

ADDIS ABABA UNIVERSITY



**ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL & ENVIRONMENTAL
ENGINEERING**

***EVALUATION OF ROAD AND LIGHT RAIL
INTEGRATION IN PLANNING, CONSTRUCTION,
OPERATION AND MANAGEMENT (Case Study Addis
Ababa City)***

BY

YITREF DERBIE

ADVISOR: DR. ALEMAYEHU AMBO

SEPTEMBER 2014

ADDIS ABABA, ETHIOPIA

ADDIS ABABA UNIVERSITY
ADDIS ABABA INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL & ENVIRONMENTAL
ENGINEERING



**EVALUATION OF ROAD AND LIGHT RAIL
INTEGRATION IN PLANNING, CONSTRUCTION,
OPERATION AND MANAGEMENT (Case Study Addis
Ababa City)**

BY

YITREF DERBIE

**A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY INSTITUTE
OF TECHNOLOGY SCHOOL OF CIVIL & ENVIRONMENTAL
ENGINEERING IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
RAILWAY CIVIL ENGINEERING.**

ADVISOR: DR. ALEMAYEHU AMBO

SEPTEMBER 2014

ADDIS ABABA ETHIOPIA

ADDIS ABABA UNIVERSITY
INSTITUTE OF TECHNOLOGY
SCHOOL OF CIVIL & ENVIRONMENTAL
ENGINEERING



**EVALUATION OF ROAD AND LIGHT RAIL INTEGRATION IN
PLANNING, CONSTRUCTION, OPERATION AND MANAGEMENT**

(Case Study Addis Ababa City)

BY

YITREF DERBIE

APPROVED BY BOARD OF EXAMINERS

ADVISOR

SIGNATURE

INTERNAL EXAMINER

SIGNATURE

EXTERNAL EXAMINER

SIGNATURE

CHAIRPERSON

SIGNATURE

ABSTRACT

Integrated transportation system is essential that shapes urban form effecting economic well-being and is a primary determinant of cities' environmental, financial and social sustainability and it is a tool for movement of people, goods and services. Due to this and other reasons, integrating different types of transportation modes is important and paramount.

This paper mainly focuses on the evaluation of the integration between Road and LRT transport system in Addis Ababa. It assesses the actual conditions and integration of the two sectors in Planning, construction, operation and management. To achieve the objectives of this study, different documents were examined and semi-structured interviews had been carried out and analyzed using exploratory method. Due to relevance and purposefulness, interviewees were selected from MoT, AACRA, ERC, and AALRT project and sector offices based on their positions, and educational relevance and professional experiences. In addition, observations had been made to the road and LRT construction sites to oversee the physical conditions.

The study has identified weak integration between the road and railway offices, unable to prepare integrated short-term and long-term plan of road and LRT, unable to prepare thoroughly studied and acceptable master plan of road and LRT network, lack of vision based on today's infrastructural implementation, absence of experiences and inadequacies in trained professionals related to the problem. Based on the findings of the research, recommendations have been forwarded to pertinent governmental offices. In addition, further research areas for other interested researchers have been suggested.

TABLE OF CONTENTS

Title	Pages
Abstract	I
Table of Contents	II
Acknowledgements	VI
List of Abbreviations/Acronyms	VI
List of Tables	VII
List of Figures	VIII

CHAPTER ONE

INTRODUCTION

1.1 Background Of The Study.....	1
1.2 Statement Of The Problem.....	3
1.3 Basic Research Questions	4
1.4 Objective of The Study	4
1.4.1 General Objectives.....	4
1.4.2 Specific Objectives	4
1.5 Significance of The Study	5
1.6 Limitation of the Study	5
1.7 Definition of Important Terminologies	6
1.8 Organization of the Paper.....	7

CHAPTER TWO

LITERATURE REVIEW

2.1 An overview of road transport and light rail transit	8
2.1.1 International Level	8
2.1.2 For the case of Ethiopia/Addis Ababa.....	11
2.2 Defining Integrated Road - Railway Transportation System	15
2.3 Rationales of Creating Integration between Light Rail Transit and Road	16
2.4 Challenges to Create Integration between Road and Rail Sub-Sectors in Addis Ababa	16
2.5 Strategies to Establish Compatible Light Rail and Road Transport	18

