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**Faculty of Technology, Civil Engineering Department under Road &
Transport Engineering Stream**

OPTIMIZING OF FREIGHT TRANSPORT AND CITY LOGISTICS
ACTIVITIES IN ADDIS ABABA

By

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Addis Ababa, Ethiopia

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**A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF
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SIGNED DECLARATION

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

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The Thesis has been submitted for examination with my approval as a supervisor.

Professor Girma Gebresenbet

Dedication

“This work is dedicated to Kibrom the darling brother for showing me the strength and patience,
Zaidom Princely Incomparable Sister for sharing me love and care, my Grand Mother and
Beloved one and Beloved Family next to the Almighty of God.

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ABSTRACT

Though goods distribution is an important part of activity in urban life as it plays a vital role in urban economy in terms of income generation and employment opportunities, nowadays urban freight distribution is creating many challenges like environmental pollution, congestion and traffic accident in the growing cities in developing nations.

Thus, this research paper aim is to optimize freight transport and city logistics activities in the city of Addis Ababa so that goods can be distributed to the city center, without jeopardizing the lives of city dwellers, depleting environment and also enabling a good economic efficiency of freight transport and maximized profit for stakeholders.

According to the traffic data collected from field survey and the historical traffic data collected from ERA, on average 19,088 and 18,428 freight vehicles per day enter and leave the city of Addis Ababa respectively out of which, 66.6%, 19.6%, 6.59%, 4.33% and 2.93% enters through gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively where, 27.94%, 27.83%, 23.67% and 20.56% were Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively and similarly 67.43%, 16.30%, 8.24%, 4.06% and 3.97% exits through the gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively accounting 27.74%, 27.59%, 23.07% and 21.60% Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively . Future prospects from the study reveal that freight traffic entering to the city and leaving the city will grow at an average rate of 10.03% and 9.63% respectively and as a result the entering and leaving freight traffic will raise to 90,633 and 86,124 respectively by 2015.

Out of the total vehicles driven within the city, only 7.53% were freight transporting vehicles accounting the least share and 36.61% were cars taking the largest share.

In view of load factor which is in terms of weight, it was found that due to limited application of city logistics measures within the city freight transporting vehicles operate at an average load factor of 53% which leads to increased transport cost. Within the city more than 146 warehouses

and 1 freight terminal are available where 59% of the warehouses are located within the main city center and major sub-centers of the city attracting huge freight vehicles and operating at a poor level of service.

Regarding to the terminal delay, it was found that terminals cause vehicles to delay for about 1-20 days. According to the study, commodity type, season and transparency of the customers, capacity of custom officers and transitors and capacity of the terminal were the basic factors that affect delay of terminals. To minimize the negative impacts, five optimum freight terminal locations were selected with the help of factor rating method and this newly selected terminals are expected to minimize the negative impacts of the freight distribution as they minimize entry of freight vehicles to the city center and terminal delay.

It is perceived that, high increase in the road freight transport coupled with the little awareness of city logistics measures and concepts within the city and the country in general are the main reasons that are causing problem within the city. Hence, strengthening freight transport data base management system, creation of awareness regarding the concept of city logistics with its advantages and environmental impacts among stakeholders and further researches on possibility cooperative freight delivery system, coordinated goods movement and investigation of the possibility to use other ports other than port of Djibouti for import and export activities should be the task of researchers and concerned authorities before the problems get worse.

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LIST OF ACRONYMS

AMG: Ambo Gate

CL: City Logistics

DBG: Debrezeit Gate

DF: Directional Distribution Factor

DG: Debrebrhan Gate

ERA: Ethiopian Roads Authority

EU: European Union

GDP: Gross Domestic Product

GIS: Geographic Information System

GOG: Gojam Gate

GPS: Global Positioning System

JIG: Jimma Gate

LOS: Level of Service

NAF: Night Adjustment Factor

OCED: Organization for Economic Co-operation and Development

O-D: Origin-Destination

SAF: Seasonal Adjustment Factor

1. Introduction

1.1 Background

In the last decades, population growth and urbanization increases at alarming rate in developing countries. Today many of the world biggest cities are in developing countries. Steady increase of unemployment, congestion, traffic accidents, social, environmental and health constraints are in and around these mega-cities.

Over the last 20 years, car traffic has grown at a rate of 5.3% per annum, and road freight traffic has grown almost at 7% per annum (OECD, 2005) and consequently, freight transportation related problems became the main challenge.

Addis Ababa is the largest and capital city of Ethiopia, with a population of 3,384,569 according to the 2008 population census. Addis Ababa lies at an altitude of 7,546 feet (2,300 meters) with an estimated area of 530.14 square kilometers (204.69 sq mi), this chartered city has an estimated density of 5,165.1 inhabitants per square kilometer (13,378 /sq mi).

Road transport system is the most important means of communication in the country providing 90% (Aklilu, 2007) of the passenger and freight transport services. Addis Ababa is linked with important cities, towns and to agriculturally, commercially and industrially active centers of the country by road. International highways also link Addis Ababa with neighboring countries such as Djibouti, Eretria, Kenya and Sudan which leads Addis Ababa to accumulate 77% (Aklilu et al, 2007) of the registered vehicles in Ethiopia.

Major rural exodus to Addis Ababa has increased the population of the Ethiopian capital by nearly 20 percent over the past 10 years this development coupled with little infrastructure, weak transport management and poor city logistics experience has strained the city's infrastructure to breaking point.

Now adays, it is common to see traffic congestion, environmental pollution and delay due to the lack of transport demand management for urban freight, lack of route planning and inappropriate location of freight and mass transport terminals in Addis Ababa.

Statistical data from the office of Addis Ababa city traffic police shows that Addis Ababa is experiencing around 700 accidents per month which accounts for 60 percent (Berhanu, 2000) of the accident that occurs in the country Ethiopia and the costs of such fatalities and injuries due to traffic accidents have a great impact on various aspects of the society

Congestion in Addis Ababa is estimated to 80% of the motor vehicles in the country are driven in the city of Addis Ababa. These factors are also coupled with low quality fuels, particularly with respect to sulphur content and rapid growth of the transport sector to contribute for the air quality deterioration in Addis Ababa (Source: urban transport study and preparation of pilot project for Addis Ababa, 2005).

Therefore, it is thought that optimizing location of logistics facility terminals and implementation of reliable city logistics measures is one of the efficient means to control freight traffic demand, since they may not only mitigate traffic congestion, lighten air pollution and save energy but also improve freight transport system, reduce the cost of urban freight transport. Optimized city logistics as a whole including determining optimum locations of terminals and logistics facilities can transfer the center of gravity of freight transport from city center to suburb, and alleviate traffic pressure in the center and improve the efficiency, safety and environment of the whole urban transport system.

1.2 Literature review

It is becoming common to see most freight flow in cities that moves by road and goods vehicle movements clearly playing an important role in the functioning of towns and cities, distributing goods to numerous locations that are vital to urban life. As a result, many different freight flows constantly enter, cross, and leave the urban areas.

In many parts of the developing world, the transport system in general and urban freight transport system in particular is characterized by a rapid growth in demand that has overwhelmed transport capacity and weaken city logistics activities. Some researches reveal that growth of road freight transport within cities and in between them has increased significantly in the past decades. Similarly, different prospects indicate that this trend will continue in the future as the urban freight transport demand is directly linked to the population and economic growth within urban areas. The resulting high level of congestion, accident and emission due to rapid growth of urban freight transport in many cities of developing country has negative impact on the level of economic development that can be achieved.

According to (Taniguchi et al, 2007), the adverse impact of city distribution can be seen from different angles. Subjects such as the economy, the society, the road safety, and environmental issues are affected by the manner in which goods are distributed within the city. Estimates indicate that 3 million person hours are lost daily in the metropolitan regions of Bangkok and Thailand (where infrastructure improvements lags well behind the growth in travel demand) as a result, there occurs a 2 hours traffic delay much of the day (Sussman and Bonsignore, 1993) and it is clear that congestion with no doubt increase the inventory carrying cost, lengthy time-to-market delays, increase transport cost, when such issues are translated to money, it costs a lot to the logistics providers, which in turn affects the economy. According to (Paul Kompfner, 2006) in Europe delays cost 1.9 billion liters of fuel (6% of annual consumption) and Congestion costs €50 billion per year (0.5% of EU GDP), which clearly indicates how the increase in logistics cost due to congestion and delay can affect the economy.

Road safety is not given due attention while designing roads for cities particularly in developing countries. Most city roads are not suitable for big trucks to supply goods and consequently, big freight trucks are observed to interfere with the transport system in the center of the city resulting high accidents. Thus, since goods are very necessary for the activities of the city and make life worth living for, such trucks must ply the city roads. Lack of better knowledge and awareness to designed good route for big trucks to reach the city center, cause more problems. Statistical data from the office of Addis Ababa city traffic polices shows that Addis Ababa is experiencing around 700 accidents per month which accounts for 60 percent (Berhanu, 2000) of the accident that occurs in the country Ethiopia and the costs of such fatalities and injuries due to traffic accidents have a great impact on various aspects of the society. Similarly as declared by (Paul Kompfner, 2006), In Europe 1.4 million road accidents occur per year costing €200 billion.

The environmental impacts imposed on the society by high traffic of trucks in the city are just abundant; this implies immediate measures must be taken to tackle the problem. The high demand of fuel by such numerous trucks in the city contributes a great deal to deplete our natural resources which are scarce. The high rate of consumption by big trucks results in high rate of emission of CO₂ and other harmful gases into the atmosphere, thereby causing air pollution (*Taniguchi et al, 2007*). Some studies in Paris also indicate that more than quarter of CO₂ emissions due to urban traffic is attributed to freight transport, although it represents less than 10% of the total traffic (WCTR, 2010). Finally, it is reasonable to say that, city dwellers enjoy the high rate of activities in the city, and also as they are customers who cause demand, the high rate of unwanted congestion and accidents caused by many big trucks in the city are not welcomed by such residents as such impacts increase the social cost of the city because of the money that is disbursed to minimize the impacts. It has been claimed by Loffler in 1999 that towns and cities are both one of the main driving forces and one of the main victims of this situation. Cities depend on efficient freight transport operations, especially by road while their further growth and economic development are also closely related to even further expansion of traffic.

On the other hand, negative impact of road freight operations on environment is expected to grow while congestion problem, especially within urban areas, is also set to get worse.

Perhaps, the most compelling aspect of these problems is that the urban poor bear the brunt of both congestion and deteriorating environmental quality as they often face the longest commuting times and spend much of their lives out of doors on congested, noisy, and polluted streets.

In most big cities around the world, the centers of the city determine the rate of economic activities in that city. Thus, a well designed and built city center will attract a lot of businesses and people every day. Therefore a well-structured, built and efficient transport, efficient logistics system is a necessity for such cities. But, as dictated by Loffler, 1999 it seems to be impossible to significantly reduce freight transport by road without affecting the needs of cities and their inhabitants.

To address these complicated and difficult problems, numerous city logistics measures such as, Load factor controls, Underground freight transport system, advanced travel information system, Cooperative freight transport system and Public logistics terminals have been proposed and implemented in several cities of the world.

1.2.1 City logistics and urban freight distribution

City logistics or urban freight transport has become an imperative concern in city planning. For years now urban planners and transport economists have observed the challenges and problems related to organizing freight transport within an urban setting. The complexity of this urban freight distribution problem and the conflicts between different key stakeholder groups (local governments, transport companies or logistic service providers, customers, inhabitants, businesses) necessitates a comprehensive solution. One such prospective solution is the development of city logistics schemes which is a relatively new field of logistics brought by the challenges of moving quantities of freight to, from and within metropolitan cities (Taniguchi, et al, 2004). During the industrial revolution, much of the freight took place between transport

terminals, such as ports and rail yards, with very limited freight into the cities. But, today, there has been a shift in the manner of those activities, with major cities acting as transit for goods to other cities.

As coined out by (Taniguchi et al, 1999a), “City Logistics is the process for totally optimizing the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, the traffic congestion, the traffic safety and the energy savings within the framework of a market economy” (Taniguchi et al., 1999). Hence, city logistics are aimed at increasing the efficiency of urban freight transport systems as well as reducing traffic congestion traffic accidents, social impact and mitigating environmental impacts. Thus we see that the aim of city logistics is to optimize logistic systems within an urban area by considering the costs and benefits schemes of both the public and private sectors.

The concept of city logistics is a distributional strategy that can be of various forms. As can be seen in Figure1.2.1, the highly density central city can be service with goods from the terminals located at the margin of the city. From these terminals, smaller vehicles are then used to transport (deliver) and pick goods and parcels to consumers in the central part of the city. The Fact that smaller vehicles are chosen is because they are convenient enough to reduce the problem of congestion.

