20601.6	14.9	17.88	866.9	1040.28
Ukraine	15775	18930	8.1	9.72	511.4	613.68
Japan	12601	15121.2	122.52	147.024	9722.5	11667
Egypt	12254	14704.8	10.55	12.66	860.8	1032.96
Iran	11182	13418.4	5.53	6.636	484.8	581.76
UAE	10177	12212.4	8.97	10.764	880.9	1057.08
Total/Average	556706	668047	810.79	972.948	1456.4	1747.68

Table6: Volume and value of major Country

Source: Sorted from Ethiopian customs data

II. Handling Costs in Port(h2u and h2m)

The costs that evolve from cargo handling activities in Djibouti depend on many factors. The charges are not as such directly linked to the length of time the cargo dwells in the port area but anyhow time has an effect as well. Consider for instance the lifting of cargo within the grace period; failure to lift it within this period entails cargo transfer charges

that count towards handling costs. The consignee's decision to transport cargo in containers without the need to strip at Djibouti is also another factor that has a bearing on the handling costs.

THC is a cost covering the transfer of the container from the hook to the stacking area and is for the account of the consignees.

There are other costs such as delivery order charges that comprise a number of costs related to administration, documentation, communication and other services not considered here.

Handling cost per unit in Djibouti

Operation	Tariffs USD/TEU	Tariffs USD/TON
Landing charge –hook to stacking	453.56	40.14
Transfer to DDP	297.16	26.3
Delivery to stripping area	83.95	7.43
Stripping	258.52	22.88
Port dues	103.5	9.16
Total	1196.69	105.9

Table7: Handling cost

Source: Djibouti Port tariffs

III. Inland Logistical Costs

The inland transit activities commence with the departure of loaded trucks from Djibouti and end with the removal of goods from the customs clearing stations. Customs, freight forwarders, consignees, transport companies and banks are the conspicuous actors in the inland transit service. The major costs associated with this leg are:

- Inland freight/transportation cost
- In-transit inventory cost
- Handling costs

The inland freight rates(h3u=h3m) in shipping line are not constant and it is depend up on type, quantity, property of goods etc. but the rate are taken from shipping line that in the year of 2014 container transporting rate. The consignee when making transport decisions has very little choice of modalities, as trucks are the dominant means for the carriage of goods.

The in-transit inventory cost (h4u and h4m) during transportation consists of the interest cost, insurance and depreciation cost but excludes the warehouse cost. The inventory cost during customs clearance will, of course, include the warehousing cost. The total time is three days for transportation plus five days for clearing.

The average inland in-transit inventory cost (h5u) per ton of break bulk cargo is greater than that of container about USD 19.32. The handling costs (h5u) of container cargo in the customs clearing areas are mostly limited to labor expenses for unloading/loading. But in multimodal this cost is excluded.

Freight Sea cost (h6u=h6m)

The transportation of sea freight cost for some country

The Freight destination is Djibouti	
Origin	cost usd/ton
Japanese ports	156
Chinese ports	85
Gulf/Indian ports	49

Table 8: Sea freight cost of some country

Notations and data

h1u=port in-transit inventory carrying cost of a unimodal in ton of containerized cargo

h1m=port in-transit inventory carrying cost of a multimodal in ton of containerized cargo

Xi = variables or inventory cost components

V= average value of per ton of general cargo.

Average unit values of goods (V) = USD1747.68 (Table6)

Average dwell time in port of a unimodal (t) = 41.4 days (Section 1 under III)

Average dwell time in port of a multimodal (t) =10 days (Maximum dwell time)

Average warehousing tariff =USD 0.9/ton/day (=10.24/11.3) (Section 1 under II)

Average bank lending interest rate= 10.5% (Section 3 under I)

Depreciation=10% (Section 3 under I)