2.6 Practices and Discussions on Creating Integration between Road and Light Rail Transit System	19
2.6.1 Road-LRT Integration Practices in Some Developed Countries.....	19
2.6.2 Planning Integration	28
2.6.3 Integration in Operation and Management	30
2.7 Benefits of Integrating Light Rail Transit over Road Transportation.....	30
2.8 Integrated Planning for Sustainable Urban Transport Systems	31
2.9 Principles to Develop an Integrated Transport.....	32
2.10 Principles to Develop an Integrated Transport	33

CHAPTER THREE

THE RESEARCH DESIGN AND METHODOLOGY

3.1 The Research Procedures and Activities Undertaken	37
3.2 Research Design and Methodology	37
3.2.1 Sample and Sampling Techniques	37
3.2.2 Instruments of Data Collection.....	38
3.2.3 Methods of Data Collection	38
3.2.4 Method of Data Analysis	39
3.3 Validity of Instruments	39
3.4 Ethical Considerations	39

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction	41
4.2 Characteristics of the Interviewees	41
4.3 Infrastructure Integration Practices in General	42
4.4 Integrating Light Rail Transit into the Roads of Addis Ababa	43
4.4.1 Planning	43
4.4.2 Design	45
4.4.3 Construction	46
4.4.4 Operation and Management	49
4.5 Community Relations	50

4.6 Challenges/Barriers of Integrating the Road and LRT System.....	50
4.7 Benefits Due to the Presence and Losses Due to the Absence of Integration.....	52
4.7.1 Benefits	52
4.7.2 Losses.....	52

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction	54
5.2 Conclusions.....	54
5.3 Recommendations	56
5.4 PROPOSED FUTURE RESEARCH AREAS.....	58

REFERENCES

APPENDICES

ACKNOWLEDGEMENTS

I owe my special thanks to the almighty GOD for His forgiveness, empowering and giving me internal courage and strength to accomplish my educational career one-step further.

Despite many people who have supported me to achieve the completion of this study, it would have not been possible without the unreserved guidance and support of my thesis advisor Dr. Alemayehu Ambo. So, I would like to say thank you for his constructive comments, support and the realization of this thesis.

Next, I cannot afford to leave out the precious support of my brother Ato Mekonnen Derbie who showed much attention and support to the success of my study;

I would like to warmly thank all the study participants, especially the interviewees from MoT, AACRA, ERC, AALRT project offices/managers, officials and professionals/experts who provided their valuable time and effort with relevant information and documents, in particular.

Finally yet importantly, I would like to extend my thanks to my mother Yeshe Demere, my friend Hewan Temesgen and my sister Gete Belay for their compassion, concerns and encouragement towards the success of this study.

LIST OF ABBREVIATIONS/ACRONYMS

AA	Addis Ababa
AACG	Addis Ababa City Government
AACRA	Addis Ababa City Roads Authority
AALRT	Addis Ababa Light Rail Transit
ABS	Automatic Block Signal
APTA	American Public Transportation Association
ATD	American Transportation Department
BRT	Bus Rapid Transit
CBD	Central Business District
DIMTS	Delhi-Integrated Multi-Modal Transit System Limited
ERC	Ethiopian Railways Corporation
FDRE	Federal Democratic Republic of Ethiopia
GTP	Growth and Transformation Plan
LRT	Light Rail Transit
LRV	Light Rail Volume
MDP	Municipal Development Plan
MoT	Ministry of Transportation
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
TMP	Transportation Master Plan
TOD	Transit Oriented Development
US	United States
WAPC	Western Australian Planning Commission

LIST OF TABLES

Table 2.1	Calgary Transit LRT and Bus Collisions and Passenger Accidents.....	23
Table 4.1	Characteristics of the interviewees	41
Table 4.2	Number of vehicles at turning points	47

LIST OF FIGURES

Figure 2.1 Light Rail Transit (SIMGN GINN, 1998:1)	10
Figure 2.2 Addis Ababa Roads Transport	12
Figure 2.3 Over pass LRT Bridge and road service around Meskal Square.....	13
Figure 2.4 AALRT and Road Network	14
Figure 2.5 Principles and process for integrated transport plans as provided by (WAPC, 2012:55)	33
Figure 4.1 Integrated road and LRT design.....	46
Figure 4.2 Road and LRT Construction	46