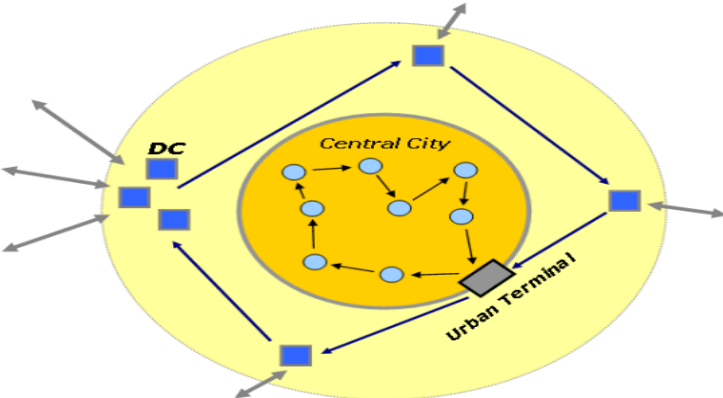


Figure 1.2.1: Goods flow in and around city center (Adapted from: www.people.hofstra.edu/geotrans/eng)

Bearing in mind the objectives of city logistics, and also the idea of achieving an efficient distribution system of goods to the city center, it is very important to cite the role of various stakeholders that are involved. Basically, there are four stakeholders in urban freight transport. These are; shippers, freight carriers, residents and administrators. Thus to achieve an efficient distribution system, the objectives of each of these stakeholders must be bear in mind, since they all have different objectives.

1.2.2 Stakeholders in city logistics

Understanding the role of, scope of activities and interaction of city logistics stakeholders is e important while deciding on suitable city logistics measure. Taniguchi et al (1999) classifies the actors in city logistics, which are referred to as “freight actors” or “stakeholders”, roughly into four groups: shippers or receivers, residents, carriers, and administrators at the city level. And Figures 1.2.2 and 1.2.3 illustrate the interaction between them.

- A. Shippers:** Are customers of freight carriers, who either send goods to other companies or persons or receive goods from them. The basic objective of these stake holders is to maximize their levels of service, which includes the cost, the time for picking up or delivering, and the reliability of transport as well as trailing information. As has become, the requirement for carriers to arrive at customers within specified time windows for pickup and delivery has become popular. With such a strict time window, smaller loads of goods are being transported frequently, by smaller vehicles. The reliability (without damage and delay) of delivering goods has become more important for Just-In-Time transport systems aggravating the urban freight distribution problems.

- B. Freight carriers:** this category of stakeholder is those who try to maximize their profits by minimizing collecting and delivering costs. They have the capacity to provide quality services to customers at a lower total cost. Their aim is to arrive at customers’ within a designated time period but, in urban areas this requirement is hardly met due to traffic congestion. Thus obviously we find inefficiency in the use of trucks since there will have to arrive at customers’ location earlier enough to avoid traffic congestion.

C. Residents: These stake holders are people, who work, live and market in the city. The residents want to have a favorable life, free of noise, congestion emission and accident and as a result they don't welcome large trucks in the city, even though these trucks are carrying commodities necessary for life. They want to minimize traffic congestion, noise, air pollution and traffic accidents, near residential areas. In contradiction to the need of the residents, retailers within the city also want to receive their goods at a convenient time, thus there is a conflicting subject in this case.

D. City administrators: the role of city administrators is to enhance economic development and increase employment opportunities. They are also responsible to alleviate traffic congestion, improve environmental conditions and increase safety of the roads within the city. They are supposed to be neutral in their activities and resolve problems within the other stakeholders, involved in urban transport. Therefore, the administrator is to coordinate and facilitates City Logistics initiatives. In fact, it is not straightforward for the city administrator to enforce strong measures to control the activities of the private sector. Misguided policies could affect the wider economic system the most difficult part for a city planner is to decide on how to deal with different actors with different perspectives and how to appropriately compromise their various interests with that of the wider population. From the illustration below, we can see that there is a close interaction (link) between the various stakeholders in this whole business of City Logistics. None of them is totally independent of the other.

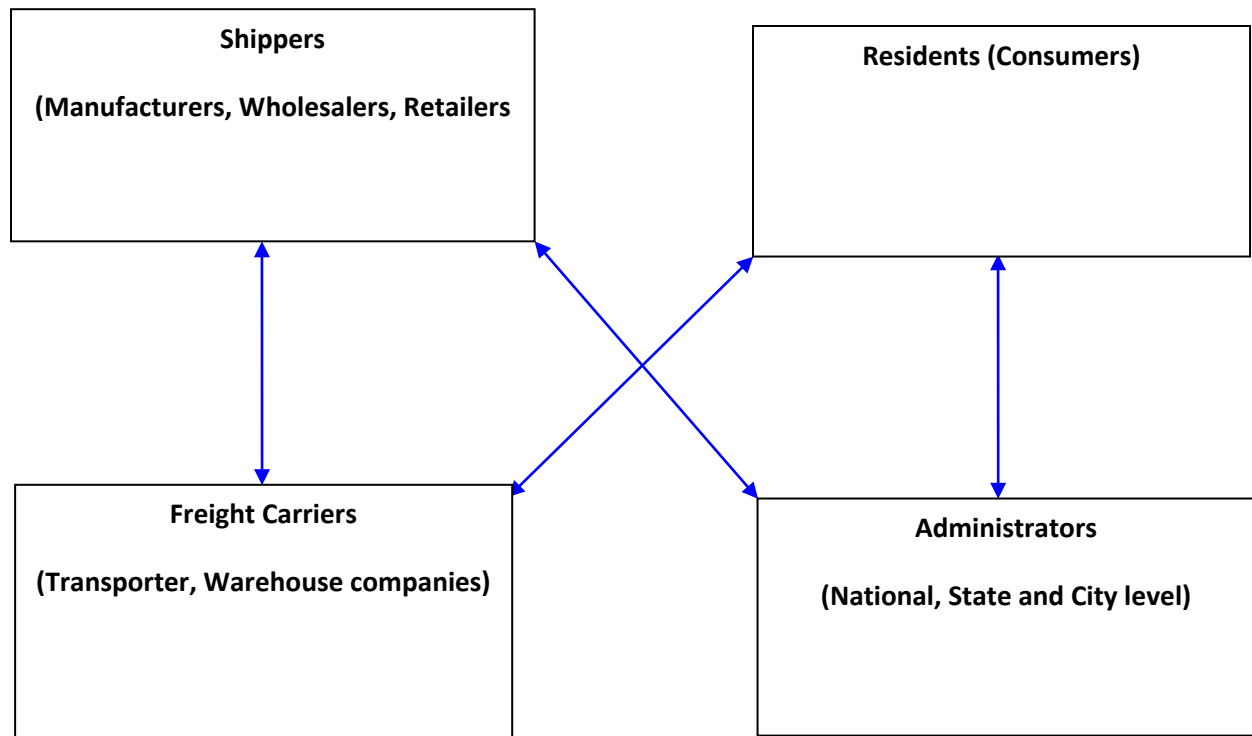


Figure 1.2.2: Key stakeholders in City Logistics (Source: City Logistics, Network Modeling and Intelligent Transport Systems, Taniguchi et al August 2000).

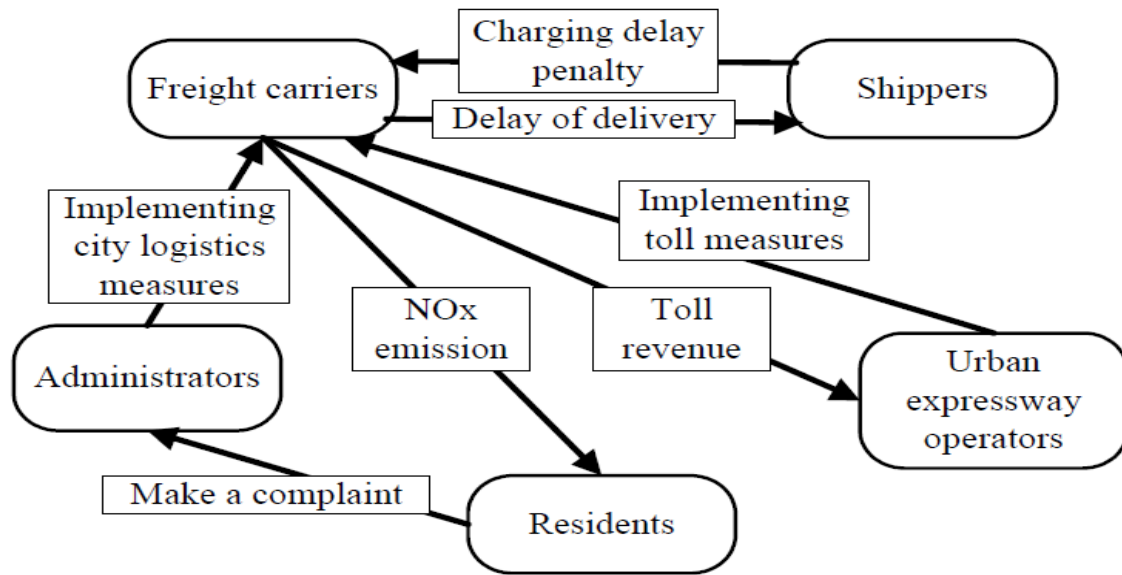


Fig 1.2.3 Interaction among stakeholders (source: Evaluating City Logistics Measures Considering the behavior of several Stakeholders Taniguchi et al 2005).

1.2.3 Urban freight transport

The exact definition for urban freight transport differs per author. Urban goods movement is defined as “the movement of things (as distinct from people) to, from, within, and through urban areas” (Ogden, 1992). This definition corresponds to Munuzuri et al. (2005) “those movements of goods that are affected by particularities associated to urban traffic and morphology”. Ambrosini and Routhier (2004) argue that this definition should be extended, so that it includes “household purchasing trips, urban road maintenance and building, waste collection, etc.” and not only the movement of goods between premises. OECD (2003) defines it as “the delivery of consumer goods (not only by retail, but also by other sectors such as manufacturing) in city and suburban areas, including the reverse flow of used goods in terms of clean waste”. Allen et al. (2000) use a broader definition for urban freight transport that includes “(1) all types and sizes of goods vehicles and other motorized vehicles used for (core) goods collections and deliveries at premises in the urban area, (2) all types of goods vehicle movements to and from urban premises including goods transfers between premises, ancillary goods deliveries to urban premises, money collections and deliveries, waste collections and home deliveries made from urban premises to customers, and (3) service vehicle trips and other vehicle trips for commercial purposes which are essential to the functioning of urban premises”.

1.2.4 City logistics measures

As it has been outlined earlier, urban freight distribution is becoming the main challenge of different cities through the world. “It is clear that Freight carriers are expected to provide higher levels of service within the framework of Just-In-Time transport systems with lower costs. On the other hand, Congestion levels on urban roads have been constantly rising due to the increasing level of traffic demand which in turn results in environmental problems, traffic accident and increasing logistics cost. Energy conservation is also an important issue not only because of the availability of limited amount of natural resources but for reducing CO₂ emissions to limit global warming.

Therefore, to have an efficient distribution system of goods to the city center it is decisive to know, understand and exercise the basic city logistics creativities and measures as such measures contribute well to maximize the efficiency of urban freight distribution.

In its current implementations, City Logistics includes a subset of the following initiatives, combined and varied for compatibility with transport planning policies for a particular city:

- Load factor controls
- New freight transport system
- Underground freight transport system
- Advanced travel information system
- Cooperative freight transport system
- Public logistics terminals

1.2.4.1 Load factor controls

It is clear that increased volume of freight vehicles in city centers is one of the main contributing factors for the depletion of the environment, increment of traffic accident and logistics costs. To reduce the negative impacts, the volume of freight vehicles within the city centers can be minimized by controlling the load factor.

According to (*Taniguchi et al, 2007*), it was in 1998 that two European cities (Copenhagen and Amsterdam) introduce a certificate system for freight carriers who deliver or collect goods within the central city areas. In Copenhagen, vehicles were allowed to use the public loading/unloading terminals in the inner city, if they only have a certificate (green sticker). And the certificate is not issued if they don't satisfy the following requirements.

- ✓ Load factors greater than or equal to 60% and
- ✓ Vehicle age less than 8years.

In Copenhagen, Companies are required to submit a report on the load factors of their vehicles every month. In order to maintain certification, the previous month's load factor should exceed 60% on average.

Similarly, in Amsterdam, vehicles weighting over 7.5 tons are not permitted to use streets other than the main streets. However, vehicles weighting over 7.5 tons are able to obtain special certificate to enter streets whenever they satisfy the following conditions.

