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ASSESSMENT OF FREIGHT TRANSPORT AND TRANSPORTATION INFRASTRUCTURES ALONG INTERNATIONAL TRADE ROUTE

The Case of China – Djibouti – Ethiopia

By

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April 2015

CERTIFICATION

I, the undersigned, certify that I read and hereby recommend for the acceptance by the Addis Ababa University a dissertation entitled: Assessment of Freight Transport and Transportation Infrastructures along International Trade Route The Case of China – Djibouti – Ethiopia in partial fulfillment of degree of Masters of Science in Road and Transport Engineering.

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A thesis submitted to the School of Graduate Studies of Addis Ababa Institute of Technology in partial fulfillment of the requirements for the Degree of Master of Science in Road and Transport Engineering.

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List of Acronyms

3PL	Third Party Logistics	FDRE	Federal Democratic Republic of Ethiopia
AADT	Annual Average Daily Traffic	FEU	Forty foot Equivalent Unit
APR	Annual Progress Report	FTLS	Freight transport and logistics Service
AXL	Axle Load	Fton	Freight tonne
B/L	Bill of Lading	GTP	Growth and Transformation Plan
BBF	Before Forward	GVW	Gross Vehicle Weight
CBA	Cost Benefit Analysis	IT	Information Technology
CCCC	China Communications and Constructions Company	MoT	Ministry of Trade
COMESA	Common Market for Eastern and Southern Africa	MoFA	Ministry of Foreign Affairs
DMP	Duraleh Multi port Project	MT	Metric Ton
DS	Design Standard	MTO	"multimodal" Transport Operator
DWT	Dead Weight Tonnage	MV	Motor Vessel
EBC	Ethiopian Broadcasting Corporation	NFTLP	National Freight transport and logistics Program
ECTS	Electronic Cargo Tracking System	PK	Point Kilometer
EEA	Ethiopian Economics Association	POD	Port of Discharging
EFY	Ethiopian Fiscal Year	POL	Port of Loading
EPSE	Ethiopian Petroleum Supply Enterprise	Ro/Ro	Roll on Roll off
ERA	Ethiopian Roads Authority	RSDP	Road Sector Development program
ERC	Ethiopian Railways Corporation	TEU	Twenty foot Equivalent Unit
ERC	Ethiopian Revenue and Customs Authority	UNCTAD	United Nations Conference on Trade and Development
ESAL	Equivalent Single Axle Load	US	United States
ESLSE	Ethiopian Shipping and Logistics Service Enterprise	USD($)	United States Dollar
ETB	Ethiopian Birr		
ETRE	Ethiopian Toll Road Enterprise		

NOTE: By definition Intermodal transport is the transportation of goods under a single contract or document, but performed with at least two different means of transport; though in Ethiopia the term 'multimodal transport' is being used to refer to Intermodal transport. And also the term 'Uni-modal' is defined as per ESLSE, a freight transport in which the imported goods have to be taxed and custom cleared at Djibouti port before entering to the premise of the nation. Therefore on this thesis it is used in a similar sense.

Unit Conversion: 1 tonne (metric ton) = 1000 Kg = 10 quintal
Note: The unit 'ton' used in the context of 'metric ton'
Foreign Exchange: 1USD = 20.0709 ETB
(National Bank of Ethiopia, Market day weighted average on December, 2014)

Abstract

Ethiopia is a landlocked country in East Africa. The ability to transport freight goods quickly, economically and reliably is very important to a nation's prosperity and competence in global market. Currently the logistics system of Ethiopia is characterized by poor logistics management system and poor transportation infrastructures. In addition to that the country is mainly dependent on only Djibouti port for international trade. Its inland transportation is also underdeveloped as only road transportation is used for main share of freight transport.

The objective of this thesis was to assess the freight transport and transportation infrastructures along the China-Djibouti-Addis Ababa (Ethiopia) trade route via Modjo dry port. The sea transportation from China to Djibouti and inland road transportation from Djibouti to Addis Ababa was also studied including the inland road transportation infrastructures along with identifying the existing freight transport and logistics problems on the international trade route. Primary data has been collected using interview and questionnaire; also secondary data from different stake holders in the freight transport and logistics in addition literatures were used to enrich the assessment. The methodology used is qualitative and quantitative type for a comparative assessment and analysis.

From the research it was found out that for containerized goods, the sea freight unit cost applied for 20TEU containers from Chinese ports of Tianjin and Shanghai to Djibouti port was USD 1,500 and USD 1,315 respectively. And for the inland road transportation, the freight rates from Djibouti port to Modjo dry port ranges from 1,734 to 1,854 USD per 20TEU container. This means it costs more to truck a container from Djibouti to Addis Ababa, than to ship the same container from China to Djibouti. In terms of time the sea transport will take a voyage time of 40days and 37days (including sea time and time in ports) from Tianjin and Shanghai ports to Djibouti port respectively. For inland road transportation from Djibouti to Modjo dry port, it takes 2 – 10 days on performance basis under normal circumstances. In the future there may be a cheaper alternative of oil pipeline and railway in the Djibouti-Addis Ababa route which are considered to be the more efficient and least cost modes of transport. As most authors agree, it is better to consider a variety of modes in combination so that the respective advantages/benefits of each mode are better exploited thus the Intermodal transportation ("Multimodal") have most significant positive impacts over the freight transport i.e. Considering other alternatives beyond the current Shipping → Trucking system of freight transport to Shipping → Rail → Trucking and Shipping → Pipeline → Trucking (Oil transport). For the case of transportation infrastructures, 65.9 % of the trunk road Addis Ababa–Djibouti border is in a good condition, 13.2% in a poor condition and the rest of the percentage in fair condition. For the case of the Bridges along the same route; 53% in a good condition, 22% in a poor condition and the remaining 25% in fair condition. The road stretching from Djibouti Border (Galafi) to Djibouti Port, 28% is in good condition, 21% of the highway in Poor to Very poor condition and the remaining percentage in fair condition. The new Addis Ababa-Adama toll road, the new Awash River crossing bridge and the under construction outer ring road of Lebu-Akaki-Goro are expected to improve the flow of traffic in the route in saving a travel time and lowering the vehicle operating cost for instance the heavy vehicles are only paying for 38% of the benefit they have gained on the new toll road. The new Electrical (environmental friendly) railway from Addis Ababa to Djibouti is likely to improve the inland freight transport system with a faster travel time of 10 hours on the route relative to the average two days taken on inland road transportation and it may be able to replace at least 94TEU containers that were transported on inland road transportation. The use of eco-friendly mode of transportation of the Pipeline and railway system will enable saving of enormous amount of fuel and a great deal of foreign currency spent by the nation in importing that much fuel from the exporters, the related CO_2 that would have been emitted to the atmosphere will be saved and the reduction of freight vehicles on the road will improve the flow of traffic on the route in reducing congestion and traffic accidents on the highway that in turn enhance the traffic safety and comfort of the road users on the route. The freight transport and logistics is still characterized having long time custom processing even if it is much better with respect to previous times and also 57% of the customers questioned chose 'uni-modal' transport over the so called "multimodal" transport. The new to be imported trucks by Ethiopian Shipping and Logistics Service Enterprise (ESLSE) may improve and increase the capacity of the freight vehicle carrying capacity to

57ton/vehicle and also if the axle load limit is increased with 2ton/axle limit, there is going to be an improvement on the vehicle operating cost. The joint command post at Modjo dry port may succeed in reducing the congested number of containers and their dwell time on the port. The expansion projects in the Djibouti port and exploring other alternatives in the nearby ports may benefit the nation in the international trade. And also the full implementation of demurrage law and electronic cargo trucking system may enhance the customs service on the international trade route. The state owned ESLSE being the only "multimodal" transport operator (MTO) should work together with different private stake holders in addressing the issues of customer's complaint and for the common benefit of the nation is expected rather than monopolizing the ongoing "multimodal" freight transport logistics service.

1 Introduction

1.1. Background

Trade is the most important way of economic growth for any country. International trade is one aspect where the Ethiopian economy participates in world trade as a supplier of its products to the rest of the world and a consumer of products from the rest of the world. Ethiopia is a landlocked nation but as per The Economist (2014a), this has not stopped Ethiopia from developing its shipping. And due to the reason that the Red Sea ports of Massawa and Assab have been off-limits to Ethiopian freight, the country has to rely on Djibouti port for imports and exports with respect to shipping. The state-owned Ethiopian Shipping and Logistic Services Enterprise (ESLSE) which is 50years old have a main objective to deliver a one stop services (Intermodal transportation system), which means the customer will have the opportunity to receive its imported goods in the premise of the nation not at Djibouti port. Although there may be many criteria that might be available for better economic integration that involves the flow of goods and services across nations, this thesis will deal with the two basic inputs to the international trade: freight transport and transportation infrastructure

According to Council of Logistics Management (1998), Logistics deals mainly with the planning, implementing and controlling the efficient and the effective flow and storage of goods from point of origin to point of consumption for the purpose of confirming the customer requirement. In this thesis, freight transport and logistics considers the transportation of goods from China ports to Djibouti port through shipping on the sea and then all the way to Ethiopia's Modjo dry port and Addis Ababa through inland road transportation. According to Brooks (2008) trade networks demand superior logistics services and centers. Brooks (2008) also stated that, minimizing financial and time costs while ensuring reliable delivery of goods depend on an efficient logistics system. When the growth of one nation is very rapid towards international trade, increase in traffic by the economic growth outpace the expansion of transportation infrastructure services; therefore reliability of trade facilitation and administrative procedures at customs are crucial, including rationalization of the customs transit system in order to reduce inspection time and simplify declaration of the documentation process (Brooks, 2008). In the nation's case, the higher annual economic growth in Ethiopia has yielded an increase in Import-Export trade with the outside world. According to Gebresenbet (2009), the concept of profit leverage by logistic cost reduction i.e. 1 USD saving in logistics cost increase benefit of international trade by 50%.This shows well why logistics cost reduction matters in the freight transport and logistics service.

Brooks (2008) stated that, transportation infrastructures such as highways and railways can reduce distribution margins of the transportation cost in narrowing the gap between prices faced by producers and consumers, thereby facilitating better improvements for both; in general efficient transportation infrastructures lower transaction costs, raise value added, and increase potential profitability. The cost of transportation globally is 15-16% of the logistics cost, in Asia a 10% reduction in transport costs would boost trade by about 3–4% (Brooks, 2008). The transportation infrastructures along the route of Djibouti to Ethiopia is of inland road transportation type since Ethiopia's another inland rail transportation route between Addis Ababa and the Port of Djibouti is

deteriorated and is no more in use. As per Ethiopian Railways Corporation (ERC) (2014), a new railway is currently under construction and expected to be completed in late 2015. And the data from ERA, the roads and bridges found in between the route of Addis Ababa-Djibouti are deteriorated mainly due to the overloading. The available roads and bridges were constructed at the time of where the Equivalent single axle load (ESAL) standard of the road was 80KN, according to ERA Pavement design manual (2002).

Afro Consult (2014) mentioned that the ESAL were not updated with the rapid economic growth and transformation of the nation, but currently under review, and there is also a heavier axle load from the freight transport of the heavy machineries transported for the mega projects undertaken such as the Grand Ethiopian Renaissance Dam and Gilgel Gibe Hydro Electric power project. The high traffic congestion on the last segment of Djibouti-Addis Ababa route (i.e. from Adama city to Addis Ababa) carries about 20,000 vehicles /day (Road Traffic Technology, 2012). This congestion is mainly due to the poor condition of the road, a narrow carriage way of the road with most length being single lane per direction and the horrific traffic accidents happening along the Addis Ababa-Adama route. These poor transportation infrastructures have resulted in higher vehicle operating costs (includes fuel, oil and tire costs) and higher cost of transportation and delay on both the freight and passenger movements. Therefore, enhancing the transportation infrastructures such as the new 6 lane Addis Ababa-Adama Toll road will reduce travel time to 40mins from the average 2hrs (Scott Wilson Group, 2008), and also the new Awash Bridge is expected to accommodate two vehicles at a time and will carry 40ton unlike the old one, as per ERA's East region Engineering team (2014). This thesis focused to address the following research questions:

i. What are the cost of inland road transportation and sea transport in freight transport?
ii. Which mode of transportation is effective means of liquid bulk cargo (i.e. fuel) transportation?
iii. What is the status of the transportation infrastructures along the route and the impact of heavy axle loading from the freight transport on the transportation infrastructures?
iv. What are the existing freight transport and logistics related problems along the international trade route?
v. What are the roles of different stakeholders in the sector to overcome freight transport and logistics problems?

1.2. Objective

The main objective of this thesis was to assess the freight transport along the China-Djibouti-Modjo-Addis Ababa international trade route and also the transportation infrastructures with identifying the existing freight transport and logistics problems along the international trade route.

The Specific objectives are to:

1) perform assessment of freight transport with respect to freight rates and voyage time between the two parts of the trade route, i.e. sea transportation from Chinese ports to Djibouti port and inland road transportation from Djibouti port to Modjo dry port
2) assess the possible means of liquid bulk cargo (i.e. fuel) transportation in terms of Economy and feasibility in Ethiopia's Fuel import.
3) assess the transportation infrastructures (i.e. Roads, Bridges and Ports) in the freight transport along the Djibouti-Addis Ababa route and identify the impacts of heavy axle loading from the freight transport on the road infrastructures.
4) identify the overall existing freight transport and logistics related problems plus the efforts of different stakeholders in the sector to overcome the existing freight transport logistics problems.

2 Literature Review

2.1. International trade in Ethiopia

Trade is the most important way of economic growth for any country. International trade is one aspect where the Ethiopia participates in world trade as a supplier of its products to the rest of the world and a consumer of products from the rest of the world. As per Table 1, Ethiopia's trade with the world has grown on average 15% annually within the years of 2005 to 2013 in both import and export trade, though the balance between the two is not even. In the years 2005 – 2013, the export share in the international trade is only 19% on average and also the trade balance is negative 5.8 billion dollar due the lower amount of export item in respect to the imported one on average as per the secondary data collected from Ministry of Trade (2014).

Table 1: *International trade of Ethiopia with the world, 2005 – 2013* (Ministry of Trade, 2014)

Year	Ethiopia's Overall Export (Values in USD)	Growth in (%)	Ethiopia's Overall Import (Values in USD)	Growth in (%)	Balance (EXPORT-IMPORT)	Export/Import in (%)
2005	896,631,487.67	-	3,795,660,670.05	-	-2,899,029,182.38	23.6
2006	999,387,458.24	11.46	4,520,692,512.18	19.10	-3,521,305,053.94	22.1
2007	1,183,268,582.46	18.40	5,326,728,715.20	17.83	-4,143,460,132.74	22.2
2008	1,542,860,713.62	30.39	8,202,224,589.51	53.98	-6,659,363,875.89	18.8
2009	1,493,635,742.93	-3.19	7,622,854,167.31	-7.06	-6,129,218,424.38	19.6
2010	2,147,314,404.94	43.76	8,327,332,579.68	9.24	-6,180,018,174.74	25.8
2011	2,542,304,496.32	18.39	8,758,393,035.08	5.18	-6,216,088,538.76	29.0
2012	2,741,297,675.80	7.83	11,659,257,527.68	33.12	-8,917,959,851.88	23.5
2013	2,591,041,908.59	-5.48	10,955,385,470.26	-6.04	-8,364,343,561.67	23.7
Average	1,793,082,496.73	15.20	7,685,392,140.77	15.67	-5,892,309,644.04	23.1

According to Ministry of Trade (MoT),

- Ethiopia's major exports include coffee, oil seeds, gold, flowers, pulses, and live animals. Coffee is the leading export, constituting 26% of total exports by value in FY 2011/12 followed by gold, which comprised 19% of the total exports.
- The country's main imports include petroleum products, machinery, metal products, agricultural and industrial chemicals, fertilizers, medical and pharmaceutical products, and food grains.

Table 2: *Share of the Top 5 Ethiopian International Trade partners, FY 2011/2012* (U.S. and FOREIGN COMMERCIAL SERVICE AND U.S. DEPARTMENT OF STATE., 2013)

No	Source of Import	Share in %	Export destination	Share in %
1	China	16.6	Switzerland	18
2	Saudi Arabia	14	China	10.4
3	India	8.4	Germany	9.7
4	Kuwait	4.3	Somalia	8
5	Japan	4.3	Netherlands	7

Table 2 of the top five trade partners in the whole import-export trade of Ethiopia, also clearly shows that China dominated as being the highest source of imported goods in sharing almost 17% of the import trade of Ethiopia in the year 2011/2012, even though the statistics from MoT (Table 3) shows a higher percentage in the same FY. From Table 3, in the year 2013, Ethiopia's export to china has grown almost four times with respect to 2005 while the import from china in the same years has grown more than five times. Also Table 3 shows that trade balance is negative US $2.6 billion in 2013, it may imply China is favored more from the bilateral trade.

Table 3: *Ethiopia-China Trade statistics, 2005 – 2013* (Ministry of Trade, 2014)

Year	Ethiopia's Export to China (Values in USD)	Growth in (%)	China's Share in Overall Ethiopia's Export (%)	Ethiopia's Import from China (Values in USD)	Growth in (%)	China's Share in Overall Ethiopia's Import (%)	Total Trade Turnover with China (Values in USD)	Trade Balance (Export-Import)
2005	78,930,604.60	-	8.80	551,084,760.65	-	14.52	630,015,365.25	-472,154,156.05
2006	71,687,707.25	-9.18	7.17	663,569,904.96	20.41	14.68	735,257,612.21	-591,882,197.71
2007	67,639,544.65	-5.65	5.72	1,019,905,728.03	53.70	19.15	1,087,545,272.68	-952,266,183.38
2008	80,619,516.78	19.19	5.23	1,688,877,778.90	65.59	20.59	1,769,497,295.68	-1,608,258,262.11
2009	211,120,847.34	161.87	14.13	1,847,107,585.35	9.37	24.23	2,058,228,432.68	-1,635,986,738.01
2010	228,213,528.45	8.10	10.63	2,021,717,658.02	9.45	24.28	2,249,931,186.47	-1,793,504,129.56
2011	280,195,080.83	22.78	11.02	1,673,884,491.95	-17.20	19.11	1,954,079,572.78	-1,393,689,411.13
2012	315,862,677.55	12.73	11.52	2,432,872,032.09	45.34	20.87	2,748,734,709.64	-2,117,009,354.54
2013	308,326,184.98	-2.39	11.90	2,952,993,491.46	21.38	26.95	3,261,319,676.44	-2,644,667,306.49
Average (%)		15.2	9.57	-	26.01	20.48	-	-

2.2. Freight transport in Ethiopia

ESLSE is established in 2011 to facilitate the growing import and export market of the country by strengthening the existence of well-organized and properly coordinated shipping and logistics services that can alleviate transit time delays and yield a significant cost savings (MoFED, 2014). According to ESLSE (2014), for the past many years, Ethiopian goods were imported through a customs transit clearance system commonly called 'uni-modal' transport. The main principle behind the 'uni-modal' system is that 'Every imported goods has to be taxed and given a custom clearance before entering Ethiopia', so due to this rule before the importer get the transit allowance, the importer has to get a release of the original Bill of lading from the bank through paying the freight transport fee and also the customs tax; these preliminary processes before transiting the imported goods to Ethiopia has took a lot of time and money which in turn led to the accumulation, congestion of more goods and incurred an additional expense towards the importers at Djibouti port. The accumulation of imported goods through 'uni-modal' transport at Djibouti port for a long period of time has incurred rental and storage cost in a foreign currency, then also when the limit of storage time reached the imported goods were taken away by the neighbor country (ESLSE, 2014). These all consequences of the 'uni-modal' transport have affected the nation's economy growth and also the customers of the ESLSE negatively and as per ESLSE (2014), these have led to seeing other alternative solution, which is the "multimodal" transport.

By definition Intermodal transport is an integrated movement of freight that involve at least two modes of transport under a single through rate with a goal of providing seamless transport system from point of origin to the final destination under one billing and liability (Brewer, 2001). In Ethiopia, the term "multimodal" was used instead of intermodal but with the same meaning of intermodal, *i.e.*, to provide seamless transport under one billing and liability on the whole movement from origin to destination, therefore on this thesis it is used in a similar sense (Amentae and Gebresenbet, 2015). As per the secondary data from ESLSE Public relation office (2014), the carrier that is responsible for the entire carriage is referred to as a "multimodal" transport operator (MTO). In practice freight forwarders have become important MTOs as they have moved away from their traditional role as agents for the sender and accepting a much wider liability as carriers also large sea-carriers have involved into MTO as they provide their customers with so-called door-to-door services, i.e. the sea carrier offers transport from the sender's premises (situated somewhere inland) all the way to the receiver's premises instead of just offering more traditional tackle-to-tackle services. ESLSE (2014) states that, MTOs that are not in the possession of a sea vessel (even though the transportation includes a sea-leg), are referred to as Non Vessel Operating Carriers (NVOC) or Non Vessel Operating Common Carriers (NVOCC).

According to ESLSE (2014), the benefits of Multi-modal transport are:

- giving loading and unloading service of imported goods within the country.
- secure the safety of the imported goods since it will be in the premises of the country.
- increasing quickness and effectiveness of the transportation service
- decreasing the rent for warehouse
- reducing the incurred cost due to the storage cost for a container
- reducing the time taken for customs clearance
- increase the number of trips by the ships
- decreasing the processes of freight forwarding
- creating closeness in between the importer and the exporter in the international trade
- in general, creating a smooth environment for international trade

The government of Ethiopia has put preliminary test of "multimodal" transport on government imported goods in 2008/2009 with the main principles of that every bank and custom duties has to be implemented in the premise of the country so that the storage time and cost of the imported goods at Djibouti port can be reduced and after the successful result achieved on the preliminary stage the government has given a directive to implement the "multimodal" transport fully on imported containerized goods and on freight vehicles of weight below 3 ton in 2011/2012 (ESLSE, 2014). According to ESLSE, it is currently acting as a "multimodal" transport operator and has started rendering "multimodal" transport service up to Semera, Mekele, Kombolcha, Adama, Modjo, and Gelan dry Ports by issuing combined transport Bill of lading (B/L). ESLSE (2014) believes that the following main alterations have been seen due to the "multimodal" transport implementation;

- ✓ The "multimodal" transport has grown to be effective and useful in reducing the time and cost of transit significantly.
- ✓ The period of container storage at Djibouti port was reduced on average from 40days to 1 week; these have saved a lot of foreign currency paid for the storage cost of the containers.
- ✓ There found to be a growth of coverage in served containerized goods from 10% in 2011 to 50% in 2014.
- ✓ The congestion of containerized goods at Djibouti port has reduced to a great extent in 2012.
- ✓ The freight and the transporter have been connected directly without the involvement of broker, which in turn has reduced the additional cost incurred in between.
- ✓ The tariff requested for freight transport from Djibouti to Addis Ababa has stayed constant, which is 95-100 ETB per quintal. And also due to the negotiation in between ESLSE and Freight transporters the tariff for the government's bulk transport has shown a discount of 6%.
- ✓ Door-to-door service is given for those investors that has got Custom license.

But still on time delivery of imported goods is in need and other existing problems covered on section 4.8. According to ESLSE (2014), In general "multimodal" transport has contributed a lot in saving time and money of the customers in that the customers were formerly, suffering a lot in that their cargo was being delayed at the port of Djibouti and consequently, being confiscated by the Djibouti government also the customers also used to suffer a lot in that they had to go to Djibouti port in search of their cargo, or had to assign someone as agent for the follow-up of their cargo. ESLSE (2014) also believes that due to the "multimodal" transport, all such problems are solved and the customers are having their cargo delivered to the site they choose. According to Afro Consult (2014), in the year 2011 the share of containerized goods transported along the Addis Ababa-Djibouti route was 87% and 50% in the Export and Import trade respectively as seen on Figure 1.

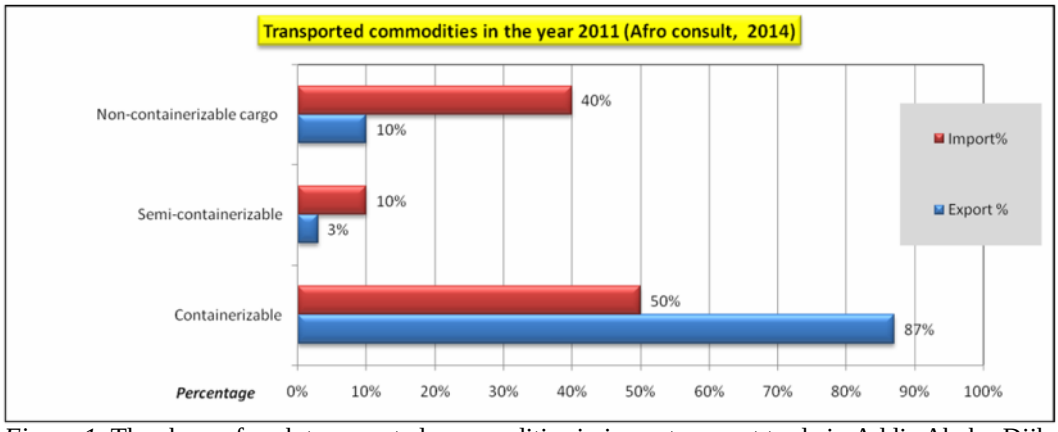

Figure 1: The share of each transported commodities in import- export trade in Addis Ababa-Djibouti route

ESLSE has been striving to increase the carrying capacity o f its vessels, therefore it has acquired an additional new 7 dry cargo multi-purpose vessels and 2 oil tanker ships at the end of 2012/2013, as a result the carrying capacity by own vessels increased from 5,676TEU to 13,119TEU containers which is 131% compared to 2010/11. And also the two additional new oil tanker ships are expected to be transport 68% of the fuel imports. (MoFED, 2014)

As per MoFED (2014) the challenges and the solutions towards ESLSE performance were;
Challenges encountered were Lack of proper information and communication technology at dry ports, time taking inspection services and limited port handling capacity.
Solutions undertaken includes a comprehensive logistics strategy is under drafting that is expected to address the root causes of the problem. In addition, in order to enhance the service at dry ports and overcome the challenges encountered, projects were undertaken in procurement of cargo handling machinery, equipment like loading and unloading vehicles, stuffing and un-staffing goods.

2.3. Major Freight transport logistics Activities and Cost Components

According to Afro Consult (2010), in the Process of Freight Transport and Logistics Service (FTLS), the first step of assessing the FTLS is to identify the major activities involved and the relative cost of the system. In principle the major cost components of the entire logistics chain could extend from the source of supply to the consumers of the product. Afro Consult (2010) also noted that the average time taken to collect shipping documents from L/C (letter of credit) opening is about 30 days which includes time required for transaction, financing and insurance arrangements and also the time taken excluding time taken for obtaining shipping document is 46days whereas the total time including time taken for obtaining shipping document is 76 days. According to Afro Consult (2010), it was mentioned that customs delays have very much improved at border checkpoints but necessary to drastically improve delays caused at Mille, Modjo and Comet compound in Addis Ababa. And also it was noted that, it is necessary to invest in this area to build the capacity of each Customs employee through training and awareness program to make each accountable for any delay of trucks for unjustifiable reason (Afro Consult, 2010). In addition for better improvement of the system of the custom as per Afro Consult (2010), to eliminate the possible truck idle time within customs premises, it was proposed that the in-bound and out-bound time of all vehicles arriving from sea port be registered and submitted to truck owners, customs office and regulators which is similar to the currently applied Demurrage system (see section 4.9), so that this timed registration would enable the concerned official to punish the offender of the system.

Afro Consult (2010) also showed that in Africa, East Africa has the highest transport cost in the world. For instance, the logistics cost proportion in 2003 was about 15% of import value compared

to 5.4% for the world average. The situation of landlocked countries, such as Ethiopia was 16% of the foreign trade values in 2008 wherein that much cost was consumed by transport and transit costs which were nearly double of the coastal countries on average at the time (Afro Consult, 2010).