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Economic transformation, and indeed, the development of any country are hardly possible without an efficient transport system, (Salim, 2003). Effective and integrated public transport plays a vital role in creating competitive economies, and livable, inclusive communities. It also has a role in reducing the reliance on fossil fuels and carbon footprint. According to the Public Transport for Perth, Department of Transport, Western Australia Perth (2011: 6), there is no doubt that efficient public transportation system comes from the implementation of the right and preferable mode of transportation with an integrated planning and operation system.

Integrated LRT and urban road transport leads to a successful transportation system. Based on the Guidelines for Preparation of Integrated Transport Plans, Western Australian Planning Commission (2012:1.), an integrated approach to transportation is a positive way to influence the planning and provision of transport systems towards more sustainable patterns. Integrated transport planning takes into account key transport issues such as transport system interdependencies, interactions between transport and land use, transport safety, traffic congestion, parking, travel demand management and accessibility.

As cities grow, they often become denser, more congested and more complex. Good transport in turn, brings everyone 'closer' together, which saves time, money and helps businesses trade, all helping the growth of economy. So, investing in roads and trains supports people, communities and the economy. This means, failure in satisfying the transport need of the society in general and the urban dwellers in particular leads to poor living standards, economic and social development, and it directly affects the national and local government policies and service provisions.

In different cities of the world, there are integrated LRT and road transport system to alleviate public transportation problems, to create quality urban life and to bring aesthetical values. For example, in Jerusalem, Israel, traffic planners have never succeeded in giving absolute priority to buses at signalized intersections when high bus volumes are present. This limits the

effectiveness of bus ways as compared to high capacity, lower frequency LRT vehicles, (Daniel and Render, 2004:774). This defect of road system transportation leads Jerusalem to plan and construct LRT system by integrating the road transportation system with major changes in road and rail arrangements. The bus network is incremental by nature and has successfully resisted attempts at structural reform over the years. The new light rail system is conceived and being presented as an integrated new transport system involving major changes in road and rail network arrangements,(Ibid).

Therefore, the transportation sub-sectors should be integrated for the effectiveness of rail and road planning, construction, maintenance and operation. In addition, the demand for road and rail transport far exceeds the capacity of government to fund these needs and thus should be seriously considered and infrastructure investments which have direct economic return should be closely monitored in terms of cost recovery and profit, and maintaining the existing infrastructures. In this regard, Western Australian planning Commission, (WAPC, 2012) found out that providing serious attention to transport planning, maintaining transport infrastructure, delivering transport services and adjusting traffic network flow is the key role played by keen governments and its success mainly depends on the prosperity of local economies and ensuring a quality of life for generations to come.

In the case of public transportation system in Addis Ababa, different researchers and writers had characterized as highly congested traffic, high accident levels, negative environmental impacts, unsafe public transport and low accessibility levels, narrow road lanes, weak land use, weak regulation and management on parking without proper right of way, (Tiblest, 2012).

Traffic congestion and air pollution within the city have reached critical levels for much of the day. There is every indication that total gridlock will result in many areas should a traffic incident occurs. It is therefore not feasible to continue restricting the provision of public transport services to minibuses and taxis. Increasing additional buses that are required to cope with the heavy passenger loading of the existing fleet will congest the city's roads even further, [Feasibility Study for AALRT, 2009]. To solve these problems of Addis Ababa public transportation system, the Ethiopian government came with a plan of building a LRT in two directions from South to North and East to West, [Bankable Feasibility Study for AALRT Project, 2009]. The construction of the LRT is currently underway.

The LRT system becomes a preferable mode of transport due to its technological advancement, best solution for traffic congestion, economic benefit, low environmental pollution and high passenger capacity. That is why most developed countries have many railway corridors and developing countries are carrying out construction.

Addis Ababa is new for the LRT technology, even though the Djibouti–Dire Dawa–Addis Ababa railway corridor was built between Nov, 1897- May, 1917 , (Babur Magazine by ERC Communication Center kits 1, No. 1, Sept, 2013). It is however difficult to gain and adopt an important and applicable experience from the Djibouti-Addis Ababa rail corridor for the current condition of urbanization.