- ✓ Load factor > 80%
- ✓ Length <9m and
- ✓ Engine must satisfy Euro II emission standard.

Similar to the case of Copenhagen and Amsterdam, mashed potato producer French company VICO exercises the load factor controlling system by changing the size of its packaging boxes to improve the loading rate of the trucks rented for delivery of its products. Combined with the introduction of specialized software for journey optimization, the loading rate increased by 60 %. This reduced the requirement for trucks in a year by 2 000 (8 000 Lorries are now rented annually instead of 10 000) for the same amount of products delivered, and reduced distances travelled by 960 000 km and fuel used by 300 000 liters. The cost of the investment was about EUR 60 000 and the payback time for the investment was less than a month (European Commission, 2000).

Accordingly, it is apparent that increasing the load factor of urban freight vehicles contribute well to enhance urban freight distribution as increased load factor reduces the number of vehicles

significantly. But, on the other hand though this measure is being applied in different cities of the world successfully its sustainability seems questionable as companies are showing interest to the principle of Just-In-Time freight delivery system (encouraging very low load factor delivery) aiming to reduce storage costs.

1.2.4.2 Underground freight transport systems

Underground freight transport systems are innovative solutions for urban freight transport problems (Koshi et al., 1992 in Taniguchi et al, 2001). In central area of Tokyo, Japan, estimated the impacts of building an underground freight transport that NO_x and CO₂ would be reduced by 10 percent and 18 percent respectively, and a reduction of 18 percent of energy consumption and an increase of 24 percent in average travel speed. But in my view, though, this measure contribute to the solution of urban freight distribution significantly cost-benefit analysis should be given priority before its implementation as it requires huge investment cost.

1.2.4.3 Advanced travel information systems

The most common techniques for logistics include Global Positioning System (GPS), Geographic Information Systems (GIS) and advanced information systems. GPS provides the service of vehicles positioning which help the control centers to monitor and dispatch trucks. GIS provides the basic geographic database for the deliverers to enable to organize their routes easier and faster. Advanced information systems provide the real-time information for both managers and deliverymen to adjust their paths as new demands occur. Therefore, the integration of GPS, GIS and other advanced information systems provides a high maneuverability of transport systems. According to (Taniguchi et al, 2007), A Japanese milk producing company practiced one effective application of *historical operation data*. After introducing a satellite based information system for one year, the company was able to reduce the number of pickup delivery trucks by 13.5% and increase their average load factor by 10%. For the study first, a computer based system was used to store detailed historical data of the pickup/delivery trucks operations, including times of starting/arriving times at the depot and customers as well as the waiting times, travelling speeds and routes travelled and after such a data is stored, the company was able to analyze this data and change their routes and schedules to substantially increase the

efficiency of the vehicle fleet. This type of system can reduce both freight transport and environmental costs within city.

Similarly, the application of advanced information system for efficient freight transport has been exercised in Europe and US successfully as the technology in the developed world is well organized and developed. But, in my thought the application of this technique in developing countries may be a problem due to its high set up cost.

1.2.4.4 Cooperative freight transport systems

The current tendencies of urban freight transport towards to deliver “Just in time” and “door-to-door” are encouraging traditional delivery pattern of freight (fewer trips and low load factor). The delivery companies usually maintained their business independently. It means two carriers might serve in the same area and such a delivery system worsens the negative impacts of urban freight distribution. Therefore, the operation of freight transport should change to have more loads and fewer trips in order to increase the efficiency differently. Without improvement, the transport costs will increase hugely to satisfy the current requirements.

The aim of cooperative delivery system is to solve the urban freight transport problem by seeking cooperation in delivery and/ or collection of the goods between many logistics firms in order to increase the load factor and reduce the number of trucks required deliver or collect goods. Cooperative use of information and cooperating in building and operating a common depot are other parts of cooperative freight transport systems (Taniguchi, et al., 2001).

Different case studies disclose that, through the implementation of cooperative freight systems increased delivery trip loads; reduced unnecessary trips, as well as pollution and costs; reduced service area overlaps; and increased service quality and company profits are some of the basic benefits achieved.

1.2.4.5 Public logistics terminals (transshipment centers), sometimes termed ‘freight villages’

The concept of freight villages/terminals has been applied in several cities, such as Monaco (Dablanc, 1998). This platforms or villages are provided by the government and operated by the private freight carriers for delivering goods to city areas. The goods are reorganized in the freight village before being delivered to the urban areas where the freight villages are located surrounding the city. The freight from outside of a city is sent to the freight village in order to classify and prepare for delivering to city area. This could increase the carrying load of vehicles and reduce unnecessary trips in the urban area. In addition, this integration benefits the private sector by reducing costs, and also the public environment by decreasing trips and air pollution.

Supporting the above theory, the concept of urban freight center was exercised in Kassel, Germany in 1994 through cooperation among 7 forwarding companies in order to deliver their commodities to the inner city of Kassel where the project was supported by the forwarding association and the chamber for industry and commerce of Kassel (Wisinee Wisetjindawat, 2010).

The basic approach used was that, the forwarding agents employ a neutral transport operator to pickup and delivery their goods to the recipients in the inner city. The concept is demonstrated in Figure below by Koehler (2003). In the early morning, the neutral carrier picks up the consignments at each forwarder’s depot and bundles the consignment at the distribution center before starting delivery tours to the recipients (Huschebeck, 2002 in BESTUFS, 2002).

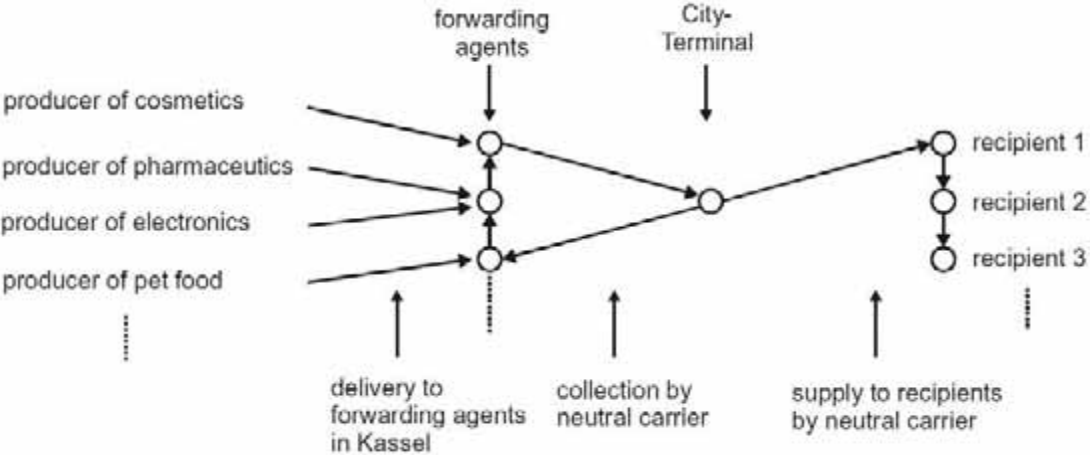


Figure 1.2.4 Kassel model (Source: Koehler, 2003)

Upon the implementation of the city logistik scheme, a study by Koehler (2003) indicate that, goods vehicle mileage towards the inner city and within the inner city reduced by 40 percent and 60 percent respectively. Load factors of trucks doubled and the delivery weight per stop increased by 15 percent.

The implementation of the Kassel freight village proves to be profitable measure for the city due to the reduced number of commercial vehicles in the city and lower emissions and it was also found that, there is little difference in terms of service quality to the recipients of the goods. There is no extra cost or inconvenience for the freight operators involved. The participating transport operators benefit from an improved image as innovative companies that act positively for the environment.

Despite all the above advantages, the project still has some problems. Koehler (2003) stated that some forwarding agents have left the cooperation. The reason could be that there is not enough interaction (eg. through regular meetings, exchanges of information, or suitable organizational structures) between the participating companies. It is important to note that the benefit to the companies is intangible; there are no direct costs saved through utilization of the scheme.

1.2.5 Conclusion

Addis Ababa, like other cities in developing countries is facing challenges related to urban freight distribution. Being road transport system the most important means of transport used for the transport of passengers and freight, the increasing demand of road transport system coupled with lack of route planning, lack of transport demand management for urban freight, inappropriate location of freight and mass transport terminals and little infrastructure is resulting high level of congestion, accident and environmental depletion.

Though Addis Ababa is experiencing serious problems resulting from the urban freight distribution, almost no research has been conducted so far in the area of city logistics. But, some

studies by consultants regarding the Addis Ababa transport master plan have been done and trials to relocate and determine freight terminal locations and public transport terminals were performed in addition, study regarding the introduction of national logistics coordination center is being carried out by the Information Network Security Agency (INSA) under the client of Ministry of Transport aiming to easily track freight vehicles so that efficiency and security of the freight transport system will be maximized. The study by the consultants gave different recommendations and some of them are implemented like the relocation of customs office which is now solving some problems but, many of the recommendations such as, location of integrated freight complexes, location of freight vehicle terminals and public transport terminals are not implemented so far. According to my observations, even this time there are many warehouses in the center of the city attracting many freight vehicles and worsening the problems which shows how much the concept of city logistics not introduced in the city.

Of course, implementation of some city logistics schemes like underground freight transport system, and integrated freight distribution centers may be problematic due the huge setup cost that the schemes may require but, some city logistics schemes like cooperative freight delivery, load factor control and advanced information systems can easily be implemented and exercised in the city with least cost and astonishing benefits.

From the literature reviewed and the case studies discussed it simply understood that no research in the area of city logistics has been done in the city of Addis Ababa. But, the area of city logistics has been active area of research in many developed and developing countries for several years. For example, in Thailand, Sweden research on cooperative freight delivery, in Japan and Netherland research on underground freight transport system, in Denmark, Netherland and France research on load factor control in Germany & Japan research on urban freight distribution centers and in Europe, Japan & USA research on advanced information system has been done showing promising benefits of the schemes. Hence, conducting a research in the area of city logistics in Addis Ababa will be critical to solve or reduce the problems that are currently observed in the city before the problems get depraved.

1.3 Research question

The critical questions that should be answered include:

- ✓ What can be done to improve the current system of freight flow in Addis Ababa?
- ✓ What can be done to minimize the operating cost of the freight transport system in Addis Ababa and the country in general?
- ✓ How can the emission, accident related to the freight flow be reduced in Addis Ababa?
- ✓ How can freight routes and freight terminal locations be optimized in the city?
- ✓ What is the significance of optimizing freight transport routes and facility location terminals? How is the significance assessed?
- ✓ Where should freight terminals in Addis Ababa be placed?

2 Objective

The main objective of this study was to optimize the freight transport and city logistics activities in Addis Ababa to improve understanding of the opportunities for improving freight flow and city logistics activities in Addis Ababa, identify obstacles to change, and recommend to the national governments those measures which lie within their competence which would enhance services in an environmentally sustainable way.

The reason, for conducting the study was based on the desire to maximize the efficiency of the urban freight transport and minimize the negative impacts that Addis Ababa is facing due to poor urban freight transport system.

The specific objectives were to:

- ✓ map out the flow of goods to, within and from Addis Ababa city
- ✓ map out the share of goods transport vehicles in relation to total traffic flow within Addis Ababa
- ✓ optimize locations of logistics facilities including terminals
- ✓ evaluate the existing warehouse location and service level
- ✓ analyze the impact of terminal delay on the productivity of trucks

2.1 Significance and impact of the study

As mentioned earlier, unless significant change in the management of urban freight transport and city logistics system is implemented constraints related to traffic congestion, traffic accident, vehicle emission and high operating costs of the freight and public transport will continue escalating.

Hence, the findings of the study could help as an important base for freight, planners and investors to make decision on policy and investment in the road freight transport industry in such a way that it helps to:

- ✓ Reduce operation cost
- ✓ Increase efficiency
- ✓ Minimize congestion
- ✓ Reduce environmental impact

3.0 Methodology

It is apparent that for any research, identifying clear and efficient methodology is a crucial for the implementation of the objectives and effectiveness of the study as a whole to provide the best quality of research result.

The nature of road freight transport study and city logistics requires close inspection of different factors that affect, limit, and determine the overall development of the system. Such investigation requires a range of methodology to enable arrive to some reasonable finding and conclusions.

The main tasks within this research includes mapping out the current system of freight transport flow to, from and within Addis Ababa, determination of the share of freight vehicles with in the city, determination of logistics facilities locations in and around the city and evaluating the level of service of warehouse by conducting field measurement with the help of GPS, interviews, field observations and questionnaires and using different methodologies ranging from simple mathematical analysis to use of models.