2.3.1. Cost of Sea Transport

According to Afro Consult (2010), these are the major indicators to determine the performance of sea transport logistics services with inland road transportation and often used as comparative indicators as shown on Table 4;

- The required number of documents,
- The time (days) needed to complete total import/export businesses and
- The estimated cost of a container in USD.

Table 4: *Levels of service and cost of foreign trade traffic for Ethiopia* (World Bank, 2007)

	Export	*Import*
Required time (Days)*	46	52
Estimated cost (USD/TEU)**	1,700	2,455

***** Total time taken for both sea and inland road transport excluding time taken for obtaining shipping document

** TEU: Twenty feet equivalent unit

At the time of the study of Afro Consult (2010) the average transit shipping cost was about USD 1,550 per TEU container. And the ESLSE rate appears to be slightly higher than the main competitors in Far East and gulf routes while it is lower in Europe and Indian routes. And also available data indicated that overall total cost was about 10% more which is very reasonable in view of the payment of freight rate in foreign exchange, saving of transfer costs. The total transit cost on Djibouti Route in 2008 was USD 3,850 per TEU container including cost of shipping, port fees and inland road transportation costs, whereas 215 USD per ton for General cargo (Afro Consult, 2010).

ESLSE currently has 15 ships of which two are fuel transporters, as shown on Table 5 (ESLSE, 2014). And it was stated that ESLSE has grown the tonnage transported which was 47,185 ton before 50years and now to 391,537 ton.

Table 5: *Name and details of ESLSE ships* (ESLSE-planning and business management department, 2014)

SN	Ships name	Year bought	Age	Carrying capacity			Type of Vessel
				Unit	DWT	No. of Containers	
01	Andinet	1984/85	28	Ton	14,895	367	Multi-purpose
02	Netsanet	1984/85	28		14,895	367	
03	Admas	1994/95	27		13,593	302	
04	Tekeze	1998/99	23		18,145	930	General cargo container ship
05	Shebele	2005/06	7		25,000	1,364	
06	Gibe	2006/07	6		25,000	1,364	
07	Assosa	2012/13	new		28,000	1,685	Multi-purpose
08	Harer	2012/13	new		28,000	1,685	
09	Finfine	2012/13	new		28,000	1,685	
10	Gambella	2012/13	new		28,000	1,685	
11	Jigjiga	2012/13	new		28,000	1,685	
12	Mekele	2012/13	new		28,000	1,685	
13	Semera	2012/13	new		28,000	1,685	
Total Dry Cargo					307,528		
14	Bahirdar	2012/13	new	Metric ton	42,150	-	Liquid cargo
15	Hawasa	2012/13	new		42,150	-	
Total Liquid Cargo					84,300		

According to the secondary data collected from ESLSE Shipping operation and chartering department on assessment of new Freight rates on November 2014, ESLSE have been sailing to

Chinese ports mainly Shanghai, Tianjin and Qingdao ports to transport general cargo including break bulk cargo, project cargo, machinery, Ro/Ro (Roll on Roll off or Vehicular items) and 200-400 containers. According to ESLSE Shipping operation and chartering department, currently five ships which are MV Jigjiga, MV Assosa, MV Finfine, MV Shebelle and MV Gibe have been deployed in this China-Djibouti route.

2.3.2. Cost of Road Transport

As per Afro Consult (2010), the cost of transportation is generally determined at that combination of distance, time and user charges. And also the major cost elements of land transport include capital cost, operating cost including fuel, maintenance, operators and overhead. The normal proportion of cost in Table 6- indicates that the components are more or less in the same range and that the major elements are fuel and lubricants consisting up to 38 % of the vehicular operating cost. Although the data is relatively old Afro Consult (2010) believed that the proportion remains more or less the same and presented only to indicate the level of magnitude and also compared to one of the existing truck operators which is the latest available.

Table 6: *Proportion of operating costs in Freight Transport Operations as per SPT consult, 2001* (Afro Consult, 2010)

Cost Item	Proportion of Operating Cost (%)	
	World Bank	*Comet*
Variable Costs		
➢ Fuel	*20-30*	*38*
➢ Lubricating Oil	*1-5*	
➢ Tires	*10-15*	*13*
➢ Spares	*15-20*	*12*
Fixed Costs		
➢ Driver and other cab staff	*10-20*	*9*
➢ Other Labor	*About5*	*5*
➢ Depreciation and interest	*15-20*	*13*
➢ Overheads and other costs	*10-15*	*10*
Total	*100*	*100*

For dry cargo, Afro Consult (2010) mentioned that the freight rate can be determined by market forces of demand and supply which the sampled rate per ton km indicates that there have been no major changes over the first five years (2000-2005) but there was a big increase during the following five years (2005-2010) in major direction of the routes of up to 14.5% even though the rate of return trip is lower still the increase is significant indicating the shortage of fleet and hence low market competition. And regarding fuel transportation, the rate is determined by the Ministry of Trade and Industry as a part of the controlled price of fuel. Although the rates are more or less similar to that of dry cargo rate, it is actually less favorable than the corresponding dry cargo rate by about 20% due to tankers drive to the port empty with no prospect for back-load (Afro Consult, 2010).

2.4. Economies achievable in freight transport

Pienaar (2013) stated “Defining the economic role of the various modes of freight transport should be one of the basic ingredients of both an economically rational government transport policy and the effective functioning of freight transport industries”. Table 7 shows the comparison between Economies of Sea transport and Road transport.

Table 7: *Economies of Sea and Road transport* (Pienaar, 2013)

Economies of Sea transport	**Economies of Road transport**
Economies of fleet size	
It is possible with large individual vessels and not necessarily with large fleet operations. Single-ship operators or operators operating a few ships are often able to compete with larger scheduled conference liners, which indicates that *sea transport enjoys little in terms of economies of fleet size.*	Increased road vehicle fleet sizes coupled with productive utilization, *can result in some economies of scale*. Potential sources of economies of scale are a workshop owned by the business for vehicle maintenance and repairs; standardization of vehicles, which reduces the quantity of spare-part inventories; discount on bulk purchases, and so on.
Economies of vehicle size	
Larger ships result in lower costs per ton (in the case of bulk shipping) and lower costs per standard container. However, larger ships may cause problems for other areas of the maritime industry, mostly at the ports. Bigger ships require more crews, wider entrance channels, deeper draughts, larger cranes and other loading and unloading equipment, sufficient storage space to hold the volumes of freight before or after loading and unloading them.	As the carrying capacity of road vehicles increases, vehicle-specific costs (running costs, such as fuel and oil consumption, maintenance and tire wear) increase less than proportionally. Also, engine size and number of crew members required increase less than proportionally to an increase in vehicle size. That means *Road transport enjoys economies of vehicle size to some extent.*
Economies of infrastructure extension	
In port operations a four times increase in container port size can reduce the cost of handling container traffic by approximately one-quarter. Sea transport does not need a supplied right of way. The travel 'way' involved, namely the sea, does not require investment. However, seaports are not owned or supplied by shipping firms, so ship owners may not automatically reap the benefits of improved port efficiencies. Port charges are levied by the owning port authority.	In view of the fact that governments typically recover road-user cost responsibility (except license fees) through levies included in the price of fuel and through toll tariffs (e.g. Addis Ababa-Adama toll). Road transport businesses with standing costs being fixed, at least on a monthly basis, extensive travelling (many Km per month) and the avoidance of travelling during periods of traffic congestion so as to increase trip speeds, *some economies of density in terms of infrastructure use can be attained*.
Economies of distance	
Generally, for container vessels and the various types of bulk carriers, in view of the high terminal expenditure and the fact that the 'way' of travel involved – the sea – does not require investment or any significant expenses apart from navigational support that may sometimes be necessary i.e. *ships enjoy substantial economies of distance as voyage lengths increase*.	Generally, owing to the high ratio of vehicle running costs (which accumulate as distances increase) to total costs of individual vehicles, and the relatively small terminal facilities or absence of own facilities, *Road transport does not enjoy significant economies of distance.*

2.5. Liquid Bulk cargo (petroleum) transportation

As per EEA (2012) research brief on Energy and Transport Services in Ethiopia, "Industrial development has placed an enormous demand on fossil fuels due to the introduction of power driven machines and means of transport. Transportation almost completely relies (95%) upon petroleum products with the exception of some railway transport that uses electrical power. While the use of petroleum for other economic sectors, such as industrial activities and electricity generation has remained relatively stable, the growth in the demand for petroleum is mainly attributed to the growth in transportation networks." And EEA (2012) mentioned that, in the case of Ethiopia, out of the total energy consumption, the share of fossil fuel (coal, oil, petroleum and natural gas) was 6.3, 6.7 and 7.1 percent in 2007, 2008 and 2009 respectively, indicating a slight

increase in the share of fossil fuel consumption of the country. And the share of the consumption of the transport sector from the total fuel import which was 91.2 % in 1997/98 increased to 95.6 percent in 2010/1.1Out of this, inland road transport took about two thirds of the share while the remaining balance went to air transport (EEA, 2012).

As per Afro Consult (2010), Liquid bulk cargo traffic is shipped from Saudi Arabia to the newly built Duraleh petroleum terminal of Djibouti and from Sudanese refinery at ElGeli located 42Kms north of Khartoum then from those sites the petroleum is transport by tankers (on Road transportation) to the hinterland and about 70% of fuel is transported to Addis Ababa out of which about 35% is used in Addis Ababa, the capital city, and the rest is reshipped to other regions of the country. The annual growth of fuel import traffic was estimated to be about 9 to 10% a year, that the transport has no or little logistics problems such as documentation and customs clearances though there was some tanker and depot capacity shortages which need to be expanded (Afro Consult, 2010). As per the data collected from Ministry of Transport by EPSE, the trend of Fuel import in Ethiopia, it has increased in the past 15 years for instance the quantity of imported Gasoil and Jet fuel on 2013/14 has almost tripled than that of the one imported back in 1999/2000 and also as fuel import has cost Ethiopia a foreign currency of USD 2.5 billion in 2013/14 as shown on Table 8.

Table 8: *The top main Imported Petroleum Products by Quantity and Value* (EPSE, 2014)

YEAR	Gasoil (Diesel oil)		MGR (Motor Gasoline Regular)		Jet Kerosene/fuel	
	Quantity (In MT)	Value (In USD)	Quantity (In MT)	Value (In USD)	Quantity (In MT)	Value (In USD)
1997/98	557,640.08	82,348,459.40	122 995.230	22 540 361.86	252 302.07	40 617 202.04
1998/99	542,936.36	62,333,035.10	135 469.490	19 707 422.42	238 835.61	32 900 282.17
1999/00	548,786.85	107,213,620.23	142 526.098	38 178 896.72	224 176.82	51 109 330.12
2000/01	610,834.62	148,077,003.22	129 964.403	39 361 905.00	225 431.23	59 840 896.27
2001/02	623,197.01	121,014,270.34	133 111.340	27 435 401.22	259 786.27	56 175 287.19
2002/03	679,281.45	156,621,192.93	148 555.240	38 708 836.08	259 630,19	64 990 080.43
2003/04	688,527.23	186,232,574.25	130 415.499	40 072 742.57	294 698,82	88 046 666.89
2004/05	773,256.14	315,556,720.43	146 093.952	58 719 743.75	334 637.79	154 533 198.76
2005/06	811,689.20	403,308,004.91	137 192.627	78 146 970.77	370 401.08	217 222 639.47
2006/07	905,477.77	519,146,278.84	143 742.952	84 245 805.13	402 311.32	246 366 769.15
2007/08	1,073,147.75	938,033,763.36	139 093.02	116 129 644.77	482 172.99	449 776 779.48
2008/09	1,203,566.76	750,960,862.34	150 098.794	85 926 963.03	506 497.34	357 984 568.61
2009/10	1,237,921.88	794,090,551.68	155 805.819	106 316 444.65	529 856.58	371 611 037.19
2010/11	1,213,751.30	697,542,180.26	141 397.217	88 941 949.25	558 461.65	303 903 157.23
2011/12	1,206,215.71	1,162,019,125.47	146 670.106	145 723 041.75	535304.32	552 702 487.69
2012/13	1,351,427.87	1,042,712,934.58	195 661.358	171 920 762.12	619 531.92	530 498 174.03
2013/14	1,558,355.48	1,475,554,535.64	211 597.943	211 765 477.18	701 425.01	703 591 737.60

As per EPSE, “Ethiopia is reported to import goods and services valued at USD 12 billion to 14 billion annually. The fuel import bill is reported to constitute 20% of total imports equivalent to USD 2.5 billion. Ethiopia’s economy is currently a “Road Dependent” in which about 90% of freight and 95% of the passenger transport happens by road vehicles which are reported to consume 65% of imported fossil fuels” (Addis Fortune, 2014).

According to EPSE on Sudan Tribune (2013), “Ethiopia imports up to 85% of its annual oil consumption from neighboring Sudan, largely due to its geographic proximity. The article continues in mentioning that the Horn of Africa nation saves at least $10 million in transit related costs per year by using Sudanese oil sources rather than importing from markets further away , such as the Middle East.”

The Afro Consult (2010) report also expressed that, regarding to fuel transport in Ethiopia, “In the future there could be a cheaper alternative of petroleum pipeline and railway in the route which are

considered to be the efficient and least cost modes of transport with respect to the inland road transportation. And the preliminary analysis of developing pipeline indicates that it is viable to build 26 inch pipeline at an estimated cost of USD 500 Million. The study need to be finalized and actions taken to implement the project which in normal cases it is the user who invests, builds and operates pipelines". In fact as per the secondary data collected from ERC (2014), the new Electrical railway is under construction and expected to be completed on Oct. 2015 and will be another alternative of fuel transport. In Ethiopia, the fuel import is currently known to be transported through the land transport only, i.e. '*Transporting a fuel through a fuel*'. The other possible ways of transportation for liquid cargo are Railway and Pipelines.

2.5.1. Rail Road

The usage of the huge railroad trains gives an advantage in a sense that it is possible to carry different kinds of goods by one single train due to the existence of different types of cars. Also Russian scientists Bildman and Prochorov (2000) think that ecological advantage by railroad transport is obvious such as use of electric locomotives has a small environmental impact. At the same time railroad transport uses less human resources in delivery of goods. Only two persons can lead the train in any point. Therefore amount of cargos, transporting in account per one person, which is employed in this process, greater than that in road transport or sea vessel in which crew of medium-size ship, more than 10 people, usually 12-15 crew members (Smyk, 2010). According to Pienaar (2013), even though approximately 75 per cent of rail transport costs are fixed over the short term, the breakeven point between revenue and total cost occurs at a very high level of production i.e. that a large volume of freight services must be sold before a profit can be realized that may imply that a profit can only be realized if there is one incumbent rail operator (a natural monopoly) in the market.

2.5.1.1. The Economies achievable in Rail transport

The Economies achievable in rail transport were discussed by Pienaar (2013) as follows;

a) <u>Economies of fleet size</u>

Economies of fleet size in rail transport are attained through operating long trains, the carrying capacity of which is well utilized, and not simply by operating a large vehicle fleet of wagons and locomotives. In this context, rail transport enjoys the highest level of economies of fleet size of all modes of transport. However, there comes a point where an additional locomotive will be needed with further train lengthening. Demand permitting, logic dictates that several wagons should be added when an extra locomotive is employed to keep the required train and locomotive traction power efficiently in balance (Pienaar, 2013).

According to Pienaar (2013), the economies from operating the longest trains and employing multiply-linked locomotives are that;

- ✓ Only one locomotive crew remains necessary for multiply-linked locomotives;
- ✓ Traffic scheduling and control of a few long trains are simpler and potentially safer than operating several short trains, which in total carry the same payload volume or mass as a single long train; and,
- ✓ The utilization of railway lines increases because the required minimum time headways and following distances between short and long trains differ proportionally less than the difference in train length.

b) <u>Economies of vehicle size</u>

The width of rail wagons is limited by the gauge of the railway line. Efficiency requires that the

same gauge be used throughout the system. The height of wagons is limited by overhead clearances along the way. The length of wagons is limited by their structural robustness to withstand the pressure exerted by payload mass on wagon sections not directly supported by sets of axles and wheels, and by the maximum axle mass loads that railway infrastructure can accommodate. Although the achievement of economies of vehicle size in rail transport is significant, it is in relative terms along with road transport the lowest, resulting mainly from the limits of vehicle dimensions dictated by technical considerations (Pienaar, 2013).

c) Economies of infrastructure extension

With rail transport, the move from a single- to a double-track system may quadruple the capacity of the line by eliminating directional conflict, and a quadruple track should more than double the capacity as it additionally also permits separation by speed (Pienaar, 2013).

d) Economies of distance

In view of the fact that rail transport has relatively high terminal costs, it enjoys substantial economies of distance as trip length increases – the highest of all modes of transport i.e. Ton/Km (Pienaar, 2013).

And Smyk (2010) demonstrated the main disadvantages of railroad transport as:

- The necessity for building of special rails.
- Expensiveness of manufacturing and building rails.
- Necessity to build specialized buildings and facilities for loading / unloading, maintenance, and repair.

Beyond that the less flexibility, less suitable for short distances and the high monopoly of the system are another disadvantage of the railway system.

2.5.2. Road transport

According to Smyk (2010), the most mobile and most convenient, especially for small operations on short and medium distance is road transport but at the same time the most expensive, less environmental friendly and wasteful. Also Smyk (2010) stated that “Road freight transport is the most important form of transport consists of the through transport of goods from factory or warehouse direct to customer’s premises” as the main advantage of freight road transportation is its low level of physical limitation however it has a high maintenance costs, both for the vehicles and infrastructures. Slack etal. (2009) adds to advantages of road transport mode, the fact that the vehicle requires no special handling facilities, and also its mobility allows delivering the goods directly "to the door of the customer” therefore, there is no need to transfer operations from vehicles to other modes of transport. The detailed economy of road transport has been already discussed in section 2.4 mentioning that road transport has economic advantage from fleet size and infrastructure, however it has less economic advantage in case of long distances.

2.5.3. Pipelines

According to Karangwa (2008), Pipeline transportation is transportation of goods such as liquid and gases also any chemically stable liquid or gas can be moved through a pipeline. Countries like Canada and Russia are major producers of crude oil and natural gas and they use pipelines for transporting these products. Karangwa (2008) also demonstrated that a pipeline system includes all parts of the physical facilities through which the product moves, including line pipe, valves, pumping units, metering stations and tanks. As per Pienaar (2013), Pipelines provide their own right of way and since the pipe component, the pumps, the tank and plant facilities are highly specialized and durable, fixed cost constitutes a high portion of the total cost – the highest of all modes (i.e.

approximately 85 to 90 per cent of pipeline transport costs are fixed over the short term) and continuous pumping may take place with no need for any return flow and no materials handling takes place, economies of scale prevail in pipeline transport. And also because of the high capital costs of a pipeline, the financial barrier to entering the market is high (Pienaar, 2013).

Financial stakeholders in pipeline operations tend to consolidate and start with a large initial investment, which tends to yield higher returns, partly because of economies of scale and partly because of inherent performance characteristics for example, a 30 cm pipe operating at capacity transports more than two times the quantity carried by a 20 cm pipe; because area varies in squared diameter ($A = \Pi d^2/4$), which in turn shows the gains from scale are substantial (Pienaar, 2013).

2.5.3.1. The Economies achievable in Pipeline transport

The Economies achievable in Pipeline transport were discussed by Pienaar (2013) as follows;

a) Economies of vehicle size and infrastructure extension

According to Pienaar (2013), Pipeline transport has unique characteristics: the carrying unit (i.e. the 'vehicle') is also the infrastructure. Also on the principle of economies of density (volume), an increase in pipe diameter can result in a lower unit cost. The fundamental relationships involved depend upon the principles of geometry concerning the relation between the surface area of a pipe's wall and its volume. Consider a circular cross-section of a pipe. Because the area of a circle is πr^2, its area increases with the square of the radius. The friction that must be overcome to move a liquid commodity through a pipeline is the friction between the liquid and the wall of the pipe. Therefore, increasing the diameter of a pipe will increase the quantity of liquid in the pipe faster than it will increase the area of the wall of the pipe in contact with the liquid. Consequently, there are gains in economies in the propulsion power required to pump the same quantity of commodity by increasing the diameter of the pipe. There are also economies in the cost of the pipe itself. For larger pipes, the quantity of body steel per unit of pipe carrying capacity is less than for smaller pipes. Pipeline transport does not necessarily require a return journey or return pumping process. This eliminates joint costs. Because cost is incurred without adding value each time goods are handled at a terminal or storage facility, a primary logistics objective is to eliminate handling wherever possible. With the carriage of crude oil and petroleum products by pipeline, this objective is fully met. Commodity intake, haulage and discharge are combined in one process, usually a remote-controlled one. An uninterrupted and prolonged throughput of a large volume of homogeneous product increases economies of density (Pienaar, 2013).

b) Economies of distance

Longer pipelines do not give rise to significant economies of distance, in fact this is almost non-existent – the lowest of all modes of transport. The reason for this is that additional pump stations and more pipes in direct proportion are required for longer distances (Pienaar, 2013).

According to Karangwa (2008), the estimation of the financial costs for the pipeline transport industry is based on the whole pipeline network this includes gathering, transmission and distribution networks and in all these types of pipeline networks, transportation is involved since the product is being moved from one point to another. In the computation of financial cost these three elements were involved: *the cost of physical assets, the operating costs and the opportunity cost of land occupied by transportation infrastructures* (Karangwa, 2008). The pipeline right-of-way can be described as a controlled activity area that includes the surface area directly above the pipeline and some specified distance on either side of the pipeline and must be wide enough to permit the pipeline operator reasonable access to maintain the pipeline and to signal to others the

existence of the pipeline so the right-of-way agreement between the pipeline operator and the landowner specifies activities or developments that are prohibited on the right-of-way without prior approval from the pipeline operator or that may not be allowed at all, for example buildings and other structures (Karangwa, 2008). Karangwa (2008) has also discussed the other issue which is might be similar to the Ethiopia's case with respect to the vast agricultural area which might be exploited for the case of using pipelines for transporting oils, "In agricultural areas, once the pipeline is in the ground, normal agricultural operations may continue unconstrained by the presence of the pipeline. However, deep-rooting vegetation should be avoided, since it could cause damage to the pipeline. Pathways, small playing fields and park areas are generally acceptable. The size of the right of way varies, but is generally a strip of land 20 meters wide which contains the pipeline, while on the either side of the pipeline there is a safety zone that extends a further 30 meters from the right of way, and on which activities are controlled. Generally, activities taking place in the pipeline right of way are restricted." And also it is expected that the opportunity cost of land varies depending on the location of the pipeline, if for example, the pipeline is under agricultural land, the opportunity cost is low since most of the farming activities can carry on but the opportunity cost is higher when the land is residential or industrial because heavy structures above the pipeline are prohibited and a certain number of commercial activities non-involving heavy structures can be allowed above and around the pipeline location (Karangwa, 2008).

Karangwa (2008) used the data of year 2000 in Canada and found out that as pipelines allow transporting very large quantities of gas and oil on very long distances, the unit cost of this transportation activity is very low (almost zero) thus for the gas pipeline transportation sector the unit cost per cubic meter-kilometer is $0.00003 in the base scenario and for the oil pipeline transportation, the unit cost was $0.012 per cubic meter-kilometer.
Finally Karangwa (2008) mentioned these key points;

- Oil and natural gas can be transported by pipeline, road, rail or ship. The most important determinant of the transportation mode is cost effectiveness and accessibility. Gas and oil are transported in large quantities and over long distances. For this reason, pipelines are the most cost effective, energy efficient and safest means of transportation.
- Oil is generally transported by road or rail over shorter distances when it is being gathered from production sites and when it is distributed to consumers. On shorter distances rail or road can be more cost effective when transporting relatively small quantities of the product.

And furthermore, these benefits weakness of pipeline transport were discussed by Capiau (2011). After conducting SWOT analysis; the most significant strengths of the pipeline system- environmental friendly, low noise pollution, reliability, the high delivery speed, low operating cost since the personnel cost is very low. And weaknesses of the pipeline system- High initial cost, different pipeline system needed for different substance groups and its origin and destinations are fixed.

2.5.4. Comparison between mode of transportation for liquid cargo transportation

From the literature review on Pienaar (2013), it was found out that;

- ✓ the cost to transport a unit of freight by air is the highest of all modes of transport, and by road the second highest on long trips.
- ✓ on short trips road is cheaper than rail transport. In view of the fact that rail transport achieves considerably more economies of distance than road transport, road transport becomes gradually more expensive than rail transport for all classes of freight as trip distances increase above approximately 500 kilometers.
- ✓ for trips shorter than roughly 150 kilometers, road transport is virtually always cheaper than rail transport. For all types of goods that can possibly be carried either by road or rail transport

between the same trip origins and destinations, the equal cost distance of the two modes lies between approximately 150 and 500 kilometers.

- ✓ overland pipeline transport is the cheapest mode for those types of commodities that can be transported by pipeline
- ✓ either rail or road transport is the cheapest mode of transport for all those commodities that cannot be carried by pipeline.
- ✓ the total unit cost to carry freight by sea is the lowest of all modes of transport and over equal distances the unit cost in ton-km to carry freight by sea is substantially lower than any of the three modes of land transport;
- ✓ On the principle of economies of density, an increase in pipe diameter can result in a lower unit cost also an uninterrupted and prolonged throughput of a large volume of homogeneous product increases economies of density.

And also it was found out that from the literature review of Capiau (2011), there are several reasons why pipeline transport is often the preferred mode of transport for oil and gas transportation,

- ✓ especially when a liquid or gas has to be transported over a long distance
- ✓ pipeline has almost no noise pollution and is usually put out of sight –laid underground or in remote areas
- ✓ a pipeline is also the least polluting mode of transport in addition a pipeline system has virtually no environmental costs, except for the little environmental costs of construction and operation.

Table 9 shows that of the three basic modes of transport which are Rail, Road and Pipeline, with respect to the cost level Road transport is the highest of Rail and Pipeline transport. For other criteria, it was also found out that;

- Lower Transportation cost level: Pipeline, because it has low operating cost.
- Higher Economy of Vehicle size: Pipeline, because Volume ~ Diameter^2
- Higher Economy of fleet size: Rail, because longest train can be managed with a crew of two people
- Higher Economy of Distance: Rail, because it carries a higher Ton/Km with respect to the two modes.

And with respect to fuel consumption and emission rates for each transport mode there is a higher consumption of fuel (liter/Km) and high emission rate of CO_2 for Road transportation than both Maritime and Rail transport per container hauled (Cenek etal., 2012).

Table 9: *A comparative of the most prominent economic features of the five modes of freight transport* (Pienaar, 2013)

Economic characteristics	Air	**Road**	**Rail**	**Pipeline**	Sea
Cost level	Highest	Second highest	Moderate	Second lowest	Lowest
Cost structure (fixed / total cost ratio)	Balanced (Second lowest, similar to sea)	Lowest	Second highest	Highest	Balanced (Second lowest, similar to air)
Economies of fleet size	Second lowest (similar to sea)	Second highest	Highest (achievable through long trains)	Lowest, non-existent (referring to number of pipes)	Second lowest (similar to air)
Economies of vehicle size	Second highest (similar to sea)	Lowest, although achievement is still significant (similar to rail)	Lowest, although achievement is still significant (similar to road)	Highest (referring to pipe diameter)	Second highest (similar to air)
Economies of distance	Second highest (similar to sea)	Second lowest	Highest	Lowest (additional pump stations required)	Second highest (similar to air)

2.6. Overview on freight transport Infrastructures in Djibouti

The overview of the transportation infrastructures in Djibouti includes specifically the Roads and ports along the international trade route of Ethiopia-Djibouti border to Djibouti port and expansion of other ports.