Nevertheless, the construction of the LRT in Addis Ababa is ongoing in two directions. Although the planning and construction of the light rail transit corridor in Addis Ababa is significant, the destruction of newly built roads and highways has become costly. This could be due to the absence of strategic planning regarding rail-road integration in the City.

Therefore, this thesis is envisaged to evaluate the current planning, construction, maintenance and operational integration between the Addis Ababa road transport and the LRT. In this regard, the researcher will evaluate the integration by gathering and assessing the appropriate data and through observations of best practices in the other part of the World and recommend possible insights and preferable directions from the findings of the study for efficient and effective integration and operation of the Addis Ababa road-rail system.

1.2. Statement of the problem

Integrating different types of transport modes, starting from construction planning to operation, is a challenging phenomenon of most urban areas. Creating suitable residential areas, increasing quality of life and improving quality of service in cities without modernized and integrated urban transportation system is difficult. With this understanding, the ERC is having constructed LRT corridors within Addis Ababa, in two directions; from east to west and north to south along the existing city streets. In this respect, the construction of a LRT within the limited space of urban roads is difficult, despite the fact that integrating road and rail transportation by itself is challenging. This problem clearly emphasized on the current construction of the AALRT, which is many newly built asphalt roads with few years of services were destructed, this seems due to absence of integrated planning between the sub-

sector offices or it might be due to other related challenges such as requirements for LRT alignment design, already occupied right-of-way. However, the fact is the destruction of newly built roads causing the loss of public finance. So, the concerned parties should give due regards to road-rail integration during planning, construction, maintenance and operation to minimize infrastructure costs and built seamless transportation system. Based on the Transportation Master plan of Addis Ababa, the road and rail sub-sector offices should prepare their respective short- and long-term road and rail network plans and goals. In view of the above, this thesis will evaluate the coordination of concerned offices during planning, construction, operation and management based on the following basic research questions.

1.3. Basic Research Questions

The following are Conceptualized research questions:

1. How coordinated are the works of the road and the rail sub-sector offices regarding the integration of their activities?
2. What are the economic, social, environmental and other losses due to lack of proper road-rail integration?
3. What are the weaknesses and strengths of road-rail integration?
4. What are quantifiable and intangible benefits and losses from the presence or absence of proper road-rail integration respectively?

1.4. Objective of the Study

The study encompasses two objectives, general and specific:

1.4.1. General Objectives

The overall objective of the study is to evaluate the road-LRT integration in respect of planning, construction, operation and management in the city of Addis Ababa.

1.4.2. Specific Objectives

The following are specific objectives:

- To evaluate the current integration status of the road and LRT in Addis Ababa;

- To determine the extent of economic, social, environmental and other losses due to the weak integration of the road- LRT sectors;
- To identify the strengths and weaknesses of the road and rail integration in respect of planning, construction, operation and management;
- To explain the benefits and losses from the presence or absence of strong integration of the two sub-sectors.

1.5. Significance of the Study

The results of this research may have the following two contributions:

- (i) The development of awareness for the road and LRT professionals, managers, and ministry of transport officials and other concerned individuals on the benefits of integration between road and LRT sub-sectors.
- (ii) Presumably, the discipline of railway engineering is new for our country and there are no research works in that regard. Therefore, this may give chance for others who are interested on road and LRT integration to make further studies on the subject adding values to the existing knowledge related to the sub-sectors.

1.6. Limitation of the Study

This research has encountered certain limitations during the course of conducting the study. One of the difficulties encountered was, some respondents were reluctant to spare their time to be interviewed. Moreover, the respondents feared to express their opinions freely due to different reasons. In addition to the above limitations, the researcher faced a difficulty of getting written documents related to the Master plan, strategic plan of Addis Ababa road and LRT, the future operation management process, the expansion project of the LRT and any detailed procedures regarding ticketing and fares.

The other difficulties faced was, the absence of literature explicitly related to the integration of road transportation and LRT system. This were the major problems challenging the research, especially literatures with similar issues were not readily available.