3.1 Data sources

In order to sufficiently map out the road freight transport situation and city logistics activities in Addis Ababa, the primarily activity was to identify pertinent data sources. Collection of extensive information from field surveys, various institutional and individual sources was

performed. Attempt has been made to collect extensive information from field surveys, various institutional and individual sources.

The bulk of data collection was made from documentary sources, among which freight transporting agencies, traders and different institutions, field investigation mainly from traffic count & interviews, freight terminals, warehouses and operation reports from different city logistics stakeholders and stakeholders involved in road freight transport business.

Most of the data sources used for this study were field measurement and survey to collect secondary data from different stake holders as mentioned above.

In addition to field measurements, questionnaires were developed and used during the survey to collected secondary data from different stake holders mentioned above.

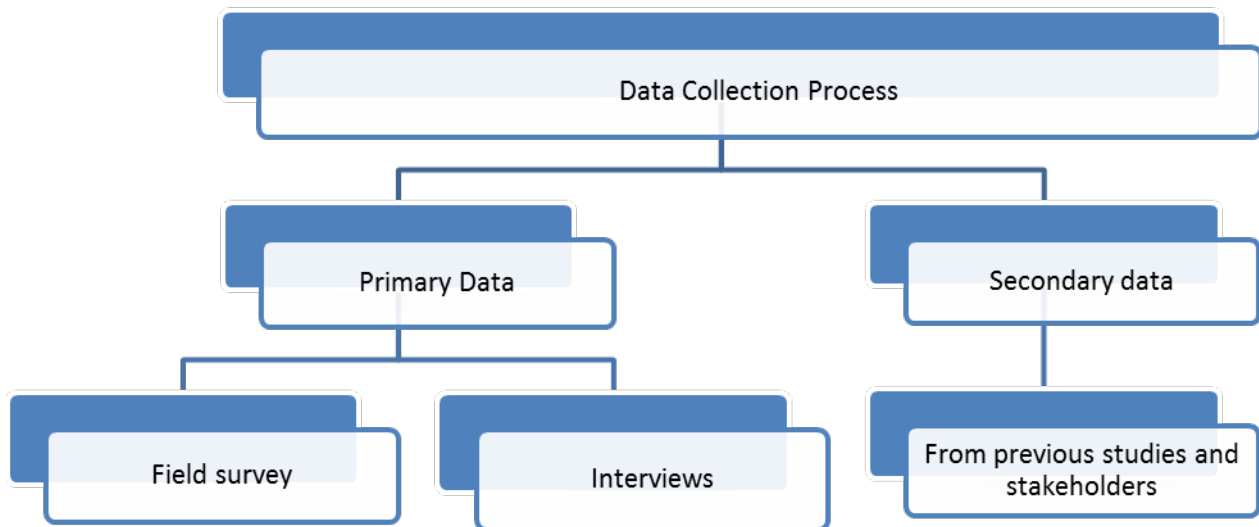


Figure 3.1 Data Collection Process

3.1.1 Sources of secondary data

As it was discussed earlier, the research requires both secondary and primary inputs. The primary inputs are collected from interviews and field survey whereas; the secondary inputs are collected

from different stake holders involved in freight transporting and city logistics activities, institutions and some other authorities which are listed in table below:

Table-3.1 List of secondary data sources

Sr.No	Secondary Data Sources	Type of Data	Remark
1	Ethiopian Roads Authority	Traffic Data	
2	Freight Transporting Agencies	Load Factor	
3	Terminal, Warehouse owners and Warehouse Managers	LOS, Capacity, Delay	

3.1.2 Primary data ollection and analysis

3.1.2.1 Mapping of freight flow

A. Data collection

It was intended that the data was to enable to:

- (a) Map out the current system of freight transport flow to, from and within Addis Ababa,
- (b) Determine the share of freight vehicles with in the city,
- (c) Determine load factor
- (d) Determine logistics facilities locations in and around the city and evaluate the level of service of warehouse different inputs are required.

Having this on mind, different techniques have been adopted to collect the required data. The different techniques adopted during the study are presented as follows.

A-1. Classified traffic count

To map out the freight flow characteristics and in order to take effective city logistics measures so that to prevent traffic problems it is critical to have information about the traffic volumes and traffic flows. Therefore classified traffic count survey has been conducted on the traffic volume along the main roads and gates to the city. The observation locations were divided into two groups. One group comprising five observation points was selected, where the major roads across the border connecting the regions outside and inside Addis Ababa were observed. The other group comprising five observation points was selected for mapping the freight flow within the city and these five locations were selected based on the intensity of freight traffic observed along the routes. After the selection of sites for the classified traffic count traffic data collectors were trained on how to collect the database on the Ethiopian Roads Authority standard and procedure. i.e.

- ❖ 5 days of 12 hour and
- ❖ 2 days of 24 hour traffic count data was collected at all the selected sites.

Selected sites for the data collection:

Group-1: Traffic count stations

- ❖ Ambo Gate
- ❖ Jimma Gate
- ❖ Gojam Gate
- ❖ Debrebrhan Gate
- ❖ Akaki Gate

Group-2: Inner traffic count stations

- ❖ Tikur Anbessa/Teklehaymanot
- ❖ Commerce College
- ❖ Shebele Hotel
- ❖ Kera Mosque
- ❖ Anwar Mosque
- ❖ Anbessa Chama

A-2. Load factor

The use of load capacity is an indicator for the efficiency of transport operations. This is usually expressed in the amount of load (in terms of either volume or weight) in relation to the maximum weight or volume that can be transported in the vehicle. Therefore, to determine the efficiency of trucks in the city of Addis Ababa and to provide suitable countermeasures of the load factor by category of vehicles has been collected through interviewing transporters and drivers.

B. Analysis technique

After completion of the primary and secondary data collection, comprehensive literature review has been made to maintain standard and consistency in the study. With the data provided and collected from field investigation, information provided from different relevant institutions, an in depth analysis regarding the share of freight vehicles, proportion of freight at all the gates and proportion of freight within the city, leaving the city and entering the city, load factor and transportation cost were performed using, tables, chart and ratio or percentage at different situations.

Forecasting approach has been also used to predict future freight transport and city logistics activities. It is apparent that there are elements to be considered in future freight movement studies as these in turn influence the supply of freight transport vehicles and city logistics activities.

To furnish governments, institutions and companies with future estimates of commodity movement, choice has been made in using forecast for the purpose of this study to do so the traffic growth rate and the GDP growth rate are used as a basic parameters to predict the future freight flow and patterns of city logistics activities will be predicted based on existing situations and governmental policies. In addition the existing freight terminals were mapped on a digital map by taking GPS coordinates.

3.1.2.2 Optimization exercise

3.1.2.2.1 Facility location analysis

The physical location of business facilities and freight terminal facilities can have a significant impact on the success of a company, a city and a country in general. The decisions where to locate goes through different steps and is based on different types of information. Location analysis is the best techniques available that help to organize site information and that can be used as a starting point for comparing different locations.

A. Location analysis steps

Every facility location analysis passes through the following steps.

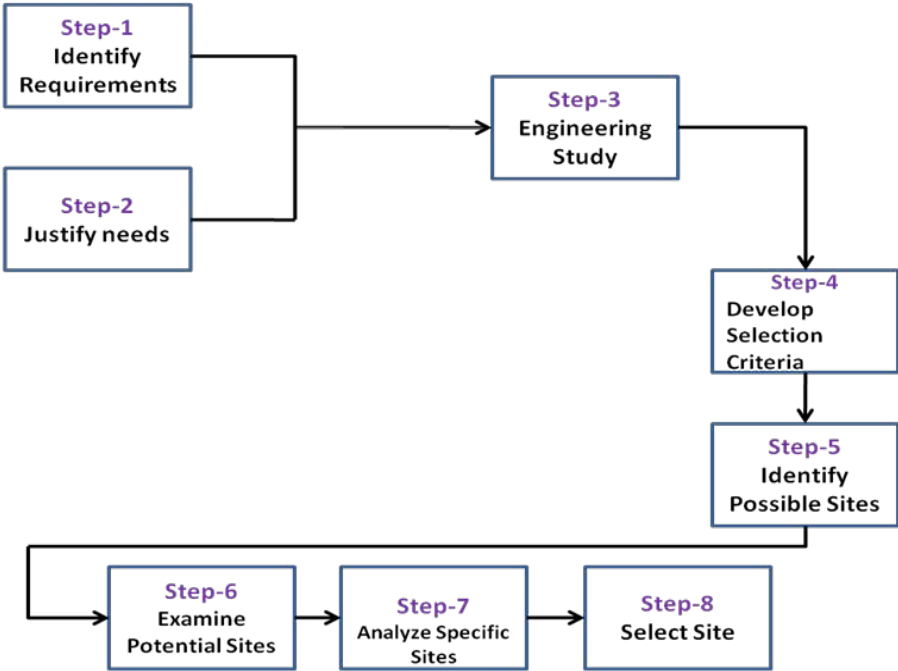


Figure-3.2: Basic steps of location analysis (Bussines logistics, Dr.Stephen M.Ruther)

B. Data collection

Selection of Appropriate Freight Terminal Location depends on different factors. Knowing this the different factors has been collected from digital maps of land use characteristics, environment, market hierarchy, road network and centrality. In addition, field survey has been conducted to verify the inputs collected from digitized maps and after the inputs are collected and verified, optimum freight terminal locations has been determined using factor rating method and finally mapped on a digital map. Some of the location determinant factors (data) collected are:

- ❖ Proximity to road infrastructure
- ❖ Available land (size)
- ❖ Cost of land
- ❖ Construction cost
- ❖ Availability of Utilities
 - ✚ Transport Facilities
 - ✚ Housing
 - ✚ Water Supply
 - ✚ Health Care
 - ✚ Light and Gas
 - ✚ Telephone
 - ✚ School
 - ✚ Entertainment
- ❖ Environmental impact issues

✚ Pollution

✚ Noise

✚ Vibration

✚ Deforestation

❖ Settlement

✚ Population density

❖ Labor

✚ Productivity

✚ Level of education

✚ Wage rate

C. Analysis technique

Once the important factors are collected Factor rating technique has been used to analyze the best location because of its flexibility.

C-1. Factor rating method

Factor rating method is the most widely used location technique which rates alternatives using both tangible and intangible factors. In the location factor rating system, factors that are important in the location decision are identified. Each factor is then weighed from 0 to 1 to prioritize the factor and reflect its importance. A subjective score was assigned next (usually between 0 and 100) to each factor based on its attractiveness compared with other locations, and the weighted scores were summed. This technique is applicable for the analysis of service and industrial location analysis. Decisions typically will not be made based solely on these ratings, but they provide a good way to organize and rank factors.

D. Factor rating technique procedures followed:

- ❖ First relevant factors has been listed
- ❖ Importance weight to each factor assigned between 0 and 1
- ❖ scale for each factor developed between 1 and 100
- ❖ Each location scored using factor scale
- ❖ Scores multiplied by weights for each factor & total
- ❖ Location with maximum total score selected

3.1.2.2 Warehouse level of service evaluation and location analysis

Warehousing is part of a firm's logistics system that stores products (raw materials, parts, goods-in-process, finished goods) at and between point of origin and point of consumption, and provides information to management on the status, condition, and disposition of items being stored. Warehousing plays a vital role in providing a desired level of customer service at the lowest possible total cost safeguarding the environment depending on different factors. Hence, studying and analyzing the warehouse LOS and Location helps to maximize the benefits that can be achieved from warehouse. Having this on mind, the level of service and location of warehouses in the city has been assessed as follows:

A. Data collection

1. Warehouse level of service

- ❖ Available space compared to the demand
- ❖ Unloading time
- ❖ Queuing time
- ❖ Waste disposal managements
- ❖ Location of the facility

- ❖ Floor and roof conditions etc.

B. Analysis technique

Once the important factors were collected Center of Gravity technique has been used for the location analysis and rating for the evaluation of warehouse level of service.

C. Warehouse level of service rating

For the evaluation of warehouse level of service the rating technique has been adopted. In this technique the most relevant factors that can affect the warehouse level of service were first identified and collected and different ratings ranging from Poor to Very good were assigned to each factor and cumulated. The Level of service of the warehouse is then rated based on the cumulated rating of factors outlined. The evaluation form used is presented below:

Table-3.2 Warehouse level of service evaluation parameters and allocated weight

Item	Weight allocated
Available space compared to the demand	40%
Unloading time	10%
Queuing time	10%
Waste disposal managements	5%
Location of the facility	30%
Floor and roof conditions	5%
Cummulated score	100%

Table-3.3 Warehouse level of service rating form

Score	Rating
-------	--------

<=50%	Poor
50%-65%	Fair
65%-80%	Good
80%-90%	Very good

3.1.2.3 Impact of terminal delay on truck efficiency

The delay of terminals at different stages is observed causing a huge reduction of truck's efficiency in different countries. To assess this in the case of Addis Ababa, impact of terminals' operational delay on truck efficiency has been examined by conducting interviews and field measurements on some selected terminals where the terminals were selected based on the intensity of freight.