Bank Lending=70% (Section 3 under I)

h2u= handling cost of unimodal

h2m=handling cost of multimodal

h3u=the inland freight rates of unimodal

h3m= the inland freight rates of multimodal

h4u= the in-transit inventory cost of a unimodal

h4m= the in-transit inventory cost of a multimodal

h5u= the handling costs of labor expenses for unloading/loading in a unimodal

h6u=fright sea cost of unimodal

h6m=fright sea cost of multimodal

h7u= pays for transit services of unimodal

h7m=Administration, communication and Documentation cost of multimodal

Uc=unimodal cost

Mc=multimodal cost

McR=multimodal cost of Railway

4.3.2 Cost analysis of unimodal

➤ In-transit Inventory Cost in Port(h1u)

Calculate

h1u= interest on capital (X1) + depreciation cost (X2) + warehousing cost (X3)

$X1 = 0.7 \times \text{unit value of goods} \times 0.105 \times \text{average dwell time in port}/365\text{days}$

$X2 = 0.1 \times \text{unit value of goods} \times \text{average dwell time in port}/365 \text{ days}$

$X3 = \text{storage tariff} \times (\text{average dwell time-grace period}) \text{ days in port}$

h1u= $X1+X2+X3$

= $0.00834V + 0.0113V + (0.9 \times 11.4)$

h1u= $14.57+19.74+10.26$

h1u=**44.57USD/TON**

➤ Handling cost(h2u)

The total handling cost of USD 1196.69 per TEU shown in Table7 covers the main expenses. The cost per ton after the container is stripped equals USD 105.9.

Finally the charge for loading on trucks/wagons is USD 12.88 making the total per ton handling cost USD **118.78**. The cost per ton is denoted as **h2u=118.78USD/TON**.

➤ The inland freight rates(h3u)

h3u=**56.85 USD/TON**

➤ The in-transit inventory cost(h4u)

$$h4u = (0.7 \times 0.105 \times V \times 8/365) + (0.1 \times V \times 8/365) + (5 \times 1.334)$$

$$h4u = 0.0016V + 0.0022V + 6.64$$

For an aggregated average value of USD1747.68 per ton of cargo,

$$h4u = 2.79 + 3.84 + 6.64 = 13.27$$

➤ **The average inland in-transit inventory cost(h5u)**

$$h5u = \text{USD } 5.29 \times 1.15 = \text{USD } 6.08 \text{ including 15\% VAT}$$

➤ **Freight Sea cost(h6u)**

Take the Chinese port of freight sea cost $h6u = 85 \text{ USD/ton}$

➤ The sub total cost for unimodal transportation becomes:

$$Uc = h1u + h2u + h3u + h4u + h5u + h6u \\ = 324.53 \text{ USD/TON}$$

➤ **Pays for transit services (h7u)**

The overall fees charged are estimated to fall approximately 3% - 5% of the total cost that an exporter or importer pays for transit services. Take 4%

$$h7u = 324.53 \times 4\% = 12.98 \text{ USD/TON}$$

Total cost/ton in the Corridor (USD)

Cost type	h1u	h2u	h3u	h4u	h5u	h6u	h7u	Total
USD/ ton	44.57	118.78	56.85	13.27	6.08	85	12.98	337.53

The major logistics costs along the Corridor are composed of five groups:

- In-transit inventory cost
- Handling cost
- Transportation cost
- The freight sea cost
- The transit services

The breakdown of the total logistics costs per ton through the Corridor is as follows:

1. In-transit inventory cost is $h1 = h1u + h4u = 44.55 + 13.27 = 57.82 \text{ USD/ton}$ or 17% (57.82/337.5) of the total logistics cost.
2. The handling cost is $h2 = h2u + h5u = 118.78 + 6.08 = 124.86 \text{ USD/ton}$ or 40% of the total cost.
3. The inland freight cost is $h3u = 56.85 \text{ USD/ton}$ or 16.8% of the total cost.

4. The sea freight cost for Chinese port is **h6u= 85usd/ton or 25%** of the total cost.
5. The pays for transit services is **h7u=12.98 USD/ton** or 3.8% of the total cost.