2.6.1. Djibouti port – Galafi highway/international route

According to World Bank (2013), the routes connecting the Djibouti port to Ethiopia are central to the role Djibouti plays in the region and the lowlands separating Djibouti city from the Ethiopian border are largely arid desert. The older route to Addis Ababa passes through Ali Sabieh and then south into Ethiopia at Dewele, This was the route taken by the railway built at the start of the 20th century and now abandoned but the national highway paralleling the old railway line is used only lightly because some 200 km immediately south of the border with Ethiopia are unpaved (World Bank, 2013).

World Bank (2013) also stated that the main highway to Addis Ababa branches off near Ali Sabieh and then runs west-northwest to the Galafi border crossing, 217 km from Djibouti city; Since around year 2000 the whole highway from Djibouti city to Galafi—flat much of the way—has been paved with asphalt, which explains why it is now the route used by the vast majority of Ethiopian traffic, even though the road distance is about 65 km longer than the southern route paralleling the railway south from Ali Sabieh: i.e. 910 km via Galafi versus 844 km via Dewele. The present condition of the highway within Djibouti varies markedly as shown on Table 10 below in which the route divided into 6 sections. Thanks to financing from the European Union, the most recently rebuilt section, from PK20 to the Grand Bara, is in good condition, except that the shoulders are inadequate, considering the very heavy truck traffic using it and continued strong traffic growth will accelerate the deterioration of the road (World Bank, 2013). As per World Bank (2013), "A useful rule of thumb is that each USD1 in maintenance avoids USD3-4 in later rehabilitation" and the 70 km between Dikhil and Galafi are already truly in need of strengthening.

In regards to construction and present condition, the route can be divided into 6 sections (World Bank, 2013):

Table 10: *Condition of the Djibouti – Galafi route Highway* (World Bank, 2013)

PK (Point Kilometer)	Start and end	Pavement condition
1-12	Djibouti city and suburbs to storage areas at PK12	Fair: 7m asphalt, wide shoulders, level
12-33	Toll collection & weigh station at PK20, to Arta turn-off	Good: 7m asphalt, drop off to gravel shoulders
33-73	Arta-Grand Bara	Good: 7m asphalt + paved shoulders 1.5m,
73-83	Grand Bara-Triangle de Ali Sabieh	V. poor, severely deteriorated AC
83-119	Triangle de Ali Sabieh-Dikhil	Poor: 7m asphalt, deteriorated, frayed edges to 1.5m gravel shoulders
119-216	Dikhil - Galafi border	Fair: 7+m asphalt, 2m gravel shoulder, fords vulnerable to floods

An important question in the World Bank (2013) literature at the time was whether Ethiopia is interested in paving the southern route highway between Dewele and Dire Dawa, which is an earth road of 198 km crossing a desert area. At present, according to The Economist (2014b), ERA has announced that it had signed an agreement with a Chinese firm, CGC (China Overseas Construction Group), to upgrade the highway between Dire Dawa and Dewele which is a three year project in

which China will finance 85% of the project. And the road joins the Djiboutian highway network, providing a direct link with the Port of Djibouti. The Economist (2014b) mentioned that the construction is scheduled to begin shortly to upgrade a 220‑km highway that will speed up land transport time between north-eastern Ethiopia and the Port of Djibouti and also in late August that a new 1billion ETB road project linking Ethiopia's Afar state to Djibouti was 93% complete. It is believed that both of the new road links will help to serve Djibouti's expanding port infrastructure and increase regional trade flows. As discussed above, for Djibouti-Addis Ababa traffic the southern route is shorter than the Galafi route by about 65 km. At the same time, the Ethiopian government already committed to construction of the new railway line in this route, and therefore may have little or no incentive to upgrade the parallel highway at the same time. (World Bank, 2013)

2.6.2. Overview of the ports and freight transport in Djibouti

Djibouti is currently the main seaport for landlocked Ethiopia. Since the war between Ethiopia and Eritrea in 1997-2000, Ethiopia has not used any of the Eritrean ports, even though Assab is located slightly closer to Addis Ababa than Djibouti port. Ethiopia relies heavily on Djibouti, which today handles about 93% of Ethiopia's imports and exports, while Berbera (in northwest Somalia) handles 3% and Port Sudan (in Sudan) 2%. Likewise, Djibouti relies heavily on Ethiopia: 85% of Djibouti's port traffic is in transit to or from Ethiopia. Ethiopia's imports include much of its supply of gasoline, diesel oil, aviation fuel and large quantities of bulk wheat (0.4-0.8 million ton per year) with other foods delivered to Ethiopia by the World Food Program (World Bank, 2013).

According to World Bank (2013), Djibouti port is a world class, deep-water port on the world's busiest shipping lane and in 2011 nearly 17,800 ships passed through the Suez Canal (50 ships per day on average), carrying almost 700 million ton of cargo, Of these ships about 1,500-2,000, that is more than 10%, stopped in Djibouti port. Djibouti's other main economic advantage is that it is well positioned and well equipped to serve as the main seaport for Ethiopia, an economy that is currently growing at about 10% per year and is expected to sustain that rate over at least the next five years(World Bank, 2013). The port of Djibouti PAID (*Port Autonome International de Djibouti*) has had a well-equipped container terminal since 1985 and a dozen berths for bulks and general cargo also from 2000 to 2010 there was considerable investment in the port and substantial improvement of its facilities(World Bank, 2013).

The World Bank (2013) has also mentioned that at Doraleh, just outside Djibouti city, a new oil terminal with deep water access started operating in 2006, and an entirely new container terminal DCT (Doraleh Container Terminal) started operating in 2009 and is operated by a joint venture controlled by the PAID (67%) and the rest 33% by Dubai Port World (DPW) through a 30-year concession contract signed in 2006 also The public-private partnership with DPW, one of the world's leading port operating companies, was central to the development of the Doraleh oil and container terminals in improving the operating efficiency. According to a report by Djibouti port official on EBC, December 2014, 85-90% of Ethiopian imported containerized goods pass through the Doraleh Container Terminal and also the number of average storage days for imported containerized goods has also reduced from 45days to 21 days.

Djibouti port contributes substantially to the Djibouti national economy having direct revenues generated by the port estimated from $65 million to $90 million per year, representing between 20% and 25% of Djibouti government revenues and also modernization of customs procedures in both countries, together with raised fees for storage in or near the port, is causing ever more Ethiopian importers to transport containers all the way to Addis Ababa or to a dry port at Modjo, 60 km short of Addis Ababa, where imports go through customs clearance (World Bank, 2013). Table

11 and Table 12 show that the cost of import and export per container are USD 910 and USD 885 respectively and this cost is lower than that of the Middle East and North Africa.

Table 11: *Trading across Borders* (World Bank, 2015)

Indicator	Djibouti	Middle East & North Africa
Documents to export (number)	5	6
Time to export (days)	20.0	19.4
Cost to export (USD per container)	885.0	1,166.3
Documents to import (number)	5	8
Time to import (days)	18.0	23.8
Cost to import (USD per container)	910.0	1,307.0

Table 12: *Nature of Procedures for import and export for Djibouti* (World Bank, 2015)

Nature of Export Procedures	Duration (days)	Cost USD	Nature of Import Procedures	Duration (days)	Cost USD
Documents preparation	13	295	Documents preparation	11	320
Customs clearance and inspections	2	170	Customs clearance and inspections	2	170
Ports and terminal handling	3	270	Ports and terminal handling	3	270
Inland road transportation and handling	2	150	Inland road transportation and handling	2	150
Totals	20	885	Totals	18	910

As per World Bank (2013), in Djibouti, Ethiopian trucking firms totally dominate the trucking market for transport of goods on the Djibouti-Addis Ababa route. And also Djiboutian truck owners and drivers have a very small share (less than 10%) of this market due to the reason that 200 to 250 Djibouti trucks barely manage to compete with 6,000 to 8,000 Ethiopian trucks and the Ethiopian trucks charge tariffs of about 3 cents per ton-km, which is exceptionally low by international standards, despite the fact that almost all trucks have to return empty because of the severe imbalance between imports and exports (imports have therefore to bear the full cost of the round trip) thus these low tariffs, combined with several other factors, such as Djibouti truckers cannot find return freight from Ethiopia and the Djiboutian buy their trucks in USD, exclude the Djiboutian firms from the trucking market on the route.

Djibouti is highly dependent on Ethiopia, and is expected to remain so because Ethiopia dominates transit traffic through Djibouti, as already noted earlier, a high share (85%) of Djibouti's port traffic is in transit to and from Ethiopia. Ethiopia's GDP (Gross Domestic Product) in 2010 was $24.9 billion, that is, 20 times greater than Djibouti's (in other words, Djibouti's GDP is only 5% of Ethiopia's) (World Bank, 2013). According to The Economist (2014b), Djibouti heavily relies on income generated from its position as a regional shipping hub; the International Trade Centre estimates that Ethiopia's foreign trade through Djibouti amounted to USD 8.4 billion in 2013. The recent improvement of the port and the highway has made the Djibouti route the most attractive to Ethiopia's traders, compared with those serving Berbera and Port Sudan;

2.6.3. Djibouti Ports expansion

According to the report on Djibouti's port facilities expansion to five (Capital Ethiopia, 2014), it was found out that Djibouti launched new port facility construction projects at Doraleh and on the southeast coast in the Arta district at a cost of 470 million dollars and the new investments will increase the number of port facilities in the country to five. According to Capital Ethiopia (2014), Damerjog Livestock Port on the southeast coast and the construction of the new Duraleh multi port project (DMP) are the projects that are intended to relieve the strain on existing infrastructure and accelerate economic development of the region.

It was found out that the DMP project, which is expected to double the port's capacity in Djibouti, should be open for service by the end of 2016. Also in December 2012 Djibouti launched the construction of the third port of Djibouti, the Port of Tadjoura, scheduled to be completed within 33 months from 2013 (i.e. at the end of 2016). This will be another option for Ethiopia and South Sudan, for their import and export activities. Port of Tadjoura will be connected to Ethiopia by road from Tadjoura to Balho and by railway with the Ethiopian town of Mekele. It was also found out that Port of Tadjoura will consist of a quay of about 435 m in length made by a circular cell structure, a typical Ro-Ro terminal about 190 m length, and an embankment of 30 hectares that will have an annual capacity of eight million ton. Currently, Ethiopia is mainly using the Port of Djibouti and the Doraleh container terminal for its import/export activities (Capital Ethiopia, 2014).

2.7. Other ports in the region offer some competition

According to World Bank (2013), competition for Ethiopian imports is essentially limited to Berbera and Port Sudan; Ethiopia does not use Assab at all for political reasons. A recent planning document Growth and transformation plan (GTP) (MoFED, 2010) aims for a 60%-30%-10% split among Djibouti, Berbera and Port Sudan respectively (Table 13). However, today Djibouti's share is more than 90% and likely to benefit in the near future from the more efficient process for customs processing and Berbera is known for the export of livestock but little else; a precondition for greater use will be major rehabilitation works on the road from the port to the Ethiopian border, i.e. within Somalia- which is unlikely as long as Somalia's political situation remains unstable also Port Sudan has a substantial disadvantage because of its long overland distance (1,900 km from Addis Ababa), unless the origin or destination of the goods traded is in northern Ethiopia (World Bank, 2013). With regard to South Sudan, this country is currently served mainly by Mombasa (Kenya) and a transit route via Uganda and the distance from Mombasa to Juba is 2,600 km, whereas the distance from Djibouti is 1,900 km and Mombasa port is often congested and costly, but Kenya is developing a new port at Lamu to relieve it also Ethnic and linguistic ties with South Sudan give Uganda an advantage, including the fact that English is the language of commerce in all three countries (Kenya, Uganda, and South Sudan) plus the trans-Uganda transit route is said to operate satisfactorily without undue impediments, whereas the route from Djibouti via Addis Ababa to Juba is said by an international freight forwarder operating in Djibouti to be "full of obstacles" (World Bank, 2013).

World Bank (2013) affirmed that Djibouti port's competitiveness can be measured not only in terms of cost and time but also reliability and other attributes such as it offers much of what international supply chains seek though handling charges for containers may be on the high side, ocean cargo rates are probably appreciably lower than those to competing ports by virtue of Djibouti's location right on the world's main east-west maritime route, and quick unloading and turnaround of container ships. For instance as per World Bank (2015), the cost of import and export per container are USD 910 and USD 885 respectively which is lower than that of in the middle east and north Africa. However, areas that particularly need strengthening are the skills of service providers (freight forwarders and shipping agents) to operate in the English language, and in mechanical and engineering functions (World Bank, 2013).

Table 13: *Distribution of Ethiopian imports and exports by sea port* (World Bank, 2013)

Sources	Year	Djibouti	Berbera (Somalia)	Port Sudan (Sudan)
Ethiopian Railways Corp	2010 (actual)	93%	5%	2%
Ethiopian Ministry of Finance	2015 (forecast)	60%	30%	10%

And as for the case of future expansion, "Somali officials are reportedly considering a project to expand container capacity at the Port of Berbera, and the Kenya Ports Authority has just signed a

contract to build a port at Lamu, which could create competition for Djibouti in the medium term. That may benefit Ethiopia through exploring also considering different alternatives and opportunities for better advantage of the fast growing Economy" (The Economist, 2014b).

2.7.1. Using Berbera and other ports

As discussed on section 2.7 other ports in the region beyond Djibouti ports which are Port Berbera (Somali), Port Sudan of Sudan and Ports in Kenya offer some competition in the region. As planned on the Ethiopian GTP I (MoFED, 2010) the share of the usage of the ports in the region expected to be of having Sea port utilization ratio of 60:30:10 for Djibouti, Berbera and Port Sudan, respectively at the end of the 2015. Even though, it was also found out that currently Port Berbera handles 3% and Port Sudan 2% of the international trade of Ethiopia (World Bank, 2013).

It was found out that, as per the announcement of ESLSE on EBC (January 03, 2015) the imposed treat to maritime transport by the pirates is improving from time to time and the one of ESLSE vessels trade routes which is at the red sea and Eden gulf has been more peaceful and secured relative to the time before 2011. And due to the new carrying capacity created through the new 7vessels, current improvement of peace and security at Somalia and also the improvement of maritime security on piracy even if the treat is still available; the ESLSE is planning to start giving service on February 2015 using port Sudan and Berbera port once in 15 days for its customers in Ethiopia, Sudan and Somalia. This will strengthen the economic tie between neighboring countries.

2.8. Assessment of Axle Loading in Ethiopia

As per the study conducted on the current outlook and assessment on the possible increase of axle load limit increase on Addis Ababa - Djibouti Highway by ERA road asset management directorate with the consultancy of Afro Consult (2014), the road transport sector is by far the most predominant mode of transportation in Ethiopia handling about 98% of the country's freight and passenger transportation. It consists of about 85,000km of motorized roads and some 450,000 vehicles of all types and the road sector absorbs a big portion of over 20% of annual capital investment and constitutes about 10% of the GDP.

Today most countries of the world including Ethiopia have axle load (AXL) and Growth Vehicle Weight (GVW) limit regulations (Afro Consult, 2014). It is generally accepted that the relationship between vehicle axle weight and the inflicted damage on the design life of the road is not linear but exponential as shown on Equation (1) and that the vehicle overload has serious consequences causing the disintegration and shortening of the design life of the road. "It is similar to an overloaded ship which could sink an overloaded aircraft which could crash and an overloaded/overstressed bridge which could collapse. Therefore the balancing of road strength and vehicle axle load is fundamental for realizing greater freight transport productivity, less road wear and optimal utilization of scarce national resources" (Afro Consult, 2014).

Based on relative damage concept, damage effect of vehicles was found to be dependent on individual wheel loads mentioned on Equation (1) (Alene, 2012);

Damage caused per pass (EF) = $\left(\frac{\text{Axle load}}{\text{ESAL}}\right)^{n}$ …….. Equation (1)

Where; EF represents the Equivalence factor of the damage inflicted

- ESAL represents the equivalent standard axle load of 8.18 ton
- n varies from 3 – 6 and an average of 4.5 is used usually (Afro consult, 2014)

"The COMESA agreement anticipate the harmonization of transport network, vehicle weight and dimension and the rules of operation of road infrastructure to achieve smooth traffic flow, increased regional trade and effective economic integration of COMESA member countries including Ethiopia" Afro Consult (2014). The need for review and reconsider of the axle load limit became necessary, due to these main reasons across COMESA (Afro consult, 2014).

- The exceptionally rapid increase of economic development of Ethiopia and the region.
- The ever increasing production, trade and traffic volume particularly on the routes.
- The development of automotive technology particularly heavy trucks and buses that impact the road pavement and structure and considering the current requests.
- The improved infrastructure design, better construction methods and modern asset management principles and
- The ever-increasing damages on roads by overloaded vehicles which caused serious damage on roads and bridges which increased both road maintenance and vehicle operating cost (VOC)

But the key reasons for reconsideration of new AXL policy in Ethiopia specifically to the nation are mentioned below by Afro Consult (2014);

- It was initiated by the rapid economic development and big growth of route traffic
- Due to the opening of the trucking market by the government which increased competition and aggressive pricing strategies, the operators started overloading which allowed them to carry excess load to assist them to get more profit and/or regain their deficit for empty haulage and low season traffic.
- The pressure was further intensified by the import-export cargo shippers and their agents who began to overloading containers and started to get into a hassle with ERA to allow them carry excess container load beyond the capacity of vehicles and load bearing strength of the road and beyond the international container standards (UNCTAD) in order to reduce their costs, since high load means lower unit VOC/tariff and more profit. Also according to the UNCTAD study, many shippers tend not only overload the 20TEU and 40FEU ISO standard containers but also use larger non-ISO standard containers.

According to Afro Consult (2014), as the consequence of these problems coupled with the inadequate enforcement gave rise to at least three basic problems:

a. Rapid deterioration to road and bridge design capacity condition
b. Extensive overload operations in spite of improved enforcement and
c. The unfair competition between legal and illegal AXL operators

Therefore due to the above reasons and consequences, it required an urgent cost-benefit analysis (CBA) with and without increasing AXL to provide a quick and short-term solution by first recognizing the problem, assessing the possible damage and allocating adequate upgrading, rehabilitation and maintenance funds (Afro Consult, 2014). According to Afro Consult (2014), although Ethiopia and its neighboring countries have their own legal limits for controlling excess load, they all have mostly harmonized their AXL as formulated by COMESA. And the study indicated that none of the regulations are based on systematic optimal cost benefit analysis and as per the existing Ethiopian law, a 6 axle vehicle with allowable 8 ton of front axle and 10 ton on each of the remaining 5 rear axles and can generally carry a maximum load i.e. GVW of 58 ton (Afro Consult, 2014).

2.8.1. Alternatives Considered for Improving AXL and GVW Limits

Based on the result of the cost benefit analysis, the Afro Consult (2014) has explored all possible alternative options and interventions that are required for possible decisions.

1. Doing nothing or postponing decisions and strictly adhering to and enforcing the existing law which is an unthinkable and wasteful strategy in all aspects under the current conditions mentioned earlier.
2. Diverting heavy traffic to other adjacent road(s) if available, but not possible now
3. Shifting heavy traffic to other modes of transport like the railways where it could be possible in the coming 2 to 3 years when the new Addis Ababa Djibouti Railway is completed
4. Strengthening or increasing the thickness of the existing pavement through overlay or reconstruction when the serviceability index reaches the terminal level
5. Implementing a combination of the policy options as the case may be based on optimal traffic distribution which is a domain of the long-term transport planning

2.8.2. Benefit of Improving AXL and GVW Limits

- ✓ It reduces damage to infrastructure – Overloaded Heavy goods Vehicle causes damage to road pavement and bridges with mathematically exponential grows impact.
- ✓ It Improves Road Safety - Decreasing the amount of overloading results in a better traffic safety.
- ✓ It discourages unfair competition – when the compliance with loading regulations increases, it means that more transport operators stay within legal load limits.
- ✓ Reduces VOC which could offset the additional cost of strengthening the road and enables companies to consolidate loads thus reducing the amount of trip and vehicles required to distribute a given quantity of freight, in say Djibouti Port, yielding economic, safety and environmental benefits.

Also increasing track AXL will result in annual saving in vehicle operating cost of 835.60Million ETB (USD 42million) and over 15 Million liters of fuel (Afro Consult, 2014).

2.8.3. Axle load limit improvement

The first recommendations for improving the AXL/GVW and management by Afro Consult (2014) could be presented in three steps:

1. Increasing AXL by 2 ton i.e. from 10 – 12 ton (i.e. 20% increment) for the Addis Ababa-Djibouti route for > 6 axles vehicles.
2. Improving the limits of Tandem and Tridem axles whose distance from the center to center is less than 1300 mm. In nations case when the axle load is increased to 12 ton for single axle the total axle of 6 axle vehicle will be 62 ton (i.e. 12+20+30).
3. Setting limits for the maximum allowable gross vehicle weight (GVW) from 58 – 68. The limit is important especially for bridges and structures. The design of bridges is based on GVW, not individual axle weight as for pavement design but is designed to carry a limited weight of vehicles. Therefore there should be a limit for GVW. The recommendation is 68 ton for gross weight of vehicles (i.e. payload of (22+2)*2 or 48 ton plus tare weight of 20 ton). This means that the payload of a 20TEU container will be 22 ton, the container weighs 2 ton each and truck tare weighs 20 ton. The long span bridge could be strengthened as required.

As per Afro Consult (2014), the other recommendations for effective enforcement of the AXL and GVW requires most of the recent SSATP recommendations based on African and International experience which include the following actions;

1. Improving Legislation: this includes changing size and weight limits, raising axle load limits, increasing penalties, imposing severe prosecution and/or suspending the licenses of persistent offenders and enhancement of road maintenance capacity,
2. Improving Institution frameworks including staff training, employee motivation and improvement of management, equipment and infrastructure. This includes appropriate weighbridges equipment, electronic linking of control stations and Weight in Motion (WIM) systems
3. Reforming licensing: this refers to the reformation of operator, vehicles and drivers licensing system including vehicle type approval, initially applicable to Addis Ababa – Djibouti Route Transport Services.
4. Adopting the COMESA fines system which penalizes the vehicle owner, the driver and the agent and applied administratively without going to the court except for the regular culprits who may lose their licenses.
5. Implementing major controls, initially at the truck importation and licensing stage and then at the origin of cargo loading and terminals where possible. Experience shows that the success factor of enforcement is a combination of strict control and severe penalty of offenders.

3 Methodology

This study is focused on freight transport and the transportation infrastructures along the China-Djibouti-Modjo-Addis Ababa/Ethiopia international trade route and mainly considered containerized goods. The methods followed to achieve the specified objectives include:

- collecting primary data (This includes the interviews and the mini-freight transport survey conducted)
- collecting secondary data (from literatures, journal papers and documents from respective government offices)
- analysis of the data to meet the specific objectives

Table 14: *Description of the Data collected and analysis method applied*

No	Data Collected	Data Analysis	Methods
1	The data for freight rates and voyage time of the sea transportation and inland road transportation was collected from ESLSE Shipping operation and chartering department and from ESLSE "multimodal" transport operation. The other supportive documents were used from different literatures found from the web and respective offices.	Using the freight rates and voyage time taken for each mode of transportation an assessment was done for the unit cost of freight cargo/ton and voyage time of each mode of transportation.	Qualitative and Quantitative
2	The data for the assessment of fuel cargo transportation was gathered from different current literatures available since the aim of the objective was to show which other mode of transport can be effective for oil transportation in terms of cost and feasibility and a primary data of the current fuel transportation for different years from EPSE through Ministry of transport was used as a supportive document.	The literatures were reviewed in order to get an insight on the different mode of transport mentioned on the objective (Rail, Pipeline and Vehicular). And a comparison based on Economy of distance, fleet size and also the rate of fuel consumption and CO_2 emission for each mode were considered.	Qualitative
3	The data for the assessment of the current status of transportation infrastructure such as roads and bridges along Addis Ababa – Djibouti international trade route was gathered from ERA central region/Road asset Management and Eastern Region/Design and Build directorate and a secondary data was used for Djibouti side of the road section. ETRE was contacted for the necessary data on Addis Ababa – Adama Expressway current service status. ERC provided a primary (interview) and secondary data for the new Addis Ababa-Djibouti electrified railway line project which is under construction. For the case of the ports and terminals the necessary current data were collected from Modjo dry port and ESLSE Inland port operation office. Data for Djibouti port was collected from literature: mainly world bank report on 2013 and2015 even if they were limited and not enough. The data for the assessment on axle weight and overloading were collected from Modjo Axle load control station and ERA/Vehicle size and axle load control team leader bureau. And a review project report between Ministry of Transport and ERA on Axle load limit was collected from ERA/Road asset Management.	The data collected for the Roads and Bridges along the route were analyzed as per their current condition with a scale of Good, Fair and Poor. And the capacity of the Modjo dry port and the current handled containers at the port was reviewed based on the data collected. The current status of Djibouti road infrastructures and Port in comparison with the other ports in the area was assessed. The axle load data gathered used to analyze and see the illegal axle loads with in a period of time and the literature reviewed on axle load limit gave an insight on the extent of the damage level caused by overloading on the roads and bridges.	Qualitative and Quantitative

4	The data for identifying the existing freight transport and logistics problem was gathered from the freight transport survey conducted using the questionnaire developed for freight transporters and 3PL/Freight forwarders in collaboration with an interview to some extent. The data for the efforts of the different parties such as ESLSE, ERA and ERCA in the sector were gathered from their respective office through documents and interviews and also other supportive literatures mentioned on the respective section were used.	A very good insight on the existing freight transport logistics problems and believed suggestions were seen from the analysis of the Freight transport survey (questionnaire) conducted on the few transporters and logistic service providers. And the efforts of different major stakeholders such as ESLSE, ERA, Modjo dry port and ERCA was reviewed from the primary and secondary data collected. And the ports expansion in Djibouti was reviewed from the different literatures.	Qualitative and Quantitative

The Questionnaire consists of closed choice or fixed questions and open-ended questions. The sample method taken into consideration was *Simple random sampling:* in which each element have an equal and non-zero chance of selection though random selection does not always produce a sample that is representative of the population. For the cross border freight transporters; as per the interview with Federal transport bureau: Demurrage officer (2015), it was found out that there are 87 associations and companies in the freight transport out of which 66 private associations are classified into smaller groups of 6 different levels from 1A (Trucks of age $\leq$ 10 years with a capacity of loading $\geq$ 30 ton) up to 3B (Trucks of age > 20 years with a capacity of loading < 30ton) depending on the Truck loading capacity and age of the truck they possess. So simple random sampling used to select a participant from each group of the transporters which were believed to give a representative of each group in medium scale since the samples were selected randomly. And the respondents were owner or higher officers in the company rather than an individual driver; because it was believed that a company owner or officer may have an aggregated thought of most drivers in the respective transport company that may enrich the response to the questionnaire relative to an individual driver in the company. For the case of the 3PL, there are about 53 licensed freight forwarding firms and 21 goods-Transit and shipping agents that are members of the Association of Ethiopian Forwarding Businesses (Debela, 2013). In this case currently there were no specific classification among the 3PL therefore another simple random sampling were applied in medium scale to get an insight of the current freight transport and transportation infrastructures with in the nation.

4 Results

4.1. Sea transportation

The analysis and results for the sea transportation can be divided into two parts;

- Freight rates for containerized goods and
- The voyage time taken by the ships from Chinese ports of Tianjin and shanghai to Djibouti port.

4.1.1. Freight Rates for Containerized goods

According to the secondary data collected from ESLSE Shipping operation and chartering department on assessment of new Freight rates (2014), it was found out that ESLSE have been sailing to Chinese ports mainly Shanghai, Tianjin and Qingdao ports to transport 200-400 containers. Table 15 shows the Freight rates of containerized goods on sea transport are presented in each sub-division of the standard 20TEU and 40FEU type containers for the main ports in consideration, Shanghai and Tianjin ports.