A. Selected terminal

- ❖ Comet terminal located at the Ethiopian customs authority compound

B. Data collection

To analyze the impact of terminal delay on truck efficiency the following data were collected by conducting interview with transistors and custom officers.

- ❖ Arrival time of the vehicle
- ❖ Departure time of the vehicle
- ❖ Minimum time required to unload
- ❖ Actual time lost
- ❖ Delay(including time in the queue)
- ❖ Arrival information
- ❖ Cost per unit time of delay

C. Analysis technique

Once the required inputs are collected, the impact of the terminal delay on the efficiency of trucks has been evaluated using the actual time lost and the minimum time required to unload as an indicator.

4.0 Result

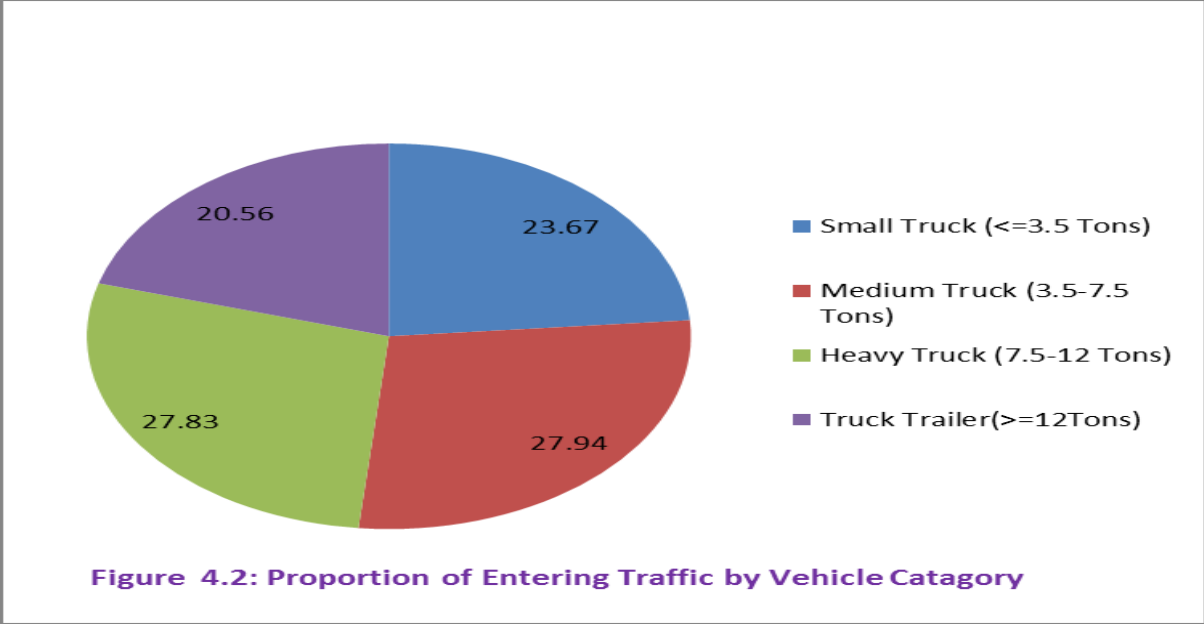
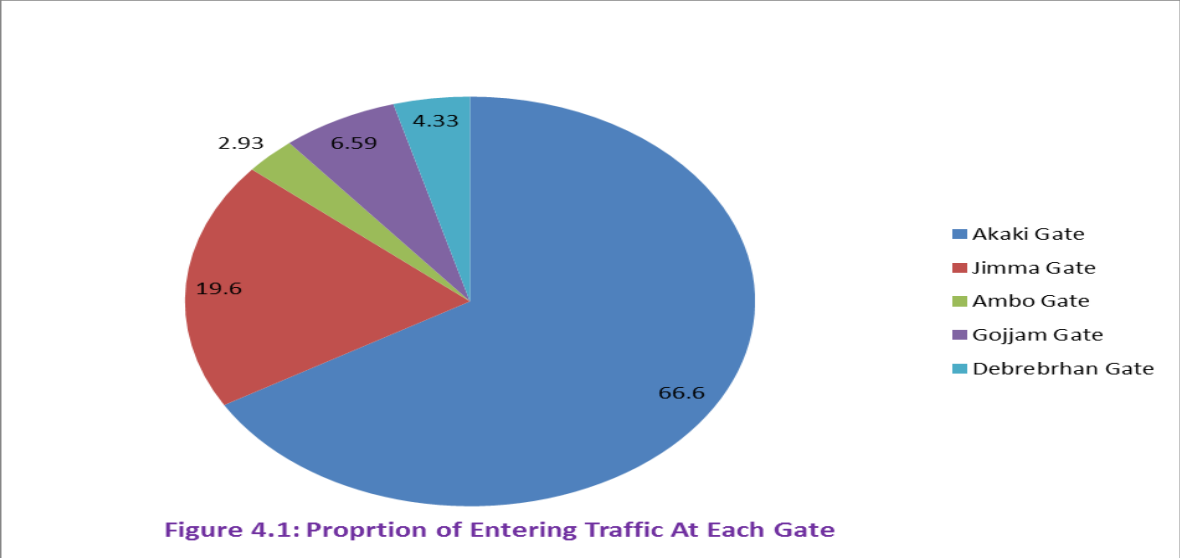
4.1 Field measurement

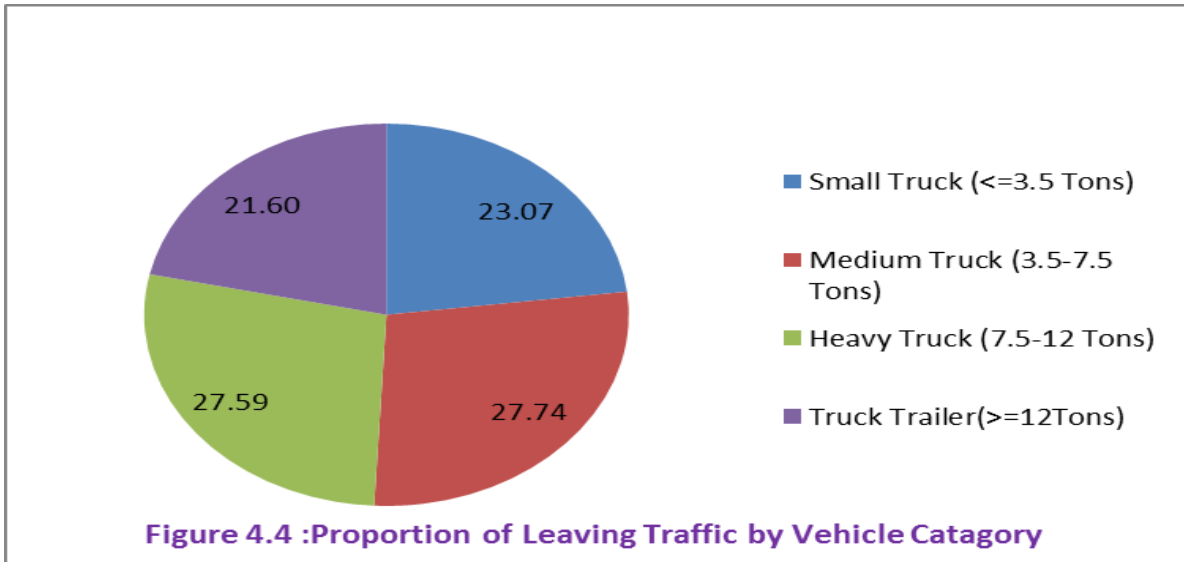
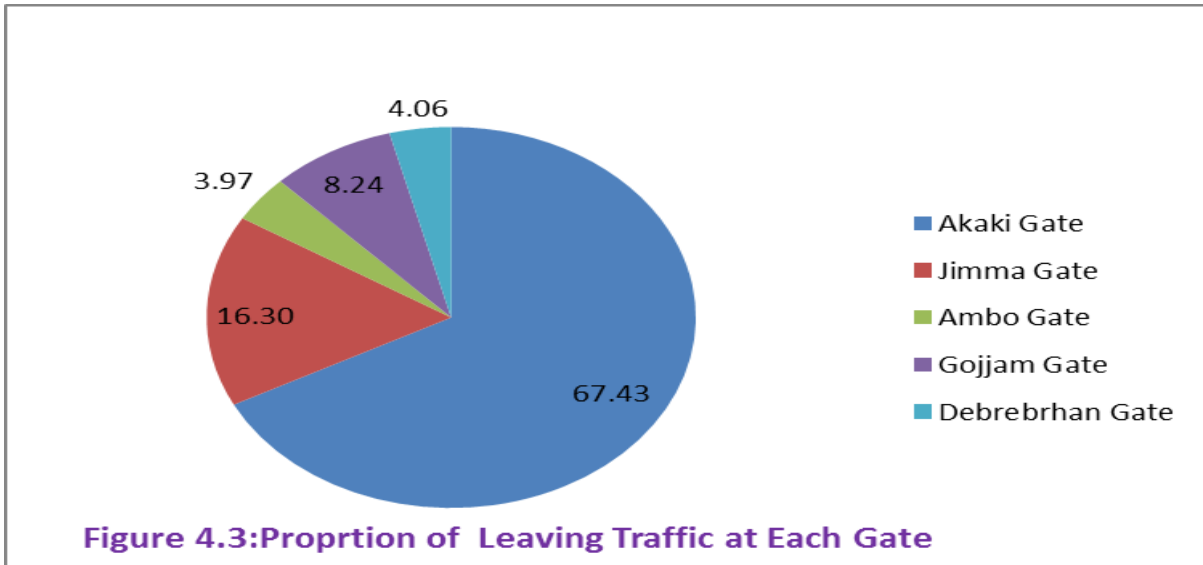
4.1.1 Mapping freight flow

4.1.1.1 Annual average daily entering and leaving traffic

Five federal roads gates in to the city of Addis Ababa connecting it to different regions and towns of the country. According to the field investigation (traffic count) carried out at all the gates to the city to map out the flow freight vehicles with in Addis Ababa, it was found that total of 19,088 vehicles enters Addis Ababa and 18,428 leaves the city on average per day. As presented in figures 4.1 and 4.2, out of the 19,088 entering traffic per day 66.6%, 19.6%, 6.59%, 4.33% and 2.93% comes from the gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively where, 27.94%, 27.83%, 23.67% and 20.56% were Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively.

Similarly, in reference to figures 4.3 and 4.4 out of the 18,428 leaving traffic 67.43%, 16.30, 8.24%, 4.06% and 3.97% passes through the gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively where, 27.74%, 27.59%, 23.07% and 21.60% were Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively.

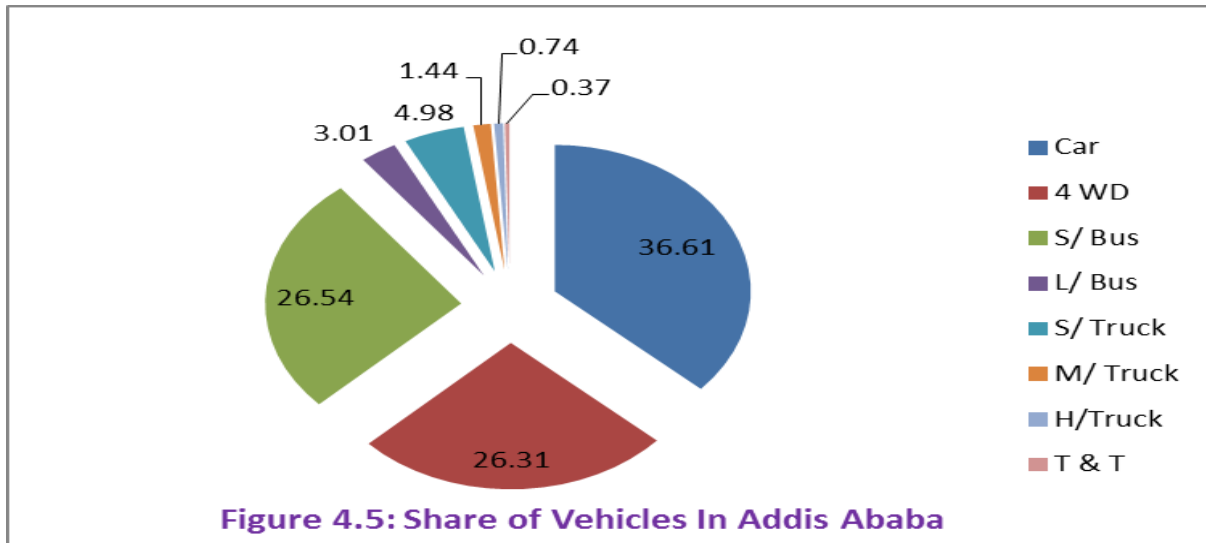




4.1.1.2 Share of vehicles and freight transporting vehicles in relation to total traffic flow in Addis Ababa

According to the traffic study carried out at different locations within the city of Addis Ababa to analyze the share of vehicles by category results presented in figure 4.5 indicate that on average out of the total vehicles driven in the city per day 36.61% were cars, 26.61% 4WD, 26.54% Small Buses, 3.01% large Buses, 4.98% Small Trucks, 1.44% Medium Trucks, 0.74% Heavy

Trucks and 0.37% Truck Trailers respectively. Hence, the proportion of freight vehicles driven within the city accounts 7.53% the total traffic.