Total cost of unimodal becomes:

$$U_c = [h1u + h2u + h3u + h4u + h5u + h6u + h7u] \text{ or } [h1 + h2 + h3u + h6u + h7u]$$

$$= 57.82 + 124.86 + 56.85 + 85 + 12.98$$

$$U_c = 337.5 \text{ USD/TON} \dots\dots\dots (1)$$

4.3.3 Cost Analysis of Multimodal Operation

➤ In-transit Inventory Cost in Port(h1m)

Calculate

$h1m = \text{interest on capital (X1) + depreciation cost (X2) + warehousing cost (X3)}$

$X1 = 0.7 \times \text{unit value of goods} \times 0.105 \times \text{average dwell time in port}/365 \text{ days}$

$X2 = 0.1 \times \text{unit value of goods} \times \text{average dwell time in port}/365 \text{ days}$

$X3 = 0$, because in multimodal operation there is no need of warehousing

$$h1m = x1 + x2 = 0.002V + 0.0027V$$

$$h1m = 3.5 + 4.79 = 8.28 \text{ USD/TON}$$

- #### ➤ Handling Costs in Port(h2m) and The inland freight rates(h3m) is the same as that of unimodal:

$$h2m = 118.78 \text{ and } h3m = \text{USD } 56.85$$

➤ The in-transit inventory cost (h4m)

During transportation consists of the interest cost, insurance and depreciation cost but excludes the warehouse cost. The time is Three days for transportation.

$$h4m = (0.7 \times 0.105 \times V \times 1/365) + (0.1 \times V \times 3/365)$$

$$= 0.0002V + 0.00027V$$

For an aggregated average value of USD1747.68 per ton of cargo,

$$h4m = 0.35 + 0.48 = 0.83 \text{ USD/TON}$$

- #### ➤ Labor expenses for unloading/loading **h5m=0**. because in multimodal operation there is no need of Labor expenses

➤ sea freight cost(h6m)

The transportation of sea freight cost for some country is shown in table 8. Take the Chinese port of fright sea cost **h6m=85usd/ton**

- #### ➤ Other costs, Administration, communication and Documentation cost(h7m)

Administration: 12.75USD/document

Communication: 21.76USD/document

Documentation: 28.4USD/document

Subtotal: $12.75 + 21.76 + 28.4 = 62.91$ USD/document, but this is by TEU=11.3TON

For one ton: **$h7m = 62.91 / 11.3 = 5.56$ USD/TON**

Total cost/ton in the Corridor (USD)

Cost type	h1m	h2m	h3m	h4m	h5m	h6m	h7m	Total
USD/ ton	8.28	118.78	56.85	0.83	0	85	5.56	275.3

The major multimodal costs are composed of the following groups:

- In-transit inventory cost
- Handling cost
- Transportation cost
- The transportation of sea freight cost
- Administration, communication and Documentation cost

The breakdown of the total Multimodal costs per ton through the Corridor is as follows:

1. In-transit inventory cost (inventory carrying cost) **$h1 = h1m + h4m$**
 $h1 = 8.28 + 0.83 = 9.11$ or 3% ($9.11 / 275.3$) of the total cost.
2. The handling cost is **$h2 = h2m + h5m = 118.78 + 0 = 118.78$ USD or 43.14%** of the total cost.
3. The transportation or inland freight cost is **$h3m = 56.85$ USD or 20.6%** of the total cost
4. The freight sea cost is **$h6m = 85$ usd/ton or 30.8%** of the total cost
5. Administration, communication and Documentation cost **$h7m = 5.56$ USD or 2%** of the total cost

The total cost for multimodal transportation becomes:

$M_c = [h1m + h2m + h3m + h4m + h5m + h6m + h7m]$ or $[h1 + h2 + h3m + h6m + h7m]$

$= [9.11 + 118.78 + 56.85 + 85 + 5.56]$

$M_c = 275.3$ USD/TON..... (2)

Therefore the cost difference and ratio between unimodal and multimodal transport operation becomes:

$$U_c - M_c = 337.5 - 275.3 = 62.2 \text{ USD/ton}$$

$$U_c/M_c = 337.5/275.3 = 1.24$$

Transporting in multimodal makes to saving 62.2USD/ton or Transporting in unimodal is 1.24times that of multimodal cost. Also the delivery time and safety of the goods are other benefits of operating multimodal.