Table 15: *List of freight rates for shipping containerized goods* (ESLSE-shipping operation and chartering department, 2014)

No.	Loading port	Discharging port	Freight rates in USD / container	
			20TEU	40FEU
1	Shanghai	Djibouti port	1,315	2,305
2	Tianjin		1,500	2,450

4.1.2. Freight Rate review for Break-Bulk

According to ESLSE Shipping operation and chartering department (2014), it was found out that;

- ✓ the break bulk trade freight from Chinese ports to various regions including the Red sea has attracted some strong Chinese shipping companies who are dictating the freight rates.
- ✓ Chinese shipping companies are giving reduced freight rates though these freight rates may not feasible for them. Their strategy seems to weaken and drive out medium size companies such as ESLSE to position themselves for the long time in the future.
- ✓ review and study of the existing freight rates applied by ESLSE due to the loss in cargo volume from Chinese ports and customers' complaints about ESLSE rates from Chinese and Far East ports,
- ✓ the costs used in the review were crude/simple estimate as there is no audited financial report.

The scope of the review of freight rates is focused for ships deployed between Red sea and Chinese ports particularly between Djibouti and Shanghai and Tianjin ports and surrounding ports for Break bulk and RO/RO.

As per ESLSE Shipping operation and chartering department (2014), it was found out that the objective of freight rate review was;

- to assess the current freight rates applied from two major Chinese ports to Djibouti and make comparison with the market freight rates.
- to possibly make some adjustment on the existing freight rates to attract more volume from the market and thereby improve the current shortage of cargo for ESLSE ships.

Cost build up for ships deployed between Djibouti port and China ports (Shanghai and Tianjin ports) is established as follow;

a) Total Round voyage cost

These assumptions and calculation of Round voyage cot were done by ESLSE-Shipping operation and chartering department (2014) and here for the purpose of this study it has been presented in a tabular form; As seen from Table 16 the total estimated round voyage cost from Tianjin port → Djibouti port → Tianjin port is USD 2,101,720 and total estimated round voyage cost from Shanghai port → Djibouti port → Shanghai port is USD 1,926,520.

Table 16: *Round Voyage cost in between Djibouti port and Tianjin and Shanghai Ports* (ESLSE Shipping operation and chartering department, 2014)

Tianjin port → Djibouti port → Tianjin port	
Description	USD
Fuel consumption at sea = 25 ton/day	25*52*620 = USD 806,000
Fuel consumption at ports = 2 ton/day	2*28*620 = USD 34,720
Daily running cost = USD 5,700	5,700 * 80 = USD 456,000
Daily depreciation and overhead cost = USD 5,000	5,000 * 80 = USD 400,000
*Port expenses at POD & POL	25,000 + 30,000 = USD 55,000
**Average cargo related cost at POD and POL	75,000 + 200,000 = USD 275,000
Agency fee (POD+POL)	25,000 + 50,000 = USD 75,000
Total estimated Round voyage cost	USD 2,101,720

Shanghai port → Djibouti port → Shanghai port	
Description	USD
Fuel consumption at sea = 25 ton/day	25*46*620 = USD 713,000
Fuel consumption at ports = 2 ton/day	2*28*620 = USD 34,720
Daily running cost = USD 5,700	5,700 * 74 = USD 421,800
Daily depreciation and overhead cost = USD 5,000	5,000 * 74 = USD 370,000
*Port expenses at POL & POD	25,000 + 12,000 = USD 37,000
**Average cargo related cost at POL and POD	200,000 + 75,000 = USD 275,000
Agency fee (POL+POD)	50,000 + 25,000 = USD 75,000
Total estimated Round voyage cost	USD 1,926,520

**Ports expenses includes "Pilotage, Port Stay Charges, Mooring/Unmooring, Harbor Dues and Rubbish Collecting".*
*** Cargo related costs includes "Stevedorage/Tally fee/Lashing and dunnage".*

b) Freight Rate

The following assumptions and calculation of freight rate were done by ESLSE-Shipping operation and chartering department (2014) and here for the purpose of this study it has been presented in a tabular form; Ships are loading general cargo including containers, Ro/Ro (Roll on-Roll off) and break bulk cargo. As per Shipping operation and chartering department (2014), the combination of these cargo types is varying from time to time but average cargo mix is as follows;

- Containers (TEU) = 300
- Ro/Ro + Break bulk (Fton) = 21,000 Cubic Meter

Based on those combination freight rates for Tianjin break bulk were found out to be $78.7 / Fton
Note that on the freight rate: weight (Freight/ton) or volume (CBM) whichever is higher will be taken into consideration.

Table 17: *Proposed list of new freight rates for shipping* (ESLSE-shipping operation and chartering department, 2014)

No.	Loading port	Discharging port	Measurement	Size/Volume of cargo (Fton)	Unit cost (USD)
1	Tianjin	Djibouti	W/M*	-Up to 1,000 ton	90
				-Above 1,000 & up to 5,000	85
				-Above 5,000 & up to 10,000	80
				-Above 10,000 & up to 15,000	75
				-Above 15,000 ton	70

2	Shanghai	Djibouti	W/M*	-Up to 1,000 ton	85
				-Above 1,000 & up to 5,000	80
				-Above 5,000 & up to 10,000	75
				-Above 10,000 & up to 15,000	70
				-Above 15,000 ton	65

*__W/M__: "Weight or Measurement "is the basis for assessing freight charges. The rate charged under W/M will be whichever produces the highest revenue between the weight of the shipment and the volumetric measure of the shipment. The comparison is based on the number of freight ton (Fton) the cargo weights compared to the number of cubic meters (CBM) of space the cargo measures.

Similarly, it was found out that the Freight Rate for Shanghai break bulk is $73/Fton. But it was mentioned that, the general market average freight rates from customers Performa and agents, for shipment of Break-bulk by Chinese shipping companies from Shanghai to Djibouti and other Red sea ports range from $55 to $60 per freight ton. It was also found out that ESLSE's existing rates for the same trading routes range from $80 to 95$ per freight ton, which is 45% to 58% higher than the average market rates range, this variation is one of the challenges ESLSE is facing now as per the current report of ESLSE shipping operation and chartering department (2014).

Therefore, the proposed list of new freight rates by ESLSE was shown on Table 17, to be applied as of December 1, 2014. The tariff base was based on weight or measurement (W/M), whichever is higher.

4.1.3. Round Voyage Time

Table 18 shows that , the round voyage time from Tianjin port → Djibouti port → Tianjin port is 80days and total estimated round voyage cost from Shanghai port → Djibouti port → Shanghai port is 74days.

Table 18: *Round Voyage Time in between Djibouti port and Tianjin and Shanghai Ports* (ESLSE-shipping operation and chartering department, 2014)

Tianjin port → Djibouti port →Tianjin port	
Description	Days
Port time at POL	13
Sea time to POD	26
Port Time in POD	15
Sea time to POL	26
Total voyage Sea time	52
Total time in ports	28
Total	80 days

Shanghai port →Djibouti port → Shanghai port	
Description	Days
Port time at POL	14
Sea time to POD	23
Port Time in POD	14
Sea time to POL	23
Total voyage Sea time	46
Total time in ports	28
Total	74 days

Where; POL – port of Loading
POD – port of Discharge

4.2. Inland road transportation

Road transport is the mode of transport that Ethiopia relies on for both domestic as well as international transport services. The imported goods that were discharged at Djibouti port, which were shipped by "multimodal" transport, are going to be transported directly to inland ports through freight vehicles of ESLSE and other private freight transporters on the sector.

4.2.1. Freight rates for containerized goods

It was found out that, similar to the case of the sea transportation, there is also freight rate assigned to the imported containerized freights including containerized goods and break bulk from Djibouti port to the different inland ports. According to secondary data gathered from Modjo Dry port

Planning and ICT Service (2014), it is found out that, more than 200 TEUs full containers per day arrive at Modjo dry port from Djibouti port on average basis through the "multimodal" transport.

Note that Freight Rates for Bulk break were not included in this section because the break bulk is transported from Djibouti to Addis Ababa and other locations through the 'uni-modal' transport system which means it will not be passing through the dry ports; according to the interview with ESLSE "multimodal" transport operation (2014).

Table 19 shows the cost of inland road transportation and Clearance cost at Djibouti for containerized goods in 20TEU or 40FEU container per Fton range from Djibouti port to Modjo dry port and also from Djibouti port to Addis Ababa in USD;

Note that Djibouti to Addis Ababa rate is only applicable for those customers that have customs bonded warehouse, customers classified by customs office as authorized economic operator and whose warehouse is in Addis Ababa and also container to be discharged at Comet (ESLSE Kality Branch office, 2014).

Table 19: *Inland Haulage Freight rate for containerized cargo shipment in USD as of August 11, 2012* (ESLSE-Multimodal transport operation, 2014)

Inland freight rate for 20TEU container in USD								
Shipment type and destinations	Up to 12.5 ton		12.5 - 15 ton		15 - 17.5 ton		17.5 - 20 ton	
	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge
Djibouti port to Modjo port								
Non – IMDG*	596	1044	596	1124	596	1179	596	1204
IMDG & Open Top	716	1044	716	1124	716	1179	716	1204
Djibouti port to Addis Ababa								
Non - IMDG	596	1084	596	1174	596	1239	596	1269
IMDG & Open Top	716	1084	716	1174	716	1239	716	1269
Inland freight rate for 40FEU container in USD								
Shipment type and destinations	Up to 25 ton		25 - 30 ton		30 - 35 ton		35 - 40 ton	
	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge	Djibouti clearance cost	Inland Haulage charge
Djibouti port to Modjo port								
Non - IMDG	976	2084	976	2249	976	2354	976	2409
IMDG & Open Top	1239	2086	1239	2249	1239	2356	1239	2406
Djibouti port to Addis Ababa								
Non - IMDG	976	2169	976	2349	976	2474	976	2539
IMDG & Open Top	1239	2166	1239	2349	1239	2471	1239	2541

**IMDG: International Maritime Dangerous Goods (e.g. explosives, toxic gases and flammable liquids)*

4.2.2. Freight haulage time

And for the case of the voyage time of the inland road transportation from Djibouti port to Modjo dry port, as per the ESLSE "multimodal" transport operation (2014) the first eight days which are counted after the cargo is discharged/unloaded from the ship are called the grace period of which without any storage or demurrage cost that means if a consignee's container may be cleared out of the Djibouti port within those eight days. So it was found out that there will be no cost incurred due to storage or demurrage cost and also from the questionnaire distributed to the freight transporters, it was found that the freight transporters take up to 2days on best performance to reach Modjo dry port under normal condition (No accident/incident and technical problem on the road that may lead to delay). Therefore the average day taken for an inland road transportation to reach Modjo dry port is from 2 – 10 days taking into consideration that the cargo loaded to the vehicle in the eighth day will reach within 2 days (best performance) including the loading and unloading time at both ports too under normal circumstances. Also it was found out that from the ESLSE "multimodal" transport

operation (2014) some number (since the exact number of the containers were not disclosed) of containers may take up to 40days to reach Modjo dry port due to the reason of 'seal of container', i.e. if the seal of the container is broken in the middle of the transfer from ship to inland road transportation, the custom officers will not accept or give the cargo a clearance pass until the containerized items are checked to be on place; because the seal is used to protect the containerized items from being stolen or tapped with other illegal stuffs.

4.3. Assessment between Sea transport and that of Inland road transportation

The assessment in between the sea transport from China ports to Djibouti port and that of that inland road transportation from Djibouti port to Modjo dry port can be done in terms of the freight rates and the voyage time for each mode of transport.

4.3.1. In terms of Freight rates

It was found out that, the freight rates comparison in between the sea transport from China ports (i.e. Tianjin and Shanghai ports) to Djibouti port and that of inland road transportation from Djibouti port to Modjo dry port. An average value with applying a standard deviation for the inland road transportation cost (Djibouti clearance cost and inland Haulage cost) of the Djibouti port – Modjo dry port which is in different freight ton range was calculated. For each type of container; i.e. an Average freight rate of USD 1,733.75 for Non-IMDG and USD 1,853.75 for IMDG/Open top containerized goods with in 20TEU container. Whereas for the case of 40FEU the inland freight rate shall be USD 3,250.00 for Non-IMDG and USD 3,513.25 for IMDG/Open top containerized goods.

Table 20: *Freight rate comparison between Inland and sea transportation of containerized goods*

No.	Loading port	Discharging port	Freight rates in USD / container	
			20TEU	40FEU
Sea Transportation				
1	Shanghai	Djibouti port	1,315	2,305
2	Tianjin		1,500	2,450
Inland road transportation				
3	Djibouti	Modjo dry port	1,734 – 1,854	3,250 – 3,513

Table 20 and Figure 2 showed that the comparison of the sea transportation and inland road transportation for containerized goods from China ports (Shanghai/Tianjin port) to Modjo dry port via Djibouti port. So it was found out that the cost of transporting 20TEU container on sea from Chinese ports of Shanghai and Tianjin to Djibouti port is USD 1,315 and USD 1,500 respectively. And similarly for 40FEU container from Chinese ports of Shanghai and Tianjin to Djibouti port USD 2,305 and USD 2,450 respectively. Whereas the cost of inland road transportation per container of 20TEU and 40FEU container from Djibouti port to Modjo dry port ranges from USD 1,734 – 1,854 with Standard deviation (STDev) of USD 70 from their average value and USD 3,250 – 3,513 with standard deviation of USD 143 from their average value respectively.
Therefore the sea transportation cost is USD 1,315 and USD 2,305 per 20TEU and 40FEU containers shipped from Shanghai to Djibouti. For shipment from Tianjin, it costs USD 1,500 and USD 2,450 per 20TEU and 40FEU containers. The cost of land transportation from Djibouti to Modjo dry port varies USD 1,734 to USD 1,854 per 20TEU and USD 3250 to USD 3,513 per 40FEU container

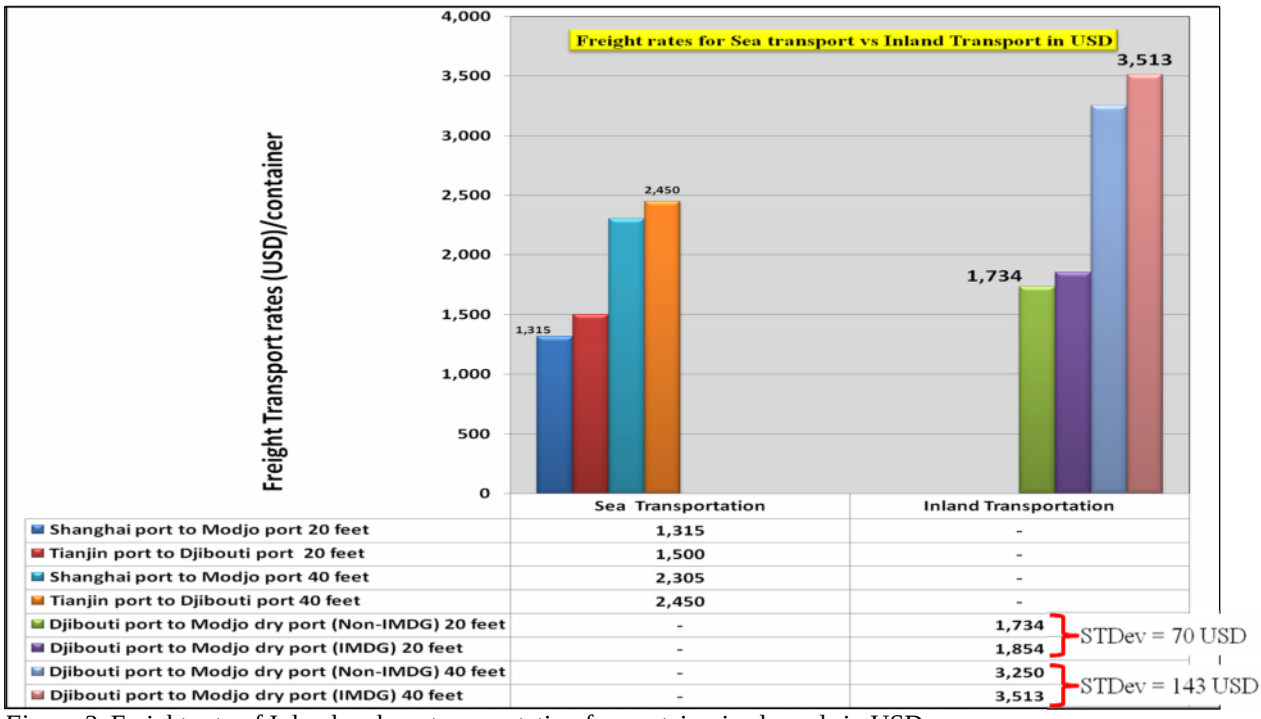

Figure 2: Freight rate of Inland and sea transportation for containerized goods in USD

4.3.2. In terms of Voyage Time

As mentioned earlier on section 4.1 ,for the case of the sea transportation from China ports to Djibouti port, the round voyage time taken by the MV ships is found out to be as follows;

i. Total Round voyage time = 80 days for Djibouti – Tianjin (i.e. 40 days for one way)
ii. Total Round voyage time = 74 days for Djibouti – Shanghai (i.e. 37 days for one way)

Whereas as it's hard to concurrently tell the voyage time without a detailed data for better accuracy but it can be estimated based on the data from ESLSE "multimodal" transport operation (2014) and the questionnaire survey conducted on freight transporters to take 2 days to 10 days based on performance and also under normal circumstance even though for the case of some containers it should be noted that it may take up to 40days to reach at Modjo dry port due to the container seal breakage.

4.3.3. In terms of Economy

As seen on literature review section 2.4, the sea transport enjoys substantial economies of distance as voyage length increases and little economies in terms of fleet size. And the Road transport enjoys some economies of fleet size and also infrastructure relative to the sea transport in this case. And also it was seen that Road transport doesn't enjoy significant economies of distance at all.

4.4. Freight transport infrastructures

Transportation infrastructures in Ethiopia which are going to be assessed with respect to the freight transport (inland transportation) includes: roads, Bridges and dry Ports.

4.4.1. Roads and Bridges along Addis Ababa - Djibouti Border(Galafi) route

According to the secondary data collected from ERA-road asset management directorate (2014), there are 12 different routes connecting Ethiopian cities to Djibouti border including their optional

routes. Here we are only interested on the main route that connects Addis Ababa to Djibouti border via Modjo and also the other main route stretching from Addis Ababa to Djibouti border via Dessie and Semera is shown as an illustration.

Table 21 shows the road length and condition of the route from Addis Ababa to Djibouti border stretching a total road length of 701Km. As seen on Figure 3, the road conditions were classified to three parts which are Good, Fair and Poor by ERA Road asset management Directorate bureau (2014) based on the current status of deterioration, Index of roughness (IR) and service period. It was found out that 13% of the road is in poor condition.

Table 21: *Roads Length and condition of Addis Ababa - Djibouti Border route* (ERA-Road asset Management, 2014)

Segment Name	Road Length (Km)	Condition (%)		
	Total paved Road	Good	Fair	Poor
Addis Ababa - Djibouti Border (Option 1)				
Addis Ababa – Modjo	79	40	25	35
Modjo - Adama	19	55	20	25
Adama - Metehara	84	50	30	20
Metehara - Awash junction	46	55	20	25
Awash junction - Gedamitu	90	*Under Maintenance*		
Gedamitu - Gewane	57	*Under Maintenance*		
Gewane - Undufo	48	70	15	15
Undufo - Adaitu	70	70	15	15
Adaitu - Mille	30	75	15	10
Mille - Semera	66	80	20	-
Semera - Serdo	40	80	20	-
Serdo - Hanef	55	80	20	-
Hanef - Galafi	17	70	30	-
Sum	**701 km**			

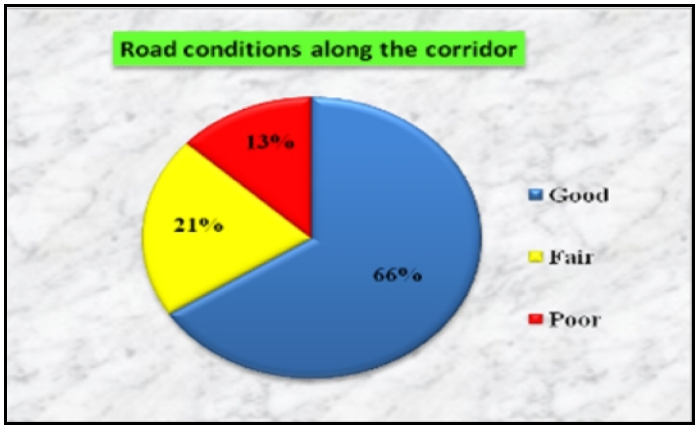

Figure 3: Road conditions along Addis Ababa and Ethiopia-Djibouti border (Galafi) route

According to the secondary data collected from ERA-road asset management directorate (2014), there are 275 different types of Bridges along the Addis Ababa to Djibouti border via Modjo trade route. It's difficult to analyze and show each one of the 275 bridges on this report but on Table 22 below shows the bridges within the segment of each road along the route with the current condition of the bridges and the total average damage % within the span.

Table 22: *Bridges condition on Addis Ababa - Djibouti Border via Modjo trade route* (ERA-Road asset Management/Bridge Management Team, 2014)

No	Segment	Road Length (Km)	No of Bridges	Total Weighted average Damage %	No of Bridges		
					Good	Fair	Bad
01	Addis Ababa – Modjo	79	12	12.83	3	7	2
02	Modjo - Adama	19	8	8.19	5	3	-

03	Adama - Metehara	84	13	13.73	5	3	5
04	Metehara - Awash junction	46	4	10.58	2	2	-
05	Awash junction - Gedamitu	90	31	17.98	5	11	15
06	Gedamitu - Gewane	57	39	14.09	12	18	9
07	Gewane - Undufo	48	11	15.57	5	1	5
08	Undufo - Adaitu	70	11	24.38	1	3	7
09	Adaitu - Mille	30	10	25.73	2	3	5
10	Mille - Semera	66	35	5.3	34	1	-
11	Semera - Serdo	40	5	8.53	2	1	2
12	Serdo - Hanef	55	33	8.38	23	8	2
13	Hanef - Galafi	17	63	9.6	46	8	9
Total		**701 km**	275	-	145	69	61

It was found out that the level of weighted average damage on the bridges extends from 8% to 24%. Also presumed from Figure 4;

- ✓ 53% of the 275 bridges along the Addis Ababa-Djibouti border via Modjo route are in a good condition
- ✓ 25% in fair condition whereas
- ✓ 22% of the Bridges are in a bad condition.

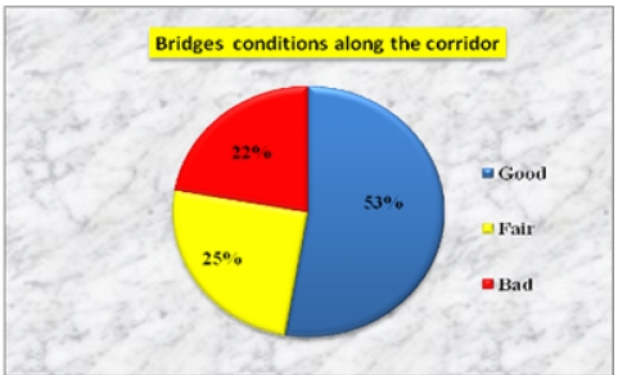

Figure 4 : Bridge conditions along Addis Ababa - Djibouti route (Galafi)

4.4.2. Addis Ababa - Adama Toll road

It was found out that the old Addis Ababa – Adama road;

- ✓ has the highest AADT comprising about 50 percent heavy trucks and due to the poor condition of the road in most engineering characteristics, trucks are delayed causing a significant economic damage to the country and passengers are adversely affected from congestion and road accidents (Scott Wilson Group, 2007).
- ✓ It is a 2-lane highway for most of its length and the road currently experiences high traffic flows especially in the satellite towns of Tulu Dimtu, Gelan, Dukem, and Debre Zeit (Scott Wilson Group, 2008).
- ✓ passes over a hilly/mountainous terrain which imposes a geometric restriction (Scott Wilson Group, 2008).
- ✓ efficient operation of a 2-lane highway depends on the ability of faster vehicles to overtake the slower ones, and this involves the use of the opposite lane in the absence of climbing/overtaking lanes and also as volumes and/or geometric restrictions increase, the ability to pass decreases. This resulting in the formation of platoons in the traffic stream. Motorists in these platoons are subject to delay because of the inability to pass (Scott Wilson Group, 2008).
- ✓ traffic levels for 2004 on the Addis Ababa-Adama existing old road has an AADT of 19,000 which was above Design Standard one (DS1) shown on Annex 1 and also consisting of 40-52% heavy vehicles therefore it was necessary to upgrade the road to the higher level of road class.

According to the interview and secondary data collected from Ethiopian Toll Roads Enterprise (ETRE) Planning and Engineering Directorate (2014), it was found out that the new Addis Ababa – Adama Toll road;

- ✓ Expected to carry up to 20,000vehicles/day at year of opening.
- ✓ It is 84.7 km long and 31 meters wide being the first toll road in the country
- ✓ expected to improve the transportation dissatisfaction in one of the nation's busiest routes.

- ✓ as part of the route to the port of Djibouti, the six-lane road will also play a key role in fostering the import and export business.
- ✓ the Ethiopian government stated that it intends to extend the road to Awash Arba in Afar regional state, some 240 km east of the capital Addis Ababa in the future during the inauguration of the toll road.

Figure 5: The Addis Ababa-Adama Toll road (Open sources (left) and Author of thesis captured)

- ✓ Can serve 6 vehicles on its 6 lanes for both directions. The three lanes at each flow direction are classified basically as;
  a) Truck Lane : 60 – 80 Km/hour (especially for heavy vehicles)
  b) Passenger car Lane : 80 – 100 Km/hour
  c) Overtaking Lane : 80 – 120 Km/hour
- ✓ a median of 3.5m wide covered with vegetation, which gives aesthetics for the road section and also compensates the CO_2 emitted from the Vehicles and also the median is guarded by rails.
- ✓ has been fenced around to prevent the entry of pedestrians and animals and also for smooth traffic flow.
- ✓ Lay-bay in 3Km range for vehicles with technical problems
- ✓ 43 over pass and 34 under pass bridges for Toll road crossing vehicles and pedestrians were constructed.
- ✓ Have 7 toll booth stations with a total of 19 entry and 29 exit doors.
- ✓ own three load control stations at Tulu Dimtu, Modjo and at Adama exit.
- ✓ the travel time from Tulu Dimtu to Adama and Vice-versa will only take 45mins and less.
- ✓ Possess 60 surveillance cameras.

4.4.2.1. Current status of Addis Ababa-Adama Toll Road

According to the interview with ETRE - Head of Planning and Engineering Directorate (2014), it was found out that the Toll road has opened to traffic on September 14/2014, since then the average daily traffic is 9,500 ADT and earning of 300,000 ETB per day on average. Table 23 shows the data for months of November and December 2014. The average passing time for a vehicle at the toll booth is 3 - 15 seconds (entering and exiting respectively).

Table 23: *Traffic flow and revenue on the Toll road* (ETRE, 2014)

Month	Total Traffic Flow of vehicles	Average Cash Collection per day (ETB)	Average Traffic Flow (Vehicles per day)
November	271,402	297,243	9,047
December	306,264	316,607	10,208

It was found out that, ETRE- Planning and Engineering Directorate (2014) conducted a traffic survey on the old road after weeks of the opening of the Toll road for traffic. It was found out that ADT on the old road (Akaki) was 11,074 which is still higher and is 55% compared to the 20,000 vehicle per day estimation mentioned above. This still shows the Toll road is yet to be utilized well.