Regarding the sector offices, it was, difficult to access documents related to, short-term and long-term plans, materials that helps to estimate the construction cost of roads built two and three years ago. The other limitation was financial problem to visit other countries for observing actual conditions, and acquiring knowledge from their experiences.

On the railway part, there is no clear and determined responses for some questions, since the China Railway Engineering Corporation takes the AALRT project through Turnkey agreement, and the ERC have not acquired all design data including, compiled and organized project documents.

1.7. Definition of Important Terminologies

It is important to provide operational definitions of terms or concepts used in this research for better understanding of the Thesis. The definitions of integration, road and light rail transit were taken from WAPC (2012) and Wikipedia (2014). Accordingly, the definitions as follows:

Integration: -A holistic approach that combines separate elements into a united system taking into account all modes of transport, land use and social, environmental and economic considerations, (WAPC, 2012:164)

Road: - Based on the Wikipedia (2014) and Microsoft Encarta Premium (2009), “the road is an open and a public way for the passenger, freight vehicles, individual automobiles and motors between two places (origin and destination) in a city or rural area with a surface of gravel, asphalt or concrete. Various forms of transportation such as trucks, automobiles, buses, motorcycles, and bicycles use roads. Roads allow trucks to move goods from points of production, such as fields and factories, directly to markets and shopping centers. Private individuals rely on roads for safe and efficient automobile, motorcycle, and bicycle travel.”

LRT: - Is a mode of urban transportation that uses mainly reserved and sometimes grade-separated rights-of-way with electrically propelled rail vehicles operate singly or in trains to provide a wide range of passenger capacities and performance characteristics at moderate costs. The American Public Transportation Association (APTA) in its glossary of transit Terminology, defines light rail as: “a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car, trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the

way. And light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley (pole) or a pantograph; driven by an operator on board the vehicle; and may have either high platform loading or low level boarding using steps.”

To sum up the above definitions, it is a public transport system that uses rail-based technology and which typically operates in urban settings. Vehicles run on the steel rails are usually relatively lightweight and propelled by overhead electrical wires, (Transport Department, London, 2011). These definitions should help the reader to formulate an image of the typical characteristics that distinguish LRT from other modes of public transport.

1.8. Organization of the Thesis

The Thesis has been organized as follows:

Chapter One is the introductory part which contains background of the study, statement of the problem, basic research questions, objectives (general and specific) of the study, significance of the study, limitation of the study, and definition of terminologies.

Chapter Two focuses on review of related literature to show the readers how the study supplements the works that have already been done on the topic, (Saunders et al. (2009).

Chapter Three includes: the research design, sample and sampling techniques, types and sources of data, data gathering instruments, the procedures of data collection and method of data analysis,

Chapter Four presents data analysis, Chapter Five presents conclusions and recommendations and Chapter Six presents proposed future research areas. Appendices are attached at the end of the Report

Chapter Two

LITERATURE REVIEW

2.1 An Overview of Road Transport and Light Rail Transit

2.1.1 International Level

Road Transport

As stated in Encarta (2009), roads originated for economic reasons, related to the need to move food and other goods from one point to another. Early transportation focused on moving food from a hunt or a harvest to the places where people lived. Trails evolved from prehistoric animal paths, and early humans carried or dragged their loads along these paths. As humans learned to domesticate animals, they transferred their loads to pack animals, such as horses, mules, camels, llamas, elephants, and dogs,.

Before 18th century, the United States of America (USA) developed the light road building processes that emphasized drainage crushed stone subgrades, and covers finely crushed stone bound with water or oil, to get good driving surface, (William, 1977:15). Nevertheless, the fast development of road is seen after the second half of the 19th and first half of the 20th century especially in USA (Ibid). Nowadays, road transport is vital to the economic development and social integration for easy accessibility, flexibility of operations, door-to-door service and reliability to the passenger and freight traffic.

Basically, the current road transportation system is very modernized and advanced in all aspects, for example; in design, construction, operation and traffic management. Most of the current cities have this type of road transportation system with different transport modes such as, public or collective passenger transport, individual motorized passenger transport, Individual non-motorized transport, and freight transport. Especially, the urban roads give all the above listed services, since in urban areas there was a congested and huge tendency of mobility, (Winder & Morin, 2009:14).

