Addis Ababa University

School of Business and Economics

Department of Management, EMBA Program

Towards Examining the Causes of the Recurrent Fuel Shortage in the Downstream Oil Business of Ethiopia

By

Fisseha Mesfin

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Advisor: Mohammed Seid (Ph. D.)

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SIGNED DECLARATION

This Research Project is my original work and all sources of materials used for the thesis have been duly acknowledged.

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Fisseha Mesfin
June, 2019

The Research Project has been submitted for examination with my approval as an Advisor

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Mohammed Seid (Ph.D.)

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List of Abbreviations/Acronyms

AGO	Automotive Gasoil
BFT	Bulk Fuel Truck
CDE	Chemin de fer Djibouti-Ethiopia
EPSE	Ethiopian Petroleum Supply Enterprise
ERA	Ethiopian Roads Authority
ESA	Ethiopian Standards Authority
EU	European Union
FDRE	Federal Democratic Republic of Ethiopia
HDTL	Horizon Djibouti Terminal Limited
IEA	International Energy Association
KPC	Kuwait Petroleum Corporation
LPG	Liquefied Petroleum Gas
MC	Meter Cube
MoMP	Ministry of Mines & Petroleum
MoT	Ministry of Trade
MT	Metric Ton
NOC	National Oil Ethiopia Plc.
NPRDA	National Petroleum Reserve Depots Administration
OLS	Ordinary Least Square
SCI	Supply Chain Integration
SCM	Supply Chain Management
SPSS	Statistical Package for Social Sciences
TTL	Truck with Trailer
VIF	Variance Inflation Factors
YBP	Yetebaberut Beherawi Petroleum

Abstract

As the country is undergoing sporadic shortage of fuel at different times and the supply chain members give different reasons, sometimes contradicting to each other, the assessment of factors influencing the level and prevalence of this shortage is of paramount importance. The purpose of this paper is to assess the causes of the recurrent fuel shortage in Ethiopia so as to ensure reliable supply of fuel in the country. To meet the purpose, quantitative as well as qualitative assessment of the existing information in the sector were made. From different literature, the study identified factors that are considered as a good measure of these aspects of the fuel supply process. Then, information from primary and secondary sources is used to conduct the assessment. Data were obtained from a sample of 248 fuel station operators, which were taken from the total population of 1006 fuel stations across the country. To select the sample a stratified random sampling followed by a simple random sampling was employed. Analysis of the raw data was approached with the help of both descriptive and inferential statistics. From descriptive tabular, charts and percentages are used. Inferential tools such as correlation and regression analysis are also utilized in the course of this study. Some of the major factors underlying the fuel shortage are petroleum supply infrastructure, regulatory gaps, sentimental factors, oil distributors' Capability and communication technology. Of all these factors, regulatory gap is the most influential determinant of the problem. Nonetheless, all the aforementioned factors do have a significant effect on the frequency and severity of the fuel shortage. Therefore, the supply chain members and the stakeholders should have a regular review and consultative meeting, maintain collaborative relationship and work collaboratively on development programs and decision making to address the issues of regulatory gaps as well as the other determinants of fuel shortage in the country.

Keywords: Petrol, Ethiopia, fuel, capability, regulation, gap.

Unit One

Introduction

The topics discussed under this unit are: the background of the study, statement of the problem, research questions, research objectives, scope and limitations of the study. In addition, the conceptual framework is presented to integrate all the constructs of the study in one.

1.1. Background of the study

Oil, formed from the accumulation of hydrocarbons, has shaped our world in many important ways over the last more than 150 years that has had lots of benefits and a wide range of applications – in transportation, industries, medicine, and at home (OPEC, 2013). Oil is one of the world's most important raw materials. It has been the world's leading source of energy since the mid 1950's. This energy source is what fuels cars, provides electricity to heat homes and water, is used in modern medicine, processes and extract the chemicals used for household cleaning products, and much more. The oil and gas industry plays a critical role in driving the global economy. The products that this industry makes support many other vital industries like the automotive industry, power generation, and manufacturing industry (Adangor, 2016).

Because of its high demand around the world, the oil and gas industry has had tight control since the beginning of its discovery. Companies have been in constant endeavour to find ways to overcome challenges and excel in this industry; and they are being put to the test with an increasing amount of control and regulation to determine who will come out ahead (Ahmad, 2016).

The nature of the oil and gas industry is very complex. Generally, it is split up into three sectors: upstream, downstream, midstream. As per EKT Interactive Inc. (2017) the upstream sector includes the processes of exploration, recovery, and production of crude oil and natural gas. This sector is widely known as the exploration and production sector. The midstream sector can include elements of both the upstream and downstream sectors. However, the main focus of the midstream sector is the gathering system. Gathering systems are oil and natural

gas storage areas where hydrocarbons obtained from the oil field are held until they can be transported to the refinery, where they are turned into marketable products. The downstream segment is extremely complex and includes diverse activities such as refining, petrochemicals, distribution, and wholesale and retail marketing. Products can include gasoline, kerosene (jet fuel), diesel fuel, heating oil, liquefied petroleum gases, and petroleum coke. Players in the downstream sector include oil refineries, petrochemical plants, petroleum distribution outlets, retail outlets and natural gas distribution companies. There are two types of players in the oil and gas industry; integrated players and independent players. Integrated players are companies who combine activities from different sectors. Independent players are companies who focus on one specialty (Aminu & Olawore, 2014).

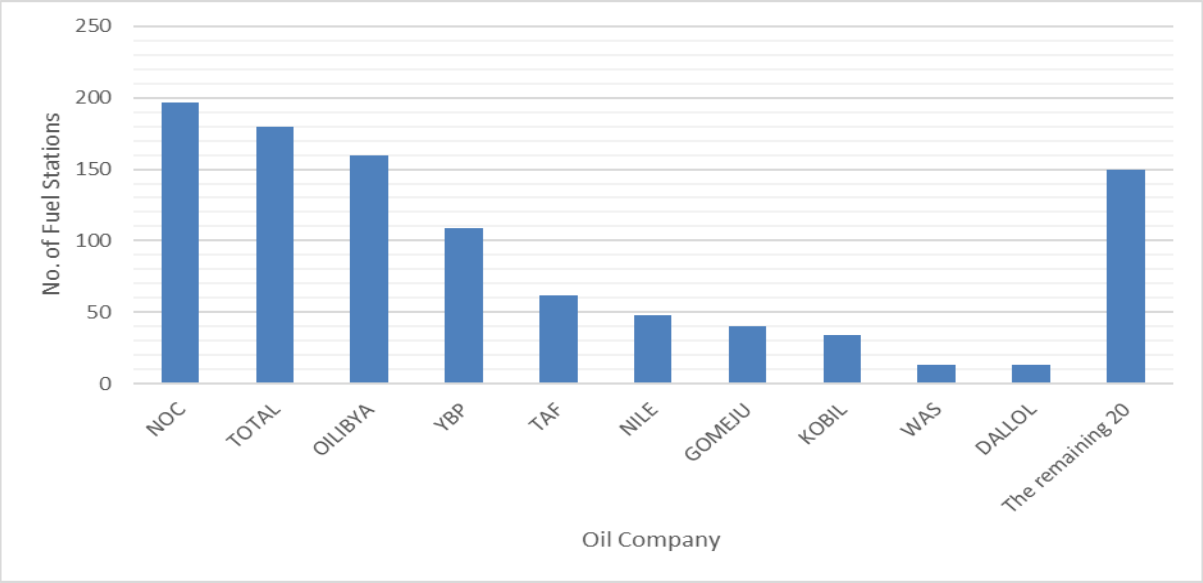
Lots of challenges are faced in the downstream oil and gas sector. The operating capacity of the global refining industries is continually constrained and therefore there is need for expansion in their various phases. Crude oil produced today is becoming heavier and sourer and product specifications are tightened by increasing strict environmental legislation. This has led to the need for changes in the refining configuration of many oil players. More so, marketing margins are getting lower as a result of competition from advantaged entrants (Colgan, 2014).

The downstream oil business of Ethiopia comprises the EPSE (Ethiopian Petroleum Supplies Enterprise – a government body solely responsible for importing fuel in the country), Oil Companies (major oil distributors), Bulk Transporters, and Retail Outlets (Gas Stations). The MoMP (Ministry of Mines & Petroleum) and MoT (Ministry of Trade) are also considered to be part of this industry as both Ministries are the industry regulators and oversee the overall operation of the industry.

As at today, there are about 30 registered oil companies in Ethiopia with the big 3 (NOC, Total Ethiopia and Oilibya) control more than 70% of the total fuel market. The 30 oil companies collectively have a total of about 1,006 fuel stations with more than half of these stations belong to the big 3 mentioned above.

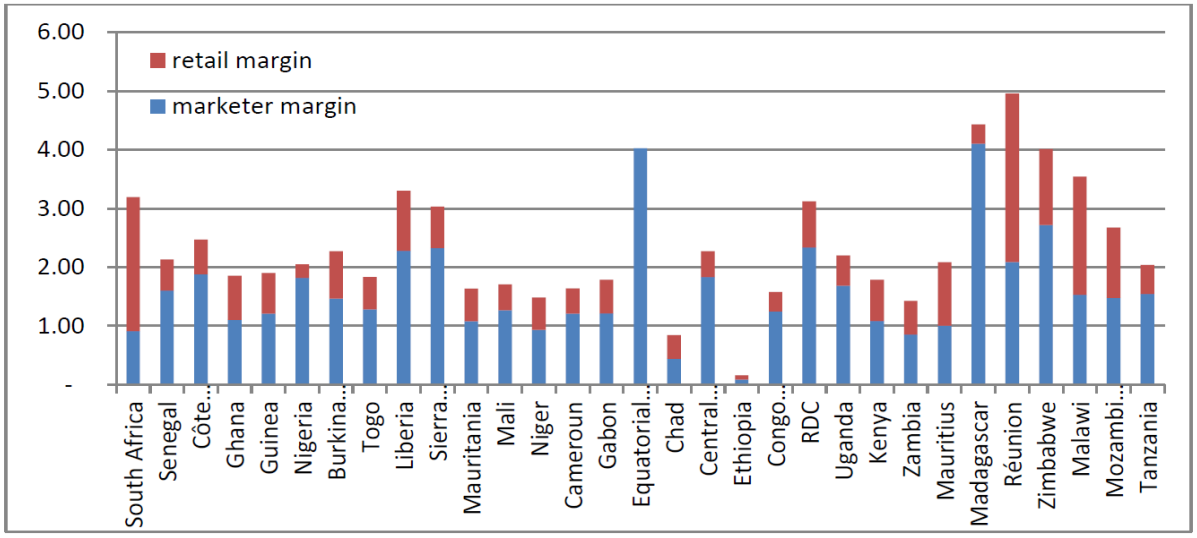
Given the size of the population, the land mass and the fastest growing economy, Ethiopia has a far less number of players in the oil sector than even the neighbouring country – Kenya (half the size of the population as well as landmass of Ethiopia) – which has more than 65 oil companies and 2,000 gas stations.

This calls for policy makers to eliminate bottlenecks and develop a better policy and strategy to attract more investment in the sector. Major players in the sector (oil companies & retail stations) make a margin of less than 1% of the pump price of fuel while the margin represents more than 10% even for most of the sub-Saharan African countries (Kundi consultants plc., 2016).



Source: Oil Companies & MoMP

Figure 1.1.: Number of Fuel Stations by Company, 2019



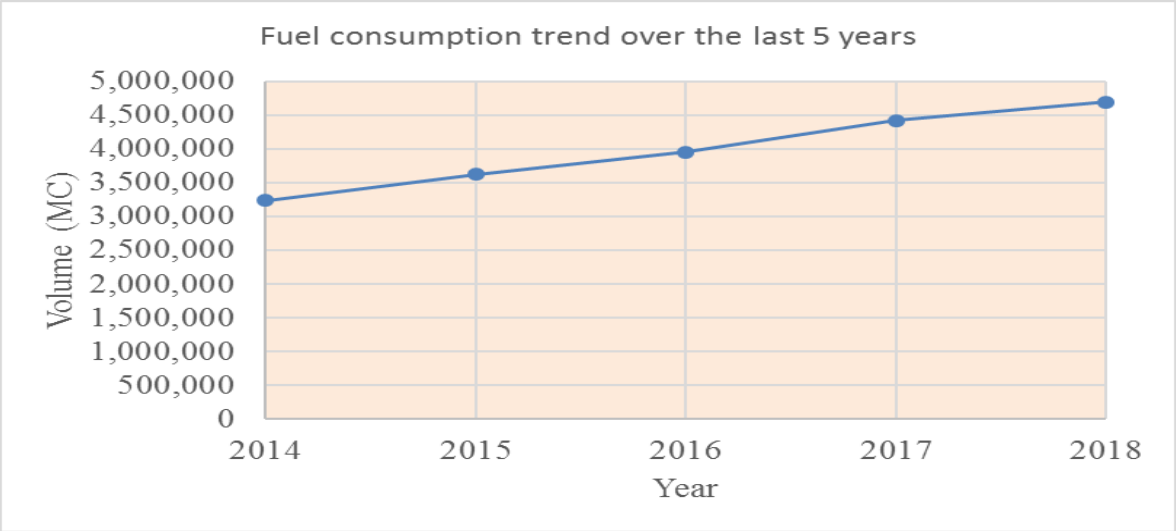
Source: Kundi Consultants Pls (2016) obtained from CITAC and cited by Melaku (2017)

Figure 1.2. – Oil Company & Fuel Station Margin of Sub-Saharan African Countries

Petroleum in its different refined products - gasoline (petrol) for cars, diesel fuel for trucks, jet fuel (kerosene) for airplanes and cooking, and lubricants for lubricating machineries and automotive is a critical commodity for any country. It is absolutely vital as the disruption of its supply and inappropriate distribution will result in chaos and disorder that detrimentally affect the economic and political situation of a nation. Our country, Ethiopia, spends more than the entire total export earnings to meet the Nation's fuel demand. Modern history shows an oil crisis is not affordable, especially to a nation on the move like us (Ethiopian Business Review, 2014).

It's needless to mention that petroleum fuels are the lifeblood of our economy that has all-rounded effect on the performance of all business activities as well as the day to day life of the people. The Transport, Construction, Mining, and the majority of manufacturing sectors are heavily dependent on petroleum products that in turn largely affect our life in general.

As per the report from EPSE, fuel demand in the country is grown by an average of 10% per annum for the last more than 5 years. Some of the contributing factors are: the rapidly increasing number of vehicles, boosting of infrastructure projects, shortage of electrical power supply (cause massive use of standby generators powered by fuel to sustain business activities), the increasing fleet size and destinations of Ethiopian Air Lines, and illegal smuggling of fuel to some neighbouring countries.