4.1.1.3 Directional distribution factor

As there was no historical directional traffic count data that enable to determine the traffic growth rate in each direction, directional distribution factors were determined using the directional traffic count collected. According to the directional traffic count conducted along the five gates of Addis Ababa directional distribution factor for each gate has been analyzed. Results summarized on table 4.1 affirm that Jimma gate accommodates huge proportion of entering freight vehicles than exit freight traffic accounting 55.5% and the least proportion of entering freight traffic contributed from the gate of Ambo contributing 43.4% .

Table 4.1: Directional distribution factor

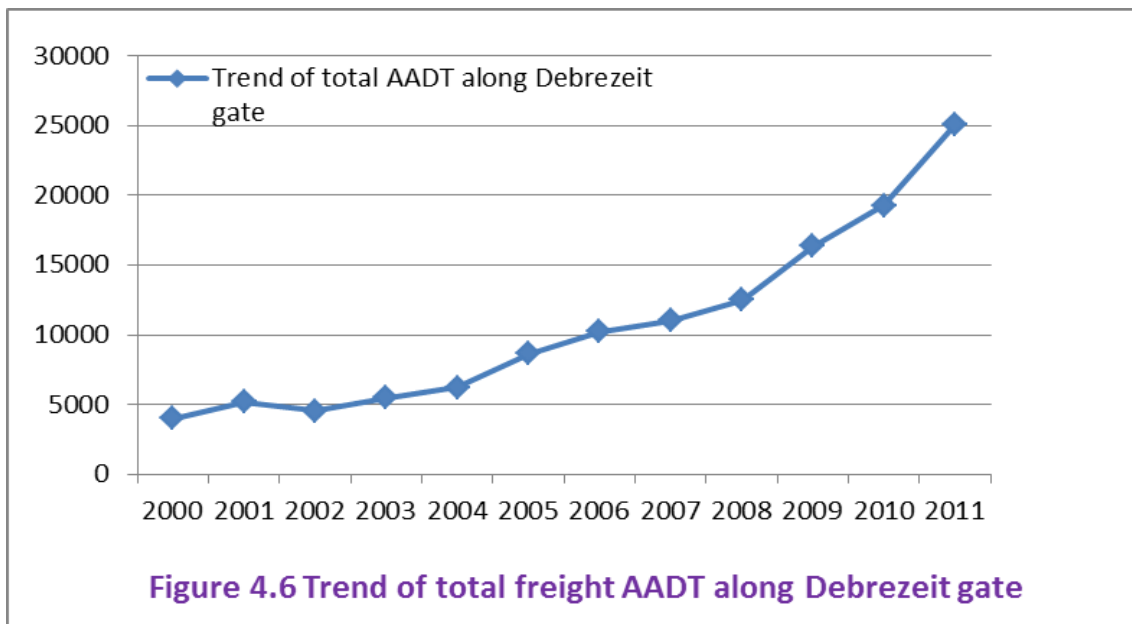
Gate	Directional Distribution Factor (%)
Debrezeit	50.6
Jimma	55.5
Ambo	43.4

Gojam	45.3
Debrebrhan	52.5

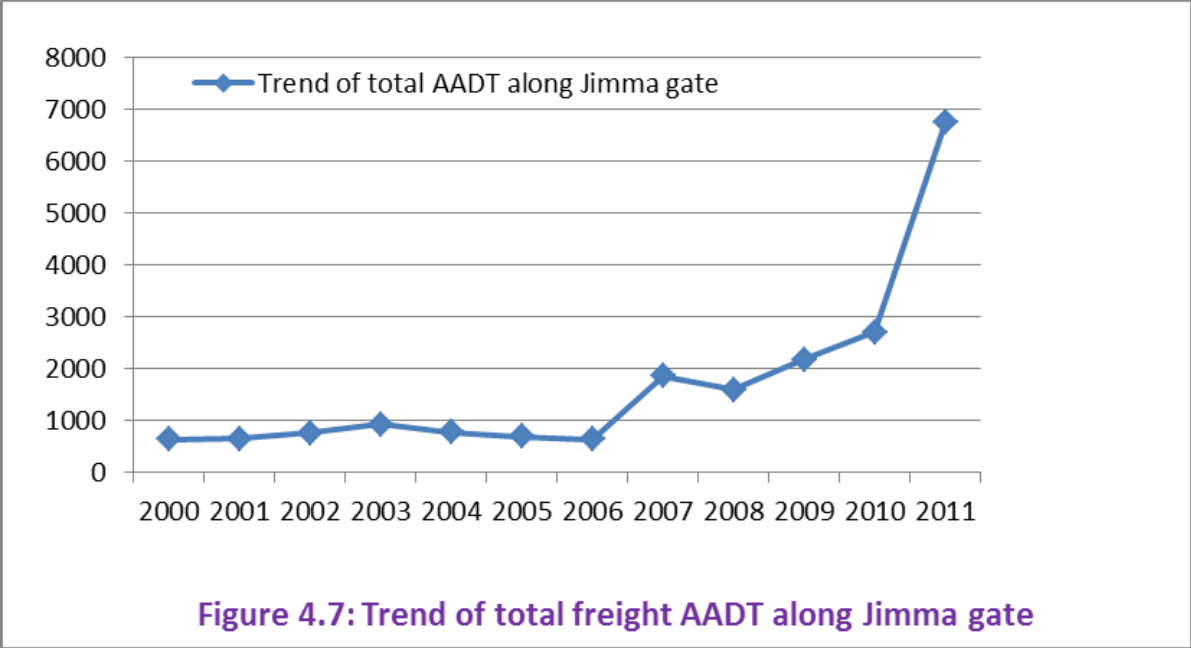
4.1.1.4 Trend of total freight traffic flow entering and leaving Addis Ababa

According to the traffic data collected from field and ten years of secondary data collected from ERA the trend of the freight traffic flow entering and leaving the city of Addis Ababa has been analyzed with the help of graphs where, trend of freight traffic along the gates of Debrezeit, Jimma, Gojam, Debrebrhan and Ambo are presented in figures 4.6, 4.7, 4.8, 4.9, and 4.10 respectively. As can be seen from the above referenced figures it was found that the freight traffic shows an increasing trend on average along all the five gates.