According to the interview with ETRE-Head of Planning and Engineering Directorate (2014), currently the Addis Ababa-Adama Toll road is encountering these challenges;

- The first encounter is that the Toll road being 3 months old it's only being used by 9,000 ADT even if it was expected to serve 20,000 ADT in the year of opening. Here it was noticed that a maximum of 13,000 ADT was registered on Ethiopian Orthodox Christian Holiday celebration at Orthodox Church of Kulubi located in Eastern part of the country.
- According to the survey conducted on the old road by ETRE in November 2014, 50% of the vehicles (mostly mini-buses and heavy vehicles) avoiding the Toll road think the tariff is too high.
- A number of horrific accidents and incidents mainly due to the poor experience and reluctance of the drivers. These incidents and accidents led to the damage of the station facilities.
- There was a problem related to entrance narrowness at the toll booth for heavy vehicles which led to damage of the expensive toll booth separator polls even if the design is standard, this also pointed out to the experience of the drivers on site.
- Even if the average passing time for a vehicle at the toll booth is 3 - 15 seconds, there can be prolonged passing time when entering if the road user doesn't make the right entrance to reach for the ticket from the toll booth operator. And also when exiting some drivers do not come with money change, which makes the passing time a little bit longer till a change is given back to the driver.
- Electric problems for the function of the station facilities, Generator couldn't handle it.

a. Benefits of Addis Ababa - Adama Toll road

According to the Interview with ETRE- Head of Planning and Engineering Directorate (2014), the new Addis Ababa-Adama Toll road as a new transportation infrastructure will provide the following main advantages,

- A quick access to Djibouti port for import-Export trade in maximizing the efficiency of the freight transport in minimizing the extreme delay on the old busy route.
- Reduce the travel time (Tulu Dimtu to Adama) from almost two hours to 45mins.
- Allow the road users to drive in freeway speed with maximum of 120Km/hr which is too impossible in the old road.
- The Road length from Addis Ababa to Adama will be shortened and Relieve the old road.
- Maximize on time delivery of imported goods to the importers by an hour difference from the old road.
- Also the exporters benefit in delivering their exported items on time to their customers.
- Also increase the number of trips from and to Djibouti port, also from Modjo dry port, so that freight vehicles can clear the imported containerized goods which in turn minimize the accumulation and congestion of imported containerized goods at the Dry port.
- Furthermore, contributes highly to the fast growing economy of Ethiopia.

Referring Table 24 it was assessed;

- V2 (Mini-Bus) : Toll charge = 76km * 0.66 ETB/km = 50.16 ETB
  Benefits in ETB = 90 ETB ($4.5) with respect to the toll charge
- V6 (Heavy vehicles, 6 axle) : Toll charge = 76km * 0.92 ETB/km = 69.92 ETB
  Benefits in ETB = 180 ETB ($9) with respect to the toll charge

Table 24: *Toll price and Benefits by the toll road to the road users* (ETRE, 2014)

Type of Vehicle	Saved time (ETB/76 km)	Saved Fuel (ETB/76 km)	Total Saved ETB	Normal Toll price ETB per Km
V1 (e.g. Automobiles)	15	71	86	0.66 birr
V2(e.g. Mini Bus)	15	75	90	0.66 birr
V3(e.g. Midi-Bus)	14	90	104	0.66 birr
V4(e.g. light Trucks)	14	136	150	0.79 birr
V5(Heavy Vehicles, 4 axle)	30	143	173	0.92 birr
V6(Heavy Vehicles, 5 axle)	30	150	180	0.92 birr
V7(Heavy Vehicles, ≥6 axle)	30	153	183	0.92 birr

Note: For simplicity the payment at the toll booth is approximated to multiples of 5 ETB.

From these two simple illustrative examples it was found out that V2 will pay only 55% of the benefits achieved. And for the other case of V6 will pay 38% of the benefit. These two cases show that the toll charge is too small compared to the benefits achieved and also it benefits Heavy vehicles more than that of the Light vehicles, which in turn means as much as the freight transport vehicles use the toll road that might benefit the freight transport in reducing the cost of transportation and also saving the vehicle operating cost incurred on the busy route.

b. Future plan for Addis Ababa-Adama Toll road

According to the interview with ETRE- Head of planning and Engineering Directorate (2014), it was found out that these are the main plans for the Toll road;

- To increase the number of road users by creating awareness about the benefits mentioned above by using the Toll road;
- To prevent the horrific accidents through creating awareness and educating the drivers (especially of the public transports and the heavy trucks) on how to use the Toll road safely.
- Three additional pre load control stations with alternative roads for heavy vehicles.
- Building recreational centers at some stations
- Identifying black spots of accidents and putting traffic signs and reflectors.
- Preserving the green area in the median by using dripping irrigation system.
- Taking care of the Electric problem with the respective government office.

4.4.3. Awash River crossing bridge

According to the interview with ERA's Engineering team on the Awash Bridge (2014), it was found out that the old Awash River Crossing Bridge;

- ✓ serving for the past 40years with 20,000 vehicles/day as part of the Addis Ababa – Djibouti international trade route, which accounts for 90% of the Import-Export trade,
- ✓ only one vehicle pass at a time as seen on Figure 6.

So ERA launched a project for the replacement of the old Awash Bridge in 2012. The technical details of the new Awash Bridge as per the interview with ERA-Engineering Team on the Awash Bridge (2014) were presented on Table 25;

Table 25: *Technical specification of the new Awash river crossing bridge* (ERA-Engineering Team on the Awash Bridge, 2014)

Type	Pre-stressed concrete 3 span continuous box girder bridge
Length	145 m
Width	9.3 m (Effective Width = Shoulder + Carriage way)
Surface Type	Asphalt pavement
Abutment	Two in number (Reverse T types)
Pier	Two in number (Rectangular with Spread foundation)
Access Roads	Two roads stretching total of 935m and effective width of 12.3m
Load Carrying capacity	40.8 ton

According to ERA-Engineering Team on the Awash Bridge (2014), it was found out that the reasons behind the construction of the new Awash Bridge are;

- The life span of the 40 years old bridge
- The traffic congestion created around due to the long waiting time to cross which was one vehicle at a time.
- The growth of traffic flow on the Addis Ababa-Djibouti trade route and also the need for more tonnage (load) to cross at a time.
- And mainly the Awash Bridge is essential transportation infrastructure of the 90% of Import-Export trade route of the nation.

From the interview with ERA-Engineering Team on the Awash Bridge (2014), It was found out that the new Awash River crossing Bridge mainly will provide;

- ✓ a quick access to Djibouti for import-Export trade in maximizing the efficiency of freight transport,
- ✓ minimizing time of delivery and also increase the number of trips
- ✓ contributing highly for the growing Ethiopian economy

Beside that Table 26 shows the comparison between the old and new Awash River crossing Bridge with an additional advantages offered.

Figure 6: The old and the new Awash River crossing Bridges (www.skyscrapercity.com and www.ena.gov.et)

Table 26: *Benefits of the New Awash Bridge with respect to the older Bridge* (ERA-Engineering Team on the Awash Bridge, 2014)

Description	*Old Bridge*	*New Bridge*
Vehicle Passing	Only one vehicle at a time	Two vehicles at a time
Crossing time	Waiting time up to 3minutes to hours	No waiting time at all
Load carrying	36.6 ton	40.8 ton
Traffic flow	Congestion due to waiting	No Congestion at all
Crossing Speed	20Km/hour	Up to 85Km/hour

4.4.4. Addis Ababa - Djibouti Railway Project

According to the interview with ERC-Addis Ababa/Sebeta-Mieso-Dewele project officer (2014), the transportation infrastructures along the route of Djibouti to Ethiopia is of land transportation type since Ethiopia's rail route between Addis Ababa and the Port of Djibouti is deteriorated and has fallen into disuse. Thus a new railway is currently under construction.

According to the secondary data collected from ERC-Addis Ababa/Sebeta-Mieso-Dewele project office (2014), it was found out that the new Addis Ababa-Djibouti railway project has a total length of 666.4Km has been started in February 2012 with a revised contract sum of USD 3.2 billion and it is conducted in two main sections and 16 sub-sections;

a) Addis Ababa/Sebeta – Meiso which stretches 327.3 Km is being constructed by CREC (China Railway Engineering Corporation) of China and

b) Meiso – Dewele/Djibouti border which stretches 339.1 Km is being constructed by CCCC of China

It was found out that, the first one was started in Feb 2012 and expected to be completed on August 2015 while the second one was started in April 2012 and expected to be completed on October 2015 (ERC, 2014).

4.4.4.1. Features of the Train

According to the interview with ERC-Addis Ababa/Sebeta-Mieso-Dewele project officer (2014), it was found out that the new railway;

- ✓ is mixed type meaning Passenger and Freight transport (Both dry cargo and Fuel) train with their own locomotives in one line,
- ✓ works in Electrification unlike the old one which was working with fuel. Table 27 shows the main technical index about the mixed type locomotive,
- ✓ the train locomotive is of Chinese technology,

According to the manufacturer of the locomotive, Dalian locomotive and rolling stock co. ltd. (2012), it was found out that HXD3C electric locomotives are the self-made high power locomotives manufactured by Dalian locomotive and rolling stock company on the basis of a new technical platform. And the main difference between HXD3C locomotive and other types of locomotives is that this locomotive is suitable for both passenger and freight traction performance and become the much-needed traction power for present rail transportation.

Table 27: *Addis Ababa-Djibouti railway project technical requirements*, (ERC, 2014)

Technical Index	Value of Technical Index
Locomotive type	Passenger locomotive: HXD3C series; and Freight locomotive : HXD3B series (AC – DC – AC Type)
Traction mass	3,500 – 4,000 ton
Type of traction	Electric traction
Electrification	Two loops of independent 132 KV incoming power supply is required for each traction substation and two loops independent 15KV power supply is required for each substation building.
Railway class	Chinese National Railway Grade II standard
Design Speed	120 Km/hour for passenger train 80 Km/hour for freight train
Travel time	8 hours for passenger train and 10 hours for freight train, considering the stops at stations.

It was also found out that, the locomotive features in high power, low energy consumption, high intelligent and convenient for repair and maintenance, etc. (Dalian locomotive and rolling stock co. ltd., 2012).

Figure 7: The Future HXD3C passenger and HXD3B freight locomotive (Dalian Locomotive and Rolling Stock Company, 2012)

4.4.4.2. The advantages of The Addis Ababa-Djibouti Railway Project

From the interview with ERC-Addis Ababa/Sebeta-Mieso-Dewele project officer (2014) it was found out that the new Railway line will be beneficial in the following aspects;

- ✓ Satisfying the national demand for Railway
- ✓ For the rapid social and economic growth of the nation.
- ✓ Uses the Green technology transport system (Electric powered railway system)
- ✓ Will support and improve the importing and exporting freight transport system
- ✓ Creating job opportunities
- ✓ Will improve the inland road transportation system in relieving the freight transport on the roads currently with a travel time of 8 hours per trip which is much better from the almost two days taken by the inland road transportation (Djibouti port – Addis Ababa);

To calculate the possible replacement of containers transported on inland road transportation; it's not easy to know the exact number of train cars (wagons) the freight locomotive is going to have. But as per the study from New Zealand Transport Agency 40 containers (double stacked) was selected since New Zealand's rail network specifies that the maximum number of wagons allowed per train is 20 (i.e. 2x20 = 40 TEU)" for single stack per wagon(Cenek etal., 2012). In Ethiopia's case since the railway line is fully electrical the clear height for double stack containers may not be achievable; therefore it is better to stick with the freight cars with a single stack per wagon of the freight locomotive for the container transport.

4.4.4.3. Estimating the number of freight wagons on the new HXD3B freight locomotive

GIVEN: Traction mass of 3,500 - 4,000 ton and weight of locomotive is 150ton (Dalian locomotive and rolling stock co. ltd., 2012)

I. Assuming a flat wagon of standard two axles and a 40FEU container having a gross load of 30.4ton with a length of 12.2m (See Annex 2).
II. According to International Union of Railways (UIC) to standardize flat wagons class of *UIC 571-1: Ordinary two-axle wagons,* the un-laden (unloaded) weight of ordinary standard two axle wagon varies from 13.5 up to 17.5 ton (UIC, 2004).
III. The total weight (including payload) of a wagon is then be on average (30.4+15.5) ≅ 46ton/wagon
IV. Taking the traction mass of minimum 3500 ton the related number of 46 ton wagon will be approximately 76 in number;
V. Therefore 76 wagons imply the train can haul 76 FEU containers;
NOTE: as discussed earlier in Ethiopia's case the electrified railway will be combined type meaning possessing both freight and passenger locomotives and it's hard to tell the number of wagons that might be assigned by the operator ERC for each locomotives. The freight is also sub-divided into Bulk, containerized and liquid cargo. The other point to be considered is also the weight limit on the axle is yet to be known.
VI. Assuming that 90-10% combination of the Freight to Passenger ratio, since the freight transport along the route is the critical reason behind the railway plus a single number of passengers wagon may handle as many passengers as a big public bus.
VII. Thus the share of the freight wagons will be approximately (76*90%) = 68 wagons
VIII. From the current studies on Figure 1(Afro Consult, 2014) containerized goods account from 50%-87% (average of 68.5%) in import-export trade. Therefore taking these into considerations the share of the container wagons will be approximately (68*68.5%) = 47 wagons of FEU containers.
IX. In considering the assumptions made on the previous steps, the Electrical combined railway may haul 47 wagons of 40FEU containers which is equivalent to 94 TEU containers per trip. This

value may increase if the traction mass is fully considered and if the passenger freight wagon is reduced.

Thus from the assessment and assumptions considered, it was found out that the new railway hauling 94TEU may replace an equivalent of 94 vehicles with their trailers (if any) of inland freight transport at least. When the inland road transportation operating fully with fuel is replaced with eco-friendly transport of the Railway line for containerized goods transport, the fuel saved which would have been consumed by the 94 vehicles replaced and also the Kg of CO_2 which would have also have been emitted to the atmosphere if they were transported on inland road transportation of trucks per one trip.

4.5. Modjo Dry Port

From the literature review on Debela (2013), it was found out that Dry ports could handle many activities such as customs clearance, temporary storages, transshipment of goods, stuffing and un-stuffing of containers, consolidation of less than container loads and maintenance and repair of containers. Also the full implementation of Modjo and other dry ports like Comet (Kality Branch office), Gelan, Kombolcha, Mekele, Dire Dewa and Semera will have big impact in reducing sea port and transit costs like the storage cost incurred in foreign currency at Djibouti ports (Debela, 2013).

According to the ESLSE (2014), currently ESLSE is administering seven dry ports including Modjo dry port and it was found out that main Services given at the Dry port are;

- ✓ Handling the import-export goods
- ✓ Loading and unloading import-export goods
- ✓ Containerizing goods and Unpacking containerized goods
- ✓ Serving as a temporary storage place
- ✓ Giving weigh bridge service
- ✓ Container wash and maintenance service
- ✓ Custom clearance service
- ✓ Banking and Insurance service

Table 28*: Full containers In and Out of Modjo Dry Port* (Modjo Dry port Planning and ICT Service, 2014)

Date	Full Container						Total TEUs in the port at the end of the month (To date)
	In			Out			
	20TEU	40FEU	TEUs	20TEU	40FEU	TEUs	
Aug. 7 - 31/2014							9,448
total	3,002	1,593	6,188	3,028	1,579	6,190	
Average (per day)	121	64	248	122	64	248	
Sept. 1 - 30/2014							8,691
total	2,961	1,547	6,055	2,884	1,771	6,426	
Average (per day)	99	52	202	97	60	215	
Oct. 1 - 31/2014							9,316
total	3,500	2,015	7,530	3,329	2,008	7,345	
Average (per day)	113	65	243	108	65	237	
Nov. 1 - 30/2014							8,461
total	2,725	1,732	6,189	3,069	1,921	6,911	
Average (per day)	91	58	207	103	65	231	
Dec. 1 - 30/2014							9,107
total	3,670	2,610	8,890	3,316	2,359	8,034	
Average (per day)	123	87	297	111	79	268	

	Full Container IN (TEUs)	Full Container OUT (TEUs)
TOTAL (Aug. 7/2014 – Dec. 30/2014)	34,852	34,906
Average per day (Aug. 7/2014 – Dec. 30/2014)	239	240

As seen on Table 28, it was found out that 239 TEUs full containers were transported on average that in turn means there were more than 200 trucks and trailers involved in transporting them to the Modjo dry port daily. Also it was known that there are 9,107 TEUs full containers in the premise of the Modjo dry port at the end of December/2014 which are also 341 TEUs lesser than that of at the end of August/2014, which means the number of containers stored at the port has declined in 4% during that period even if the reduction was more that of November which was 10% with respect to the one in August 2014. As per Table 28 the number of checked in and checkout containerized goods per day for August month were almost balanced though those that are stored at the dry port for long period of time due to different reasons have not been cleared. The reasons for the congestion of containerized goods are explained on section 4.9.2.

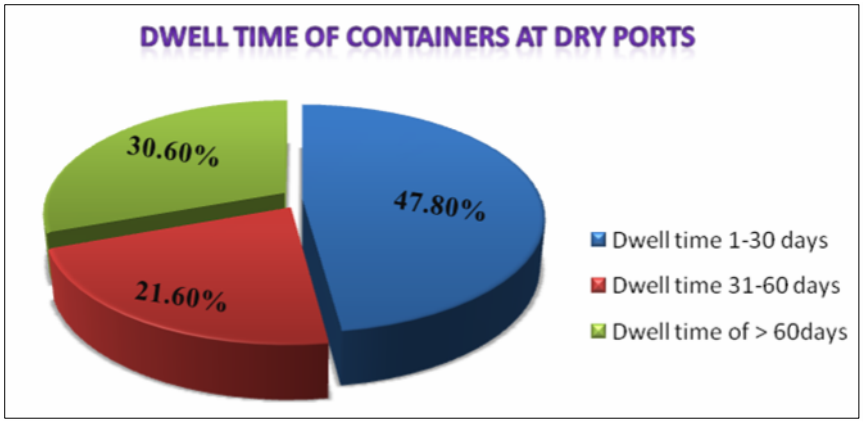

Figure 8: The average dwell time of containers at the dry ports in Ethiopia (ESLSE, 2014)

Table 29: *Port and Terminal Daily container status summary for a typical day* (ESLSE inland ports operation coordination division, 2014)

Branch	As of date	Full containers								Total in TEU	Average dwell time per container In days
		20TEU				40FEU					
		BBF	In	Out	Balance	BBF	In	Out	Balance		
Modjo	17/12/2014	3,398	134	134	3,398	2,797	87	115	2,769	8,936	57
DireDawa		42	3	0	45	25	2	2	25	95	23
Semera		18	0	0	18	4	0	0	4	26	-**
Bekelcha		0	0	0	0	0	0	0	0	0	0
Comet*		600	33	17	616	393	17	7	403	1,422	73
Mekele		142	29	6	165	61	2	3	60	285	24
Kombolcha		54	8	2	60	84	2	6	80	220	15
Gelan		0	0	0	0	1	0	0	1	2	258
TOTAL		4,254	207	159	4,302	3,365	110	133	3,348	10,986	-

** The former comet now it is known to be as ESLSE's Kality Branch office.*

***It is hard to tell the dwell time for the "multimodal" containers at Semera since most of the containers are some other different type of cargos like Auction cargo for instance.*

From Table 29 it was found out that the average dwell time of containerized goods at the Modjo dry port is 57 days which is almost two months. Based on ESLSE (2014), the number of days for containerized goods at the Ethiopian dry ports analyzed as of February 2014 has been summarized on Figure 8;

4.6. Overloading in the international trade route

According to Afro Consult (2014) study it was found out that most operators in Ethiopia observe and remain within the allowable legal limits; however there are some (14 – 30%) that continue breaking the law by overloading the trucks and moreover, many (56%) of the Ethiopian carriers operating on the route are old (over 10 years), outdated and technically unfit trucks that are unsuitable for handling even the legal limits carry overloaded containers that cause serious damage to roads, bridges and the vehicles themselves.

As per the secondary data collected from ERA- Vehicle size and Axle load management team leader (2014), Table 30, it was found out that 247,909 axles of 59,803 vehicles (Medium and Heavy) that were weighted in the period of July 2013 - June 2014 at Modjo size and weight control station. Of the entire measured axle load at each range, the illegal axle weights which were beyond the axle load limit (8ton for Front axle and 10ton for Rear axle) are 14,082 and accounts for 6% of the total axles weighted. Almost all of the illegal axles which are also called overloaded were in the rear axles since the freight load is concentrated beyond the front axles usually.

Table 30: *Yearly Axle load report at Modjo size and weight control station* (ERA Vehicle size and Axle load management team leader, 2014)

July 2013 - June 2014											
Axle Load in Ton	Axle load distribution							Total Axle Weighted			
								Front		Rear	
	F1	F2	R1	R2	R3	R4	R5	Legal	Illegal	Legal	Illegal
1 - 2	-	-	-	-	-	-	-	-	-	-	-
2 - 3	-	-	-	5	2	2	2	-	-	11	-
3 - 4	19	-	-	3	1	5	7	19	-	16	-
4 - 5	80	-	4	7	18	11	7	80	-	47	-
5 - 6	1,842	1	21	14	49	163	187	1,843	-	434	-
6 - 7	26,788	2	84	90	670	1,177	2,023	26,790	-	4,044	-
7 - 8	30,876	-	469	492	1,570	5,237	7,317	30,876	-	15,085	-
8 - 9	136	-	3,159	3,710	7,599	10,896	9,344	-	136	34,708	-
9 - 10	44	-	49,403	49,529	12,469	5,144	3,329	-	44	119,874	-
10 - 11	18	-	2,627	2,168	356	132	124	-	18	-	5,407
11 - 12	-	-	219	214	227	44	29	-	-	-	733
12 - 13	-	-	563	686	117	66	9	-	-	-	1,441
13 - 14	-	-	2,294	2,053	61	70	5	-	-	-	4,483
14 - 15	-	-	728	668	38	33	5	-	-	-	1,472
15 - 16	-	-	116	84	10	3	1	-	-	-	214
16 - 17	-	-	45	8	3	3	-	-	-	-	59
17 - 18	-	-	40	-	2	1	-	-	-	-	43
18 - 19	-	-	21	1	-	-	-	-	-	-	22
19 - 20	-	-	8	-	-	-	-	-	-	-	8
20 - 21	-	-	1	-	-	-	-	-	-	-	1
21 - 22	-	-	1	-	-	-	-	-	-	-	1
TOTAL	*59,803*	*3*	*59,803*	*59,732*	*23,192*	*22,987*	*22,389*	*59,608*	*198*	*174,219*	*13,884*

Note that - F Stands for Front and R stands for Rear and
- The Axle load interval is in a way that (a,b] except for the first row.
- The Axle load limits for FRONT : 8 ton and REAR: 10ton

As per Table 31, it was found out that 67,919 axles were weighted in the period of August 2014 - October 2014. Of the entire measured axle load at each range, the illegal ones which are called the Overload are 5,212 and like the previous illustrative year almost all of them were in the rear axles and with respect to the rear axles weighted at the stations 10% of them were illegal or overloaded as seen on Figure 11;

Table 31: *Monthly Axle load report at Modjo size and weight control station* (Modjo size and weight control station, 2014)

From August 2014 up to October 2014											
Axle Load in Ton	Axle load distribution							Total Axle Weighted			
								Front		Rear	
	F1	F2	R1	R2	R3	R4	R5	Legal	Illegal	Legal	Illegal
1 - 2	-	-	-	-	-	1	-	-	-	1	-
2 - 3	1	-	-	1	-	-	1	1	-	2	-
3 - 4	4	1	-	1	1	11	-	5	-	13	-
4 - 5	84	-	-	-	1	14	53	84	-	68	-
5 - 6	1,456	-	-	1	12	143	112	1,456	-	268	-
6 - 7	6,473	1	13	11	235	482	362	6,474	-	1,103	-
7 - 8	7,810	1	110	140	464	1,729	1,065	7,811	-	3,508	-
8 - 9	18	-	2,397	2,622	1,527	2,381	2,792	-	18	11,719	-
9 - 10	13	-	11,519	11,264	3,831	1,642	1,938	-	13	30,194	-
10 - 11	9	-	1,014	1,006	713	327	335	-	9	-	3,395
11 - 12	-	-	17	22	36	8	14	-	-	-	97
12 - 13	-	-	79	74	22	14	7	-	-	-	196
13 - 14	-	-	467	444	21	16	7	-	-	-	955
14 - 15	-	-	202	219	8	4	3	-	-	-	436
15 - 16	-	-	30	29	3	2	1	-	-	-	65
16 - 17	-	-	10	2	2	-	-	-	-	-	14
17 - 18	-	-	3	1	-	-	-	-	-	-	4
18 - 19	-	-	6	1	-	-	-	-	-	-	7
19 - 20	-	-	-	-	-	-	-	-	-	-	-
20 - 21	-	-	1	-	1	1	-	-	-	-	3
TOTAL	*15,868*	*3*	*15,868*	*15,838*	*6,877*	*6,775*	*6,690*	*15,831*	*40*	*46,876*	*5,172*

Note that - F Stands for Front and R stands for Rear and
- The Axle load interval is in a way that (a,b] except for the first row.
- The Axle load limits are FRONT : 8 ton and REAR: 10ton

Another simple illustrative example is used to show the relative damage concept of the axle load with respect to the standard axle load (ESAL); Consider these two different axles (Alene, 2012) A and B where A= 16.4 ton and B = 4.1 ton, which are double and half of the ESAL (8.2 ton) respectively. Therefore using Equation 1 above and with n=4;

CASE A: Equivalent factor = $(16.4 / 8.2)^4 = 16$

This means damage caused per pass is 16, and also it's the same amount of damage inflicted by 16 passes of standard 8.2 ton Axle load.

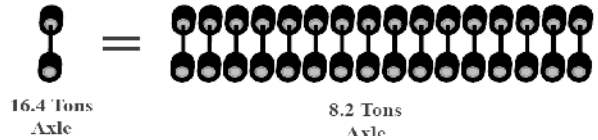

Figure 9: Axle load representative diagram 1 (Alene, 2012)

CASE B: Equivalent factor = $(4.1 / 8.2)^4 = 0.0625$

This means damage caused per pass is 0.0625, and also it means that 16 passes of 0.0625 (i.e. 1/0.0625) will be the same as the damage created by the one ESAL 8.2 ton.