Source: own collection of data from EPSE

Figure1.3. –Trend of fuel distributed in Ethiopia over the last 5 years

It isn't uncommon to see intermittent fuel shortages in Ethiopia at different times. However, as heard often in different press releases, it has become a frequent phenomenon and developed to be a chronic problem over the last few years. Many factors are said to have contributed towards this problem. Among the repeatedly stated reasons indicated in the different local print media, like "The Reporter" and "Fortune Addis", obtained from the press briefings of government officials and industry leaders are: poor transportation and storage infrastructure, poor ICT, political and social unrests, regulatory/policy gaps and oil distributors poor capability.

1.2. Statement of the Problem

Having noted the importance and criticality of liquid fuel products in our economy, a smooth, uninterrupted and sustainable fuel supply operation along the supply chain is imperative. However, a supply glitch in the fuel supply chain has been a frequent phenomenon to observe for so long and has been developing to a chronic problem over the last few years despite the growing number of new players and huge additional investments being made in the sector. The causes of this problem could be of many, but unless the major problems are identified and addressed with immediate effect, it's easy for one to foresee its damaging effect on the whole economy in a short period of time.

Ethiopia, the landlocked country, spends about 3 billion dollars for importing fuel. With the much publicized economic growth in the past decade and huge federally funded infrastructure projects, like the Ethiopian Great Renaissance Dam, new railways along with flourishing private investments, the need for increased fuel supply is crucial and consumption has been rising every year. Consequently, Ethiopia has recently been suffering from recurrent fuel shortage due to various reasons. The recurrent problem with fuel shortage is causing serious public concern, interrupting economic activities and outrage. (Ethiopian Business Review, 2014).

According to the different press briefings by the petroleum supply chain members in the country, major factors that are escalating the problem would be categorized under sentimental factors, regulatory gaps, weak collaboration and communication gaps among the supply chain members, distributors' capability, and fuel transportation and storage infrastructure. This in-turn could negatively affect economic and business sustainability in Ethiopia. (The Reporter, Jan.19, 2019)

Oil distributors are up in arms over margins set by the Ministry of Trade. The Ethiopian Bulk Fuel Transport Owner's Association, with around 3,500 fuel trucks registered under its umbrella, has been arguing that the tariffs for fuel transportation in the country are too low and that their business has been hurt. Oil retailing companies aren't content with their profit margins from selling fuel. As the costs of running the business and the investment capital went up their profit margins from selling oil went down. Despite the fact that domestic retail prices of petroleum products are adjusted monthly, in line with oil price movements on the world market, the profit margin they earn from each litre of petroleum they sell has decreased, even when compared to the profits they used to earn over the past thirty- forty years. Currently, oil companies and retailers in Ethiopia earn a profit margin of less than 1% of the pump price of a litre of fuel. With this small margin they get by selling fuel products, oil distributors barely survive (FORTUNE News Letter, 10 November 2018).

Poor infrastructure, gaps in information sharing, political unrest, lack of well integrated ICT, and mismatch of the deployed logistics resource with the growing demand are among major challenges in the sector (Melaku, 2017). Government now should have the tools for resilience, understand where the pinch points are and evaluate options to address them. Government should also aim to upgrade infrastructure to ensure that services are resilient. Resilient infrastructure fit for our long-term needs is vital to economic development.

Hence, this study tried to examine the influences of the factors that are believed to be major determinants of fuel supply by members of the fuel supply chain of the downstream oil business of Ethiopia and propose possible solutions in order for government and business leaders develop strategies to mitigate recurrent fuel shortages and increase the efficiency of petroleum product supply so as to sustain business development; and to wake up the government to put effective regulation, updated policy and strategy intended to alleviate the escalating nation-wide critical problem.

1.3. Research Questions

The central research question that drove this study are the following:

- ✓ What are the extents of infrastructural & ICT influences on the fuel supply of the country?
- ✓ How do the regulatory gaps & sentimental factors affect the fuel supply of the country?

- ✓ What does the influence of oil distributors' capability on the fuel supply of the country look like?

1.4. Objective of the study

1.4.1. General Objective of the study

The major objective of this study is to describe the recurrent fuel shortage in the downstream Oil Sector of Ethiopia that intended to alleviate the ever-escalating problem.

1.4.2. Specific Objectives

Fetched from the major objective, specific objectives of the study aimed:

- ➢ To assess the extents to which the infrastructural provision and ICT influence the fuel supply of the country.
- ➢ To describe the effects of the regulatory gaps & sentimental factors on the fuel supply of the country.
- ➢ To identify the influence of oil distributors' capability on the fuel supply of the country.

1.5. Scope of the Research

The study is expected to describe the recurrent fuel shortage in the downstream oil sector of Ethiopia. In line with this, it is intending to identify the influences of major factors that cause recurrent fuel shortages in Ethiopia and discusses appropriate solutions to mitigate the problem.

1.6. Limitations of the Research

The study would be comprehensive if it encompasses all sectors and stakeholders as well as both the downstream & upstream supply chain. However, due to limited time and resources and wide geographical area of the country, the study was delimited to oil distributors – oil companies and retail stations only. Unable to include all the stakeholders in the study is among the limitations of this study to generalize the findings. Limiting the focus to senior leadership perspectives also limited the generalizability of findings.

1.7. Significance of the Research

This study will be significant to major stakeholders described above (oil distributors, government, corporate consumers, etc…) in improving the regulatory gaps, creating a conducive environment for the current distributors to function efficiently, to attract new investment in the sector, and hence alleviate the recurrent fuel shortage in the country. It can also serve as a base for researchers who are interested to conduct further study on the subject.

Unit Two

Review of related Literature

2.1. Overview of fuel Supply Operations

Various literature studies reveal that petroleum is obtained from crude oil, a complex mixture containing many different hydrocarbons that vary in appearance and composition from one oil field to another (OPEC, 2013). The crude oil provides fuel to the economy by petroleum refinery operation. Petroleum refining is the process of separating the many compounds present in crude petroleum. As explained on petroleum refining process, (OPEC, 2013), refining adds value by converting crude oil (which in itself has little end-use value) into a range of refined products, including transportation fuels. The primary economic objective in refining is to maximize the value-added in converting crude oil into finished products. The basic refinery operation includes; fractional distillation (separation) process thermal cracking (changing size), catalytic process, treatment, formulation (changing shape) and blending. Refined Petroleum products include: Liquefied petroleum gas (LPG) and compressed natural gas (CNG), motor spirit /petrol (MS) of all grades and naphtha, aviation spirit, solvents of all types, aviation turbine fuel (ATF), super kerosene oil (SKO), light diesel oil (LDO), high speed diesel (HSD), Furnas oil (FO) of all grades, lubricating oils and greases including base oil, wax of all grades and bitumen (Chakra, 2009).

Regular gasoline is a refined product of petroleum consisting of mixture of hydrocarbons, additives, and blending agents. The composition of gasoline varies widely, depending on the crude oils used, the refinery process available, the overall balance of product demand, and the product specifications. Additives and blending agents are added to hydrocarbon mixture to improve the performance and stability of gasoline (Chakra, 2009). These compounds include anti-knock agents, anti-oxidants, metal deactivators, lead scavengers, antirust agents, anti-icing agents, upper –cylinder lubricants, detergents, and dyes (Naveen G. etal. 2015).

Though not practical in Ethiopia, consumers in other countries have a choice of several kinds of gasoline at fuel stations. The majority of pumps usually offer a product called “regular,” other pumps are labeled “premium,” “super,” or something similar, and their product sells at different prices higher than the price of “regular.” The difference in name and price is based on the gasoline’s “octane.” As per Minnesota department of commerce on consumer guide on

gasoline octane facts (Minnesota Department of Commerce, 2004), regular gasoline has an octane rating of at least 87; and in EU, gasoline is required to have minimum octane rating of 85. In Ethiopia, the minimum octane no required by the specification is 81 (ESA, 2009).The Minnesota department of commerce also noted explained about what octane is and defined octane is a measure of a fuel's tendency to knock or ping when it is mixed with air and burned in the cylinder of an engine. The rating is called octane because the gasoline's ability to prevent engine knock has been rated against the performance of pure hydrocarbon octane, which has a rating of 100.Gasoline, which is made from a blend of many other hydrocarbons, may have a higher or lower rating, depending on how its anti-knock performance compares to the performance of pure hydrocarbon octane.

Kerosene is a liquid fuel, similar in composition to other fuels, obtained from distillation of crude oil. In some places it is also known as 'paraffin'. The main use of kerosene is a base for aviation fuel but it also has application as a solvent in paints, cleaners, pesticides, and some eye medicines. In many developing countries, it is a common fuel for stoves, heaters and lamps; and in developed countries it's a fuel for home central heating systems (OPEC, 2013). As detailed in the regular gasoline adulteration in Senegal (ESMAP, 2005), Kerosene is more difficult to burn than gasoline, so that its addition results in higher levels of harmful emissions even from catalyst-equipped cars i.e. cars equipped with conversion of engine-out pollutants. The higher sulfur level of kerosene can deactivate the catalyst and lower conversion of engine-out pollutants. If too much kerosene is added, octane quality will fall below the octane requirement of the engines and engine knocking can occur. Besides possibly damaging the engine mechanically, knock can increase harmful emissions which are, amongst others, ozone precursors. With gasoline vehicles not equipped with catalysts, the exhaust smell from kerosene is often rather acrid, creating unpleasant conditions in crowded city streets.

Theft, fraud, smuggling, laundering, corruption are among the many crimes committed along the fuel supply chain. Hydrocarbons crime, in all its forms, has become a significant threat not only to local and regional prosperity but also to global stability and security. Combating this pervasive criminal activity is more difficult by the reality that many of those in a position to curb the situation are the ones benefiting from it (Ralby, 2017).

Although difficult to quantify, ongoing malpractice in the downstream oil sector of Ethiopia is a common practice. It could be assumed that this malpractice takes place mainly at the

transportation and retail level, though some oil companies which are new entrants to the industry are rumored to be participating in.

Adulteration has been an issue since long in many countries. It's also a big issue in our country, too. But, thanks to the government's subsequent measures in reducing the price gap between the two grades and finally equalizing the prices of Gasoil & Kerosene in February 2017, the issue has been significantly reduced henceforth (MoT- revised fuel price, Feb. 2017). Though the issue is said to be reduced for the major share of the Ethiopian fuel market belongs to Gasoil, adulterating is still an issue as far as gasoline is concerned because of the price differential between gasoline and kerosene. As can be referred in officially published pump price of fuel by MoT, it clearly appears that the price difference between kerosene and gasoline (about 3 birr/liter) on the other hand creates a very strong incentive for malpractice at the retail level. Adulteration is the act of mixing low grade fuel (in our case Kerosene) with the relatively higher grade fuel - gasoline or gasoil (ESMAP Technical Paper, 2005).

In an effort to combat adulteration, a fuel marking and vehicle tracking program in Uganda reduced the amount of adulterated fuel from 29 percent to as little as 1 percent in its first year of application of the techniques. But at the same time, the regulators who test the state's fuel marking program routinely steal 22 liters per truckload, amounting to 1.2 million liters per year at one border crossing alone (Ralby, 2017).

Another global issue practiced in the downstream oil sector is theft. According to the report from the 'Atlantic Council – Global Energy Center' released in January 2017, 30% of all hydrocarbon products of Nigeria is smuggled into neighboring countries. The same report indicates that an estimated number of 660,000 cars in Morocco and Tunisia run all year long on fuel smuggled from Algeria. The same issue is also a concern in Ethiopia as per the informal communications and press briefings at different times. Transporters caught red-handed in the Somali region while transporting fuel for the illegal trade to neighboring country at different times as per the press briefings of police and MoT.

2.1.1. Supply Chain Management

Supply chain (SC) is a dynamic process that requires uninterrupted flow of information, materials and funds across multiple functional areas, within and between chain members in order to meet customer's requirements and to maximize their profit. Such dynamic process

requires immediate acquisition and constant re-evaluation of partners, technologies and organizational structures (Saad, Udin, & Hasnan, 2014).

The oil and gas industry is involved in a global supply-chain that includes domestic and international transportation, ordering and inventory visibility and control, materials handling, import/export facilitation and information technology. Thus, the industry provides a classic model for implementing supply-chain management techniques. In a supply-chain, a company is linked to its upstream suppliers and downstream distributors as materials, information, and capital flow through the supply-chain. (Chima, 2007).

The oil and natural gas industry is one of the world's largest and most capital intensive industries. The petroleum supply chain is characterized by a very complex network of companies that are involved in engineering-intensive activities to develop petroleum sources. Broadly classified, a petroleum supply chain can be divided into two segments: upstream and downstream. The upstream segment involves exploration and production of crude oil from onshore and offshore reserves, while the downstream segment predominantly focuses on refining crude oil and marketing the various refined products and derivatives, which are delivered to domestic and industrial consumers (Ahmad, 2016).

The connections and nodes in a Supply Chain achieve functions that contribute to the value of the products passing through the chain and thus its achievement. Any connection that does not carry out well reduces the overall effectiveness of the whole Supply Chain. As competition in international markets is progressively dependent upon the lead time or arrival time of goods as well as their quality, coordination between suppliers and distributors has become an important characteristic of the Supply Chain. As customer satisfaction is a crucial benchmark of the success of the Supply Chain, effective management of the linking processes is crucial. The supply chain in the oil industry is considered a complex one where there exists a linkage between upstream suppliers, downstream distributors, information and capital flow through the chain. (Wawuda & Mugai, 2016).

As per Ogulin (2014), supply chain management is concerned with the coordination of resources and capabilities within a firm and across a network of vertical and horizontal business partners. In the context of globalization, rapid technology evolution, shortening product lifecycles, and changing management philosophies, the management of supply chains has become increasingly complex. Supply Chain Alignment (SCA) provides an approach to respond to these challenges. Based on the theory of the resource-based view of the firm

(RBV)(Barney, 1991), SCA is defined as a concept that explains the efficient and effective allocation of supply chain resources and related capabilities to better serve customers and markets, improve the coordination of product, process and information flows, and to create value for shareholders and stakeholders (Ogulin, 2014).

The goal of supply- chain management is to provide maximum customer service at the lowest cost possible (Chima, 2017). A customer is anyone who uses the output of a process. Therefore, the customer's customer is important to any organization that is focused on customer service. In a supply-chain, a company will link to its upstream suppliers and to its downstream distributors in order to serve its customers. Usually, materials, information, capital, labor, technology, financial assets and other resources flow through the supply-chain. As the main goal of a firm is to maximize profits, the firm must maximize benefits and minimize costs along the supply-chain. The firm must weigh the benefits versus the costs of each decision it makes along its supply-chain. Supply-chain management is therefore an extension of the focus on customer service (Chima, 2007).