4.4 Application of Multimodal system by ERC

Rail is very cost effective for transport of products in bulk and also of high value container cargo in dry freight containers and ISO tank containers, where it is also a very secure means of transport. Fuel oil by rail would normally be handled by 60-tonne capacity rail tanks (cisterns). This is not possible in Ethiopia. Dry freight containers need to remain unstuffed in the condition in which they were loaded at the point of origin for as long as possible and ideally right up to the customer's door.

True multimodal transport is dependent on rail for efficiency on journeys of more than about 600 km. A higher carrying capacity with greater motive power would have resulted in a more flexible freight operation, with a capacity to handle 1.8 million tons a year, with heavier trains. The plan under the previously planned concessionaire agreement was to import 46 new locomotives and 600 wagons. The lack of such a service between Djibouti and Addis Ababa remains a severe constraint on the cost effectiveness of multimodal transport in Ethiopia.

4.5 The Requirement to implement multimodal transport in ERC

Multimodal transport by rail is here and is here to stay and, with the dynamic of open access, old players will disappear and new operators will appear. The introduction of new operators will ensure that remaining old players change their ways and that innovation will continue in to the future. Further innovation is necessary if the demand on the railway to increase production and contribute to solving environmental and congestion problems is to be met, with Intermodal transport one of the promising concepts to do so. Still, in the highly competitive business environment, it will be difficult to achieve this and to provide the quality and performance that customers demand for an acceptable price.

Some signs of the intense commercial and political pressure on the railway operators in the intermodal chain. By this pressure, compromise in quality and price are being

forced, sometimes to the point where production plans becomes ideal and everyone in the transport chain struggles to maintain some sort of quality. The international operating opens access operators will have some of the answer towards providing a higher quality service at a lower cost thereby ensuring continuing innovation.

The use of multimodal transport implies overall structural changes covering new trade and transport practices. Various measures are needed to implement multimodal transport, from the streamlining of commercial regulations to the development of transport infrastructure. The upgrade of three main elements is necessary for an efficient multimodal transport system. These elements are commercial practices, administrative production plan and transport infrastructure.

4.5.1 Commercial practices

I. Merchants

There are no international conventions in force governing contracts for the international sale of goods, so disputes and misunderstanding have often arisen between buyers and sellers, mainly because of different interpretations about the terms used in the contracts. These terms deal with delivery conditions between the buyer and the seller, and their main purpose is to divide the costs and risks of the transport movement and related operations between the two parties. In other words, these terms determine at what point the seller has fulfilled his obligations so that the goods could be said to have been delivered to the buyer.

II. Banking practices and documentation system

In the transport of goods in break bulk form, the critical point at which the carrier accepted responsibility for the goods and the risk of the goods often passed from the seller to the buyer was the ship's rail. In the financing of such sales, the banks were accustomed to receiving a bill of lading issued once the goods were on board the ship. With containerization and the carrier accepting to transport the goods by more than one mode of transport this critical point moved inland, with the carrier accepting the goods for shipment before the ships rails, initially at the container yard.

4.5.2 The production plan

A proven way to achieve a well prepared intermodal train service is to produce a "production plan" The production plan should describe tasks and responsibilities in the

chain, as well as more typical railway issues like a timetable the plan requires input from all participant in the chain and within the railway operator. The plan should result in each participant knowing what and when to do. The plan is not a law; the plan is a tool to achieve high performance. The danger of the well communicated and agreed plan is that it becomes inflexible, while it is essential that all parties maintain the flexibility to make changes to improve performance.