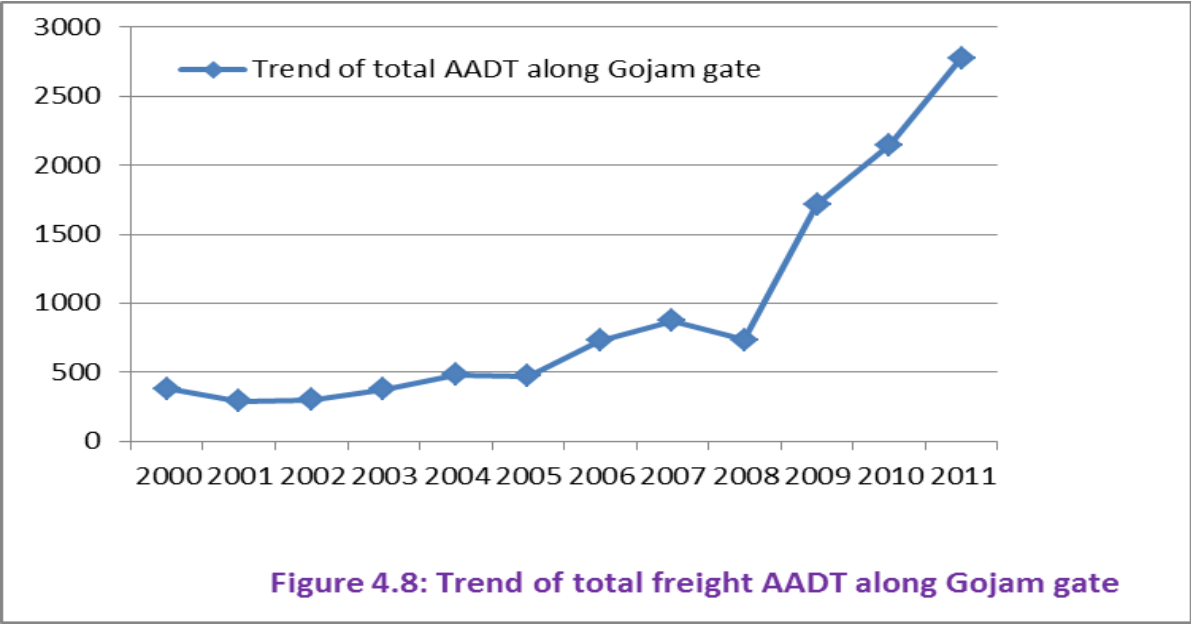
i. Debrezeit gate



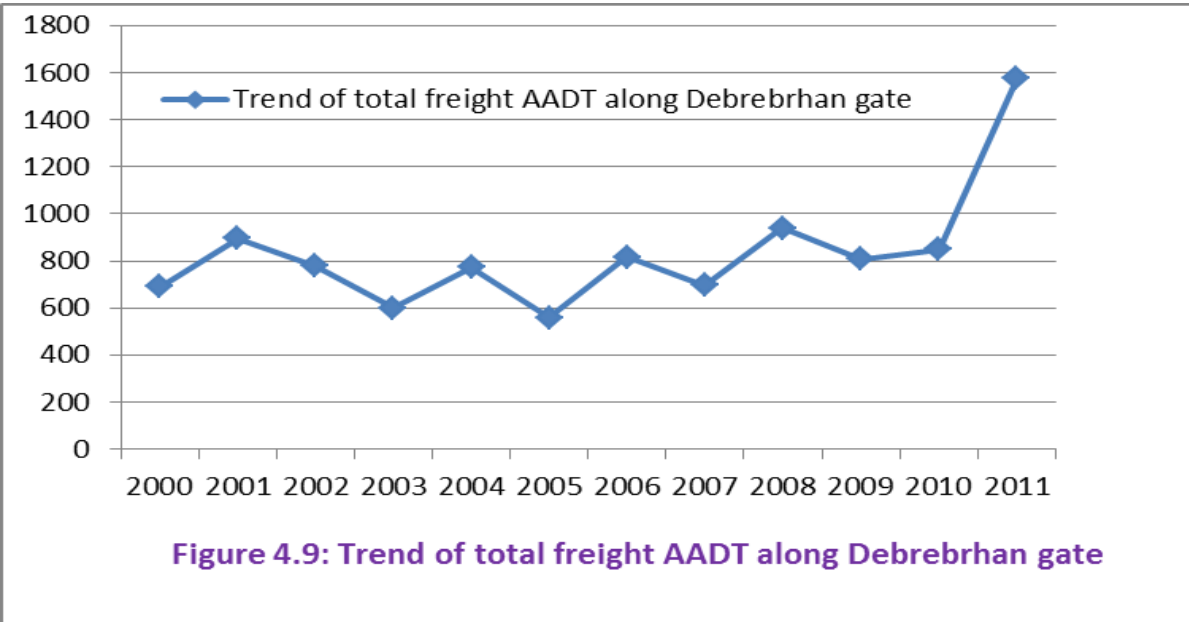
ii. Jimma gate



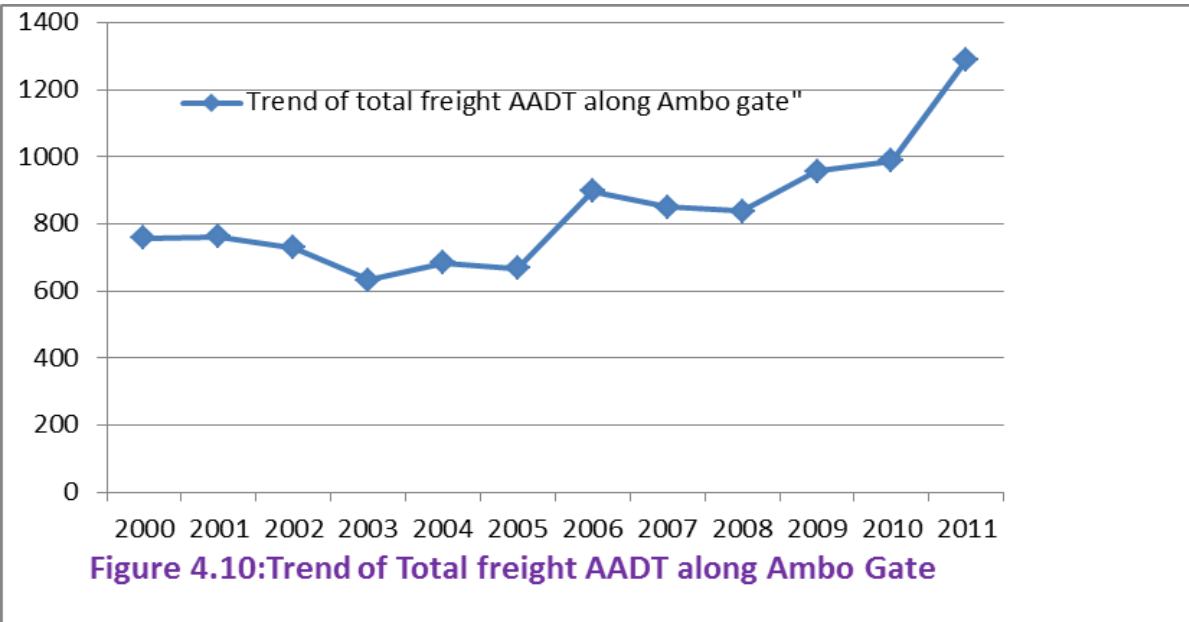
iii. Gojam gate



iv. Debrebrhan gate



v. Ambo gate



4.1.1.5 Freight traffic growth rate and prediction of future freight prospects

According to the 10 years of traffic count data collected from the Ethiopian Roads authority and the analyzed traffic data from the one week traffic data collected from field, results of the average traffic growth rate of the entering and leaving freight traffic were found as 10.03% and 9.63% respectively. As summarized in table 4.2 the largest growth of traffic is observed along the gate of Jimma which accounts 20.05% for entering traffic and 16.07% for exit traffic and the least along the gate Ambo which accounts 2.54% for entering and 3.32% for exit. In addition, prediction of future entering and leaving freight traffic has been conducted assuming that the above estimated traffic growth rates will remain uniform and with the help of the above mentioned traffic data and results are summarized in table 4.3 and 4.4.

Table 4.2: Freight traffic growth rate at each gate

Gate	Total r. average (%)	DF(entering/total) (%)	r.avg(entering) (%)	r.avg(leaving) (%)
Jimma Gate	36.12	55.5	20.05	16.07
Gojam Gate	25.16	45.3	11.4	13.46
Debrezeit Gate	18.98	50.6	9.6	9.38
Debrebrhan Gate	12.50	52.5	6.56	5.94
Ambo Gate	5.86	45.3	2.54	3.32

Table 4.3: Prediction of future freight at each gate (entering freight traffic)

Gate	Average entering freight traffic growth rate (%)	2011	2015
Debrezeit	9.6	12,704	58,613
Jimma	20.05	3,739	20,085
Ambo	2.54	560	2,327
Debrebrhan	6.56	827	3,648
Gojam	11.4	1258	5,960
Total		19,088	90,633

Table 4.4: Prediction of future freight at each gate (leaving freight traffic)

Gate	Average Entering Freight Traffic Growth rate	2011	2015
Debrezeit	9.38%	12,426	57,145
Jimma	16.07%	3,003	15,215
Ambo	3.32%	731	3,073
Debrebrhan	5.94%	749	3,274
Gojam	13.46%	1,519	7,417
Total		18,428	86,124

4.1.1.6 Estimation of load factor

As per the interviews conducted with six private and governmental transporting agencies to estimate the load factors in terms of weight of freight it was found that the vehicles involved in the transport of freight operate at an average load factor of 53%. During the interview data's regarding the load factor of freight vehicles by category was collected and presented in table 4.5.

Table 4.5: Average load factor by vehicle category

Vehicle category	Capacity in Ton	Load factor (load/capacity) from O-D (%)	Load factor (load/capacity) from D-O (%)	Weighted average load factor (%)	Possible O-D of vehicles
Pick Up	1	100	0	50	Within city
Isuzu	3.5	100	0	50	Within city
Medium Truck	10	100	0	50	Within city
Volvo	24	100	0	50	Within city and away
Enterie	24	100	0	50	Within city and away
PTY	25	100	0	50	Within city and away
Fit Turbo	30	100	0	50	Within city and away

DAF	30	100	0	50	Within city and away
Mak	30	100	44	72	Within city and away
Turbo Star	30	100	0	50	Within city and away
Nissan	38	100	0	50	Within city and away
Euro Trucker	40	100	10	55	Within city and away
Sino Truck	40	100	22	61	Within city and away
Scania	40	100	22	61	Within city and away
Trucker	40	100	0	50	Within city and away
Turbo	40	100	0	50	Within city and away
<i>Average</i>		100	6.125	53.58	

4.2 Optimization exercise

4.2.1 Mapping of the existing Freight terminals and warehouses

According to the collected location of existing warehouses and Freight terminals it was found that more than 146 warehouse and one freight terminal are available within the city. The map showing existing warehouse and freight terminal locations is shown in figure 4.11.

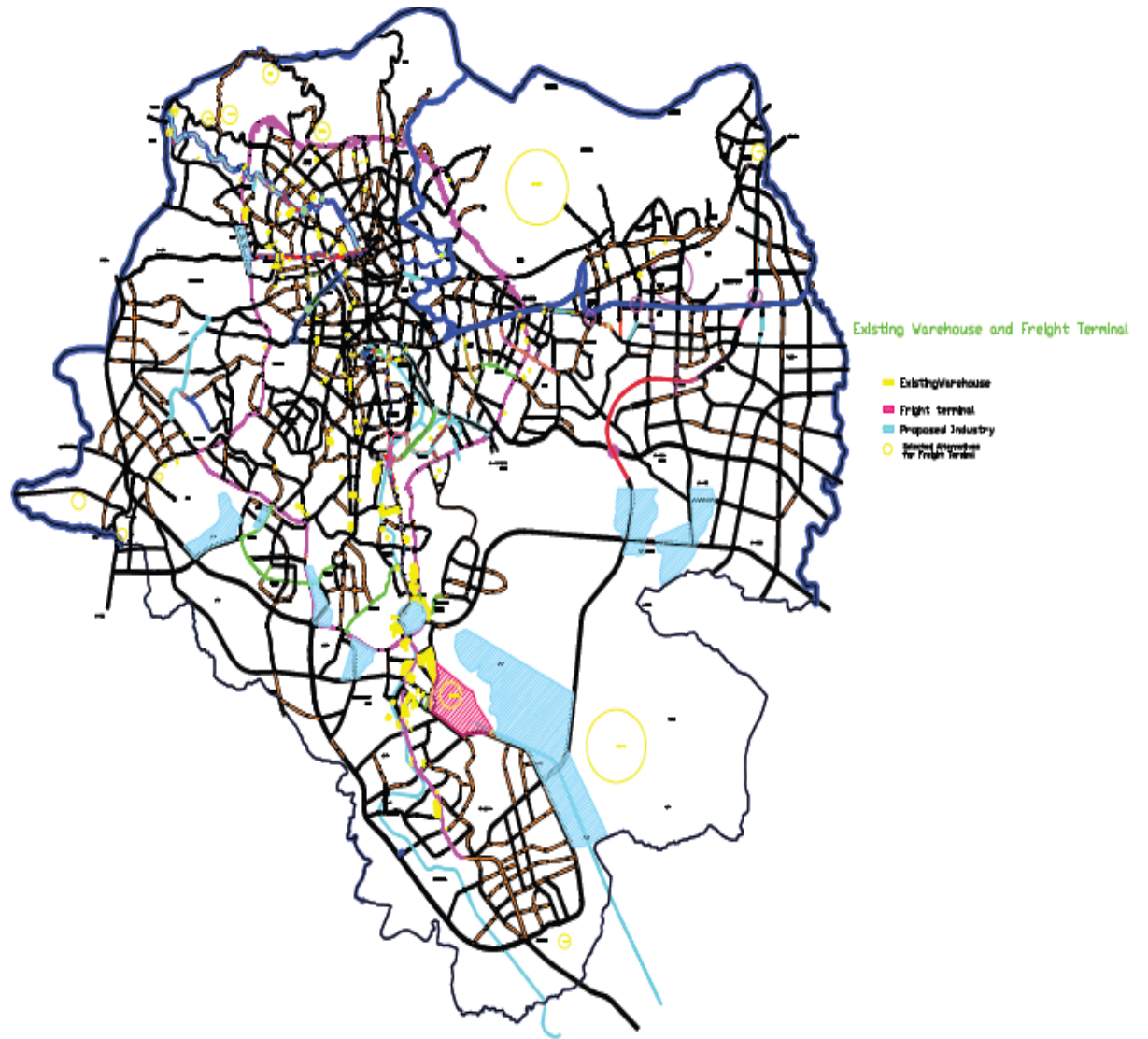


Figure 4.11: Location of Existing Warehouses and Freight Terminal

4.2.2 Evaluation of freight terminals' location

With the help of the collected digitized land use, road network, market hierarchy and centrality the optimum freight terminal locations were determined using factor rating method as a tool at all the gates of Addis Ababa where results are presented in table 4.6 and figure 4.12.

Table 4.6: Coordinates of selected freight terminal locations

Name of the gate	Coordinates of the best Site selected	
	<i>X</i>	<i>Y</i>
1. Debrezeit Gate	475751	985463
2. Jimma Gate	464009	990378
3. Ambo Gate	465718	1002617
4. Gojam Gate	469646	1004013
5. Dessie Gate	486486	1001471

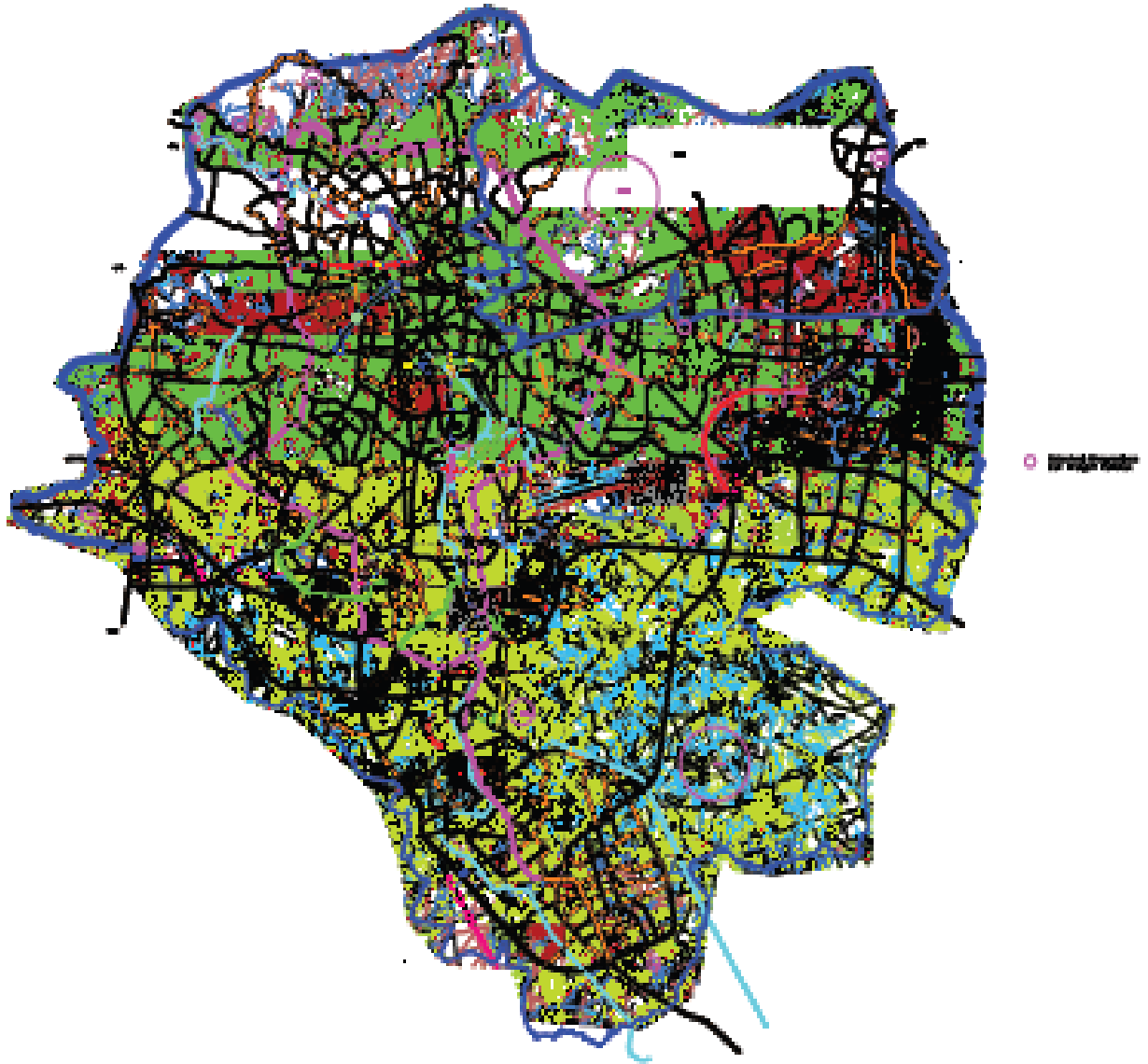


Figure 4.12: Selected alternatives for freight terminal location analysis

4.3 Evaluation of warehouse level of service

According to the visit conducted along some selected warehouses and the interviews made with managers of the different warehouses, most of the warehouses visited were found operating at poor level of service. The results regarding the warehouse LOS are summarized in table 4.7.