Supply chain management has been extended beyond the boundaries of the single firm to include vertical partnerships with suppliers and customers, as well as horizontal partnerships with transport, logistics and supply chain services providers. This created the need for coordination of capabilities across company boundaries. A supply chain capability is determined by the combination and intensity of sharing strategies, information, process, knowledge, skills, and incentives across the supply chain (Ogulin, 2014).

In Ethiopia, the fuel supply chain comprises: International traders supplying to EPSE, EPSE (the sole importer of fuel in the country), Oil Companies, Retail Fuel Stations, Bulk Fuel Transporters, and Industry Regulators (MoMP, and MoT).

2.1.2. The Downstream Oil Sector of Ethiopia

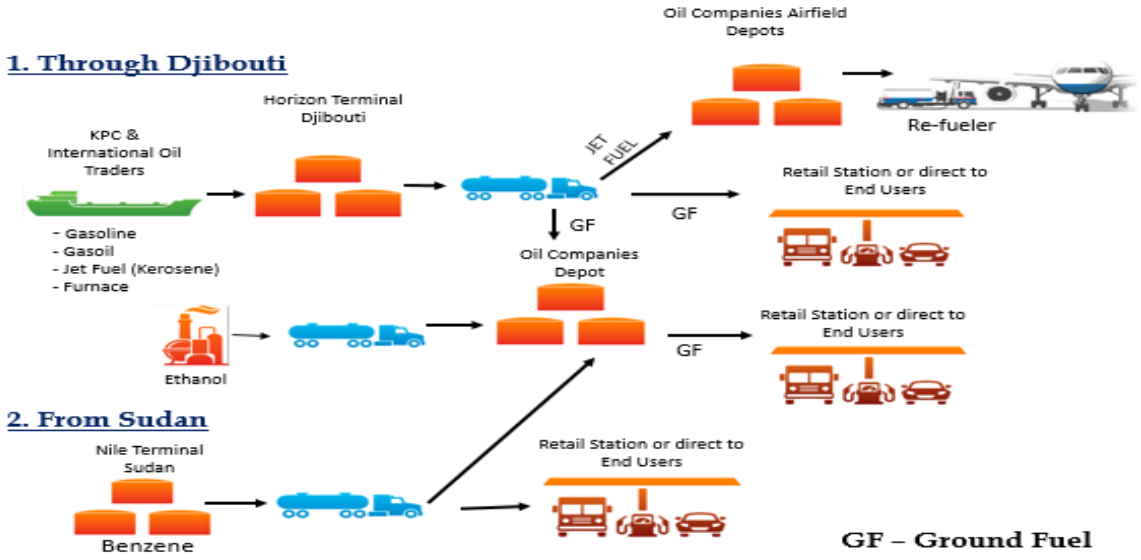
Ethiopia, being completely dependent on imported refined petroleum products for its entire oil demand, has only downstream oil business. The main players of the sector are EPSE, Oil Companies, Retailers (Fuel stations), Bulk Fuel Transporters, and Regulators (Ministry of Mines & Petroleum, and Ministry of Trade).

Along the fuel supply chain of Ethiopia, the EPSE – the sole importer of petroleum fuel– imports refined petroleum fuels and stores using leased horizon depots at Djibouti/horizon

terminal, and inland depots. The Oil Companies (major Distributors& Marketers) buy and load fuel products from Horizon/Djibouti Terminal depots using road tankers by contracting with Bulk Transporters, and deliver to their retail outlets and bulk corporate consumers. The inland depots of EPSE are used to store fuel products for national reserve in case of emergency and crisis (Melaku, 2017).

To make fuel distribution more efficient, the Ethiopian Petroleum Enterprise and the National Petroleum Depot Administration merged in July 2012 to form a new entity, The Ethiopian Petroleum Supply Enterprise (EPSE) that would be solely responsible for purchasing and supplying the nation's fuel. EPSE has 13 depots, throughout Ethiopia, and two branch offices, in Djibouti and Sudan.

Ethiopia purchases and imports petroleum products in two types of procurement agreements: through bilateral agreements with foreign governments and through international open tender from foreign oil companies. Currently, Ethiopia buys petroleum products from the Kuwait Petroleum Corporation (The entire Jet Fuel and a portion of AGO) and Sudan (a certain portion of gasoline – about 17%) through these bilateral agreements; while Petro China is awarded to supply the remaining part throughout 2019 by winning the open tender floated in September, 2018 (The Reporter, December 2018).



Source: Melaku, 2017

Figure 2.1- Fuel Supply Chain of Ethiopia

2.2. Status of Logistics Infrastructure

Ethiopia is a land-locked country with no direct access to the sea, hence, is reliant on ports of neighboring countries – mainly of Djibouti. The main corridor into Ethiopia is through Djibouti port for commercial, government and humanitarian cargo. 80% of the goods handled by Djibouti Port are destined to Ethiopia (Fekadu, 2013). Alternative ports are Port Sudan and Berbera. Mombasa port could be an option for southern parts of Ethiopia, but is currently not a time- or cost-efficient option. Ports in Southern Somali are not accessible due to the on-going conflict, and the ports of Assab and Massawa in Eritrea, which geographically would have been natural options, are still not functional due to the bad political climate between the countries for about a quarter of a century.

As per Fekadu (2013), the Ethiopian Roads Authority (ERA) is responsible for the maintenance of the federal road network of more than 41,000 km across the country which includes about 4,400 bridges and 40,600 culverts. The Djibouti-Ethiopia Railway (Chemin de fer Djibouti-Ethiopien, or CDE) Project consists of a 25-year railway operating concession for the 780 km railway running from Djibouti to Addis Ababa through Dire Dawa. The railway, constructed at the beginning of the 20th century, has deteriorated due to lack of maintenance, poor management, and lack of commercial focus.

The Addis-Assab road has been the primary trade route for traffic from Ethiopia to the Port of Djibouti. Ethiopia does not have any major river ports. Gambella Region has the Baro River which has been utilized during the rainy season for transporting emergency supplies to the Upper Nile State of South Sudan in 2012 and 2013. (Fekadu, 2013).

Logistics infrastructure consists of roads, railways, airports, sea ports, ICT and energy production (Srivastava, 2006). Dry ports and freight stations, and warehouses are important elements of logistics system. Market structure contributes to efficiency of freight transport and logistics system by connecting producers and consumers.

Energy consumption for transport in sub-Saharan Africa has increased by 4% per year since 2000 and was around 50 MT (million Tones) in 2012. The consumption is heavily concentrated on vehicles IEA (2014). The report also mentions that road transport in sub-Saharan Africa is typically characterized by a high degree of diesel use. In most of African countries, diesel has a share of above60%, except in countries where gasoline prices are

relatively low (such as Nigeria - only 12% diesel). The report continued, and mentions that transport fuel is subsidized in several countries in Africa, but is still expensive relative to average incomes of the population. Poor condition of the roads and the low affordability of fuels also lead to relatively low use of cars and trucks, compared with the global average. As a result, the cost of transporting goods in Africa is among the highest in the world.

2.2.1. Road Infrastructure

The development of road networks in the country has generally been progressing on the basis of highway and road sector development programs. Apart from urban roads and rural trails and footpaths, the present road system could be generally divided into three hierarchical functional classifications: the Federal, Regional and Rural roads. As per a research in 2010, the length of Federal and Regional road network is about 46,812 of which 6,938 is asphalt/concrete surfaced (Afro Consult & Trading PLC, 2010). This is road network density of 0.57 km per 1000 of population or 41.4 km per square km of area. This value for the weighted mean of road density in all of Africa is 2.6 km per 1000 persons and density of 58km per 1000 square km (Asnake, 2006).

The trunk road network radiates from Addis Ababa to the regional cities with minimal of gridding. Often areas close by through air distance are hundreds of kilometers by road because one should pass through Addis Ababa. This makes agricultural freight transport within country from areas with excess produce to deficient areas often expensive (Wubshet, 2011). The federal road network gives good connectivity to all major cities, ports and main international entry points. However, only about 30% of the rural areas are connected with all-weather road and many of these roads are in poor condition (Asnake, 2006).

2.2.2. Rail Infrastructure

Aggressively working on building an extensive rail network, and understanding the strategic importance of railway infrastructure, the FDRE established the Ethiopian Railways Corporation (ERC) under the Ministry of Transport in 2007 with a mandate to create a modern nationwide railway network, replacing the Franco-Ethiopian railway that is no longer in service (ERC, 2017).

The corporation currently owns 3 electrified standard gauge railway lines: the Addis-Djibouti, Awash-Weldiya, and the Weldiya-Mekele railways with the first one has already

been completed in October, 2016 though not fully operational so far. There are still others in the planning phase.

There is also operational metro system in the capital, the Addis Ababa Light Rail. The Addis Ababa Light Rail Transit project which has a total of 34 km has been completed and began passenger operation in September 20, 2016 which is highly supporting the city's public transport. This is a big achievement for ERC. (ERC, 2017).

The total length of the railway system is 2,185km, of which 1,401km is electrified (Wikipedia). The new corporation will be a significant factor in future corridor transportation and the development of railway network throughout the country. The share of the new railway of the corridor traffic could easily be up to 75% of foreign trade which will be incorporated in the second phase of the ten-year plan period (Afro Consult, 2010).

There is also a plan to transport fuel by rail wagons using the electric-powered railway system that has just been completed from Djibouti to Sebeta a couple of years ago. The plan for the National Railway Network of Ethiopia was to build eight new railway lines for freight and passengers covering a total distance of 5,000 kilometers working across the country by 2020. But the railway that connects to Duraleh petroleum terminal of Djibouti port and then from Awash main line to the Awash NPRDA depots have not been started yet. The areas to be supplied from this depot depend mainly on the number of trains to be dedicated for the purpose and the storage & loading capacity of the terminal. The realization of this plan will reduce the lead time for fuel delivery and hence will contribute in alleviating the current fuel shortage. (Melaku, 2017).

2.2.3. Pipeline Infrastructure

The use of pipelines has a long history. For instance, more than 1,000 years ago, the Romans used lead pipes in their aqueduct system to supply water to Rome. As early as 400 B.C., the Chinese used bamboo pipes wrapped with waxed cloth to transport natural gas to their capital Beijing for lighting. Clay pipes were used as early as 4000 B.C. for drainage purposes in Egypt and certain other countries. But, an important development of pipeline technology happened in the 18th century when cast-iron pipes were manufactured for use as water lines, sewers, and gas pipelines. A subsequent major development was the introduction of steel pipe in the 19th century, which greatly increased the strength of pipes of all sizes. In 1879,

following the discovery of oil in Pennsylvania, the first long-distance oil pipeline was built in this state (Hendy, 2017).

As per Konersmann (2009, pipelines, for they are laid underground and because their job is to connect widely distant places, they have certain particular technical safety features peculiar to them. Pipeline routes must be adapted to the constraints of infrastructure and topography, and environmental protection must be taken into account, as well as the possibility that the pipe system may be damaged by external influences.

As per the evidence from numerous incidents in many places of the world, even minor leakages can have significant damages on watercourses and the soil, and in many cases, people are also injured. Pipelines must of necessity cross roads and railways or are laid in parallel to such lines of communication. As a result of vibrations caused by traffic, this proximity can lead to ruptures. But a pipeline failure can have many other causes which cannot be predicted with any certainty and which even show regional particularities. In the interests of safe transport and land planning, it would therefore be worthwhile to be able to evaluate at least the possible consequences in terms of damage that might result from a pipeline rupture (konersmann, 2009).

Pipelines constitute one of the most efficient containments for the transport of large quantities of liquid and gaseous fuels over large distances. From a comparison of the frequency and consequences of pipeline accidents with other means of transport, transporting fuel by pipeline is shown to be the safest mode of transportation as depicted in the table below from the study in USA.

Table 2.1 – Safety of transport systems in the transport of oil per '000' kms

	Pipeline	**Tank-wagon**	**Tanker**	**Barge**	**Road tank-vehicle**
Fatalities	1.0	2.7	4.0	10.2	87.3
Damage	1.0	2.6	0.7	0.9	2.3
Fire/Explosion	1.0	8.6	1.2	4.0	34.7

Source: Konersmann, 2009

Amongst the advantages of pipelines over other means of transport are:

- They are ideally suited to transport liquids and gases.
- Pipelines can be laid through difficult terrains as well as under water.
- They have very low energy consumption.
- They need very little maintenance, and
- Pipelines arc safe, environmental friendly, and cheap means of transport.

Some of the disadvantages are:

- Not flexible, i.e., it can be used only for a few fixed points.
- Capacity cannot be increased once it is laid.
- Difficult to make security arrangements for pipelines.
- Underground pipelines cannot be easily repaired and detection of leakage is also difficult. (Barnawal, 2018).

Despite the enormous benefits it may bring to the country, Ethiopia has no petroleum pipeline infrastructure so far. There was an official agreement with a US company called 'Black Rhino' after a feasibility study was conducted and acceptance was secured for same, however, government has cancelled the deal soon in 2017 due to shortage of finance (The Reporter, 2017).

2.2.4. Sea Transport

Ethiopia as a land locked country, owns no sea ports and is using Port of Djibouti for import/export trade. The country owns a public sea transport commercial enterprise called the Ethiopian Shipping Lines Share Company. As per Fekadu (2013), it is a modern shipping enterprise operating a fleet of 9 ocean-going vessels of which five are multipurpose general cargo ships, three semi container ships and one roll-on-roll-off vessel, with the total carrying capacity of over 150,000MT. It also charters vessels to reinforce its own fleet and works hard to promote containerization and inter-modal transport handling all the facilitation and freight transport and logistics including customs clearance, inland transport up to dry ports of import goods. At present the company handles about 83% of the country's sea-borne general cargo import with own and chartered vessels and operates about 4,000 owned and 200 leased containers. The company's share of export cargo is small because the ships are selected by the importers on the other side of the sea. The Company is planning to buy 9 new vessels with the total capacity of 250,000 MT of which 7 are multipurpose with 28,000MT each and

2 tankers with 83,000MT. The company is using advanced ICT between headquarter and on board ships, training of its staff in its new Debrezeit center. (Afro consult & trading, 2010).

At present about 12 shipping lines serve Ethiopia through Djibouti. On the other hand no international shipping line, except the Ethiopian Shipping Lines, gives direct sailing service to Ethiopia without transiting and a stopover in some other port. The other big liners have hubs in areas like Yemen and Singapore where the Companies move their huge vessel capacity from and to major international O/D and provide feeder services to Djibouti.

2.2.5. Fuel Storage Facility

One of the major obstacles for efficient freight transport and logistics system of the country in rural, regional and international freight movement and distribution system is lack of storage facilities, adequate loading and unloading equipment and efficient management of the system(Afro Consult & Trading PLC, 2010).As per the report from EPSE, it has a total of about 13 strategically located inland depots at different locations of the country with a total storage capacity of 0.36 million cubic meter. The biggest of which is the one located in Awash with a holding capacity of 0.13 million cubic meter.