1. Trade facilitation

One of the main problems that occur in international trade is that each country has its own rules and procedures concerning the import and export of goods, and also that the cargo velocity today has outpaced the document velocity, in other words, the goods in many cases and on certain routes may arrive before the transport documents. This is one of the reason for the success of courier services but courier services are however not the ideal solution to the problem of getting the various documents to their destination fast enough.

2. Terminal arrangements

Terminal comes in all sorts and sizes, in much varying levels of activity. There are terminals served by only one train a day, and terminals where arrival and departures are an almost continuing process through the day and night. The terminal process is not something that starts when the train arrives; large part of it is completed before the train arrival. The operational plan shows that a good interaction benefits the transport chain with regard to the production plan, issues that need to be included are:

- Loading cut off time, train available for rail operator;
- Train available for terminal operator;
- Administrative procedure and deadlines;
- Delay train message.

3. The rail operator

The railway operator has to transport within the corset of the intermodal transport chain, the straightjacket of the railway and the strop of the bank round his neck. In the planning process of a new train service, one encounters a dilemma of the railway industry service.

4. *Communication*

A location where customer/terminal operator can reach the rail operator 24hours a day can be costly, but essential part of operations. Knowledgeable, customer orientated, multi-lingual staff, available to monitor performance and to assist and solve problems can be a great help to ensure best performance and customer care. In addition, the concentration of staff involved in short term planning, wagon control, and maintenance planning, quality control etc. will greatly facilitate communication.

5. *Documentation and Custom*

Detailed attention in the operational plan to the requirement for consignment notes, custom documents and goods banned from the train will help to ensure that paper work and customs do not become an obstacle to performance. If transport is completed the customer needs to be aware of his obligation and his minimal rights.

6. *Wagons*

Intermodal wagons in a shuttle are used far more intensively than the normal freight wagon in wagon load systems and, unfortunately, a number of incidents have proven that to maintain reliability, additional preventive maintenance has to be considered to prevent stress injuries.

4.6 Benefits of Multimodal

4.6.1 Economic Benefit

Economical Benefit of Ethiopian Railway Corporation: it is economical benefiter when implementing a multimodal operation let us see with example.

Taking an assumption of Railway multimodal transport cost, by considering shipping multimodal transport cost. In equation one and two unimodal and multimodal total cost of shipping line become 275.3USD/ton and 337.5USD/ton respectively. When come to rail way multimodal transport cost by subtracting inland transport cost $h_3=56.85\text{USD/ton}$ from shipping multimodal cost $M_c=275.3\text{USD/ton}$.

$$275.3\text{USD/ton}-56.85\text{USD/ton}=218.45 \text{ USD/ton}$$

Then, adding inland rail transport cost 34.224usd/ton to 218.45 USD/ton becomes:
 $218.45\text{USD/ton} + 34.224\text{usd/ton} = 252.68\text{USD/ton}$

Therefore, 252.68USD/ton is a multimodal transportation cost of the rail way.

$$M_cR = 252.68\text{USD/ton} \dots\dots\dots (3)$$

Notations and data

The data is taken from feasibility study

Freight cost 0.046 USD /ton-km.

The Kilometer from Addis Ababa to Djibouti = 744km

The inland transport cost of rail = 34.224usd/ton

Initial stage of Import Goods = $479 \times 10^4\text{t}$ (Table 5)

Initial stage of Export Goods = $148 \times 10^4\text{t}$ (Table 5)

Assumption

The unit cost of the goods in multimodal transportation is 252.68USD/ton from (3).

Calculation

The transporting cost in the route of Addis Ababa to Djibouti = 34.224usd/ton

There is taking two approaches

1. Maximum railway performance
2. Minimum railway performance

1. Maximum railway performance

As mentioned before 5trips/day are required to take all importing goods and 2trips/day for all exporting goods. But 3trips of the train travel without load (idle) in exporting position.

There are two cases: The first case: The inland cost increased, if the feasibility study wouldn't include idling cost. The second option is take the inland cost, in to consider the feasibility study including the idling cost.