In general, the road transport has grown significantly during the past six decades and it has direct linkages to the rest of the economy with a strong multiplier effect. It is also essentially a derived demand depending upon the size and structure of the economy and the demographic profile of the population, (Government of India Planning Commission, 2006). In addition, creating integration with different modalities is a challenging issue for the development of the road transportation.

Especially in cities, there were different mode of transportation move at a time with a number of passengers, bicycles, motorists, automobiles, freight vehicles, railway trains, walking modes. That is why creating a sustainable transportation system is the headache of most city administrations to address accessibility of all the above modes.

Light Rail Transit

With regard to the historical development, a large number of light railway systems have been built in towns and cities worldwide during the past 40 years. Although most of them have been developed from original city tramway systems, there are many new systems particularly in cities in the USA, England, France, Spain, Hong Kong, Australia and even in semi-rural areas of Europe such as Tenerife. In North Africa, new light railway systems were recently opened in Tunis and Algiers, (Feasibility Study, AALRT, 2009).

The modern design of Light Rail Vehicle comprises electrically driven carriages with steel wheels running on steel rails. Using modern technology (example resilient wheels on resiliently supported rails), modern vehicles are virtually silent in operation and with low maintenance costs. Further, the power supplied can be obtained from renewable sources (example hydro) such that pollution levels from the vehicles are extremely low; hence, they can be classified as ‘environmentally friendly’. They do not use expensive imported fuel as required by diesel buses, (Ibid).

Due to these and many other reasons, LRT gains a good acceptance of implementation to city’s transportation system by different city administrations and governments. This causes the LRT system to be constructed widely and extensively in different cities of developed countries. Based on the, (SIMON G., 1998:1.), it provides the opportunity to run uninterrupted through busy streets in built-up areas with limited environmental/social disturbance and easy access for all members of the community.

To date, the European and North American continents remain the leaders in LRT. Within Europe, in particular, LRT provides emphasis on access for all members of the community and the ability to introduce a transit system into already heavily built-up urban areas that suffer from significant peak time congestion. someone can conclude that the emerging of the LRT system makes different cities to be attractive, suitable to live and increases the movability of the people and it enables the cities to give a high quality of service, (The Benefits of Light Rail: <http://www.ottawalightrail.ca> (official website of Ottawa)).

A major attraction of LRT is its greater flexibility and versatility. It can be placed in high-speed sub ways, in the streets, on elevated structures, on private rights-of-way, with or without grade crossings, in the median of highways, and on abandoned railroad rights-of-way. LRT possesses many operating possibilities. A light rail vehicle can be operating in the middle of a busy street in one moment and function as a high-speed rapid transit moments later.”



Figure 2.1 Light Rail Transit (SIMGN GINN, 1998:1)

It is not just the public who is happy with light rail, but also the world’s environmentalists and urban planners who are equally delighted.

Light rail viewed not only as efficient but also environmentally friendly in terms of pollution and blending into the existing urban landscape, since it involves neither massive engineering works nor atmospheric pollution from vehicles. To date, LRT has been well received around North America and Europe. “In many countries, they are forming vocal interest groups to

publicize their love of light rail”, (Newsweek 9, 1993). The 1980s and early 1990s have seen light rail emerge as a major player in public transport in North America, Europe and parts of Asia, (SIMON G., 1998:1).

2.1.2 The Case of Ethiopia/Addis Ababa

Road

In Ethiopia, road transport is the dominant mode and accounts for 90 to 95 percent of motorized inter-urban freight and passenger movements, (Ibrahim Worku, 2011:1.). However, because of its limited road network, provision of infrastructure has remained one of the formidable challenges for Ethiopia in its endeavor towards socio-economic development and poverty reduction (ERA, 2008). The Ethiopian Roads Authority (ERA) investigated the link between the country’s development plan and the road sector policy (ERA, 2008). The study generally indicated that there is a well-established nexus between the development plan of the nation and the road sector policy. As we discussed before, well-planned and constructed transportation system is the main motor of countries development, (Ibid).