As per the latest product uplift report of EPSE (Table 2.4), this storage capacity can only cover the 3 weeks' consumption of the country. As a common strategic practice by most governments, the country was supposed to hold a stock level of at least its 3 months consumption at any point in time for emergency use in case of crisis. This indicates that there is a huge gap to be filled in this regard. Noting this gap, the government is under preparation to construct a depot at Dukem, 37 km from the capital, with a storage capacity of 0.24 million cubic meter that will increase the current capacity by 67% though the gap from the strategy is still big (EPSE press briefing through the reporter, 2018).

Table 2.2 – Horizon Terminal Storage Capacity

Product Type	**Storage Capacity (In MC)**
Gasoil	110,000
JET-A1/Kerosene	85,000
Gasoline	15,000
HFO	30,000
LFO	21,000

Source: Melaku M., 2017

Table 2.3 – Horizon Terminal Loading Capacity in May 2019

#	Product	N° of Loading Bay	N° of TTL	Quantity (MC)
1	Diesel	6	210	9,450
2	Jet A-1	2	60	2,700
3	Kerosene	2	50	2,250
4	Gasoline	1	22	990
5	HFO	1	15	600
6	LFO	2	10	400
	TOTAL	**14**	**367**	**14680**

Source: own collection of data from EPSE, May 2019

Table 2.4 – The 5 month product uplift of Oil Companies

Product	Vol. (MC)
Gasoline	299,653
Jet A1	373,009
Gasoil	1,183,711
Kerosene	71,731
HFO	50,918
LFO	53,409
Total	**2,032,431**

Source: EPSE Product uplift report for the year-to-date as at May 31, 2019

2.2.6. ICT

Difficulties can arise when oil and gas companies make technology decisions independently along their supply-chains. Thus, their information systems are neither coordinated nor compatible, and information is not readily shared back and forth along the supply-chain. Adapting a supply-chain wide technology strategy can also result in every user of the system along the chain seeing a single file system, can access all computational servers with high speed data access, can connect to real-time high speed visualization, and can participate in realistic collaboration, and be provided instant service irrespective of the user's location. This also allows the business leaders to manage the enterprise from anywhere (Chima, 2007).

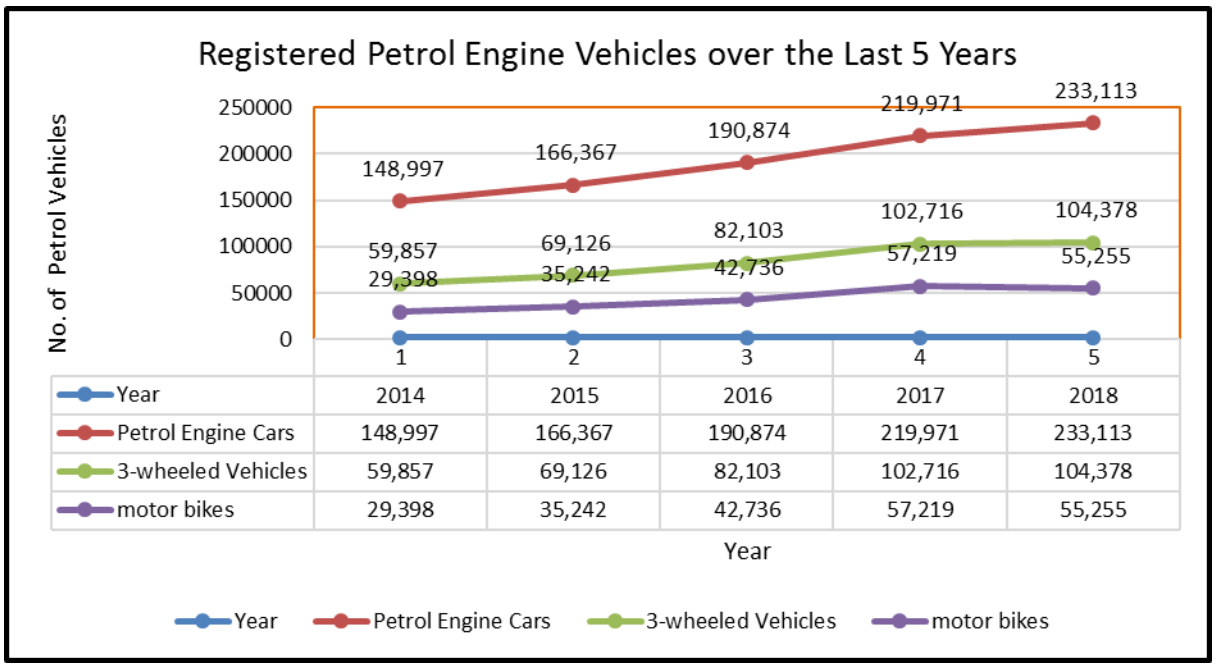
The use of ICT in logistics in Ethiopia is almost non-existent. One area bar code is used at cash register of supermarkets but it is not connected with inventory or warehousing management system. MoT's plan is to introduce tracing and tracking using GPS, and software, databases and other logistics ICT applications. It indicates that there is a lot yet to be done in this regard.

2.2.7. Energy Production & Fuel Demand Growth

Source of energy for all freight vehicles is fossil fuel. It is important to have reserve at depots and make fuel available always at filling stations. Cargo handling equipment may run on fossil fuel or on electricity. When it comes to ICT and fuel dispensing pumps, electric is required. As it stands now, there are interruptions often, which are due to inefficiency and incapability of Ethiopian Electric Power Corporation, as is expected from a public enterprise of least developed countries. Starting from May this year, EEU cut power supply at least for 8 hours per day. This power cut has a noticeable impact on fuel distribution in different ways:

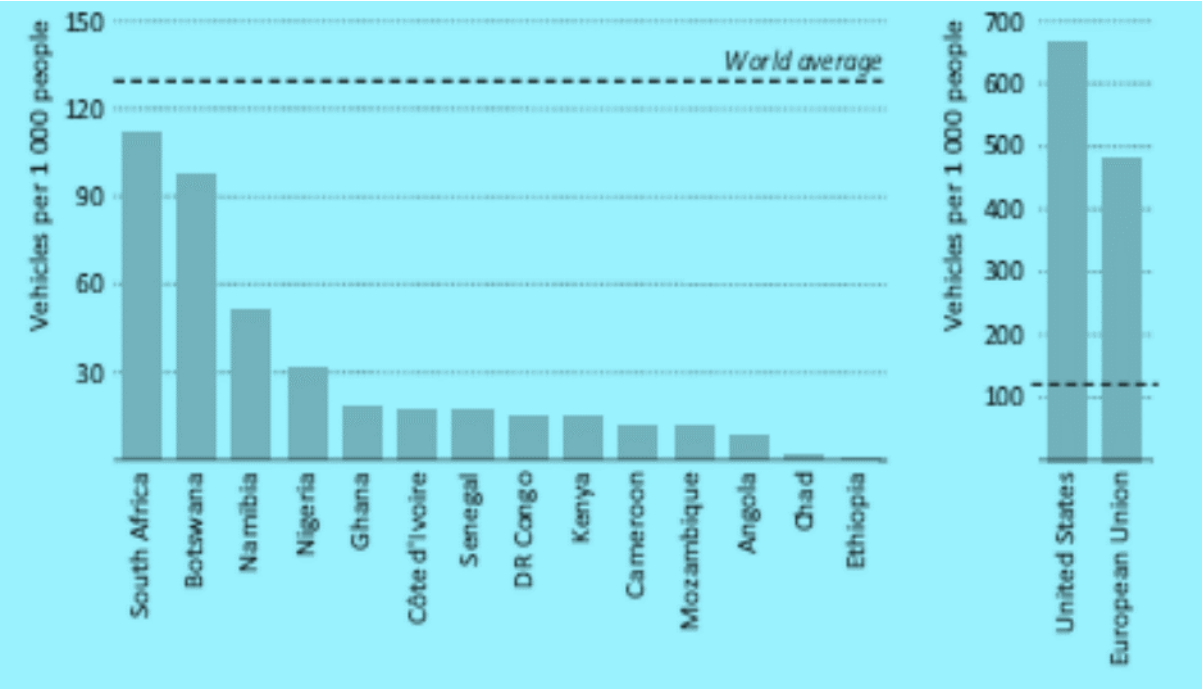
i. Has direct effect on fuel stations for them being unable to operate during power-cut
ii. Most of the manufacturing and service industries make use of standby generators that are powered by diesel and petrol fuels to sustain their business which brings about unexpected fuel demand growth and shares a good part of the fuel meant for motorists.

The number of vehicles imported in to the country is also growing at an alarming rate which directly translated in to fuel demand growth. For instance, as per the data obtained from Federal Transport Authority shown below in the figure (excluding Harari & Gambela Regions), gasoline-motor vehicles registered in the country has shown a 65% growth over the last 5 years alone - between the periods 2014 to 2018 (Federal Transport Authority). Although car ownership in Ethiopia is still much lower even when compared to the neighboring African countries, the growth shown in recent times is tremendous. Unfortunately, our road infrastructure, fuel storage and fuel distribution capacities haven't been grown in a similar pace.



Source: Federal Transport Authority, 2011 E.C.

Figure 2.2 – Number of Registered Petrol vehicles in Ethiopia (excluding Harari & Gambela Regions)



Source :(IEA - African Energy Outlook, 2014)

Figure 2.3 – Car ownership in some African countries, 2014

2.3. Empirical Reviews

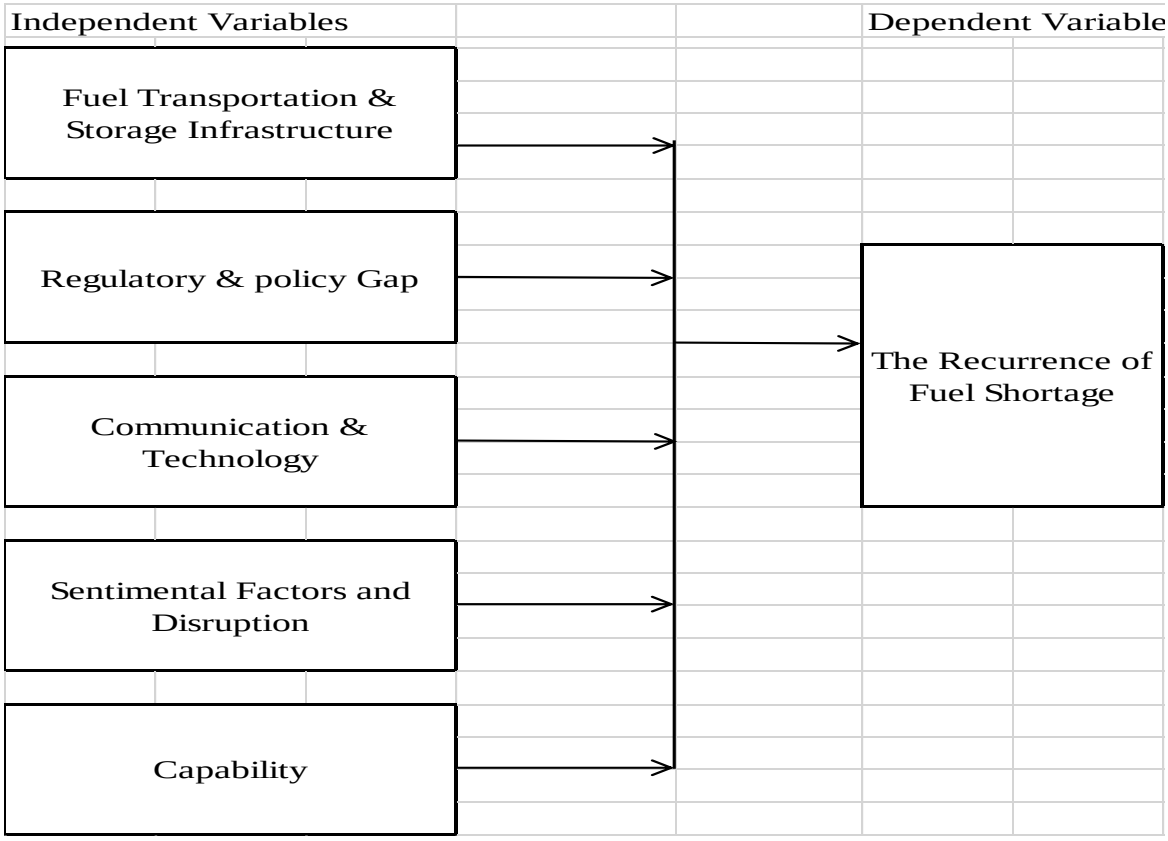
According to the study by Nyathon, Augustino & Nhial (2016), the prevailing shortage and high price of fuel in south Sudan are a consequence of explanatory factors such as absence of refining and storage infrastructures, and growing demand for fuel from electricity producing and consuming sectors which are exacerbated by gaps in regulatory frameworks. Consequently, that has led to fuel hoarding and shortage, hikes in transport cost, reduced productivity, and the soaring prices of commodities. South Sudan's lack of downstream infrastructures to refine crude oil and stockpile sufficient fuel for local consumption has left the country with sporadic shortage of fuel supply and high prices (Nyathon, Augustino & Nhial, 2016).

The study by Melaku M. (2017) concludes that lack of information sharing among the supply chain members of the industry, the quality of the forecast provided by Oil Companies, and that EPSE does not have a well-integrated ERP system are the main factors that affected the importation of fuel into the country in line with the need of customers. Moreover, since the supply chain partners do not follow a collaborative approach on addressing the overall supply chain problem as a system, the solution usually comes from one side and it is mostly just to provide reactive solution, not to give a sustainable and proactive solution after jointly investigating and analyzing the root cause of the problem. Although, the forecast was inflated, there was shortage of product at the main supply points. This shows that either EPSE has intentionally imported less fuel than the forecasted amount (thinking the figure is inflated) or the order was not placed on time or there was shipment delay. The study further concluded that there is incompatibility between the growth of fuel demand in the country and the logistics resource deployed to support the supply chain process. These constraints cumulatively have been obstructing smooth flow of fuel to the end customers.

According to the press release posted by 'The Reporter' on December 1, 2018, the illicit fuel trade in the capital Addis Ababa and regional towns is also among the causes for the gasoline shortage throughout the last quarter of 2018. Increasing illegal fuel trade is found to be exacerbating the situation since October last year. The CEO of EPSE said that fuel stations are illegally selling gasoline to individuals and as a result fuel is sold in kiosks in every corner of Addis Ababa while motorist are unable to get it at the gas stations. This calls for a dynamic and up to date revision of policies and regulations in the overall process of fuel supply.

2.4. Conceptual Framework

The conceptual framework shown below in figure 1.4 is developed by the researcher from the factors, discussed in the previous sub-topics, which are identified to be the major causes of the recurrent fuel shortage.



Source: own design, 2019.