In this study take the second option,

When taking the second case there is a loss of 30% of total cost for idling travel for three trips and makes crisis. Therefore after calculating the total inland cost of import (5trips/day) and export (2trips/day) subtracting the cost of (3trips/day) train travel without load (idle) in exporting position.

From the initial stage of forecasting, the transport cost for Import goods will be:

$$= (479 \times 104t) \times (34.224 \text{ usd/ton})$$

$$= 163,932,960 \text{ usd}$$

From the initial stage of forecasting, the transport cost for Export goods will be:

$$= (148 \times 104t) \times (34.224 \text{ usd/ton})$$

$$= 50,651,520 \text{ usd}$$

$$\text{Subtotal cost} = 214,584,480 \text{ usd} \dots\dots\dots (4)$$

The train travel without load (idle) in exporting position

$$3 \times 2625 = 7875t/\text{day}$$

$$= 283 \times 10^4 t/\text{year}$$

$$(283 \times 10^4 t) \times (34.224 \text{ usd/ton}) = 97,025,040 \text{ usd} \dots\dots\dots (5)$$

The crisis becomes: 97,025,040 usd

The total cost paid for transporting is subtracting (5) from (4).

$$214,584,480 \text{ usd} - 97,025,040 \text{ usd} = 117,559,440 \text{ usd}$$

This price is for railway single mode of transport cost.

Most of company the profit margin is 10%-40% of the total cost. Therefore, I take the minimum profit 10%.

The inland transport of railway profit will be:

$$10\% \text{ of } 117,559,440 \text{ usd}$$

$$= 11,755,944 \text{ usd, profit}$$

In the case of multimodal transport the giving service increasing as well as the profit becomes increase.

Assumption

The unit cost of the goods in multimodal transportation is 252.68 USD/ton from (3).

Therefore:

From the initial stage of forecasting, the transport cost for Import goods will be:

$$= (479 \times 104t) \times 252.68 \text{ USD/ton} = 1,210,337,200 \text{ USD}$$

From the initial stage of forecasting, the transport cost for Export goods will be:

$$= (148 \times 104t) \times 252.68 \text{ USD/ton} = 337,966,400 \text{ USD}$$

$$\text{Subtotal price} = 1,584,303,600 \text{ USD}$$

The train travel without load (idle) in exporting position from (5) is **97,025,040 usd**.

The total cost paid for transporting is:

$$1,584,303,600 \text{ usd} - 97,025,040 \text{ usd} = 1,487,278,560 \text{ usd}$$

Take the profit 10% of total cost:

$$10\% \text{ of } 1,487,278,560$$

$$= 148,727,856 \text{ USD profit}$$

Therefore: if Railway is operator of multimodal in initial stage of operation the profit that gain in its maximum performance will be: **148,727,856 USD per annual**

2. Minimum railway performance

For Importing goods out of 5 trips take 2 trips/day that is the same as that of Exporting 2 trips/day.

Use the same trip for both Import and Export Goods,

From the initial stage of forecasting, the transport cost for Import goods will be:

$$= (189 \times 104 \text{ t}) \times 34.224 \text{ USD/ton}$$

$$= 64,683,360 \text{ USD}$$

From the initial stage of forecasting, the transport cost for Export goods will be:

$$= (148 \times 104 \text{ t}) \times 34.224 \text{ USD/ton}$$

$$= 50,651,520 \text{ USD}$$

Total price will be: **115,334,880 USD**

Profit margin is 10% of the total cost. Therefore, the profit in inland transport for this case is also: 10% of 115,334,880 USD

$$= 11,533,488 \text{ USD, profit}$$

When transportation is a multimodal the giving service is increase as well as the profit of it.

Assumption

The unit cost of the goods in multimodal transportation is 252.68 USD/ton from (3).