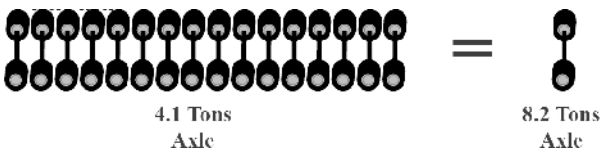

Figure 10: Axle load representative diagram 2 (Alene, 2012)

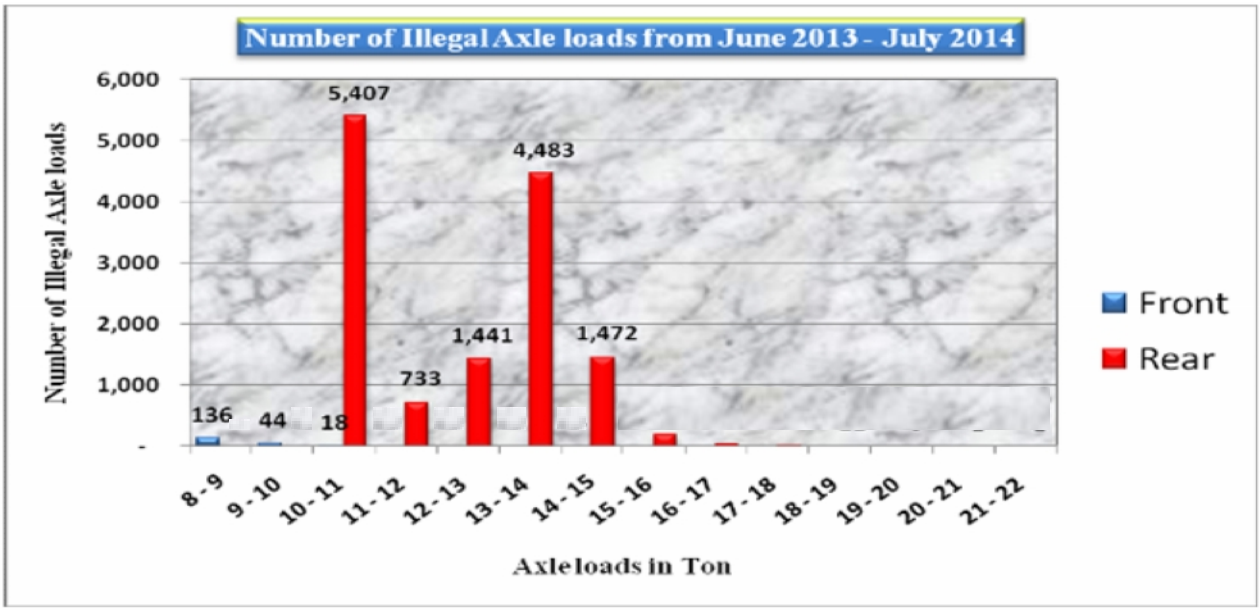

Figure 11: Number of illegal axle loads at Modjo control station from June 2013-July 2014 (ERA Vehicle size and Axle load management team leader, 2014)

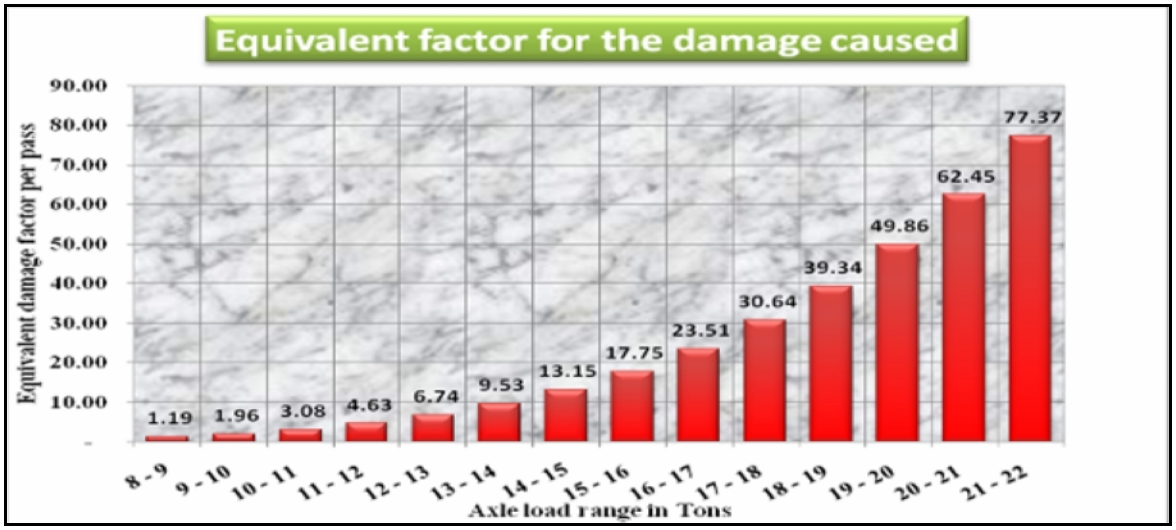

Figure 12: Equivalent factor for the damaged caused by the overloaded axles.

4.7. Freight transport and logistics Survey

The intention of the survey was to gain a greater insight on the attitude towards the current freight transport system and logistics services in Ethiopia. The survey conducted on two key players in the freight transport and logistics service which are; Cross border Freight transporters and Logistics service providers (3PL) / freight forwarder on company basis. And the survey was conducted using Questionnaire as a primary data collection tool. Most of the questions for the questionnaire were drafted from Logistics and Transport IT Survey sponsored by Kewill (2012) on Transport intelligence and then modified to suit the cases of the specific respondents and scenarios in Ethiopia.

4.7.1. Cross border Freight transporters

A total of 12 individuals from different cross boarder freight transporters participated in the survey prepared in the form of Annex 4. And only 9 of the companies, which are of different levels from 1A (Trucks of age $\leq$ 10 years with a capacity of loading $\geq$ 30ton) up to 3B (Trucks of age > 20

years with a capacity of loading < 30ton, responded to the questionnaire survey. The remaining 5 did not reply to the questionnaire on time and some did not cooperate at all due to different reasons.

The responded questionnaires, in which the template is shown on Annex 4, are categorized as follows;

a) **Trade route**
All the 9 participants use the Djibouti-Addis Ababa road via Modjo dry port.

b) **Days of time in transportation**
Most of the participants agree on that it takes 2-3 days' time to transport containerized goods and Bulk commodities to and from Djibouti port and also gave a 3-4 days' time for transporting machineries. And in aggregate 90% of the transporters make 4-5 trips/Month and the remaining 10% make 6 trips /Month per each truck to and from Djibouti port.

c) **Challenges and measures taken on the trade route**
This was a multiple choice question which they can select as many problems they could find. It is found that 67% of the responders have agreed on insufficient lane width for wide loads as a major problem and 78% of them lack of trailer drop-off/pickup facilities for trucks whereas 89% of the responders found long processing time (customs clearance) and poor roadways/older road conditions as a serious problem as shown on Table 32.

In addition to the revealed problems in the Table 32 some of the freight transporter companies mentioned additional specific impediments as a problem they are facing on the freight transport along the Addis Ababa – Djibouti route,

- No sufficient parking lanes/locations for freight trucks
- 'Kebele' (County) youths intrusion during unloading and loading
- Time constraint to cross cities
- Waiting time at check points
- Highway congestion at Addis Ababa – Adama road
- Long custom clearance and documentation problem at customs office
- Lack of port equipment facilities and machineries during loading and unloading containers
- Long detention time while loading and unloading because the port officers are not systematic / efficient and also they are not applying their maximum efforts.
- Driving at night is found to be risky and difficult on the Djibouti-Galafi road.
- Roadway speed break at a very close interval on the trunk road at Awash National Park
- Low bridge clearance at Akaki area
- No system to replace older trucks with new ones
- Insurance companies do not act fast
- Demurrage system is not being applied yet
- Congestion at the entrance of Kality customs branch office, due to the road and light railway construction the road is narrowed

Table 32**:** *Number of response for the stated problems on the trade route*

Conditions	Number of response for each Levels from 1 up to 5 1 - not a problem & 5 - very serious problem					
	1	*2*	*3*	*4*	*5*	Degree of Response to the problem in %
1. Highway congestion	3	1	3	1	1	**56**
2. Merging lanes	4	0	0	0	5	**56**
3. Long time processing (customs clearance)	1	0	3	2	3	**89**
4. Highway interferences with rail lines (i.e., grade crossings)	6	0	2	0	1	**33**
5. Turning at traffic lights	6	0	1	0	2	**33**
6. Inadequate local streets capacity	5	0	2	1	1	**44**
7. Insufficient lane width for wide Loads	3	0	1	1	4	**67**
8. Insufficient bridge/tunnel clearances (height)	2	2	1	1	3	**56**
9.Lack of trailer drop-off/pickup facilities for trucks	2	0	2	1	4	**78**
10.Curfew restrictions on movement of large and heavy trucks	5	1	1	1	1	**33**
11.Poor truck access to shipping Terminals	3	1	3	1	1	**56**
12.Poor truck access to intermodal facilities	2	2	4	1	0	**56**
13. Sleeping problem	4	2	1	1	1	**33**
14.Poor reliability due to accidents and incidents	0	4	1	2	2	**56**
15. Unsafe roadway geometrics	5	2	0	0	2	**22**
16. Poor reliability due to weather Conditions	6	1	2	0	0	**22**
17 Poor roadways/Older road conditons	1	0	2	3	3	**89**
18. Language problems on international roads	5	0	1	2	1	**56**
19. Poor Signage on the roads (Traffic Signs)	3	1	2	1	2	**56**
Others (please specify)						

Note: The ranking was given from 1 up to 5 based on ‘not a problem’ and ‘serious problem’ respectively. Therefore rank ‘2’ up to rank ‘5’ means a percentage of 25% to 100% degree of problem. The criteria for the higher degree of response to the problem(%) for this analysis was taken into consideration that the rating given ‘3’ and above by the respondents, since the rating of ‘3’ is 50% margin relative to the serious problem rating of ‘5’.

More than 90% of the transporters mentioned the following as a consequence of the above impediments on in the freight transport system.

- Shortage of income/revenue
- High vehicle operating cost i.e. loss of truck tire and high fuel consumption
- High maintenance cost
- Spending a lot of time in one trip reducing the number of trips
- Plan and schedule of the transport company fails
- Commitment to pickup or deliver goods on time fails
- Forced to change tariffs due to more down times
- Spending on storage cost in foreign currency (USD) at Djibouti port
- Affected the efficiency of trucks and also the fleet management system
- When lanes are merged abruptly the occurrence of accident increase, which causes damage of commodities and the trucks itself
- In general, the problems inhibited the growth of the “multimodal” transport system

Towards their effort to compensate for the problems mentioned above, the aggregated response by the 90% of the responded transport companies is mentioned as follows, where 10% of the respondents mentioned “NOTHING” in responding this particular question because they believed that there is no other optional route.

- ✓ Forced to drive at night time to escape from the impediments on the road way at day time, though even at night time they have to drive through fear and intimidations because of the possible theft and penalty.
- ✓ Believed in training their drivers ;
  Develop skill of their language to communicate with the concerned body at Djibouti port.

- ✓ Trying to apply the demurrage system as much as they can;
  Registering the time of arrival and unloading time at the delivery location/port
  Reporting to the owners if there is some problems with the registering time
- ✓ Giving incentives to their drivers on their early arrival and also based on the more trips they made in a month time with respect to the possible defined range of time by the company, even though this may relate to possible traffic safety problems.

The response on this particular question is shown on Figure 13; it was noted that 85% of the respondents has mentioned that the possible measures they took to compensate for the transportation impediments has not yielded any change at all (minimal) and 10% of them stated there was no change while the remaining 5% was not sure of whether there is a change.

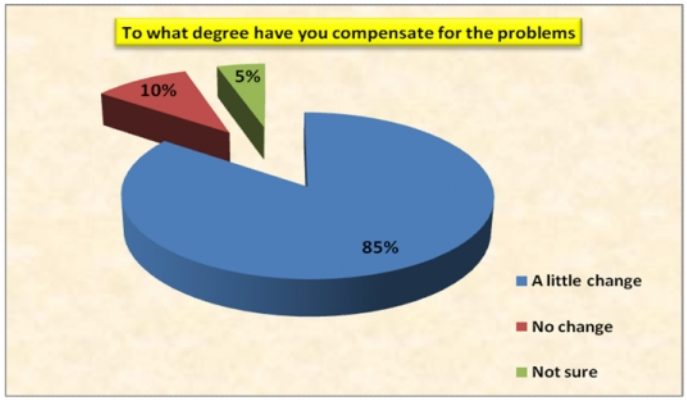

Figure 13: Number of response to what degree the problem is compensated

d) **Dangerous situation in Traffic**

It's found out that from the owners of the freight transport company owners; for issues causing a dangerous situation in traffic, 56% of the transporters chose bad general condition of roads as an impediment, 67% of them on other road users not taking into account the special requirements of heavy vehicles and poor maintenance of roads and 78% of them agreed on higher impediment through the traffic was the high speeds of other road users and overtaking by other road users.

Table 33: *Number of response to dangerous situations in Traffic for freight transport drivers*

Conditions	Number of response for each Levels from 1 up to 4 1 - not a problem & 4 - very serious problem				
	1	*2*	*3*	*4*	Degree of Response to the problem in %
Low speeds of other road users	4	5	0	0	-
Drivers carelessness	3	6	0	0	-
Drivers fatigue	5	4	0	0	-
Bad condition of the vehicle drivers drive	4	3	1	1	22
Timetables that are too tight	6	1	2	0	22
Drivers speed which is too high	3	3	3	0	33
Speed limiters in heavy goods vehicles	4	2	2	1	33
Navigation difficulties (finding the way)	5	0	3	1	44
Bad general condition of roads	2	2	1	4	56
Other road users don't take into account the special requirements of heavy vehicles	1	2	1	5	67
Poor maintenance of roads	1	2	2	4	67
High speeds of other road users	1	1	5	2	78
Overtaking by other road users	2	0	3	4	78

Note: The ranking was given from 1 up to 4 based on 'not a problem' and 'serious problem' respectively. Therefore rank '2' up to rank '4' means a percentage of 33.3% to 100% degree of problem. The criteria for the higher degree of response to the problem(%) for this analysis was taken into consideration that the rating given '4' and above by the respondents, since the rating of '4' is 67% margin relative to the serious problem rating of '4'.

e) **Transportation Improvements**

As per the proposed or revealed transportation improvements only 8 respondents have filled this part one left it open. The result on Table 34 shows that 100% of the 8 transporter companies agreed on the improvement of rest areas (e.g. Motel) for the drivers and also truck parking areas for the trucks, 63% of the respondents agreed on the improvement of highway ramps and route connectors and 75% of them stressed on the improvement on the information services on the transportation system and improving the highway/route lane capacity.

Table 34: *Number of response to highway improvements*

Possible improvements	Number of Response on the possible measures to be taken		
	No	Yes	Aggreed on the suggestion (%)
Highway ramps?	3	5	63
Highway/route connectors?	3	5	63
Highway/route lane capacity?	2	6	75
Rest Areas?	0	8	100
Truck parking areas?	0	8	100
Information services?	2	6	75
Other infrastructure? (specify)			

f) **Alternative Route followed**

All the 9 respondents replied that they consistently drive a regular route or pattern of routes each week to and from Djibouti port, mentioning that since there is no other better alternative until Adama. (Note: Numbers of the trucks use the new Addis Ababa-Adama toll road from Adama when approaching Modjo and from Tulu Dimtu when leaving Addis Ababa)

g) **Addis Ababa-Adama toll road**

Eight of the nine respondents stated that they use the new Addis Ababa Adama toll road. The one transport company replied they are not using the new toll road because of waiting decision from other bodies on the how to proceed. All the respondents believed that the new toll road is beneficiary.

And the mentioned benefits are listed below:

- ✓ Save travel time
- ✓ Reduces vehicle operating cost i.e. Save fuel cost and Reduces loss of tire
- ✓ Reduces maintenance cost
- ✓ Increases traffic safety and decreases the number of accidents that may occur
- ✓ No traffic congestion at all
- ✓ Has wider lanes compared to the old road
- ✓ Has dedicated lane for heavy vehicles
- ✓ Saving a minimum of 1 hour/truck on each trip.

The possible comment given by the respondents on the Addis Ababa-Adama toll road is listed likewise; Only 45% of the respondents left these comments and it was aggregated as follows;

- Similar joining roads should be constructed from Galan to Tulu Dimtu
- It needs a roadway light/ illuminate to drive at night time
- Awareness should be created by providing training to truck drivers and other users how to use it wisely and safely.

h) **New Awash crossing Bridge**

All the respondents believed that the new Awash River crossing bridge is beneficiary.
And the mentioned benefits are listed below;

- ✓ It calmed the steeply approach roadway in both ways.
- ✓ Wide lanes relative to the older bridge
- ✓ It saves the waiting time while waiting for other vehicles to cross, which have been in hours sometimes if there is an incident.
- ✓ Allows to cross on high speed
- ✓ Reduce the number of accident occurring around the bridge
- ✓ Can come across the bridge with heavy freight goods
- ✓ Feels safe while crossing the bridge

i) **Addis Ababa - Djibouti Railway project**

The expectation from the new Addis Ababa-Djibouti railway line is;

- ✓ Burden will be shared
- ✓ Port rent (storage cost) will be saved since it will transport a lot of commodities at a time
- ✓ Fast delivery time for imported and exported items
- ✓ Interesting infrastructure which facilitates the international trade in transporting huge bulk goods and containers

But some respondents were having a belief that;

- Trucks may be forced to work inside Ethiopia only
- It may be a high competitive towards their business
- It's ambiguous to the transporters on market basis because there may be no enough/sufficient cargo in the market to haul/transport to and from Djibouti port
- Fear of the accidents which may occur due to the train

j) **Freight axle load limit**

The opinion towards freight load limit and overloading both in Ethiopia and Djibouti;

- ✓ Some transporters mentioned that Djibouti load limit handling is more advantageous to haul heavy goods at a time than Ethiopia, for instance In Djibouti it's allowed to load more than 40ton per truck, even though more than 20% of the road section is structurally in poor condition.
- ✓ ERA is importing a heavy goods such as bituminous material in barrel weighing 46ton (overloaded)
- ✓ Some transporters even blamed the freight forwarders for making them believe that the cargo is within the acceptable load limit before loading and then at the load stations the transporter end up arguing more with the control officers, so drivers/transporters are forced to check the weight before loading on the truck and agreeing to transport the cargo.
- ✓ A challenge of carrying heavy loads with older trucks, getting penalized for that

k) **Existence of theft**

56% Respondents those that said yes to the existence of theft, has specified the type of thefts they have experienced or heard for the open-ended question as follows;

<u>Location</u>

- Some specified that the theft and attack usually occurs at Awash and Adaitu

<u>Time of theft/attack</u>

- Usually during night time

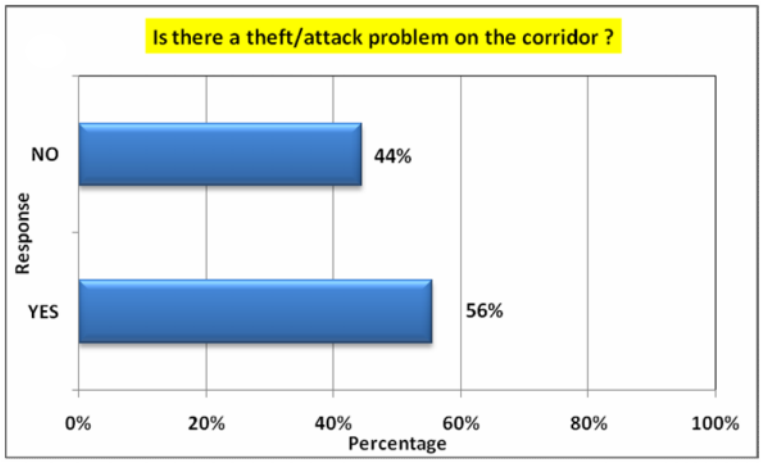

Figure 14: Theft problem on the route

Target Items

- Exported commodities, since it's usually bulk transport. E.g. Coffee
- Imported items in break bulk, since it's easy to snitch instantly rather than the containerized goods. E.g. Reinforced bars

Case

- One transporter mentioned that, a driver was killed and the imported goods damaged and some stolen and the truck were damaged.

And they are trying to do and recommend minimizing the effect of theft problem;

- ✓ Most of the respondents said that, case will be reported to Authorities and usually responded and solved
- ✓ Avoiding driving after midnight rather driving at day time and resting at night.
- ✓ Driving in groups is more safer
- ✓ Theft exposed cargos should be rested and spend the night time around governmental compounds or at nearby police station
- ✓ Some preferred to transport containerized goods
- ✓ Heavy penalties should be imposed on those peoples/groups because they are disrupting the trade growth somehow by terrifying the transporters
- ✓ Maximize the police presence at those usual theft locations
- ✓ And everyone including the public, police, soldiers and authorities have to cooperate and work together in battling these transportation impediment

At last the freight transporter companies have given additional comments and opinion on the whole "multimodal" transport system and its logistics in the open-ended questionnaire part as follows,

- ➢ One respondent stated that, the transport sector is not operating on Free-Market based policy,
  Some said they are forced to work on minimal tariffs. Even if the through rate from Addis Ababa-Djibouti is 105 – 110 ETB/quintal Road transport Authority is force them to work on 90 ETB/quintal which is 15 – 20 ETB less per quintal and has that much variance on the profit of the company.
- ➢ Freight forwarders were blamed for not paying the freight transport bill on time, the payment may lag for 2months and more one transporter said.
- ➢ Some say the tariff/ through rate imposed is not profitable and should be reviewed.
- ➢ Demurrage law has to have an executive body of itself for the well implementation.
- ➢ Custom processing time should be reduced and the way of service should be improved at the customs offices.

- Addis Ababa-Adama Toll road: orientation and awareness should be created to freight transport owners and how to utilize it wisely and safely, since the accidents occurring sometimes are horrific.
- More unloading port equipment and Manpower such as Ridge stacker should be used at dry ports and warehouses to reduce the waiting time.
- Driving License: the system of giving driving license should be reviewed because big teenagers are using the loop hole in the system to manipulate it in getting the 4th driving license for driving heavy freight vehicles just without the need for the 2nd or the 3rd license which is now is one reason for the horrific traffic accidents on the way of Addis Ababa-Djibouti said one Transporter on their respondent box.
- Roads in and out of ports should be given attention.
- So many problems and incidents are believed to happen due to the poor condition and narrow lanes on the route.

4.7.2. Logistics service providers / freight forwarder

A total of 10 individuals from different Logistic service providers (3PL) or freight forwarders participated in the survey prepared in the form of Annex 5. And only 7 of the companies responded to the questionnaire survey. The remaining 3 did not reply to the questionnaire on time and were not able to fill the questionnaire.
According to the Council of Supply Chain Management Professionals, 3PL is defined as "a firm that provides multiple logistics services for use by customers.

a) **General information**

- All of the respondents were logistics service provider (3PL)/ freight forwarders.
- About the year of experience 71% are in the sector for 1 – 10years' time while the rest of the respondents were beyond 10 years of experience.
- All of the respondents are operating in Addis Ababa – Djibouti port trade route.
- 86% of the seven respondents who have also fewer than 50 employees are operating mainly from Addis Ababa.

b) **Supply chain software (IT systems)**

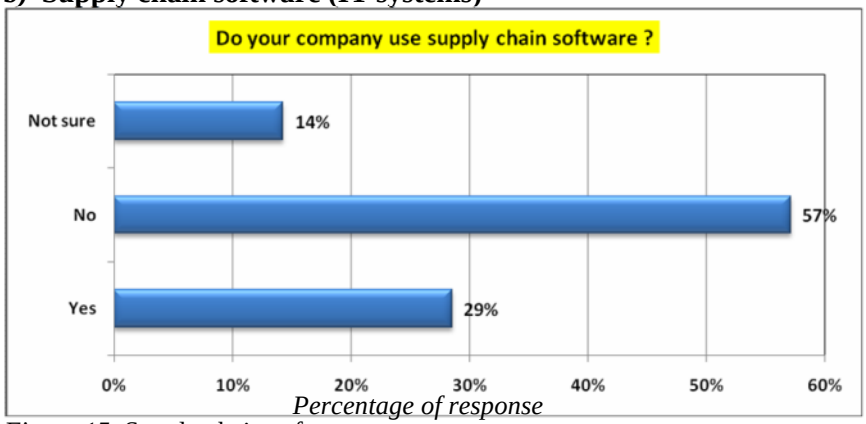

Figure 15: Supply chain software usage

As per the graphical representation of figure 15, 57% of the respondents do not use supply chain software while only 29% are currently utilizing supply chain software for operating cost of their company.

c) **Importance of supply chain IT systems**

Those 29% who replied yes in using information technology of supply chain have chose Freight forwarding, transport management and customer relationship as an important part of the software systems and also it enables them to share information/collaborate with customers.

One respondent who is a logistic service provider and is currently working inside Djibouti replied on the software is becoming a barrier to their ability to react to new business opportunities or business re-designs even though they did not mention the reason why specifically on the questionnaire provided.

***d)* Evaluating a possible new supply chain IT system in the future**

Only five of the respondents which are also willing to work together in sharing information with other different parties working on the logistics sector have replied to this question. As seen on Figure 16 below, 60% of them replied that the main criteria they use to evaluate a new supply chain information technology (IT) system is Project return on investment, which is defined as the benefit to the investor resulting from an investment of some resource. A high return on investment (ROI) means the investment gains compare favorably to investment cost. As a performance measure, ROI is used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. And the 40% of them needed a timescale for the benefit to be realized.
Note: this question was opened to choose more than one criteria to apply that's why it adds up more than 100%.

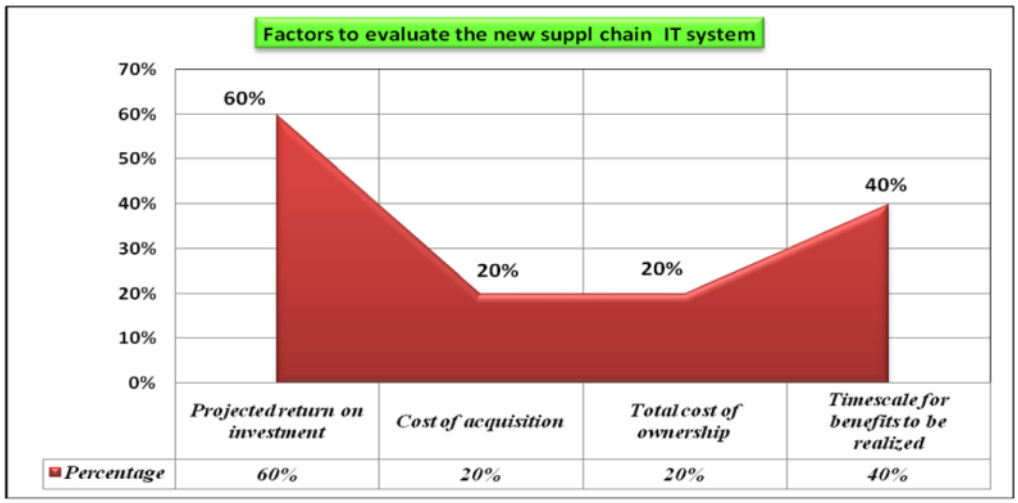

Figure 16: Factors to evaluate new supply chain IT system

***e)* Return on investment from a new supply chain IT system**

Likewise here 5 respondents who mentioned the factor that is important for evaluating a new supply chain IT system has participated in this question and 60% of them set a time frame of 1 to 2years to see the return of the implemented new supply chain IT system while the remaining 40% did not set timescale yet.

***f)* Transport logistics quality**

Almost all except one (who did not answer this section) has agreed that Transport logistics quality can be defined as the degree in which the performance of the freight transport operations across modes in the supply chains meets stated service criteria. And two of the respondents also operating inside Modjo dry port and one of which is using supply chain software, added these points to emphasis the importance of transport logistics quality. Described the transport logistics quality as;

- Short or on time delivery period
- Lowering transport cost
- Handling of customer goods Safely
- Meeting customer requirements and expectations

In view of relative importance in ensuring quality logistics 5 of the respondents agreed that Standard combined transport product – scheduled combined transport service with standardized procedures, specific time, specific schedule, and specific information.

***g)* Importance or significance in business strategy**

All the respondents agreed on that meeting customer requirement was the most significant in their business strategy and improving operational visibility and opening new markets are other significances in improving the business strategy of the transport logistics.

Note: this question was opened to choose more than one criteria to apply that's why it adds up more than 100%.