Figure 2.4 - Conceptual Framework

Unit Three

Research Design and Methodology

3.1. Introduction

The research adopted a mixed research approach in gaining a much deeper understanding of Ethiopia's downstream petroleum supply problems. Thus, qualitative methods of data collection and analysis were also used in addition to the questionnaire.

3.2. Research Design

The aim of the study was to examine the challenges affecting performance of the fuel supply chain in the downstream oil business of Ethiopia and to achieve this; the researcher used descriptive research design. Descriptive studies are more formalized and typically structured with clearly stated evaluative questions (Meyer, 2010). It serves to attain a variety of research objectives such as description of phenomenon or characteristics associated with a subject population, estimates of proportions of population that have these characteristics and discovery of associations among different variables. The design enabled the study to combine both qualitative and quantitative research approaches. Qualitative approaches enable collection of data in the form of words rather than numbers. It provides verbal descriptions rather than numerical (Kothari, 2011). Mugenda and Mugenda (2003), states that qualitative methods can be used to gain more in-depth information that may be difficult to convey quantitatively. Quantitative approach strives for precision by focusing on items that can be counted into predetermined categories and subjected to statistical analysis (Taylor, 2013). The use of these two approaches reinforces each other (Zhu et al, 2013). The research used this approach because the data collected using the main questionnaire was quantitative and was analyzed using statistics while the data collected using interview is analyzed/ described qualitatively.

As noted in Creswell (2009), mixed research is an approach that combines or associates both qualitative and quantitative research methods: enables mutual collaboration of each other via the use of multiple sources of collecting data, contextualizes the analysis by providing richer details and initiates new lines of thinking through attention and surprises, turning ideas around, and providing fresh insights.

3.3. Data Sources and collection techniques

Both primary and secondary data sources are used in an attempt to achieve the objectives of the study. Both data types come from the main actors in the oil distribution sector of the country including the government.

3.2.1. Target Population

Supervisors of all the 1006 stations of the 30 oil companies were the target population for the present study, particularly for the survey questionnaire. For the interview, the marketing and logistics managers of all the 30 oil companies in the downstream oil business of Ethiopia are the target population. Verbal data through interview was gathered from these managers about the extent to which the infrastructural provision influences the fuel supply of the country, the effect of the regulatory gap on the fuel supply of the country, the influence of oil distributors' capability on the fuel supply of the country, the effect of the Sentimental factors and its effect on the fuel supply of the country as well as the extent and effect of communication technology on the fuel supply of the country.

3.2.2. Sampling Techniques and Sample Size

As it is both difficult and unnecessary to deal with all the target population that is homogeneous and large, the researcher resorted to the use of sample survey. Accordingly, a sample survey of registered oil companies was conducted. This involved all station supervisors in all the 1006 stations of the registered oil companies, which finally resulted to our unit of observation. The purpose of sampling is to secure a representative group which enabled the researcher to gain information about a population. To get unbiased representative of this population, stratified sampling was used depending on the number of stations each oil company has in the country.The sampling technique that served as a device to select the sample from the lists of the sampling frame was simple random or lottery method of sampling technique. In addition to lottery method, purposive sampling technique was employed by the researcher in order to make interview with selected employees.The oil companies cumulatively own 1006 stations in Ethiopia. To increase precision and minimize sampling bias, Yamane's (1967) formula was used.

$$n = \frac{N}{1+N(e)2}$$

Where: **n** = the sample size, **N**=the study population, **e** = the margin of error.

For fuel stations

Given N=1006, e= 5%

$$n = \frac{N}{1+ N(e)^2} = \frac{1006}{1+1006(0.05)^2} = 1006/3.515 = 287 \text{ stations (represented by their supervisors)}$$

Out of the 287 participants, 248 are found to be responsive. Thus, the response rate was 86.4%. For the interview, ten petroleum business leaders from the top 5 oil Companies (2 from each of the 5 companies) that contribute more than 80% of the total fuel market share in the country have participated in the survey who have a great deal of experience in the Logistics and Marketing divisions of the oil companies were purposefully selected for the interview. Purposeful sampling is used to select participants based on the subject of the study. Purposeful sampling guarantees the relevance of participants to the research question (Bryman, 2012). Purposeful sampling allows researchers to select participants who will provide the best responses to address a study problem (Smith, Colombi, & Wirthlin, 2013). Petty et al. (2012) asserted that purposeful sampling mitigates personal bias and helps generalize findings to a larger population.

Table 3.1. Sampling Technique

Oil Companies	Population	Sample
Total Ethiopia	180	51
Oil Libya	160	46
NOC	197	56
YEP	109	31
TAF	62	18
NILE	48	14
Gomeju	40	11
Kobil	34	10
WAS	13	4
Dalol	13	4
Others	150	42
Sum	1006	287

Source: own survey, 2019

3.2.3. Method of data collection

Data for the research consists of two parts, primary and secondary data. The secondary data was collected from the monthly uplifting performance of each company by product type as well as from various reports on the infrastructural, regulation and company specific issues. Self-administered questionnaires were used to collect the primary data from each oil company's representative. Both open ended and closed ended types of questions were used. The questionnaires were designed in such a way to give a comprehensive overview of the factors associated with the recurrent fuel shortage in Ethiopia.

3.2.4. Method of Data Processing and Analysis

A. Data processing

In this activity the first task was editing, coding, classifying and tabulation of collected data. This data processing procedure has two phases: First data was cleanup in which the collected raw data was edited to detect errors and omissions in response and for checking that the questions are answered accurately and uniformly. Editing involves a careful and critical examination of the completed questionnaire, in terms of fulfillment with the criteria for collecting meaningful data, and in order to deal with questionnaires not accordingly completed. The next phase is the process of assigning numbers follows. Coding involves assigning numbers to answers so that responses can be grouped into limited number of classes and categories. This helps to reduce the response into a limited number of categories or classes and then the process of classification or arranging large volume of raw data in to groups with common characteristics will be apply. Data having the common characteristics place together and the data was summarized in tabulation and displayed for further analysis

B. Data Analysis

The statistical packaging for social science (SPSS) version 20 was utilized to analyze the data obtained from primary sources. To summarize demographic data of respondents, charts, tables and percentages was used. The data was analyzed using descriptive statistics like frequency, mean and standard deviation and inferential statistics such as correlation, regression. Descriptive statistics allow presenting the data acquired in a structured, accurate and summarized manner by tabulation and measures of central tendency (mean and standard deviation). The descriptive statistics was utilized in the current research to analyses the data

includes frequencies, percentages, means and standard deviations. According to Sekaran (2000), "inferential statistics allows researchers to infer the relationship between two variables from the data through analysis; differences in a variable among different subgroups; and how several independent variables might explain the variance in a dependent variable". The following inferential statistical methods were used in this study. To ascertain whether a statistically significant relationship exists between two variables, the Pearson Correlation Coefficient was used. Cohen (2000) posit that the Pearson Product Moment Correlation Coefficient is a widely used statistic for obtaining an index of the relationships between two variables when the relationships between the variables is linear and when the two variables correlated are continuous. Multiple linear regression analysis was used to identify the dominant factor among the independent factors that have stronger relationship with turnover intention. The variable of the highest beta value is considered as the dominant factor. It can be specified as follows

$$Fuel\ Shortage = \beta 0 + \beta 1 * Infrastructure + \beta 2 * regulatory\ gap + \beta 3 * ICT + \beta 4 * sentimental\ factor + \beta 5 * capability + \varepsilon$$

3.2.5. **Ethical Consideration**

To assure respondents security, their name and other private information which describe about the respondent swill never be disclosed. The data obtained from the respondents were confidential. The obtained data had only been used for this academic purpose. The privacy and morality of the respondents has preserved.

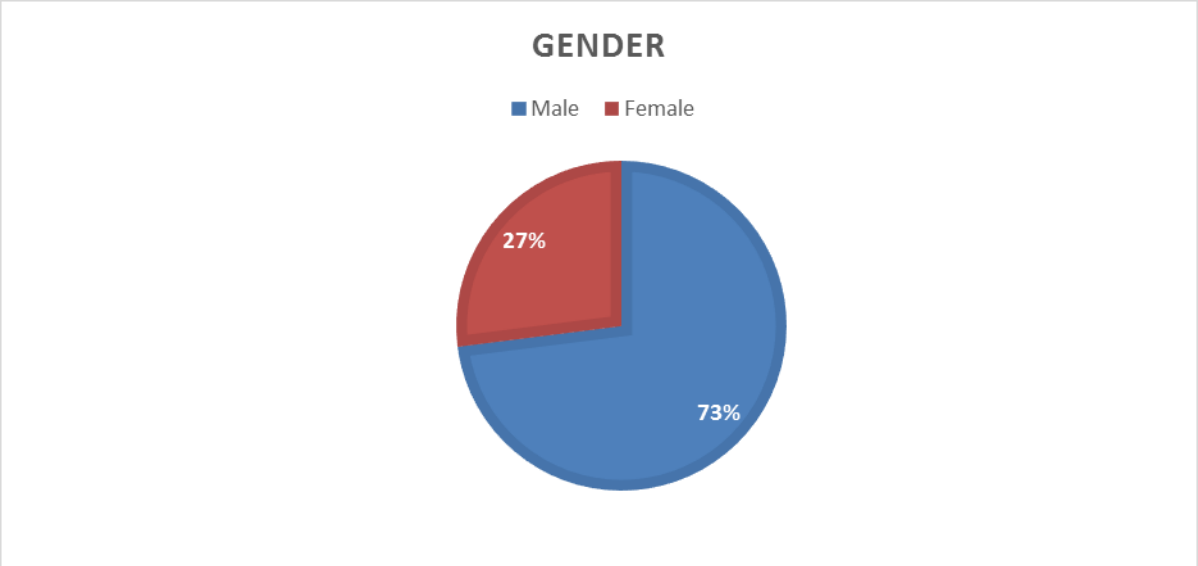
CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. General Background of the respondents

4.1.1. Sex of Respondents

As depicted in figure 4.1 below, which described the gender distribution of respondents, majority of respondents - which are about 73% - are male and the remaining 27% are female.



Source: Own survey, 2019

Figure 4.1 - Sex distribution of the respondents

4.1.2. Age of the respondents

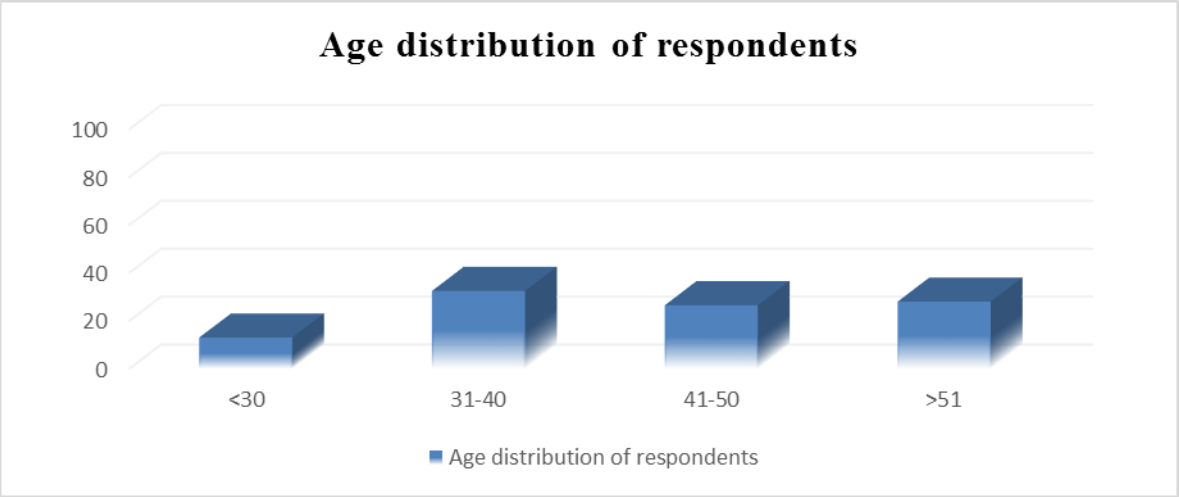
The Table 4.1 below depicts that the average age of the respondents is 51.9 years. Though there exists variation in the age of the respondents, this average age of respondents indicate that the respondents are well informed about the trends of fuel supply history in the country.

Table 4.1 - Descriptive Statistics of respondents' age

	N	Minimum	Maximum	Mean	Std. Deviation
Age	248	23.00	73.00	51.9718	11.23665
Valid N (list wise)	248				

Source: Own survey, 2019

In addition to the average, the Figure 4.2 below also shows that the information regarding to age distribution of respondents so that majority of respondents which are about 32.5% are found in the age between 31-40, followed by the age group of above 50 which covered 28%. The age group of 41-50 comprised 26.5% and the remaining 13% of respondents are under the age of 30.



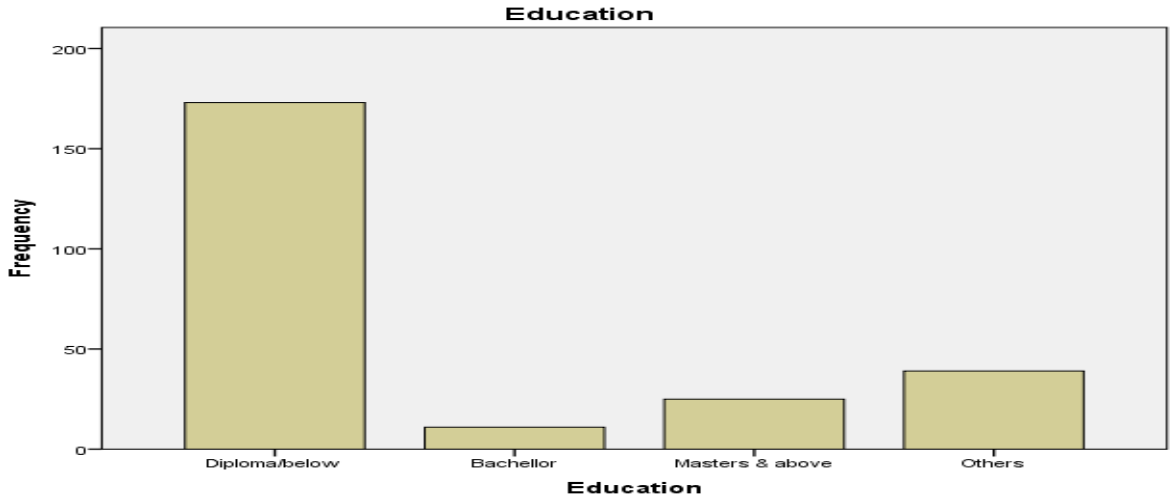
Source: Own survey, 2019

Figure 4.2 - Age Distribution of the respondents

4.1.3. Educational levels of respondents

According to Figure 4.3 below majority of the respondents are diploma and below education qualification while a few of them are bachelors. There still are significant number of Masters Degree holders. As indicated in the result below the predominant proportion of the respondents are capable of handling cases related to the distribution of fuel and they are

mostly in charge of the management the day to day activity pf the fuel station all over the country.