Table4.7: Summary of warehouses level of service

Name of warehouse	Level of service	Remark
Comet Warehouse No-1	Fair	
JINAD	Poor	
Coffee Board	Good	

4.4 Evaluation of terminal delay on efficiency of trucks

According to the interview made at the Ethiopian customs office located at comet compound the delay, unloading time required and the queue time are presented as follows.

Table 4.8 Summary of terminal delay (the case of 40ft container freight)

Terminal Name	Unloading time		Queue time		Total delay	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Comet Terminal	1:00hr.	1:30hr.	2:30hr.	3:00hr	1day	20days

5.0 Discussion

5.1 Mapping of freight flow

Out of the 19,088 entering freight traffic per day 66.6%, 19.6%, 6.59%, 4.33% and 2.93% were observed entering through the gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively where, 27.94%, 27.83%, 23.67% and 20.56% were Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively. Similarly, out of the 18,428 leaving traffic 67.43%, 16.30, 8.24%, 4.06% and 3.97% were found leaving through the gate of Debrezeit, Jimma, Gojjam, Debrebrhan and Ambo respectively where 27.74%, 27.59%, 23.07% and 21.60% were Medium Trucks, Heavy Trucks, Small Trucks and Truck Trailers Respectively. The results obtained declare that the largest proportion accounting 66.6% and 67.43% of the freight vehicles were observed entering and leaving through the gate of Debrezeit respectively while, the least proportion of freight vehicles were observed entering and leaving through the gate of Ambo comprising 2.93% and 3.97% respectively . Similar study by Asnake also indicated that before the Ethio-Eritria conflict only 1% of the import and export activities has been taking place through the port of Djibuti as Ethiopia had access to three ports called Assab, Massawa and Djibuti at which Assab was accomodating majority of the international trade but, today almost all the international trade are taking place through the port of Djibuti which results huge proportion of freight vehicles to enter and leave through the gate of Debrezeit.

Analysis of freight traffic trend presented on Figures 4.6-4.10 indicate that though the trend of freight traffic growth entering and leaving the city of Addis Ababa is observed rising and falling, on average pattern of freight flow along all the gates can be treated as increasing. The reason for the increasing trend of freight traffic might be because of the increasing trading activities (import and export), construction activities and economic growth of the country. Similarly, as can be seen from the results the trend of freight traffic along Debrezeit gate shows remarkable change after 2000 than other gates resulting to the shift of export and import activities from ports of Massawa and Assab to port of Djibuti as a result of the Ethio-Ertria conflict by 2000 but, as can be seen from figure 4.7 Jimma gate constitutes the greatest traffic growth than other gates which might result from the increasing demand of coffee for export and internal uses and freight

entering through Jimma gate contributes 20.05% while, Gojam, Debrezeit, Debrebrhan and Ambo retains 11.4%, 9.6%, 6.56 and 2.54% respectively.

Resulting to the increasing economic growth, trade and construction activities along the country, future prospects of the freight entering to and leaving the city reveal that the total entering and leaving freight traffic will raise remarkably from 19,088 and 18,428 to 90,633 and 86,124 by 2015 respectively.

As presented in figure 4.5, share of cars with in the city of Addis Ababa comprises the largest share as compared to other transport vehicles and accounts 36.61% of the total traffic driven with in the city. Similarly, the least share of vehicles with in the city comprises freight vehicles which is expected and accounts 7.53% of the total traffic within the city. Within the city of Addis Ababa though the share of freight transporting vehicles is small, these vehicles were observed causing unnecessary delays, traffic accidents and emission within the city due to the interference of freight transport vehicles to public transport vehicles within the city as a result of in appropriate location of warehouses and limited number of freight terminals.

Within the city of Addis Ababa and across the country Ethiopia in general, freight vehicles operate at a very low load factor in terms of weight, about 53%. Asnake, 2006 in his study, has also found load factor in terms of weight of long distance freight vehicles as 60%. But this doesn't mean that the load factor of vehicles in terms of volume is similar to the load factor in terms of load and is actually greater.

From the results obtained it is apparent to say operating vehicles at a reduced load factor results to reduced efficiency of freight transport vehicles and increased transport cost which aggravate the negative impacts of the urban freight transport system.

The reason for the reduced load factor (in terms of weight) of freight vehicles can be seen from different angles but the basic reasons might be the unbalanced import and export activities, poor concept of city logistics measures and little application of city logistics measures within the city and the country in general.

5.2 Mapping of the existing freight terminals and warehouses

Within the city of Addis Ababa More than 146 ware houses and 1 freight terminal has been observed where 59% of the warehouses concentrate within the main city center and the major sub-center of the city. As can be seen from the result (map) majorities of the warehouses are located near to the city main center and attract huge freight transporting vehicles which results to the depletion of the quality of transport and the environment.

5.3 Terminal delay on efficiency of trucks

As presented in figure 4.11, only one freight terminal is available within the city of Addis Ababa and as per the visit and interview conducted on the terminal to evaluate the impact of terminal delay it was found that terminal delay depends on type of commodity, transparency of customers and season.

In case when the commodity are of similar type, perishable and chemical, since examination, inspection and tax pricing allocation takes small time vehicles may be released within 1-3days. But if the commodities are of different type, spare parts and with unknown mark, since examination, inspection and tax pricing allocation takes longer time and coupled with lack of customs officers capacity, limited knowledge of transistors and lack of transparency from customers lets freight to stay within the terminal for 5-20 days.

Similarly, during the peak season like June, X-Mass, Easter and New year since there is high demand for freight, warehouses are full this time and vehicles are even observed waiting to unload for more than three days affecting the efficiency of trucks and economic activity.

Hence, in general it can be said that the basic reasons for the delay of terminals are commodity type, customer's transparency, warehouse capacity, capacity of the customs officers, and capacity of transistors.

5.4 Evaluation of freight terminal locations

As discussed above there is only one freight terminal in Addis Ababa which shows how much management of freight transport has been neglected. Resulting from the limited number of

freight terminals within the city the city is suffering from high level of congestion, environmental pollution and reduced efficiency of the freight transport system.

To minimize the negative impacts discussed above, 15 freight terminal location alternatives were selected where three alternatives are for Debrezeit Gate, for Jimma Gate, for Ambo Gate, Debrebrhan Gate and Gojam Gate. Though the analysis using factor rating method is subjective to minimize subjectivity of the method the selected parameters are sub-divided and examined at which finally, five best alternatives are selected.

If these newly analyzed freight terminal locations are implemented, it is obvious that the efficiency of transport system will be maximized; pollution, accident and congestion will be minimized as entry of freight vehicles to the city centers will be reduced significantly.

6.0 Conclusion and recommendation

6.1 Conclusion

The following conclusions may be drawn from the study regarding the Freight transport and City Logistics Activities within the city of Addis Ababa.

- ❖ As can be seen from the results freight transport activities will increase significantly in the future.
- ❖ Inappropriate location of freight transport facilities like warehouses are the most contributing factors for the delay, congestion, accident and environmental pollution within the city.
- ❖ Reduced load factor of freight vehicles result to increased transport cost.
- ❖ In adequacy of freight terminals contributes to the reduction of trucks efficiency and excessive delay.
- ❖ Little attention has been given to the concepts of city logistics within the city.
- ❖ Commodity type, customers transparency, capacity of custom officers and transitors and capacity and poor design of warehouses (terminal) are the main reasons for the delay of terminals.
- ❖ Application of the city logistics measures within the city can bring a lot of solutions.
- ❖

6.2 Recommendation

As the economy grows, it is fact that there is a continuing increase in the need for freight transport and transport in general. As the policy of Ethiopia is now encouraging innovative agriculture and increased industrial production and coupled with the economic growth of Ethiopia demand for freight transport will rise unquestionably.

Resulting to the economic growth and the policy of Ethiopia the total international trade to and from Ethiopia is now growing at a significant rate and as a result the amount of freight entering

and leaving to the city of Addis Ababa is increasing significantly affecting the quality of life to the city residents.

Therefore, the road freight industry in Ethiopia and specifically the urban freight transport system in Addis Ababa will need a major restructuring with the help of the city logistics experiences and measures but, as a matter of fact, the awareness of the society and the stakeholders needs to be a priority for such schemes to succeed. Therefore at this stage, the researcher suggests that proper research regarding some city logistics measures such as night freight delivery system, cooperative freight transport system and possibility of freight coordination, route and vehicle optimization should be carried out to ascertain the role and benefit of the various stakeholders before embarking any city logistics measures in the city center and in addition possibility of using other ports for the import and export activities other than the port of Djibouti should be investigated to minimize the entry of freight traffic to Addis Ababa. If such gaps are not considered, then the project will start only to fail in the nearest future.

Hence, in order to achieve sustainable mobility of goods in the city the following recommendations are in order:

- ❖ First and foremost, freight transport database should be established to encourage future research in the area of freight transport and city logistics.
- ❖ The proposed national logistics coordination center should start operation as soon as possible as it helps to maximize security of freight, efficiency of freight transport system, load factor and minimize the transport cost.
- ❖ As the freight traffic within the city is increasing appropriate freight terminals selected should be constructed before the existing problems go worst.
- ❖ Construction of bypass roads connecting the five gates can late freight traffic to go to its destination without interfering the traffic within the city.
- ❖ Most of the warehouses are located within the city main center attracting huge freight traffic to the city center and hence, to improve the efficiency, safety and environment it is better to relocate some of the warehouses from the city center.

- ❖ To improve the warehouse level of service and minimize delay, design standard of warehouses should be set considering capacity and demand, orientation, size and number of gates, ventilation requirements and waste disposal management issues.
- ❖ Cooperative freight delivery practice should be introduced to maximize the efficiency vehicles and the transport system in general.
- ❖ Attention should be given to improve the level of service of the available warehouses.
- ❖ Capacity of stakeholders involved in the urban freight transport should be built with the help of campaigns and seminars.
- ❖ Appropriate traffic management measures should be studied and implemented within the city to smoothen the traffic flow.
- ❖ Study regarding vehicle optimization and route optimization can be done to improve the study further.

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ANNEXES

**ANNEXE-A: TRAFFIC ANALYSIS AND DATA COLLECTION ALONG THE GATES OF ADDIS
ABABA**

ANNEXE-B: ERA HISTORIC TRAFFIC DATA

ANNEXE-C: TRAFFIC GROWTH RATE ESTIMATION AND TREND ANALYSIS

ANNEXE-D: TRAFFIC ANALYSIS AND DATA COLLECTION WITHIN ADDIS ABABA

APPENDIX-E: LOAD FACTOR DATA COLLECTION

APPENDIX-F: FREIGHT TERMINAL LOCATION ANALYSIS

APPENDIX-G: TERMINAL DELAY

APPENDIX-H: WAREHOUSE LOS DATA COLLECTION