From the initial stage of forecasting, the transport cost for annual Import goods will be:

$$= (189 \times 104 \text{ t}) \times 252.68 \text{ USD/ton}$$

$$= 477,565,200 \text{ USD}$$

From the initial stage of forecasting, the transport cost for annual Export goods will be:

$$= (148 \times 104 \text{ t}) \times 252.68 \text{ USD/ton}$$

$$= 337,966,400 \text{ USD}$$

Total price will be **= 815,531,600 USD**

Profit margin is 10% of the total cost. Therefore, the profit in multimodal transport for this case is: 10% of 815,531,600 USD

$$= 81,553,160 \text{ USD, profit}$$

If Railway is operator of multimodal, in initial stage of operation and in minimum performance the profit will be: **81,553,160USD, profit per annual.**

For example: The Ratio between multimode and single mode in rail way is: $81,553,160/11,533,488=7.07$.

Operating Multimodal transport in railway is 7.07times greater profit than that of single mode of transport in initial stage of forecasting and in minimum performance of railway.

Economical Benefit of customers is Minimizing storage & demurrage cost, which comes from waiting freight at the port until the transportation facilitate. Therefore, It is not requires additional cost rather than the agreement with the operator. Therefore;

- Increasing economic development of the country
- Decreasing the freight cost
- Encouraging the customer for further working

4.6.2 Social Benefit

Multimodal transportation is planned and organized mode of transportation system of the freight. The customer once deals with multimodal operator, no need of other transitory contact. Every information gates from the operator, without worry he involve on his personal work and his Goods will be transport within the system. Therefore;

- Reduces time of delivery
- Reduces unnecessary operation delay
- Reduces accident & loss of cargo in transit
- Increases customer working time
- Customer satisfaction
- The Developments for our country
- Additional professionals employ for the system
- Develop international trade market & etc

Chapter 5: Conclusion, Recommendation and Future work

5.1 Conclusion

In our country multimodal transportation is until now not developed specially in railway transportation. The study covered the multimodal transportation in the route of Addis Ababa to Djibouti in Ethiopian railway Corporation.

In future Railway is enough performance to implementing the multimodal operation one of the reason is the capacity and quantity of wagons, out of 1100 wagons 462 wagons will be for single mode of transport and 638 wagons becomes as a reserve and uses for multimode transport, the other is market availability as indicated in forecasting, initiating multimodal operation.

Transporting in multimodal makes to saving 62.2USD/ton or Transporting in unimodal is 1.24times that of multimodal cost and Operating Multimodal transport is 7.07 times greater profit than operating single mode of transport. Therefore the Economical profitability of railway increase as a result of service of transportation mode increases. In the case of social Benefit of multimodal operation are, Reduces time of delivery, reduces unnecessary operational delay, and reduces accident & loss of cargo in transit, decrease the freight cost and increases customer working time. Therefore the Customer satisfied and encourage for further working.

In the study, railway multimodal operation is for both Importing and exporting goods. In the future railway play significant roll to minimize a transportation problem because the new railway start to operate in single mode of transport, in the next, railway will be operator of multimodal transportation.

5.2 Recommendation

As we know that in our country airline, railway and highway by single mode of transport can't meet the increasing demand therefore making the best use of each mode and creating multimodal operator among them are key to rising demand for transportation. There are requires actions to get start in each mode of transport for their own multimodal operation.

By considering enough performance of railway to implement Operating Multimodal transport is much greater profitable than that of single mode of transport. Hence I can recommend Ethiopian Railway use multimodal operator for their better economic efficiency and social effectiveness, in addition to this every mode of transport use their multimodal operator and make the multimodal transport route is the most competitive for our country and give the responsibility for those multimodal transport corridors so when a wide range of transportation is available, users can prompt to Importing and Exporting Goods.

5.3 Future work

- The multimodal container shipment planning with multiple origins and destinations.
- The multimodal container shipment planning with random demands.
- By using current technology establish well-organized information technology.
- The integration of railway with other mode of transport such as highway and airway in the case of freight transport system.
- Scheduling time table in the route of Addis-Ababa to Djibouti freight transport in multimodal
- Develop the system to controlling and transfer mechanism of the freight.