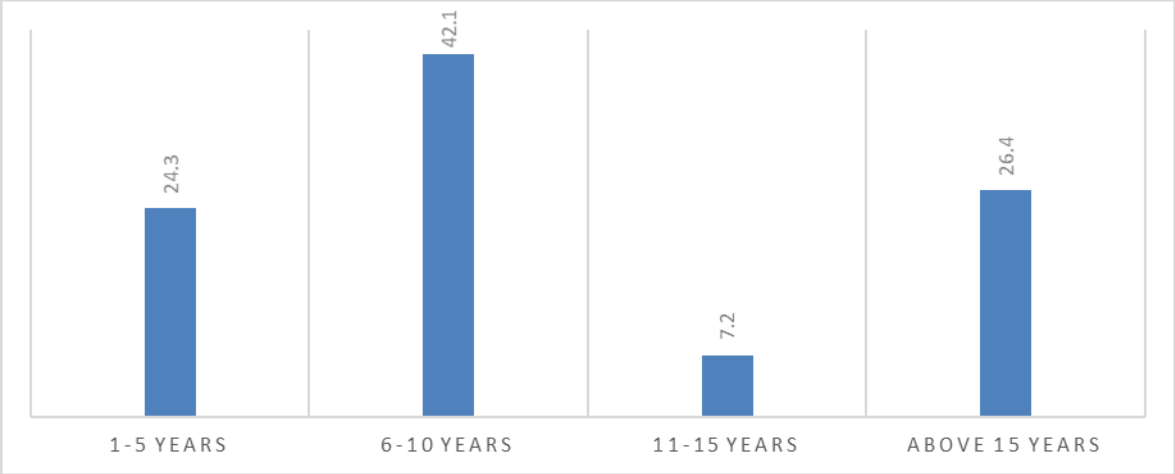


Source: Own survey, 2019

Figure 4.3 - Educational qualification of respondents

4.1.4. Tenure in the sector

As the total services of employees and leaders are placed in the figure 4.4 below, out of 248 employees, 61 (24.3%) respondents were 1-5 years of experiences, 104 (42.1%) respondents were 6-10 years of experiences, 17 (7.1%) respondents were 11-15 years of experiences and 66 (26.4%) respondents were above 15 years of experiences. They are likely to have good exposure to the problem and would therefore be in the position to provide valid information for this study.



Source: Own survey, 2019

Figure 4.4–Tenure of the respondents in the sector

4.2. Descriptive on the Perceived Levels of the Variables of Interests

The measurement of the variables of interest was approached in an indirect way. Proxy measurements have been used to determine the level of the various variables of the study. Accordingly, the prevalence of fuel shortage was measured with the help of three proxies; whether there is an ever-decreasing waiting line at the fuel stations from time to time, as to whether the shortage doesn't result in serious problem of halting the usual business and if it has not become a common phenomenon to see roads blocked due to long waiting lines at the gas stations. By calculating a composite average, a mean was used to estimate the perceived level of fuel shortage in the country. As depicted in Table 4.1 below, out of a 7-point likert scale, 2.44 (0.859) is the perceived level of agreement to the fact that there is little problem in relation to fuel shortage. Hence, it is implied that there is a significant perception of fuel shortage in the sector.

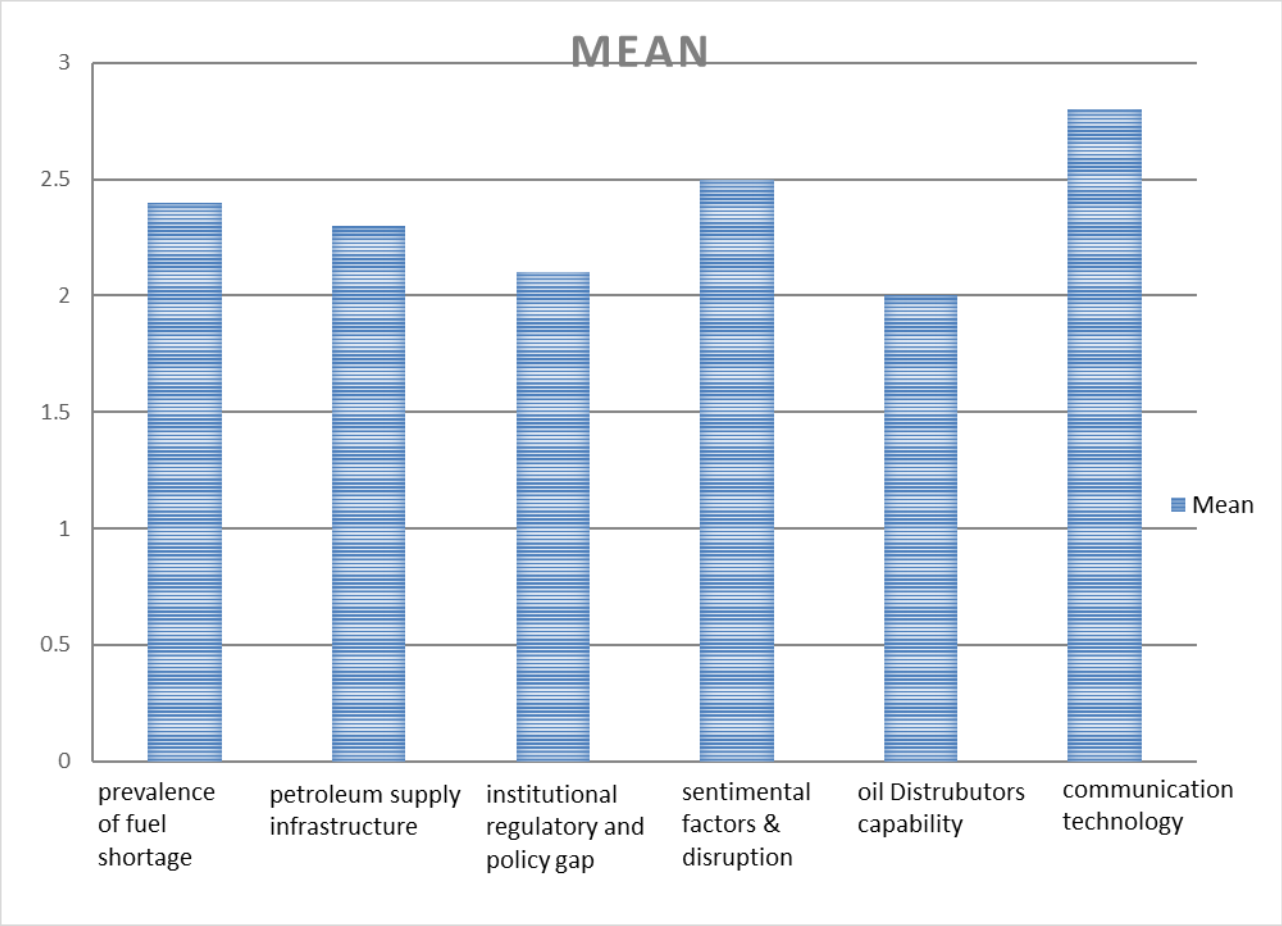
This shortage is believed to be attributed to several factors, some of which are accounted for in this study. Accordingly, such factors as Petroleum supply infrastructure, regulatory gaps, sentimental factors, Oil Distributors Capability and Communication technology were measured with six proxy items each. Accordingly, the average perceived level of the variables is displayed with both tabular (see table 4.2. below) and chart (see figure 4.5. below).

Table 4.2 - The average overall perceptions of respondents

Variables	Mean	Std. Deviation	N
Prevalence of fuel shortage	2.4422	.85906	248
Petroleum supply infrastructure	2.2769	.78113	248
Institutional, regulatory and policy gap	2.0450	1.14742	248
Sentimental factors & Disruption	2.5399	1.21577	248
Oil Distributors Capability	2.0121	1.04125	248
Communication technology	2.8138	1.20482	248

Source: Own survey, 2019

The figure below is an evidence of the distribution of the respondents' perception about both the dependent and the independent variable. According to the figure, the highest of all average perceived performances of the factors that are believed to be the cause of the recurrent fuel shortage is that of communication technology followed by sentimental factors. The least is oil distributors 'capability, implying that the factor is the most susceptible cause of the recurrent fuel shortage.



Source: Own survey, 2019

Figure 4.5 - Measures of central tendency

4.3. Test of Linear Association

Correlation is a technique for investigating the relationship between two quantitative variables. In this regard, Pearson's correlation coefficient (r) is a measure of the strength of the linear association between the two variables. Correlation provides the platform for regression to predict the values of the dependent variable based on the known relationship that exist between the independent variable and the dependent variable (Samuel and Lawrence, 2015). Therefore, in order to determine whether there are significant relationships between the various dimensions of the oil sector performance factors, Pearson Correlation Coefficient analysis is used. According to Hair, Money, Samuel, & Page(2007), the Pearson correlation coefficient values can be grouped as ±0.91 to ±1.00 (Very strong), ±0.71 to ±0.90 (High), ±0.41 to ±0.70 (Moderate), ±0.21 to ±0.40 (Small but definite relationship), and ±0.00 to ±0.20 (Slight, almost negligible). The result of the correlation analysis in Table 4.3 indicates that all the dimensions of the fuel sector performances such as Petroleum supply

infrastructure, regulatory gaps, Sentimental factors, Oil Distributors Capability and Communication technology (r=0.297, -.190, .239, -.266, -.250) have moderate association with the recurrent fuel shortage. In the same vein, all the independent variables have a coefficient correlation that is moderate (Hair, Money, Samuel, & Page, 2007). Though it may not be necessarily true, this indicates the absence of multi-co linearity among these variables. The absence of multi-co linearity is also evidenced due to the magnitude of the correlation between the independent variables that are not very strong, as all of them are less than 90%.

Table 4.3 - Test of Linear Association

Variables	1	2	3	4	5	6
Prevalence of fuel shortage	1.000					
Petroleum supply infrastructure	.297**	1.000				
Institutional, regulatory and policy gap	-.190**	.224**	1.000			
Sentimental factors & Disruption	.239**	-.226**	-.331	1.000		
Oil Distributors Capability	-.266**	.1590	.3750	.174***	1.000	
Communication technology	-.250**	.155**	.1020*	-.251	.295**	1.000

Source: Own survey, 2019

4.4. Tests ordinary least square assumptions

As part of the regression analysis five assumptions have to be fulfilled. These assumptions include normality, linearity, reliability, goodness of fit, and multi co linearity. Test for each of the assumptions are run carefully and confirmed by comparing with well-established theories of the assumption. Fortunately, all of the assumptions are fulfilled in the present study. Details of the assumptions are discussed as follows.

4.4.1. Goodness of Fit Test

To identify the key determinant dimension of the recurrent fuel shortage, an OLS regression analysis is conducted. Accordingly, the overall perceived level of fuel recurrence is regressed on the dimensions of five independent factors, i.e. the dependent variable is perceived overall level of fuel shortage, while the independent variables are petroleum supply infrastructure, regulatory gaps, sentimental factors, oil distributors' capability and communication technology. The result of ANOVA test also confirms that there are statistically significant variations on overall satisfaction on the basis of at least among some of the parameters considered in the study at 1% significance level. Positive significant coefficients confirm that

all the significant dimensions of the recurrent fuel shortage have a significant effect on the overall level of fuel shortage, which is in line with the hypothesis.

Table 4.4 -Goodness of Fit Test with ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25.742	5	5.148	7.959	.000[b]
	Residual	156.541	242	.647		
	Total	182.283	247			

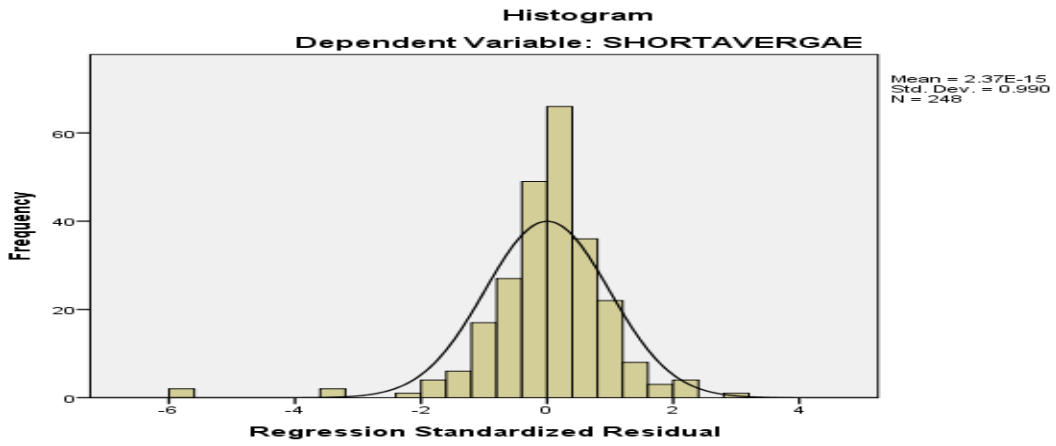
Source: Own survey, 2019

a. Dependent Variable: SHORT1AVERAGE

b. Predictors: (Constant), ICTAVERAGE, SENTMAVERAGE, POLICYAVERAGE, INFRAVERAGE, CAPBAVERAGE

4.4.2. Test of Normality

As can be seen from Figure 4.6 below, the distribution of the data is skewed neither to the left nor to the right. This implies that most of the observations are around the expected vale (Mean). Hence, it is relatively symmetrical and fit to be analyzed statistically.