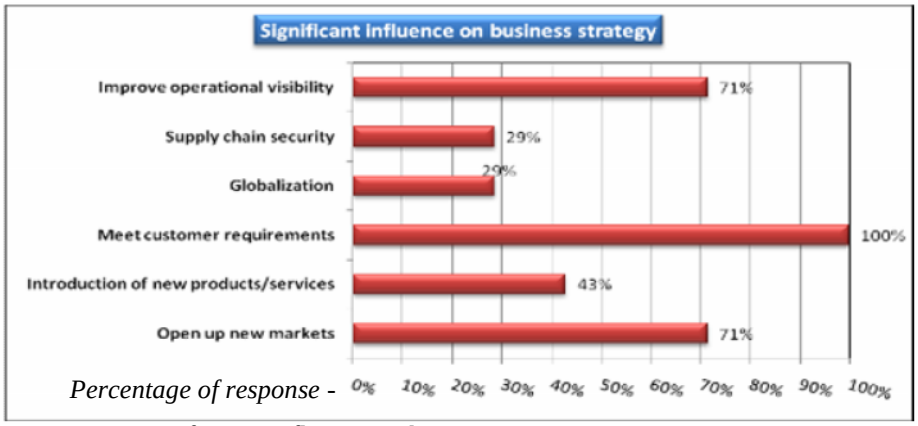

Figure 17: Significance influence on business strategy

***h)* To respond effectively to customer demand**

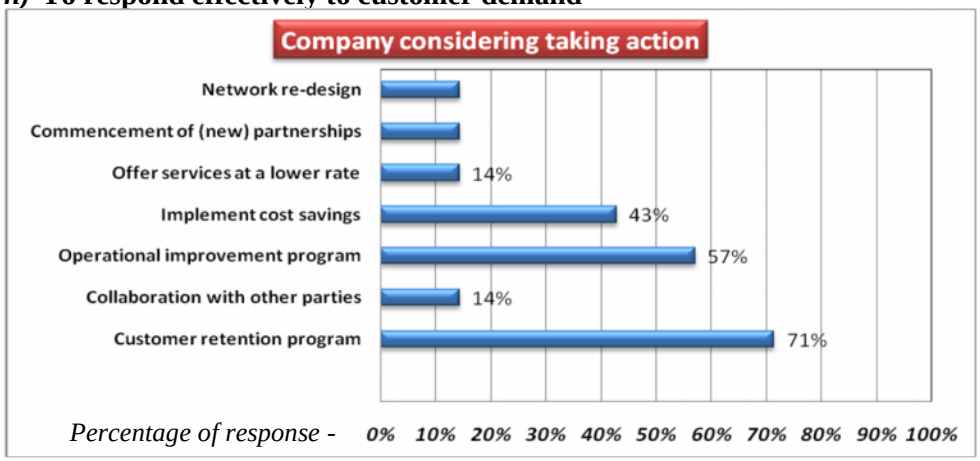

Figure 18: Company considering taking action to respond to customer demand

In this question the most actions represented by the respondents are aggregated as follows. As per the response from the logistics service and freight forwarder only 14% of the respondents are willing to offer services at a lower rate to stay competitive and more than 70% of them are considering in taking action on applying *customer retention program* which is the activity that a selling organization undertakes in order to reduce customer defection. Successful customer retention starts with the first contact an organization has with a customer and continues throughout the entire lifetime of a relationship.

Note: this question was opened to choose more than one criteria to apply that's why it adds up more than 100%.

***i)* Information sharing/collaboration in the future**

For this case 57% of the 3PL respondents which most of them are currently utilizing supply chain software agreed to collaborate on information in the future while the 14% were not willing even if they did not specify their reasons.

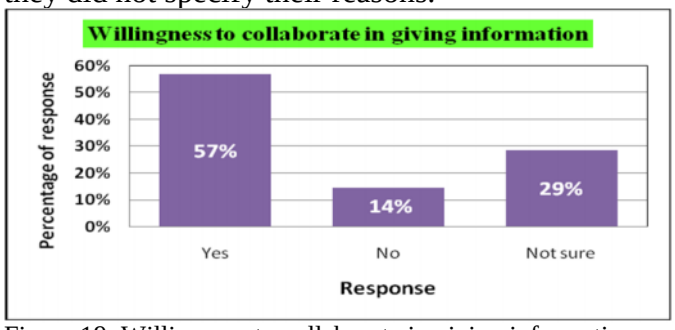

Figure 19: Willingness to collaborate in giving information

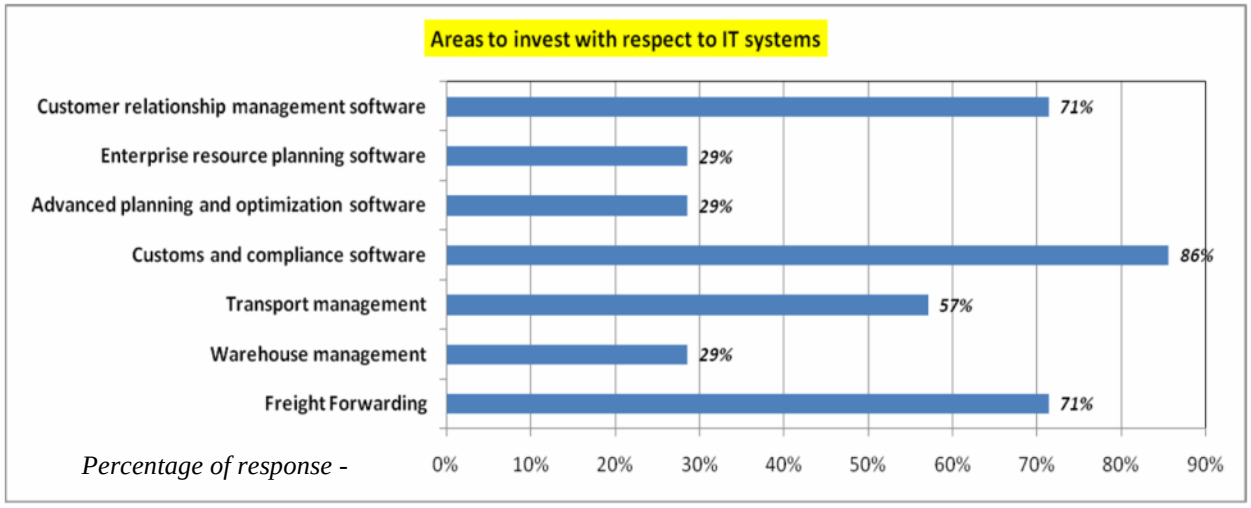

Figure 20: Areas to invest with respect to IT systems

j) Long-term IT investments

More than 70% of the respondents are now willing to invest on the IT in terms of custom and compliance software, freight forwarding and customer relationship management software as shown on Figure 20.

k) Observed problems in the Freight transport and Logistics service

The response of the seven logistics service providers and freight forwarders, most having an experience of more than 5 years has stated these problems in one way or another. It is aggregated and listed as follows;

- The main problem is that most of the sector is led by unprofessional peoples and brokers.
- Also lack of professionalism since work is done not on the basis of knowledge through training rather it is done on the basis of experience; this is mainly because there is no specific institution which is dedicated for giving training in Freight transport and logistics service.
- Shortage of man power in the sector.
- Compared to previous years the current status of the logistics service is better, since the available cargo is has sufficient transporting companies.
- The lack of coordination between logistics service providers and concerned Authorized offices.
- Not all the transportation companies have an insurance covered truck which has to be entrusted to transport cargos.

- In “multimodal” transportation the transported goods have no equally assigned time to be uploaded from Djibouti port to Dry ports, there is no defined rule for this.
- Shortage of well-equipped and high carrying capacity freight vehicles
- Road infrastructures on the route are in poor conditions due to the high range of freight transport. And also there is no alternative better route.
- Custom processing time is still taking long days.
- Problems related to unwillingness of the cargo owners to unload/clear the imported goods on time.
- The necessary payment of freight forwarding from the importers is not paid on time.

l) **“multimodal” and ‘uni-modal’ transportation**

As seen on Figure 21 below, 57% of the respondents preferred more of ‘uni-modal’ transportation on the current basis and 29% of the respondents preferred “multimodal” transportation. And 14% of them were not taking sides rather preferred to operate on both systems. The reason behind the preference of the two type of respondents is elaborated as follows;

- “multimodal” transportation as an idea is better than ‘uni-modal’ transportation system but when we see the case of Ethiopia this operation are operated by one government owned company ,ESLSE, with limited man power, offices and logistics facility and machineries. If they improve this entire services, “multimodal” will be more feasible and implemented better than ‘uni-modal’ system.
- “multimodal” transportation system is better in minimizing cost of foreign currency at Djibouti for the importer and the country overall, it also facilitates the import and export trade more relative to the ‘uni-modal’ system.
- ‘uni-modal’ transportation works best once the necessary payment and documentation run at Djibouti port by the freight forwarders and also it has created many job opportunities to others.
- ‘uni-modal’ transport is more preferable. But the lack of space and talent and the delay in arrival time are the shortcomings of the “multimodal” case.
- Cost wise ‘uni-modal’ transportation is preferable, whereas in terms of safety and other issues “multimodal” transportation is preferable.
- Both are good to be applicable still. But due to the lateness in delivery of imported goods in “multimodal” transport system, prefer to go with the ‘uni-modal’ system.

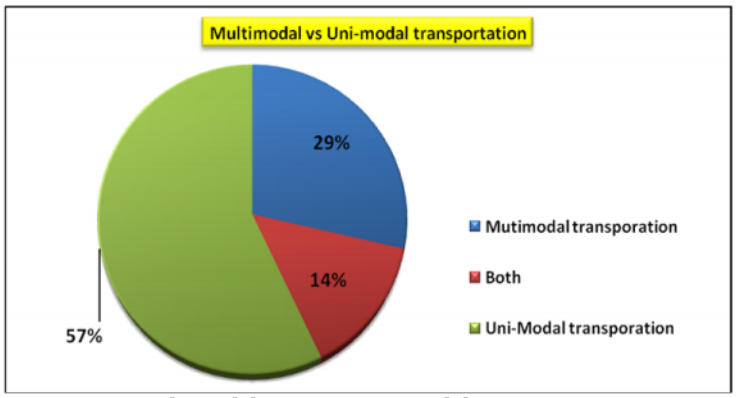

Figure 21: “multimodal” versus ‘uni-modal’ transport system

m) **Suggestions and recommendations by the respondents**

- ESLSE shall improve shortage of experienced man power, shortage of logistics machines.
- ESLSE have to avoid monopolistic thinking and work together with other potential logistics service providers in the private sector.

- The transport authority should assign better trained personnel in number and vehicles other than the current transport system.
- Emphasis and special attention should be given by the higher education in training more students in freight transport and logistics.
- The government must try to handle all the customers of shipping equally without partiality when to discharge the imported goods from the dry ports at a specific period of time.
- Instead of trying to shift to from manual to automated instantly they could have used a hybrid approach i.e. move to automated system gradually as the available talents and resources grow too.
- The custom offices still take a long time of processing in practice, even if they are saying in Medias they took only 3 days, they have to improve the services they are providing.
- The fleet management system should be governed by a systematic executive body and should be accompanied by Information technology systems.

***n)* Addis Ababa –Adama Toll road**

All the seven respondents part of the small scale survey agree on the benefit of Addis Ababa-Adama Toll road and are currently using it except one respondent implied they did not used it yet and one couldn't mention the benefit since they have no idea.

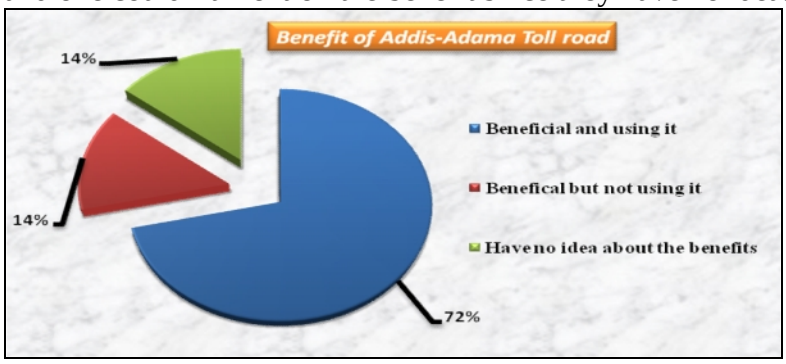

Figure 22: Addis Ababa-Adama toll road usage and benefits

Here are the aggregated common advantages mentioned by almost all of the six logistic service providers;

Advantages

- Minimize the wasted time on the busy route just to go to Modjo dry port from Addis Ababa
- The road simplifies the traffic jam that was in the older busy route.
- There is no congestion at the new toll road it's a freeway.
- It reduces vehicle operating cost for transporters
- Saves time
- Reduces fuel consumption
- It shortens the travel distance
- It assures the safety of cargos as well as maintain prompt delivery

Out of the seven respondents on this question only two has left comments on the Addis Ababa-Adama Toll road;

Comments

- Drivers must be well informed how to use it since it's a new highway type for Ethiopia and also to reduce the possible horrific accidents that might happen on the fast lane highway.
- Minimize the toll fee even though they may not have applied any economic assessment

***o)* Awash River crossing bridge**

Out of the seven respondents, Five of them think that the newly constructed Awash Bridge is beneficial in the way that it will improve the traffic flow around the ridge but one didn't think its

beneficial in a way that it may not create a significant difference from the existing traffic system and the last logistic service provider replied blank. In general the benefit they are expecting is saving in terms of vehicle operating cost and reduce the delay in deliver time of both imported and export goods which was created in queuing for long period of time waiting for each vehicle to cross at a time.

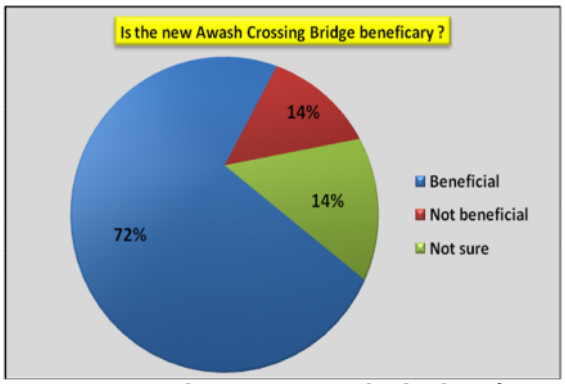

Figure 23: Awash River crossing bridge benefit

p) **Opinion towards overloading and axle load limit**

These are the opinions given by the three respondents on the available axle load limit and overloading while the rest leave the question blank.

- Freight load limit is necessary for the roads and bridges to serve their design year.
- Overloading does not only affect the transportation infrastructures such as roads and bridges but also the vehicles, since it increases the maintenance cost and lessen its service years.
- The overloading is destroying the roads in the specific route, Addis Ababa - Djibouti; it is by noticing which side of the road lane is being cracked or failing.

From the points raised it looks like these respondents are those who are working within the load legal limit.

q) **Ethio-Djibouti railway line**

- It may facilitate the transportation of passengers and also bulk cargos.
- It will be used to ship much bulk cargos in a short period of time with less transportation price also.
- Even if the railway is beneficial, it should be balanced with the existing vehicular transport meaning that the existing trucks have to enable to get cargos to transport if not the job opportunity will be closed.

r) **Attack or theft of transported goods**

All but one responded that there is no theft problem in the freight transport currently, mentioning also they take a much care to whom they entrust/handover their cargos plus they inferred that they have a reliable partners for transportation and also one mentioned they use a container seal as a preventive measure.

And the one responded that the theft exists, explained the case they experienced or noticed; lost tires, tools, money and sometimes human life.

s) **Recommendation/suggestion to minimize the theft problem**

This question response by the respondents was mostly similar and is aggregated as follows for better view;

- To use the latest cargo tracking technologies such as GPS and also CCTV cameras.

- Transmitting the cargo data to Galafi customs online keeping the weight data discreet, then performing an efficient scanning and weighing for possible snitch.
- The concerned police should carry out surveillance randomly in the possible locations and stations.
- And also maintaining peace and security in the route yields safe transportation

At last the logistics service provider companies have put additional comments and opinions on the whole "multimodal" transport system and its logistics in open-ended questionnaire part as follows,

- The government should participate or work together with the private sector such as importers and local societies to get the better output of the "multimodal" transport system, it should not be monopolized.
- Adjoining roads should be constructed / upgraded at the main gets of import and export trade.
- In case of the 'uni-modal' and "multimodal", until "multimodal" become better and more applicable the government should allow the 'uni-modal' transport system to minimize the burden created on the government owned ESLSE who is exercising the "multimodal" transport system at the time.
- The need for competition in the sector (both ESLSE and the private sectors) should be taken into consideration since it has a direct effect on enhancing the efficiency and effectiveness of the transportation logistics.
- For the case of the "multimodal" transport system, it's good to avoid unnecessary and unrealistic ambitions towards the transportation logistics. Everything should be changed gradually not at a time.

And beyond what two questionnaire survey mentioned, as seen on section 4.6 above there is a congestion of containers at dry ports; As per Modjo Dry port Planning and ICT Service (2014), it is mainly as a result of the customers/ importers not willing to pick their imported goods on time, financially since the storage cost is quiet smaller with respect to the foreign currency paid when the imported goods are stored at Djibouti port ('uni-modal' transportation case) and also it's in hard currency. The other suspected reasons by Modjo Dry port Planning and ICT Service (2014) are due to looking for other business opportunities in the expense of the custom clearance they have to pay for the clearing out the container and market assessment that's waiting for a better unit price of the imported item on the market while it's under the premise and the guard of the nation. Even if there is an SMS notification system when their goods arrive at the port, still there is no improvement.

4.8. Efforts of different stakeholders in the sector

The efforts of different government offices and private stake holders should be taken into consideration in minimizing or reducing the problems and challenges the freight transport and its logistics services are concerned.

4.8.1. Ethiopian Shipping and Logistics service Enterprise (ESLSE)

According to annual Plan of Ethiopian Shipping Logistics Service Enterprise for 2007 EFY (2014), Warehouse means any place, including port and customs warehouse that provides loading and unloading facilities including packed and unpacked goods in container. It was found out that recognizing the shortage of warehouse supply at national level, the government of Ethiopia has engaged in the construction of mega warehouses under the ownership and management of Ethiopian Shipping and Logistics Service Enterprise (ESLSE).

- The construction of stuffing stripping warehouse with a area of 5400 Meter Square size has been completed.
- Around 41% of the works of the construction of another mega warehouse with an area of 5400 Meter Square has been completed.

And also according to the interview with COMET freight transport officers (ESLSE Kality Branch office) (2014), it was found out that the government of Ethiopia is on the way of importing 215 Trucks (Renault) which have a carrying capacity of 57ton for freight containerized and break bulk transportation.

4.8.2. Modjo Dry port

As seen on the section 4.6 the containers dwelling time is 57days on average (taking into consideration between those cleared out of the port within a day and the ones stayed for a year or more). It was found out that these containers are congesting the dry port due to the consignee or the importer not clearing off the imported containerized items from the dry port on time, even if there is already been a grace period of eight days free of storage cost on the port and also an SMS system to notice the customers when there containers arrive at the dry port. From the interview made with Modjo dry port ICT and planning officer (2014), it was found out that the predicted reasons were:

- the importers rather chose to store it at the port because of the security at the port in the premise of the nation and also the cargo has also insurance during the time it stays there.
- the importers will be charged more if they rent a warehouse or other store for their imported goods so they try to save that cost.
- the storage cost charged at the port is with Ethiopian Birr (ETB) and also the rate is less with respect to the Djibouti port storage cost which is in USD.
- the importers spent the cost of the custom clearance on other investments rather than clearing out the imported items from the port.
- and the importers wait while they do market assessment for their imported items i.e. waiting for a higher demand or higher price.

Therefore to tackle these known/predicted obstacles, the respective offices at Modjo dry port are taking managerial measures beyond executing the cost of storage, established a joint command post with Modjo dry port revenue and customs branch office to contact and reach those customers who have many containers on the site and those who are big importers to clear out their containers as soon as possible. That is one of the reasons as per the interview with Modjo dry port ICT and planning office (2014) that the average dwelling time is decreasing from time to time.

4.8.3. Ethiopian Revenue and Customs Authority (ERCA)

According to the GTP annual progress report (MoFED, 2013) Custom information management system (ASCUDA++) was implemented at all custom branch offices and information generated from the system was used for customs procedures implementation, post clearance audit, import export trade, etc. And ASYCUDA++ is providing useful import-export information to ease customs duty and tax assessment and enforcement activities. In addition ASYCUUDA software installation and configuration service has been given to branches. For the case of cargo trucking and scanning system, its implementation helps to maximize the use of technology to support balance between trade facilitation and customs control efficiently and enhance monitoring flow and movement of goods and vehicles in transit form. During the 2011/12 Electronic cargo trucking system plantation of machines in selected places and request for technical accreditation were undertaken while development of infrastructure for setting-up the scanning machines and manual for management of scanning machine were among the major achievement regarding Electronic cargo scanning system.

4.8.3.1. Electronic Cargo Tracking and Monitoring system (ECTS)

It was found out that, ERCA has been implementing technologies that prevent illegal trade and the related thefts from happening. Of all the systems Electronic cargo tracking system is one of them. And also this system enables to control both imported and exported items in a location that is difficult to control with the officers.

According to the ECTS module from ERCA: Addis Ababa-Kality Customs branch office (2014), ECTS is a tracking system that will be installed or planted on a freight vehicle (carrying such as bulk material, container or oil tanker) and will track and monitor the whole cargo transportation of the vehicle from point of origin to point of destination using sensors and monitors for instance its location, incidents that might have happened on the way will be monitored and registered on the system. The Electronic devices planted on the vehicle works wirelessly using a Radio frequency Identification (RFID) technology in two ways that are real time and relevant time. The real time system as its name indicates it will enable acquiring any information related to the location of the cargo and its status will be delivered to the control stations wirelessly at instant of time in need e.g. Incident happened will be known at the time it happens. Whereas Relevant time system will register all the necessary data related to the incidents that might happened on the way and other in the memory card and the information on the memory card will be retrieved after the vehicle reach the control station e.g. Incidents happened will be known after they happened.

According to the interview with ERCA: Addis Ababa-Kality Customs branch office Transit team officer (2014), the ECTS was installed by a company of Israel and America called Hi-G-Tek on 2013 G.C. with 3.1 million USD and it was tested on 100 trucks on the routes Gahalfi – Modjo – Kality, Ghalafi – Mekele and Dewele – Dire Dewa. Also during the interview with the officer these advantages, challenges and future plan were mentioned as follows;

Advantages

- Enables to track and monitor the cargo transported by freight transport from point of origin to point of destination
- It will control the case of theft on imported and exported items in a significant level.
- Controls transporting of illegal items with legalized goods.
- It will reduce the time taken by manpower to check every item at the control stations.
- Since information is transmitted instantly in the case of real time system, it will enable to react to incidents that might be happening on the roadway immediately.
- It will preserve image of the nation towards the international export trade when exported items are protected from theft on the way to their destination.

Challenges faced

Even if the ECTS has the above advantageous and need to be implemented fully in the freight transport sector, there are challenges that are hindering the immediate implementation as per the interview with the ERCA: Addis Ababa-Kality Customs branch office transit team officer (2014). The challenges faced are listed below,

- Lack of awareness towards the technology
- Capacity building through training is yet to be developed
- Internet facility and coverage is too poor on the trade route of Addis Ababa – Djibouti to implement the real time system of the Electronic cargo tracking and monitoring system.

- The electronic devices/sensors are expensive, for instance a containerized good needs only one seal which costs 20,000 ETB whereas one oil tanker cargo vehicle needs 16 sensor devices called seal for all openings and it costs 320,000 ETB birr, which is too expensive to invest on each of the cargo vehicles tracking system.
- The willingness of the freight transporters is low.
- Due to the high sensitivity of the electronic sensor on the seal and the poor condition of most of the roadways, one Alert on the device may be costly and disturbing.

Future planning

As per the information gathered from the ERCA-Addis Ababa Ababa Kality Custom Branch office/Transit team, scanning technology is going to start running at Awash and Galafi check points based on the risk level of each item. This will minimize the waiting time at check points.

4.8.3.2. Truck Demurrage System

According to FDRE proclamation no:811/2013 (2013),Truck-demurrage-proclamation, it has become necessary to transport export and import goods with appropriate cost and within short period of time to the port or from port to consumer distribution channels across the country; whereas, the inefficiencies of shippers and consignees, warehouses providing loading and unloading facilities and regulatory bodies conducting inspection are resulting in considerable time loss in truck operations; whereas, it has become necessary to enact a legislation on trucks demurrage to avoid such loss of time in truck operations and to increase the frequency of use of trucks and thereby increase freight carrying capacity and shorten the waiting time of goods at ports to minimize unnecessary costs and to avoid related problems. "Demurrage" means a payment to compensate for detaining a truck beyond the time limit allowed: a) for loading or unloading by a sender, consignee or warehouse; or b) for inspection conducted by a government regulatory body;

According to the proclamation any sender or consignee or warehouse operator shall have the obligation: a) to load within 8 hours and unload within 6 hours a truck with loading capacity of 20 ton or above; or to load within 5 hours and unload within 4 hours a truck with loading capacity of less than 20 ton. If the sender/consignee failed to do this there is going to be a demurrage per hour of delay, which ranges from 75 ETB – 200 ETB based on the delay period and vehicle loading capacity.

4.8.4. Ethiopian Roads Authority (ERA)

According to MoFED (2014), it was found out that the opportunities, treats and the measures taken.

Opportunities for the road sector (MoFED, 2014)

- Fast growing finance and technical support of foreign countries and donors.
- Growth of Ethiopian government revenue
- Growth of interest of foreign contractor and consultant companies to participate in the road construction sector.
- The continuity of the second growth and transformation plan after 2014/15
- Growth of execution capacity the sector

Treats to the sector (MoFED, 2014)

- Finance shortage since the next growth and transformation plan (GTP II) has taken into consideration of the future sustainable growth of the nation as an input.

- Shortage of foreign currency for executing projects since the foreign currency is collected from the export trade of the nation.

Measures Taken (MoFED, 2014)

- Taking into consideration of the might happen lack of finance and shortage of foreign currency, it has been worked on completing projects on time and also using foreign aid / loan to construct highly expensive projects demanding high finance.

4.8.4.1. Lebu-Akaki- Goro Outer Ring Road under construction

According to the feasibility study of Lebu-Akaki- Goro Outer Ring Road by Core Consulting Engineers plc (ERA, 2012), Completion of the Addis Ababa – Adama Toll Road will bring substantial change to the congestion of traffic and the accident along the route from Akaki to Adama, however, there are no improvements ongoing on the section from Kality round about at Ring Road to Akaki. Already the Kality – Akaki road is highly congested by the existing traffic flow, hence, the completion of the Toll Road project will worsen the congestion on Akaki – Kality road section. Therefore it was necessary to consider an outer ring road of Akaki – Goro and Akaki – Lebu having PAS-1 (Principal Arterial Street) road functional classification with four lanes main carriageway, two lanes frontage, and walkway of 5m width in each direction (ERA, 2012).

Figure 24: Partial view of the Lebu - Akaki Ring road construction around Tulu Dimtu

It was found out that the construction of these outer ring roads in combination with the Addis Ababa – Adama Toll road is expected to enhance the mobility of vehicular traffic, especially since 50% of the vehicles operating on the road are large trucks transporting goods and services between Addis-Ababa and the Port of Djibouti (ERA, 2012). These outer ring roads, Akaki – Goro and Akaki – Lebu are currently under construction.

4.8.4.2. Awash – Adama Expressway under planning

As per the secondary data collected and an interview made with ERA/Eastern region Design and Build Directorate (2014), it was found out that large portion of the traffic on Awash – Adama road are heavily loaded trucks transporting import and export goods. And even one of the lanes has been damaged severely as it serves for the import trucks of which almost all are heavily loaded. Therefore the detail Pre-feasibility studies and Design of Awash – Adama Expressway (ERA, 2013) was conducted by Beijing Expressway Supervision Co. Ltd in JV with Beza Consulting Engineers

Plc. As per the interview made with ERA/Central region planning department (2014) it was also found out that the construction of the Awash – Adama expressway awaits a final approval from the government and also a donor for the finance of the road. And it may be expected to be achieved soon because the Ethiopian government mentioned that it intends to extend this road to Awash Arba in Afar regional state, some 240 km east of the capital Addis Ababa on the inauguration of Addis Ababa-Adama Toll road.

5 Discussions

The cost of the inland road transportation from Djibouti port to Modjo dry port through freight vehicles is found out to be 35% higher than that of the sea transport from Chinese ports (Tianjin and Shangai) to Djibouti port with a STDev of 7%. As for the total time of freight transport, it takes 39-50 days from Shangai and Tianjin port of loading respectively to Modjo dry port; based on performance basis under normal circumstances. It was also noted that the first eight days (grace period) at Djibouti port are free from any storage and demurrage cost. But some unaccounted for containers may take up to 40days to reach Modjo dry port through the inland road transportation due to the reason of 'seal of container' breakage. The cost variation between the two modes could have been higher if the cost of time (delay) changed into monetary value for the inland road transportation. Table 35 shows the comparison in between different studies conducted on the foreign trade traffic for Ethiopia.