References

1. Optimal rail container shipment planning problem in multimodal transportation Engineering Optimization Vol. 44, No. 9, September 2012, 1057–1071. By Chengxuan Cao*, Ziyou Gao and Keping Li
2. Rail renaissance based on strategic market segmentation principles Southern African Business Review Volume 16 Number 1 2012
By Dr. J.H. Havenga
3. International Journal for Traffic and Transport Engineering, 2011, 1(2): 89 – 107 the potential of rail-road integration for port-hinterland freight transport in Nigeria, By Andrew Egba Ubogu¹
4. Multimodal Transportation, Logistics, and the Environment: European Management Journal Vol. 18, No. 4, pp. 398–410, 2000
By Michael Berry, and Dennis Rondinelli
5. Decision of Multimodal Transportation Scheme Based on Swarm Intelligence, Published 24 April 2014. By Kai Lei,¹ Xiaoning Zhu,¹ Jianfei Hou,² and Wencheng Huang¹
6. Multimodal transportation systems modeling challenges, the Netherland, February 2012. By Reem Fawzy Mahrous
7. 2nd Conference of Transportation Research Group of India (2nd CTRG) Performance Evaluation of Multimodal Transportation Systems. P. Phani Kumara, Dr. Manoranjan Paridab, Mansha
8. A Strategy and Transformation Study for ESLSE, October 18th 2013, <http://www.mtbs.nl>
9. Ethiopia/Sebeta-Djibouti/Nagad Railway
Feasibility Study Part I General Specification, Executive Edition Ethiopian Railway Corporation September, 2012, <http://www.fineprint.cn>
10. An analysis of the import trade logistics service through the Ethio-Djibouti corridor. By Alemu Ambaye Sebhatu, shipping management, October, 2005.
11. Reliability of Railway Systems By: M.J.C.M. Vromans @ 2005
<http://www.erim.nl>
12. Factors Influencing the Choice between Road and Multimodal Transportation. Department of Science and Technology, Sweden, November, 2013
By: Martin Heljedal

13. A Multimodal Transport Network Model for Advanced Traveler Information System By: Jianwei Zhang*, Theo Arentze, Harry Timmermans
Eindhoven University of Technology, Eindhoven, The Netherlands, 5612AK
14. Efficient Multi-Modal Route Planning
By: Dirk Kienle, May 7th, 2012
15. Strategies to Improve the Efficiency of a Multimodal Interdependent Transportation System in Disasters. © 2013 The Authors.
<http://www.sciencedirect.com>
16. Research of Security Authentication for Railway Passenger and Freight e-Commerce
International Journal of Computer Theory and Engineering, Vol. 5, No. 5, October 2013
By: Xue Hu, Yang Li, Lei Meng, Jisheng Li, Xianning Tian, and Yong Zhang
17. Freight Transportation Planning on the European Multimodal Network
By: Jean-François Geerts and Bart Jourquin EJTI, no.1 (2001), pp. 91 – 106
18. Home-Activity Approach to Multimodal Travel Choice Modeling
By: Sascha Hoogendoorn-Lanser, Rob van Nes, Serge P. Hoogendoorn, and Piet Bovy
Journal of the Transportation Research Board, No. 1985, Transportation Research Board of the National Academies, Washington, D.C., 2006, pp. 180–187.
19. Deregulation impact on the railway freight transport sector's future in the Baltic sea region, By Milla Laisi, Finland on the 25th of October, 2013, at noon.
20. The Transportation Mode Distribution of Multimodal Transportation in Automotive Logistics Procedia - Social and Behavioral Sciences 96 (2013) 405 – 417
<http://www.sciencedirect.com>
21. Planning Problems in Intermodal Freight Transport: Accomplishments and Prospects. Published online: 20 Jun 2008.
<http://www.tandfonline.com/page/terms-and-conditions>
22. Multimodal Transportation of Goods under Ethiopian Law
By: Tsehai Wada, [http:// www.abbyssinialaw.com](http://www.abbyssinialaw.com)
23. Planning Freight Railways
By: eds Nigel G Harris & Felix Schmid, July 2003