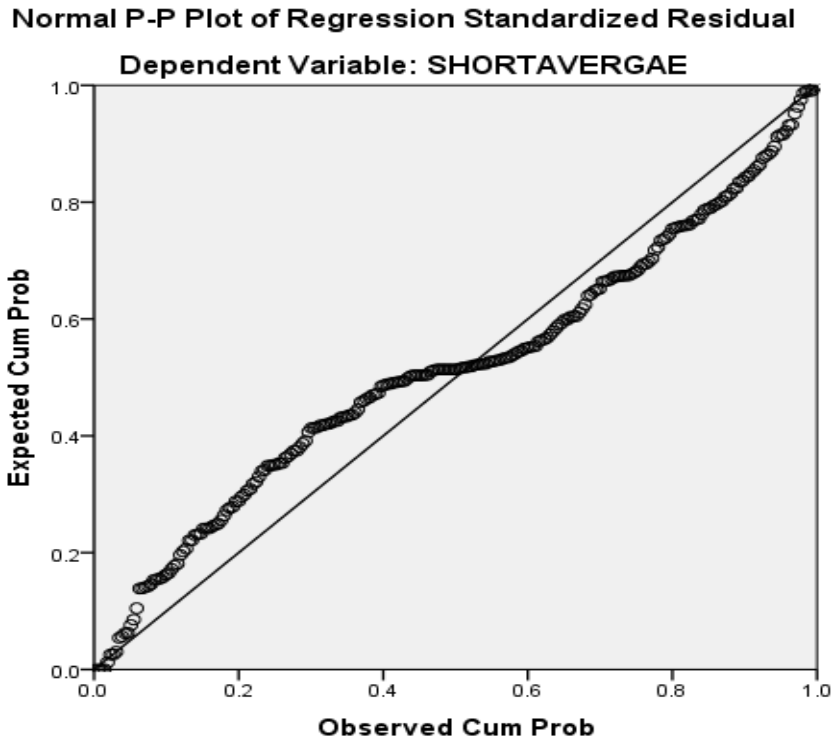
Source: Own survey, 2019

Figure 4.6. - Normality Test

4.4.3. Linearity Test

Another assumption about regression is the existence of linear relationship between the variables of interest i.e. $Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots \beta nXn + \varepsilon$. In this case, the

overall perception of fuel shortage is dependent on various factors, such as Petroleum supply infrastructure, Institutional, regulatory and policy gap, Sentimental factors & Disruption, Oil Distributors Capability and Communication technology. As it is depicted in the Figure 4.7, the relationship is definitely linear with the pattern increasing from left to right. As a result, the proposed multiple linear regression is logical and fit for the purpose.



Source: Own survey, 2019

Figure 4.7 - Linearity test

4.4.4. Absence of multicollinearity

A regression diagnostic test to detect the presence of multi-collinearity is carried out using SPSS by examining the values of Tolerance Level and Variance Inflation Factor (VIF), which are measures of collinearity among independent variables. As can be seen in Table below, the results reveal that values of the tolerance level ranged from 0.884 to 0.943 which are larger than the recommended cut-off threshold of 0.10. Similarly, VIF values in this study ranged from 1.06 to 1.2 which are much lower than the recommended cut-off threshold of 10. Hence, multicollinearity is not a problem to go forward with the rest of the analysis.

Table 4.5 - Multicollinearity Test

Variables	Tolerance	VIF
Petroleum supply infrastructure	.884	1.131
Regulatory gaps	.943	1.060
Sentimental factors	.908	1.101
Oil Distributors Capability	.872	1.147
Communication technology	.886	1.129

Source: Own survey, 2019

4.4.5. Data Reliability

Test of reliability of the data set is conducted using the Cronbach's Alpha. The Cronbach's alpha coefficient was estimated for each dimension of all the data set. As can be seen from Table 4.6 below the data for all dimensions has a Cronbach's alpha above 70 percent. This confirms that the data is reliable to continue with the data presentation and analysis. Accordingly, Petroleum supply infrastructure (0.715), regulatory gaps (0.818), Sentimental factors (0.806), Oil Distributors Capability (0.767) and Communication technology (0.710).the reliability of the data on the fuel shortage is also maintained with a Cronbach alpha of 0.71, which greater than the cutoff point that is 0.7. Accordingly, the discussion and analyses are conducted based on this data set.

Table 4.6. Data reliability

S/N	Dimensions/Variables	Crombach Alpha	Number of Items
1	Petroleum supply infrastructure	71.5	6
2	Regulatory gaps	81.8	6
3	Sentimental factors	80.6	6
4	Oil distributors' capability	76.7	6
5	Communication technology	72.6	6
6	Prevalence of fuel shortage	71.0	3

Source: Own Survey, 2019

4.5. Regression Analysis

4.5.1. Coefficient of Determination

In addition to the assumptions, tests of determination were also indicted with the coefficient of determination as indicated in table 4.7 below. The result in the table implies that the model is overall significant with more than 99% confidence level (sig. F change = 0.000) and the R^2 is estimated at 0.66, which means 66 percent variation in the dependent variable can be explained by the variation in the independent variables of the model. Therefore, the model is considered fit to over all the data. Thus, 66% of the time, the causes of fuel shortage can be attributed to the five independent factors that are mentioned in the model i.e petroleum supply infrastructure, regulatory gaps, sentimental factors, oil distributors capability and communication technology.

Table 4.7 -Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.8124[a]	.660	.653	.46083	.891	395.666	5	242	.000

Source : Own Survey, 2019

a. Predictors: (Constant), ICTAVERGAE, INFRAVERGAE, SENTAVERGAE, POLICYAVERGAE, CAPABAVERGAE

b. Dependent Variable: SHORTAVERGAE

Table 4.8- The effects of the independent factors on the prevalence of the fuel shortage

Model	Un standardized Coefficients		T	Sig.
	β	Std. Error		
(Constant)	2.698	.243	11.085	.000
Petroleum supply infrastructure	-0.205	.070	2.937	.004
Regulatory gaps	-0.368	.046	-1.477	.000
Sentimental factors	-0.277	.044	1.741	.083
Oil distributors capability	-0.191	.053	-3.628	.000
Communication technology	-0.140	.045	-3.100	.002

Source: Own survey, 2019

The value of β is used to show which independent variable is most predictor of the dependent variable. The advantage of β is to provide a constant scale, and that the βs are comparable, that the greater the value of the unstandardized regression coefficient the more the independent variable explains the dependent variable (Zikmundet al., 2010). An unstandardized coefficient beta used to determine the strong predictor of the recurrent fuel shortage by giving a measure of the contribution of each variable to the model. A large value

indicates that a unit change in this predictor variable has a large effect on the criterion variable.

Among the five factors that are believed to be influencing the prevalence of the fuel shortage, the highest Beta value and the most significant compared to other with (β = -0.368, p<.01). Thus, regulatory gap has the highest effect on the prevalence of the fuel shortage. This indicates that when there is an increase of one unit in regulatory gap, it will result in a 0.368 unit decrease in the prevalence of the fuel shortage. Moreover, the regression result indicates that petroleum supply infrastructure with (β= -0.205, P<0.01), oil distributors' capability with (β= -0.191, P<0.01), communication technology (β= -0.14, P<0.01) have significant negative influences on the prevalence of the fuel shortage. Sentimental factors are however marginally significant predictor of the prevalence of the fuel shortage in this case.

Regulatory gap is the most significant predictor of the prevalence of the fuel shortage as it is evidenced from the regression coefficient confirmed at a 95% confidence interval. An efficient and sustainable fuel supply depends on regulatory frameworks that are used to manage and regulate the sector to safeguard against potential crises. In line with this, Ethiopia's petroleum sector suffers misalignment of regulations and other resources that facilitate its performance in the downstream sector. Though all of the factors have a negative significant influence on the fuel shortage patterns in the country, the regulatory gap has a prominently significant effect on the dependent variable. Due to the present study, it was possible to identify 66% of the factors that are responsible for the prevalence of the fuel shortage in the country. This implies that there are still numerous factors that could cause the fuel shortage in the downstream of the Ethiopian petroleum sector.

In practice and according to the interview held with the oil company operators, the institutions lack clear coordination in dividing and executing roles and responsibilities as stipulated in the petroleum proclamation. For instance, the ministry drafted the petroleum policy and produced guidelines for fuel companies, fuel stations, and depot registrations, though policy-making process, for the petroleum sector, might have begun before the Commission was established. The primary tasks of the ministry include monitoring, assessing, and adjusting prices of fuel in the market, but instead, what is coming out clear of the petroleum sector in Ethiopia is lack of appropriately coordinated activities. This lack of clear division of labor leads to duplication of responsibilities and misaligned priorities.

4.6. Analysis the interview Results

10 business leaders from the top 5 oil companies (Logistics and Marketing/Sales Managers who have no ownership title) that cover more than 80% of the total fuel market in the country are purposely selected for this interview for they are the ones who have first-hand information on the fuel supply issues. The response rate is 100% (all the 10 leaders took part in the interview and respond to all the questions raised).

Interviewing a small number of participants often results in a deeper understanding of the phenomenon, leading to better analysis of responses and identification of themes (Marshall and Rossman, 2016). Researchers protect the confidentiality and privacy of participants to avoid exposure to a harmful situation (Yin, 2014). Thus, the responses of participants are strictly kept confidential.

4.6.1. Prevalence of fuel shortages

All the responders affirmed that there has been intermittent fuel shortage in the country over the last many years, but, claimed that the ones shown over the last few years are significant in terms of the frequency of happening and the extent of the damage. Over the last few years, it has been common to see long queues of vehicles around fuel stations in many cities of the country including the Capital searching for fuel, that even have exacerbated the high traffic jams that are already annoying people in the capital city. The trend of lining up at fuel stations doesn't show improvement till this very day. The lining up of cars at stations is one indicator for the fuel shortage, and other possible indicators are: product hoarding at stations, illegal fuel sales through shops and garages at higher prices (as much as 5 times their original price), individuals carrying jerry cans and other containers lining up at fuel stations to buy fuel, and increased number of diversions before reaching the originally assigned sites.

4.6.2. Infrastructural influences

7 of the 10 participants believe that fuel supply infrastructure has a noticeable contribution to the recurrent fuel shortage. They claimed that the conditions of the roads that stretch out from Djibouti aren't in good condition to serve the ever increasing number of returns of fuel trucks from-to Djibouti. The Djibouti - Addis line has only one route through Awash which is the busiest route in the country that handles the greatest number of passes and heavy weights in both directions than any other main route stretching out to the borders of the country. So

many times in the past, this route has experienced a number of blockades that lasted for a number of days due to maintenance work on a damaged part of the road, sudden traffic accidents, social or political unrests, and naughty flood. These kinds of blockades are common phenomena along the route. There is also an extended layover along the line for a number of hours as every truck has to pass through the customs checkpoint in Awash.

Except one of these 7 respondents, the others also believe that the number of available roads in the country, irrespective of their quality, is also not adequate enough to handle the current fuel requirement of the country. Unfortunately, there is no any other alternative means of transporting fuel than the road so far. The rail tankers meant to transport fuel from Djibouti to Awash hasn't still got in to operation.

Given the topography of the country and the less operational cost after it's laid, pipeline is a very good option to be considered to transport fuel in Ethiopia. An American company called Black Rhino conducted a feasibility study and presented to Ethiopian a few years ago. The proposal initially got approval but later the government changed its mind and cancelled the deal for financial reason. Therefore, our fuel transportation is completely road dependent in the foreseeable future.

All the participants ascertained that the inland and Djibouti depots' storage and loading facilities aren't sufficient enough to secure sustainable supply for the current and ever-growing fuel demand of the nation. As can be referred to table 2.2, table 2.3 and table 2.4, at the current fuel consumption rate of the country, Djibouti terminal depots under their full storage capacity can hold only the two weeks gasoil consumption of and just a one week gasoline demands of the country. The gasoline daily loading capacity of the terminal can only meet less than 50% of the daily demand of the country.

As per the press briefing of the CEO with the reporter, posted on line on July 7, 2018, EPSE has confessed that Djibouti horizon terminal has capacity limitations to meet the growing Ethiopia's fuel import; and now become unable to accommodate the increasing fuel imports. As a result the government is thinking of building depots at Djibouti terminal. The total storage capacity of all the 13 inland depots is around 360,000MC, which at the current consumption of fuel (around 410,000MC/month, refer to table 2.4) can only hold the 26 days fuel consumption of the nation. Ethiopia, being a land locked country, and fuel being a strategic commodity, the country should have kept a fuel reserve of volume at least equal to

its 3 months consumption. Therefore, the storage and loading capacities of both the DHT and inland depots are far below our fuel demand.

4.6.3. Regulatory Issues

Economic regulation refers to restrictions on prices, quantity, and entry and exit conditions for certain industries. There are two main types of regulation: regulation of structure and regulation of conduct. The former includes setting merger controls, removing entry barriers and restrictions on the line of business, or breaking up an integrated incumbent. The regulation of conduct covers firms' pricing behavior in terms of level and structure. The most common economic argument for regulation is to address market failures, economies of scale (and scope) in production, or inequities in demand. (Aldaba, 2004).

There are 2 institutions that mainly oversee the overall operations of the downstream oil business of Ethiopia – MoMP and MoT: the first one provides certificate of competency to enter in to the business and construction permit, while the second one mainly focuses on regulating the prices and calibration issues.

All the 10 respondents concluded that the sectorial policies aren't accommodative of all the important matters and issues related to the fuel supply. The issue isn't about the number of institutions but it's on the level of authority they have on important matters and on how they dispose their responsibilities in facilitating attainment of sustainable fuel supply and addressing the malpractices and bottlenecks. Apart from the industry players, the different print media has been exposing the sharp practices in the sector: adulteration, theft, smuggling, illegal diversions, product hoarding, and not availing products at stations around month ends on speculation of price revisions. Despite the numbers of media coverage and public outrage, most of the issues still prevail without taking fundamental measures in alleviating the problems. As a result, illegal trade and shortages of fuel on public stations become a usual practice now a days.

As per all the responders, the low distributors' (oil companies, retailers and transporters) margin, fixed by the government, is believed to be the main reason for most of the issues related to fuel supply in the country. No one is willing to invest a huge money in constructing a fuel station to get a gross margin of less than 1% of the value of fuel traded unless they plan to make it up through some sharp-practices/malpractices. Fuel transporters can't also sustain in the business at the allowable rate of transportation, given the skyrocketing operational

costs like the escalating prices of spare parts and tires, without involving in some of the malpractices: adulteration, in-transit theft, illegal trade and smuggling. This year, in the month of May alone, 50 fuel trucks from a single transport association leave the industry and join in the dry cargo transportation where they get a better earnings in which rate isn't regulated. Oil companies will also be unable to cover the operational costs at the given margin unless they have a good lubricant market or support their business by involving in the trading of other petroleum related commodities - bitumen, petcock, coal, chemicals, etc...

All these issues hinder the distributors from expanding their businesses: investing in storage infrastructures, new vehicles and new fuel stations. It also promotes the increment of malpractices in the sector. For instance, Ethiopia, having double the population and landmass of Kenya, has less than half the number of stations and oil companies of Kenya. This is purely a result of the policy and regulation issue of Ethiopia which don't attract new investment in the sector for its very low and fixed margin. Moreover, in the absence and less accessibility of fuel stations in smaller towns and rural areas (that cover the largest part of the country), the public is exposed to higher prices, contaminated fuel and unsafe practices from intermediary traders who take advantage of lack of access to fuel stations in outlying areas. These sales also represent undeclared tax revenues for the Authorities. Besides, even in the stations further away from major cities, the price control usually gets looser and exposed to corruption.

Calibration of trucks is done periodically by MoT. The capacity of the calibrating unit of the Ministry is very limited and give a long appointment for truckers. Sometimes, transporters prefer to stay in long lines for calibration that may take a number of days before returning to Djibouti which results in artificial shortages of trucks.