Table 35: *Comparison of cost of foreign trade (import) traffic for Ethiopia (Sea transportation + Inland road transportation cost)*

No.	Estimated Cost of Import trade USD/TEU	Estimated Voyage time in Days	Different studies
1	2,893	42	World Bank, 2007
2	3,850	46	Afro Consult, 2010
3	2,960	44	World Bank, 2015
4	3,049 – 3,354*	39 – 50*	This Study

* Estimated min and max range of imported rate for the Fareast/Chinese ports only used
Note: This voyage times do not include the time of document preparations.

Road transport is cheaper than rail in short trips because of the flexibility and rail transport achieves considerably more economies of distance than road transport. For trips shorter than roughly 150 kilometers, road transport is virtually always cheaper than rail transport. And also it's found out that overland cross-country pipeline transport is the cheapest and safest mode for those types of commodities that can be transported by pipeline such as fuel. Either rail or road transport is the cheapest mode of transport for all those commodities that cannot be carried by pipeline such as fuel; for importing fuel on the nations case i.e. Djibouti to Addis Ababa through the means of these modes of transportation may be advantageous.

The main highway connecting Addis Ababa to Djibouti port via Modjo dry port stretches more than 900Km; significant stretch of the roads and bridges are deteriorated and are in poor condition which needs a maintenance or reconstruction. The new Addis Ababa-Adama toll road is providing a better alternative for heavy vehicles more in reducing vehicle operating cost, benefiting road users with a safer and time saved trip too. So as many as the freight transport vehicles use the toll road it benefits the freight transport in reducing the cost of inland road transportation and though the number of vehicles using the road is still less due to the unawareness of the road users towards the benefit with respect to the tariff imposed. The new Awash River crossing bridge is expected to improve the long queue in waiting time created by vehicles on the older bridge. Also it will reduce the accidents that might occur in the vicinity of the older bridge because the new bridge will allow crossing of two vehicles at a time with a 40.8ton limit and a speed limit of 85Km/hr. The new Electrical railway from Addis Ababa to Djibouti is mixed type and will mainly improve the land transport system in relieving the common freight transport on the roads. Based on the assumption taken, the electrical railway hauling 94TEU may replace the equivalent 94 vehicles with their trailers (if any) of freight transport at least. When these vehicles working with fuel are replaced with

eco-friendly transport of the railway line, fuel consumed and CO_2 emitted to the atmosphere will be saved.

There is a congestion/accumulation of containerized goods at Modjo dry port with average dwelling time of 57days. The congestion of containers is mainly as a result of the customers are not willing to pick the imported goods on time due to the lower storage cost charged with respect to the foreign currency paid when the imported goods are stored at Djibouti port ('uni-modal' transportation case). The other reasons are; looking for other business opportunities in the expense of the custom clearance they have to pay and market assessment that's waiting for a better unit price of the imported item on the market while it's under the premise and the guard of the nation. Djibouti today handles about 93% of Ethiopia's imports and exports, while Berbera (in northwest Somalia) handles 3% and Port Sudan (in Sudan) 2% (World Bank, 2013). Ethiopian government aims for a 60%-30%-10% split among Djibouti, Berbera and Port Sudan (MoFED, 2010). Djibouti's is likely to continue being so; because Djibouti port's competitiveness can be measured not only in terms of cost and time but also reliability and other attributes like for instance as per World Bank Group (2015) the cost of import and export per container is lower than that of in the middle east and north Africa. The other factor is that Port Berbera is unlikely as long as Somalia's political situation remains unstable also Port Sudan has a substantial disadvantage because of its long overland distance (1,900 km from Addis Ababa), unless the origin or destination of the goods traded is in northern Ethiopia (World Bank, 2013).

According to the assessment towards overloading; of the entire measured axle load at Modjo station, the illegal axle weight which was beyond the axle load limit (8ton for Front axle and 10ton for Rear axle) accounts for 6% of the total axles weighted. These overloaded vehicles with containers are causing serious damage to roads, bridges and the vehicles themselves.

From the mini-survey of freight transporters, 67% of the responders have agreed on insufficient lane width for wide loads and other road users don't take into account the special requirements of heavy vehicles, and 89% of the responders found long time processing (customs clearance) and poor roadways conditions as a serious problem. All of the transportation companies have agreed on the improvement of rest areas for the drivers and also truck parking areas for the trucks. To minimize the possible theft on the route; avoiding driving after midnight and resting theft exposed cargos around governmental compounds or at nearby police station during the night time was recommended. For the case of the freight forwarders, 57% of the respondents preferred more of 'uni-modal' transportation on the current basis and 29% of the respondents preferred "multimodal" transportation. The main reasons were "multimodal" transportation is operated by one government owned company ,ESLSE, with limited man power, offices and logistics facilities and 'uni-modal' transportation works best once the necessary payment and documentation run at Djibouti port and also it has created many job opportunities. But if the company improves the entire logistic services and cooperates to work together with the private sector, "multimodal" will be more feasible and implemented better than 'uni-modal' system.

Ethiopian government under the ownership of ESLSE is engaged in constructing mega warehouses. One is the construction of stuffing stripping warehouse with an area of 5,400 meter square size. Also the government of Ethiopia is on the way of importing 215 trucks (Renault) which have a carrying capacity of 57ton for freight containerized and break bulk transportation. This new trucks in turn compensates the need for transporting heavy freight goods distributed over the axles of the new trucks which saves the transportation infrastructures from further damages and deterioration and also the saves the high vehicular operating cost of old trucks in the system. To tackle the congestion and of containerized goods at Modjo dry port, the respective office at Modjo dry port are taking managerial measures beyond executing the cost of storage. A joint command post with Modjo dry port revenue and customs branch office established to contact and reach those customers who have many containers on the site and those who are big importers to clear out their containers as soon as possible; so that the dry port can utilize the capacity at hand effectively and concentrate on other upgrading facilities needed inside the dry port (e.g. more logistics equipments

such as ridge-stacker). ERCA also has been working on the improvement of the custom system by trying to introducing electronic cargo tracking and monitoring system (ECTS) for freight transporting vehicles from point of origin to point of destination which will reduce the time taken by manpower at check points. This system will protect the transported items from theft especially those of bulk items susceptible to instant theft and also advances the system of cargo tracking throughout the trip; even though applying this technology especially the real time system needs a telecommunication infrastructure with fast internet coverage along the inland trade route and also the willingness of the customers to use the technology. ERCA is also planning to run the Digital scanning machines at check points of Awash and Galafi for better and fast custom checking; expecting to reduce the delay in waiting time for clearance. The new demurrage system which will control the time of arrival of the freight at the point of delivery and its unloading time; will give another strength for the freight transport through minimizing the delay incurred in waiting time for unloading and loading by the freight transporters. ERA is engaged in construction of Lebu-Akaki-Goro Outer Ring Road, which connects the Addis Ababa-Adama toll expressway to Addis Ababa will reduce the congestion created in between the gate (Tulu Dimtu) and Akaki. Awash – Adama Expressway under planning stage will also be an additional strength to the roadway in the route just like Addis Ababa – Adama Expressway in reducing the travel time and also the vehicular operating cost.

6 Conclusions

The following conclusions can be drawn from the assessment of freight transport and transportation infrastructures on the international trade route of China – Djibouti – Addis Ababa via Modjo dry port;

- The cost of Inland transportation is 35% (STDev=7%) higher than that of the Sea.
- It costs more to transport a container from Djibouti port to Modjo dry port, than to ship the same container from China to Djibouti port.
- The freight transport from china to Modjo dry port will take 39 and 50 days from Shanghai and Tianjin port respectively on normal circumstances. Though some containers may take more than 80 days to reach Modjo dry port due to the reason of 'seal of container' breakage.
- Overland pipeline transport might be the cheapest mode for those types of commodities that can be transported by pipeline such as Oil and gas. Either rail or road transport might be the cheapest mode of transport for all those commodities that cannot be carried by pipeline.
- For trips shorter than 150 kilometers, road transport might be cheaper than rail transport.
- 65.9 % of the trunk road Addis Ababa–Djibouti border is in a good condition, 13.2% in a poor condition whereas the rest percentage in fair condition. And 22% of the Bridges along the same route are in a poor condition. Whereas the road stretching from Djibouti Border (Galafi) to Djibouti Port, 21% of the highway is in Poor to Very poor condition.
- The new Addis Ababa-Adama toll road in the international route is providing a better alternative with its fast lanes in replacing the congested and busy route of the older road in reducing vehicle operating cost. The heavy freight transport vehicles are benefiting in paying only 38% of the benefit they gain at toll booth and due to the heavy vehicles dedicated lane on the toll road.
- The new Awash River crossing bridge is expected to improve the long queue in waiting time created by vehicles to cross the older bridge and may reduce the number of accidents at the site.
- The new Electrical (environmental friendly) railway from Addis Ababa to Djibouti is likely to improve the inland freight transport system with a faster travel time of 10 hours on the route relative to the average two days taken on inland road transportation and it may be able to replace at least 94TEU containers that were transported on inland road transportation with trucks that in turn means it may replace freight of more than 94 vehicles with trailers (if any) relieving the strain. Thus fuel will be saved, CO_2 emission will be reduced also reduction of freight vehicles will reduce the congestion and traffic accidents on the busy route.
- Congestion of containerized goods with an average 57days of dwell time at Modjo dry port exists.
- Djibouti ports competitiveness may continue since the government is working on expansion of ports. Also Port Sudan is 1,900 Km from Addis Ababa and stability of Somalia is still in question.
- Freight transport companies have agreed on the existence of a long custom processing time at the Modjo dry port, poor condition of the roadway on the route and lack of trailer drop off/Pick up facilities.
- 57% of the logistic service providers preferred more of 'uni-modal' transportation than "multimodal" on the current basis and 29% of the respondents preferred "multimodal" transportation.
- ESLSE is planning to start giving service using Port Sudan and Berbera port may strengthen the economic tie between neighboring countries and widens the alternatives the nation have.
- The government of Ethiopia is on the way of importing 215 Trucks (Renault) which have a carrying capacity of 57ton for freight containerized and break bulk transportation that may increase the capacity and efficiency of the inland road transportation.

- The Lebu-Akaki-Goro Outer Ring Road under construction, which connects the Addis Ababa-Adama toll expressway to Addis Ababa more and will be expected to reduce the congestion created in between the Addis Ababa Adama gate road (Tulu Dimtu) and Akaki. And also the Awash – Adama Expressway under planning will also be an additional strength to the roadway in the route just such as Addis Ababa – Adama Expressway.
- Doraleh multi-port project (DMP) which is expected to double the port's capacity in Djibouti will also be expected for service by the end of 2016, and it is intended to relieve the strain on existing infrastructure and accelerate economic development of the region.
- The high rate of shipment for Ethiopian vessels may affect the competitive capacity of Ethiopia in international trade where Chinese companies have more strategies to dominate this trade route.

7 Recommendations

- More wide study with respect to the sea freight rate competition at Far East (China) trade route should be conducted for the fair competition of ESLSE ships on the route.
- Use of oil pipeline and railway transport an alternative in the Djibouti-Addis Ababa route which may be the efficient and least cost modes of transport for Ethiopia with less logistics problem with respect to the inland road transportation.
- Better to consider a variety modes of transport in combination, so that the respective advantages/benefits of each mode are better exploited thus the Intermodal transportation ("Multimodal") have most significant positive impacts over the freight transport. This means Considering other additional alternatives besides current Shipping → Trucking system of freight transport ;
  - ✓ Shipping → Rail → Trucking (for both oil and dry cargo transport) and
  - ✓ Shipping → Pipeline → Trucking (for oil transport).
- Rehabilitation and maintenance of the roads and bridges that are in poor condition may be required for better efficiency of the freight transport traffic along the international trade route.
- Creating more coordinated awareness creation strategies to the users of the new Addis Ababa-Adama toll road involving different companies and government agencies.
- Some freight forwarders who own many trucks might not have a positive attitude towards the railway infrastructure. However, the import and export volume of Ethiopia is increasing and this should be considered in awareness creation activities.
- The improvement of rest areas for the drivers, also truck parking areas, avoiding driving after midnight that means driving at day time and resting at night and also theft exposed cargos should rest to spend the night time around governmental compounds or at nearby police station is recommended to achieve smooth and safe freight transport from the numerous private freight transporters.
- Companies should be encouraged to invest in information technologies (IT) relevant to their activities in import and export trade sector.
- The state owned ESLSE being the only "multimodal" transport operator (MTO), should participate or work together with the private sector such as importers, freight transporters, forwarders and local societies to get the better output and benefit of the nation from the "multimodal" transport system, it means that the system should not be monopolized.
- Opening a higher institution/Training center fully dedicated to the Freight and logistics service sector training, so that the sector will have numerous trained and intellectuals on the current modernized logistics service.
- To create more awareness through Medias, seminars also reach those customers who have many containers on the dry ports to clear out their containers may reduce the average dwelling time of imported containerized goods at the dry port.
- Implementing modernized technologies such as Electronic cargo tracking and monitoring system (ECTS) and running Digital scanning machines at check points of Awash and Galafi, may yield a safe delivery of imported goods and reduce the custom process time at the check points. ERCA has to work with Ethio-Telecom for better internet facilities and coverage along the route and also the government may have to involve in the import of the expensive Fuel tanker seals needed per truck.
- Further study on cost and benefit analysis of expanding the Addis Ababa – Adama Expressway to Djibouti which may give an additional strength to the roadway with respect to reducing travel time, vehicle operating cost, reducing fuel consumption, lowering the inland haulage rate, faster delivery time, higher number of trips (8-10hr/ Trip based on Addis Ababa-Adama toll road) and in improvement of the overall freight transport and logistics service along the international trade route.

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Annex 1: Design Standards vs. Road Classification and AADT

(ERA, Geometric Design Manual-2002, Chapter 5)

Road Functional Classification	Design Standard No.	Design Traffic Flow (AADT)
TRUNK	DS1	10,000 – 15,000
LINK	DS2	5,000 – 10,000
MAIN ACCESS	DS3	1,000 – 5,000
COLLECTOR	DS4	200 – 1,000
	DS5	100 – 200
FEEDER	DS6	50 100
	DS7	30 – 75
	DS8	25 – 50
	DS9	0 – 25
	DS10	0 – 15

Annex 2: Weight and length of standard containers

(Source URL: http://www.worldshipping.org/about-the-industry/containers and http://www.molhk.com/pages/dry-cargo-containers , accessed 05-03-2015)

Description	20feet container	40feet container
Length	6.1 m	12.2 m
Maximum gross weight	24,000 kg	30,480 kg
Empty weight	2,400 kg	3,980 kg
Max pay Load	21,600 kg	26,500 kg

Annex 3: China– Djibouti – Addis Ababa (Ethiopia) International Trade route

Annex 4: Sample Questionnaire template for Freight transporters

1.**Do you use the Djibouti-Addis Ababa road via Modjo dry port as part of your freight transport?**

Yes ⬭
No ⬭

2. How many days it take to transport goods from Djibouti port to Modjo dry port?

Truck types can be Single unit truck, Truck with a trailer, truck with 2 trailers……etc

Truck Types used	Type of goods transported	Season of year	Time Taken in Days

3. Do you have any access problems in or out of specific manufacturing plants, industrial parks or intermodal transfer yards? If yes, please describe.

_____
_____
_____
_____
_____
_____

4. Do any of the following conditions present problems for freight shipments to or from your company and/or facility? (Please Circle your alternative on the rating)

_____
_____

Condition	Rate from 1 to 5 1 - not a problem 5 - very serious problem	Please describe the location and nature of the Problem.
1. Highway congestion	1 2 3 4 5	
2. Merge lanes	1 2 3 4 5	
3. Long time processing (customs clearance)	1 2 3 4 5	
4. Highway interferences with rail lines (i.e., grade crossings)	1 2 3 4 5	
5. Turning at traffic lights	1 2 3 4 5	
6. Inadequate local streets capacity	1 2 3 4 5	
7. Roadway turning radius	1 2 3 4 5	
8. Insufficient lane width for wide Loads	1 2 3 4 5	
9.Insufficient bridge/tunnel clearances (height)	1 2 3 4 5	
10.Lack of trailer drop-off/pickup facilities for trucks	1 2 3 4 5	
11.Curfew restrictions on movement of large and heavy trucks	1 2 3 4 5	
12.Poor truck access to shipping Terminals	1 2 3 4 5	
13.Poor truck access to intermodal facilities	1 2 3 4 5	
14. Sleeping problem	1 2 3 4 5	
15.Poor reliability due to accidents and incidents	1 2 3 4 5	
16. Unsafe roadway geometries	1 2 3 4 5	
17. Poor reliability due to weather Conditions	1 2 3 4 5	
18. Poor roadways/Older roads	1 2 3 4 5	
19. Narrow roads	1 2 3 4 5	
20. Language problems on international roads	1 2 3 4 5	
21. Poor Signage on the roads (Traffic Signs)	1 2 3 4 5	
Other (specify)	1 2 3 4 5 1 2 3 4 5 1 2 3 4 5	

5. How does the above problems affecting you and your company?

_____
_____
_____

6. What do you do as a transporter to compensate for these problems?

_____
_____
_____
_____

7. To what degree are you able to compensate for the problems?

_____
_____
_____
_____

8. How often have the following things caused a dangerous situation for you in traffic?
(Please Circle the suitable alternative)

Highway Conditions	Never	Some times	Often	Very often
Other road users don't take into account the special requirements of heavy vehicles	1	2	3	4
High speeds of other road users	1	2	3	4
Low speeds of other road users	1	2	3	4
Overtaking by other road users	1	2	3	4
My own carelessness	1	2	3	4
My own speed which is too high	1	2	3	4
My own fatigue	1	2	3	4
Bad condition of the vehicle I drive	1	2	3	4
Speed limiters in heavy goods vehicles	1	2	3	4
Timetables that are too tight	1	2	3	4
Poor maintenance of roads	1	2	3	4
Bad general condition of roads	1	2	3	4
Navigation difficulties (finding the way)	1	2	3	4

9. Which improvement in the transportation system would the respondent like to see?

Questions	Answers (YES/NO)
Highway ramps?	
Highway/route connectors?	
Highway/route lane capacity?	
Rest Areas?	
Truck parking areas?	
Information services?	
Other infrastructure? (specify)	

10. Do you consistently drive a regular route or pattern of routes each week?

Yes ⬭
No ⬭

Please describe the route or routes you most frequently drive to or from your company

_____
_____
_____

In driving the route(s) listed above, Is it your choice of roads a result of any impediments/Obstacles on roads ? Otherwise that would represent a better routing.

Yes ⬭
No ⬭

11. Do you use the new Addis-Adama Expressway as part of your route?

Yes ⬭
No ⬭

12. Do you think the new Addis-Adama Expressway is beneficiary?

Yes ⬭
No ⬭

12a) If Yes, Please describe the advantage you got from the new expressway relative to the older road.

_____
_____
_____
_____

12b) Do you have any comment on the Addis-Adama Expressway? If Yes, please describe it below.

13. Do you think the newly built Awash River crossing Bridge is beneficiary?

Yes ⬭
No ⬭

If Yes, Please specify the benefit you are getting from the newly built Awash River crossing Bridge relative to the older bridge?

14. What do you expect from the upcoming Ethio-Djibouti railway line?

15. What is your opinion towards freight load limit and Overloading both in Ethiopia and Djibouti?

16. Is there any attack or theft of transported goods during freight transportation?

Yes ⬭
No ⬭

16a) If Yes, Please specify the type of thefts you have experienced or heard of and their effects?

Questionnaire for Freight Transporters

16b) What is your recommendation/suggestion to minimize and avoid these and other problems?

Is there anything about freight transport and logistics you want to tell us which were not mentioned in our survey questions? Please do share it with us; we will be glad to have extra opinion.

Please state the following core details about yourself and your organization. This data will only be used to analyze the results for educational purpose and to contact you. It will not be shared with any 3rd parties.

Name:

Company:_____

Email Address:

Phone Number:_____

*** THANK YOU AND YOUR PARTICIPATION IS APPRECIATED ***

Annex 5: Sample Questionnaire template for Logistics service providers

Questionnaire for Logistics service providers and Freight forwarders

1. General information

Question	Answer Choices
What type of services provider is your company?	Logistics Service Provider (3PL) ⬭
	4PL ⬭
	Freight forwarder ⬭
	Road transport company Warehouse ⬭
	Other Logistics(please specify) ⬭
Years of experience in the transport logistics Sector?	None ⬭
	1 – 5 years ⬭
	6 – 10 years ⬭
	10+ years ⬭
In which routes do you mainly operate?	To and from Addis Ababa ⬭
	To and from Modjo dry port ⬭
	Inside Djibouti ⬭
	Others
How many employees does your company employ approximately?	Over 2,000 ⬭
	Under 50 ⬭
	51 - 100 ⬭
	101 - 250 ⬭
	251 - 500 ⬭
	501 - 1,000 ⬭
	1,001 - 2,000 ⬭

2. Current Information Technology (IT) Facilities

Question	Answer Choices
Do you utilize supply chain management software to manage your operating costs?	Yes ⬭ No ⬭ Not sure ⬭

Questionnaire for Logistics service providers and Freight forwarders

3. Quality Issues

Question	Answer Choices
Transport logistics quality can be defined as the degree in which the performance of the freight transport operations across modes in the supply chains meets stated service criteria.	I agree ⬭
	I do not Agree ⬭
	No comment ⬭
	Transport logistics quality can be defined as (please add your opinion) ⬭
Please prioritize/sort your view on the relative importance of these elements in ensuring quality logistics (from 1 to 5, where 1 represents highest and 5 represents lowest) * **Standards of Professional Competence** - standards of knowledge and experience to be taken into account for recognition of professional competence of individuals, providing logistic services. * **Quality Management along Supply Chain** - standards of service, covering entire supply chain. * **Quality Contract** - binding legal agreement between service provider and user stipulating quality parameters, consequent mutual responsibilities and compensation. * **Individual Service Quality Provisions/Criteria** – parameters for the measurement of quality of transport logistics performance. * **Standard combined transport product** - scheduled combined transport service with standardized procedures, specific time, specific schedule, and specific information regime.	1 ⬭ 2 ⬭ 3 ⬭ 4 ⬭ 5 ⬭

4. Business Strategy

Question	Answer Choices
Which of the following issues significantly influences your business strategy (please tick all that apply)?	Open up new markets ⬭
	Introduction of new products/services ⬭
	Meet customer requirements ⬭
	Globalization ⬭
	Supply chain security
	Improve operational visibility ⬭
	Other (please specify) ⬭
Which of the following areas is your company	Planning optimization ⬭
	Customer retention program ⬭
	Collaboration with other parties
	Operational improvement program ⬭
	Implement cost savings ⬭
	Offer services at a lower rate ⬭

Questionnaire for Logistics service providers and Freight forwarders

If Yes, How important do you feel the following software systems are in assisting you in managing your operations? (1 being most important and 5 being least important)	1 2 3 4 5
✓ Freight Forwarding	⬭ ⬭ ⬭ ⬭ ⬭
✓ Warehouse management	⬭ ⬭ ⬭ ⬭ ⬭
✓ Transport management	⬭ ⬭ ⬭ ⬭ ⬭
✓ Customs and compliance software	⬭ ⬭ ⬭ ⬭ ⬭
✓ Advanced planning and optimization software	⬭ ⬭ ⬭ ⬭ ⬭
✓ Enterprise resource planning software	⬭ ⬭ ⬭ ⬭ ⬭
✓ Customer relationship management software	⬭ ⬭ ⬭ ⬭ ⬭
✓ Other (please specify)	⬭ ⬭ ⬭ ⬭ ⬭ ⬭ ⬭ ⬭ ⬭ ⬭
Do you consider your current logistics software as a barrier to your ability to react to new business opportunities or business re-designs?	Yes ⬭ No ⬭ Not sure ⬭
If Yes, What are the main reasons for this barrier?	Financial implications ⬭
	Training of users ⬭
	Dependence on innovations of current vendor (lock in) ⬭
	Length of time to implement a new system ⬭
	Other (please specify) ⬭
Which (if any) of your supply chain trading partners does your current software enable you to share information/collaborate with?	Customers ⬭
	Partner companies ⬭
	Logistics networks ⬭
	Industry resources (e.g.shipping schedules) ⬭
	Other (please specify) ⬭
	None ⬭

Questionnaire for Logistics service providers and Freight forwarders

taking/considering taking action in, in order to respond more effectively to customer demand (please tick all that apply) ?	Commencement of (new) partnerships ⬭
	Network re-design ⬭
	Offer VAS/VAI (value-added services/logistics) ⬭
	Open up in new geographic markets ⬭
	Outsource logistics to 3PL ⬭
	Other (please specify)

5. Information Technology (IT) Plans

Question	Answer Choices
Is your company looking to increase information sharing/collaboration in the future?	Yes ⬭ No ⬭ Not sure ⬭
Does your organization have long-term IT investments on the agenda for the following :	Yes / No / Not sure
✓ Freight Forwarding	⬭ ⬭ ⬭
✓ Warehouse management	⬭ ⬭ ⬭
✓ Transport management	⬭ ⬭ ⬭
✓ Customs and compliance software	⬭ ⬭ ⬭
✓ Advanced planning and optimization software	⬭ ⬭ ⬭
✓ Enterprise resource planning software	⬭ ⬭ ⬭
✓ Customer relationship management software	⬭ ⬭ ⬭
✓ Other (please specify)	

6. Information Technology (IT) Evaluation

Question	Answer Choices
Which factor is most important when evaluating a new supply chain IT system?	Projected return on investment ⬭
	Cost of acquisition ⬭
	Total cost of ownership ⬭
	Timescale for benefits to be realized ⬭
	Other (please specify) ⬭
How quickly would you expect to start seeing a return	Within 12 months ⬭

on investment for a new supply chain IT system implemented within your business?	13-24 months ⬭
	2-5 years ⬭
	No set timescale ⬭

Different Issues and Developments

What overall problems do you observe in the Freight transportation Logistics in Ethiopia??

8) What is your opinion on Multimodal and uni-modal transportation , which do you prefer ?

a) Do you have any suggestions and recommendations for the problems?

9. Do your company use the new Addis-Adama Expressway as part of your route?

Yes ⬭
No ⬭

Does your company think the new Addis-Adama Expressway is beneficiary?

Yes ⬭
No ⬭

If Yes , Please describe the advantage your company got from the new expressway relative to the older road.

Do you have any comment on the Addis-Adama Expressway? If Yes, please describe it below.

10. Do your company think the newly built Awash River crossing Bridge is beneficiary?

Yes ⬭
No ⬭

If Yes, Please specify the benefits your company is getting from the newly built Awash River crossing Bridge relative to the older bridge?

11. What is your opinion towards freight load limit and Overloading in freight transportation both in Ethiopia and Djibouti?

12. What do you expect from the upcoming Ethio-Djibouti railway line?

13. Is there any attack or theft of transported goods during freight transportation?

Yes ⬭
No ⬭

If Yes, Please specify the type of thefts you have experienced and their effects on your company?

What are you trying to do to minimize the effect of theft problem?

What is the response of Authorities towards the problem?

What is your recommendation/suggestion to minimize and avoid the theft problem in the future?

Do you have anything to add or say which were not mentioned in the survey? (Please, share it with us)

Please state the following core details about yourself and your organization (If you are willing). This data will only be used to analyze the results for educational purpose and to contact you. **It will not be shared with any 3rd parties**.

Name: _____

Company:_____

Email Address:_____

Phone Number:_____

*** THANK YOU AND WE APPERCIATE YOUR PARTICIPATION ***