This regulatory issue has all rounded effect in the fuel supply chain that has resulted in under developed capability of distributors. Most of the distributors are in a position of poor financial, material, technological and logistical capacities for the effective and efficient performance of their duties.

4.6.4. Influence of Sentimental factors

All the participants respond in a similar manner that the domestic unrests and conflicts around borders have significant negative influence on the fuel supply of the country. When there are domestic conflicts (as shown in the country over the last 4 years) road blockade,

illegal trading, forced diversions of trucks and smuggling are observed to be frequent phenomena. When there are rumors of conflicts, panic buying behavior of consumers, illegal trading of fuel through shops and individuals motor bikers, and product hoarding by fuel stations are among the exacerbating activities for the recurrent fuel shortage in the country.

Conflicts around bordering countries, especially of Djibouti and Sudan, has also a detrimental effect in the fuel supply. For instance, about 90% of the gasoline supply of the country was sourced from Sudan. Due to the subsequent political situations that has happened in the country over the last 7-8 years, it has dropped to around 40% over the last few years and now, since recently, it's drastically dropped below 20% of the total gasoline demand of the nation. Even a minor misunderstandings with those countries could have drastic effects on the supply of fuel to the country. We need to consider other alternative ports to import fuel in order to have a backup in case of crisis and secure sustainable supply of this strategic commodity.

4.6.5. Capability of the supply chain partners in meeting demand

All the participants except 2 respond that the EPSE (government) is capable enough to avail forex for the purchase of fuel and import the required quantity usually in good time. However, as far as the storage and loading capacity is concerned, it's worrisome that Gasoline is already in short supply and the other products may also face similar problem soon unless a remedial action is taken immediately. There is a plan by the government to construct storage depots in Djibouti terminal in collaboration with the Djibouti government. A design work for the construction of the biggest inland depot around Dukem town (that will increase the current total storage capacity of inland depots by 67%) is underway. After the realization of those projects and the conclusion of the remaining works of the railway connecting the terminals and depots, the EPSE's storage and loading capacity will be improved noticeably. However, such capacity development should be planned proactively and done regularly in order to go hand in hand with the demand as the fuel demand of the nation is growing sharply from time to time.

As for the oil companies, all the respondents believe that the dominance of the market only by few players is a result of the level of capabilities of the oil companies. Out of the total 30 registered oil companies, the top 3 (NOC, Oilibya and Total) alone cover about 70% market share of the fuel supply in the country - with NOC taking the major part (32%). This is a clear indication that capability gives the leverage over competitors to dictate and dominate the

market. The human, logistical, material, and financial capacities of oil companies play the key role in acquiring the market and attracting big corporate customers without much marketing effort. This has been evidenced in NOC that with its biggest logistics capacity (contracting with more than 1,300 trucks out of the less than 3,500 fuel trucks in the industry), having the very competent human resource, having the biggest financial capacity, having the very good reputation of successfully serving mega projects and industries, has had the biggest portfolio of corporate customers in the industry. Thus capabilities of oil companies play an important role in attaining and maintaining a relatively greater efficiency of fuel supply in the country, and hence customer satisfaction.

4.6.6. Information Communication influence

All the respondents agreed that the information flow between the government and oil companies is moderately good. There are times when the government don't want to be open and provide information on time. This could be done deliberately sometimes for the sake of security, and the other time due to hide internal weaknesses and faults. There are times when wrong decisions are taken due to the unavailability of the right information at the right time.

As for the deployment and utilization of latest technologies (real-time stock monitoring, vehicle tracking systems, flow meters, etc…), the industry is almost in its infant stage and a lot has to be done by all stakeholders to develop ICT in the sector and help in alleviating the problems in the fuel supply chain of the country.

Chapter Five

Summary, Conclusion and Recommendations

5.1. Summary of findings

The findings from the study indicated that there is regulatory gap in the industry in addressing the major problems (such as local transportation networks, strategic reserves, storage facility, distributors' margin, monitoring malpractices, etc… in the sector) in maintaining sustainable fuel supply.

The study also revealed that the available transportation & storage infrastructure isn't sufficient enough to meet the growing demand of fuel in the country. Fuel demand has been growing by more than 10% annually for the last 5 years. However, the storage and loading facilities don't show a similar growth trend to cope up with the ever increasing fuel demand.

It also showed that distributors' capability isn't up to the level of expectation of the government and their customers in order to meet continuity of smooth supply. The ones that have a better capability are shown to be better performers in the fuel supply chain.

Moreover, sentimental factors (price change speculation, political & social unrests, rumors in supply shortage from the source, and fear of the unknown) have been disrupting fuel supply over the last 5 years. ICT is also not up to date in delivering the required support to the sector: there is no real-time stock monitoring and vehicle tracking system is in its infant stage in the country.

In general, these issues described above cumulatively resulted in recurrent fuel shortage in the country.

5.2. Conclusion

In line with the objectives of the study and the analysis of raw data, the following conclusions are drawn:

As far as the assessment of the extent to which the infrastructural provision influences the fuel supply of the country, it is imperative to conclude that infrastructure has a great role to distribution of oil in Ethiopia. Despite there being other means of efficient distribution of fuel

in the globe, Ethiopia is solely dependent on road transport for the entire transportation of fuel. Thus there is a need to improve and work at better implementing strategies to improve road network in the country. As the fuel demand of the country is continuously increasing (on average 10% per annum), and there are so many reasons for road blockade, there is also an urgent need to improve the fuel storage facility in the country to sustain supply during crisis.

With regard to the objective to describe the effect of the regulatory gap on the fuel supply of the country, the petroleum regulatory gap is significantly responsible for this lack of clear separation of roles and responsibilities in the sector. The regulatory policy is good on its own merits, however, it falls short in comprehensively addressing the downstream oil sector. For example, it fails to address data management and ownership on downstream oil sector, depot policy, strategic reserves, issues related to distributors margin and local transport networks.

As for the attempt to identify the influence of oil distributors' capability on the fuel supply of the country, the distributors' capability is found to be a significant and a negative correlate and predictor of fuel shortage. Capacity has a direct effect on distribution of oil in Ethiopia. Greater capacity means greater returns and efficiency. There is need to enhance and improve on capacity from all angles to achieve the best of returns.

Sentimental factors were also found to have an effect on the fuel supply of the country. Accordingly, the moment such behaviors prevail, it is expected that the country will soon or later face fuel shortage.

The assessment of the extent and effect of communication technology on the fuel supply of the country also shows a significant effect on the prevalence of the fuel shortage.

5.3. Recommendations

In line with the objective of suggesting mitigation mechanisms to lessen the recurrence of the fuel shortage in the country and the findings from both the quantitative and qualitative data and the consequent conclusions, the following recommendations are worth considering for the mitigation of the recurrent fuel shortage across the nation.

To achieve timely, reliable, and sustainable supply of fuel, there requires a revision on regulations of the sector on petroleum products supply and distribution mainly on fuel distribution margins, strategic reserves, inland as well as horizon depots, local transportation

routes as a tool to meet local consumption and to prevent future fuel shortages. But, until the revised petroleum regulation is out with details addressing all the major issues of the sector comprehensively and pragmatically, fuel crisis may continue to be a recurrent nightmare in the country.

The study also recommends that the government should direct more funds to improve on transportation and storage infrastructures and patrolling along the main road corridors from the main source to enhance the efficiency of oil distribution in Ethiopia. The government can liaise with other foreign governments and stakeholders to expand and improve infrastructure all over the country so as to increase the efficiency of fuel distribution. Long and bureaucratic government procurement procedures which cause delay in maintenance of infrastructure should be abolished for the factor to be the least obstacle to the fuel delivery process. The government should also consider alternative means of fuel transportation like commencement of the already constructed rail infrastructure for fuel transportation, and consider installation of pipelines – the very cheap (at least operationally) and very fast means of fuel transportation over road.

The government should regularly examine its supply chain infrastructure to improve on its capacity. The concerned government body should develop Energy guidelines which impose stiff penalties on oil marketers whose oil products overstay in the distribution system, and installation of flow meters to enhance product flow and distribution.

The study recommends that there is need to improve on IT through trainings, advancement in new technology since we are living in the technological era. The government should change in technology or introduce new technologies to monitor the distributors and control malpractices in the sector

Members of the downstream fuel supply chain should have a regular business review and consultative meeting to discuss transparently on the entire supply related factors and then design strategies and make decisions jointly. Whenever there is a force majeure that hinders the normal distribution process, the government should openly communicate the problem to oil companies in no time and authorize supply of products from the national reserve depots with immediate effect.

All stakeholders should discuss with open mind on how to address price change speculation with win-win solution that takes into account all members of the supply chain.

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Appendices

Questionnaire for the Oil companies' Representatives (Fuel Stations)

Dear Sir/Madam;

Attached you find a questionnaire related to a study of the causes of recurrent fuel shortage in Addis Ababa. The aim of the study is to explore the incidence and causes of the fuel shortage, as well as indicating possible mitigating mechanisms. To help in this effort, the enclosed questionnaire is being circulated to representatives of the oil sector players in Addis Ababa. You are kindly requested to participate in this survey. All you need to do is to complete this questionnaire, which should not take you more than 30 minutes. Of course, your responses will be kept strictly confidential. Should you have any questions or concerns regarding completing the questionnaire, please call 0929-939803.

Please fill in your email address _____ so as to receive feedback on the survey result.

Thank you in advance for your time and effort in completing this survey questionnaire. Your help is highly appreciated.

Sincerely,

Fisseha Mesfin

Part I: General Respondents' Background

1. Gender

   Female ☐

   Male ☐

2. Number of years worked in the downstream oil sector_____
3. Please indicate your age group

   18-25 ☐ 26-33 ☐ 34-41 ☐ 42-50 ☐ above 51 ☐

4. Level of education: Grade 10 completed ☐ Grade 11-12 completed ☐

Diploma/ Bachelor degree ☐ post –graduate degree (MA/PHD) ☐ other ☐

Part II: Basic Research Questions

Please put a tick (√) in the boxes which mostly explain your attitudes. The score levels are described as:

1- Very Strongly Disagree 2-Strongly Disagree 3- Disagree 4- Moderately Agree

5- Agree 6-Strongly Agree 7- Very Strongly Agree

S. No.	Items	Scales of Agreement						
1	Infrastructural Influence	1	2	3	4	5	6	7
1.1.	The conditions of roads from port to different destinations in the country are suitable to deliver fuel on time.							
1.2.	The available roads for transportation of fuel from Djibouti to different destinations in the country is adequate to ensure timely delivery of fuel.							
1.3.	There are adequate options/alternatives to transport liquid fuels in the country.							
1.4.	The level of integration between the various infrastructural provisions are well performing.							
1.5.	The number, storage and loading capacity of inland depots are adequate enough to fill gap and meet demand during crisis.							
1.6.	The storage and loading facility and capacity at horizon terminal is adequate enough to meet							

	demand							
2	Institutional, policy and Regulatory gaps	1	2	3	4	5	6	7
2.1.	There are adequate number of institutions to settle matters related to fuel supply.							
2.2.	The accessibility of the available institutions for the settlement of fuel related matters is adequate.							
2.3.	There are clear policies on every matter related to the fuel supply activities.							
2.4.	There are no noticeable gaps between the policies and practices of the fuel supply in the country.							
2.5.	The regulations for the fuel supply behavior are well tuned to the nature of the fuel supply of the country.							
2.6.	The regulations cover all the important matters around the fuel supply operations.							
3	Sentimental Factors	1	2	3	4	5	6	7
3.1.	The fuel supply reliability isn't highly affected by the political situations in the country.							
3.2.	Conflicts on regional boarders has little chance to jeopardize the fuel supply of the country.							
3.3.	There is little chance for the fuel supply to be interrupted due to disagreements between Djibouti and Ethiopia.							
3.4.	The monthly adjustments of the fuel price have no effect on the availability of the products to the end							

	users.							
3.5	Fuel hoarding and selling at prices above the price cap at stations aren't common practices during crisis.							
3.6.	Panic buying by motorists/consumers increasingly become a common phenomenon in reaction to rumors of fuel shortage.							
4	Distributors' capability	1	2	3	4	5	6	7
4.1.	Retailers of the fuel products have a good financial capacity.							
4.2.	Retailers of the fuel products have enough skilled manpower to deliver the services.							
4.3.	Retailers of the fuel products have an up-to-date technology to manage fuel supply on spot.							
4.4.	Retailers of the fuel products use appropriate forecasting models to estimate the demand for the fuel products.							
4.5	Oil Companies' financial capacity don't have a significant impact on the distribution of fuel							
4.6	Oil Companies' logistics capacity & reputation don't have noticeable influence on the efficiency of fuel distribution.							
5	Information communication Technology	1	2	3	4	5	6	7
5.1.	There is a good culture of sharing information among the parties to the fuel supply in the country.							

5.2.	The information received on the status of the sector's performance are helpful for the subsequent decision by the oil companies							
5.3.	Information is fairly distributed for all companies without bias.							
5.4.	Wrong decisions are not common, as there is no misleading information from the concerned body.							
5.5.	Wrong decisions are not common, as there is no information delay from the concerned body.							
5.6	Oil Companies and transporters use up-to-date communication technology to monitor drivers' behavior and arrival time.							
6	Prevalence of fuel shortage	1	2	3	4	5	6	7
6.1.	There is an ever-decreasing waiting line at the fuel stations from time to time.							
6.1.	Overall, the shortage doesn't result in serious problem of halting the usual business.							
6.3.	It has become a common phenomenon to see traffic congestion around fuel stations due to long waiting lines at the gas stations (R).							

Interview Questions

1. Do you believe that there is a recurrent fuel shortages in the country? If yes, how often is it happening and how do you describe the current trend?
2. What are the indicators for the existence of fuel shortage?
3. How is the status (in terms of quality & quantity) of the roads against the current fuel demand of the nation? What alternative means of fuel transportation do we have at hand or should we consider for the future?
4. How do you describe the storage and loading capacities of both the inland depots and horizon terminal against the current fuel demand of the country?
5. Do we have clear policies as well as accessible and adequate number of institutions to address all issues related to fuel supply? Please describe.
6. How do you see the policies and regulations against the actual practices of fuel distribution and their coverage of all important matters in the subject? Please describe in detail.
7. To what extent are the domestic and bordering countries' political and social unrests influence the fuel supply in the country?
8. How do the fuel distributors (Oil Companies, Retailers, and Transporters) and the general public react to speculations on supply disruption and periodical price adjustment?
9. Please evaluate the overall capacity of the fuel supply chain partners (EPSE & Fuel Distributors) in meeting the ever-growing fuel demand of the nation.
10. How do capabilities influence the Distributors' efficiency in meeting their commitments and attaining competitive advantage?
11. Would you please discuss the culture and fairness of sharing information among the supply chain members of the sector?
12. Do supply chain members apply latest technologies and devises in monitoring and controlling the supply efficiency and malpractices in the sector?