The history of road transportation in Addis Ababa begins from the inception of the city; that is, Minellik II constructed the first ever two roads in the city as well as in the country that stretched from Addis Ababa to Addis Alem and from his Palace to the British Embassy in 1902. In 1904, the first roller was imported by Minellik II and was being pulled by many people for its operation, (AACRA Special Edition, Magazine, 2014:89).

According to the AACRA Magazine (2014:89), Emperor Minellik II was also believed to be the first in importing cars in Addis Ababa and introduced the car technology in the city for the first time. However, the cities modern road construction was highly interlinked during the ruling period Emperor Haile Selassie. During this period, a number of contractors were organized to carry out road construction. The first public office to be established by the Haile Selassie Government to construct roads was the Public Works Department. After a few years, this department was upgraded to a ministerial level under the name of the Public Works Department and Addis Ababa got the chance to establish its road development organizational structure. Then it was decided for Addis Ababa to have a mayor and a council in 1942, the city roads construction and maintenance was organized under the municipality. To fulfill the road construction activities together with building works the “road and building works” was

established). This department stayed until 1993 without a fundamental organizational change, (Ibid). Through this process, the AACRA was established in 1998 to be administered by board of directors to construct, maintain and administer the road works in Addis Ababa by the city administration, (Ibid). Starting from this time, AACRA have the mandate to plan, construct, and operate the Addis Ababa city roads.

Despite the above, the current Addis Ababa city transportation activities are characterized by high accident occurrences, high traffic congestion, negative environmental impacts, unsafe public transport and low accessibility (Tiblest, 2012). Although there are constraints in road transport and infrastructure and lack of efficient public transport system, significant increase in private vehicle ownership is happening day-by-day exacerbating traffic congestion, traffic accidents, environmental degradation and social depression in the City. The growing usage of motorized private vehicles, coupled with the increasing congestion levels, also leads to increased fuel consumption thereby making the transport system economically unsustainable and expensive to the society, (DIMTS, 2014:12.)



Figure 2.2 Addis Ababa Road Transport

As a part of various initiatives to develop sustainable transport system for Addis Ababa, comprehensive transportation studies conducted in the past suggested development of multi-modal transport system (DIMTS, 2014:12). Subsequently studies were also

conducted to determine suitable public mass transit system technology as per local needs. Based on recommendations of these studies (Ibid), a LRT network was thus finalized and adopted for implementation, (Ibid). In addition to the LRT, the Addis Ababa City Government (AACG) mandated the consulting firm, Egis Rail and Lyon Town Planning Agency – LTPA to study a mass transport corridor, which is Bus Rapid Transit (BRT) for the Addis Ababa City that could feed the LRT system. The objective was to propose a solution, easy to implement that could run with and without the LRT system being operational.

Light Rail Transit

Regarding the railway stream, Ethiopia had two corridors that run between Djibouti and Addis Ababa and Messawa-Asmara which was constructed during the last of 19th and first of 20th century. (Babur Magazine 2013). However, this rail corridor was not modernized either infrastructure wise, or institutionally resulting in poor operation and maintenance management. Furthermore, there were not competent professionals either quantitatively or qualitatively that were trained in railway technology, maintenance and operational management.



Figure 2.3. Over pass LRT Bridge and road service around Meskal Square.

Due to this and other similar reasons, the corridor stopped providing transport services. However, the current Ethiopian government has started building a LRT Project in Addis Ababa to overcome the city's chronic transport problem which was included in Ethiopia's Growth and Transformation Plan to be implemented between 2010/11 and 2014/15.

Currently, the project is underway and is planned to be completed by the end of 2014 or the beginning of 2015. The Light Rail Transit is stretched in two major directions from East to West and from North to South with a total length of nearly 35km, (Feasibility study of AA LRT, 2009).

According to the Feasibility Study, the proposal for the Phase I of the LRT system comprises an East – West Line from Ayat to Tor Hailoch (17.35km) and a North – South Line from Arada Giorgis to Kality (16.90km). The total length of the Phase I LRT system will be 34.25km. The two lines utilize common tracks between Meskal Square and Lideta along the Ras Mekonen Street and Chad Street, a distance of approximately 2.7km. The LRT system has been designed to primarily operate at-grade. Grade separation structures are only provided where heavy traffic movements cross the line; highway widths are inadequate to incorporate a median alignment at ground level.

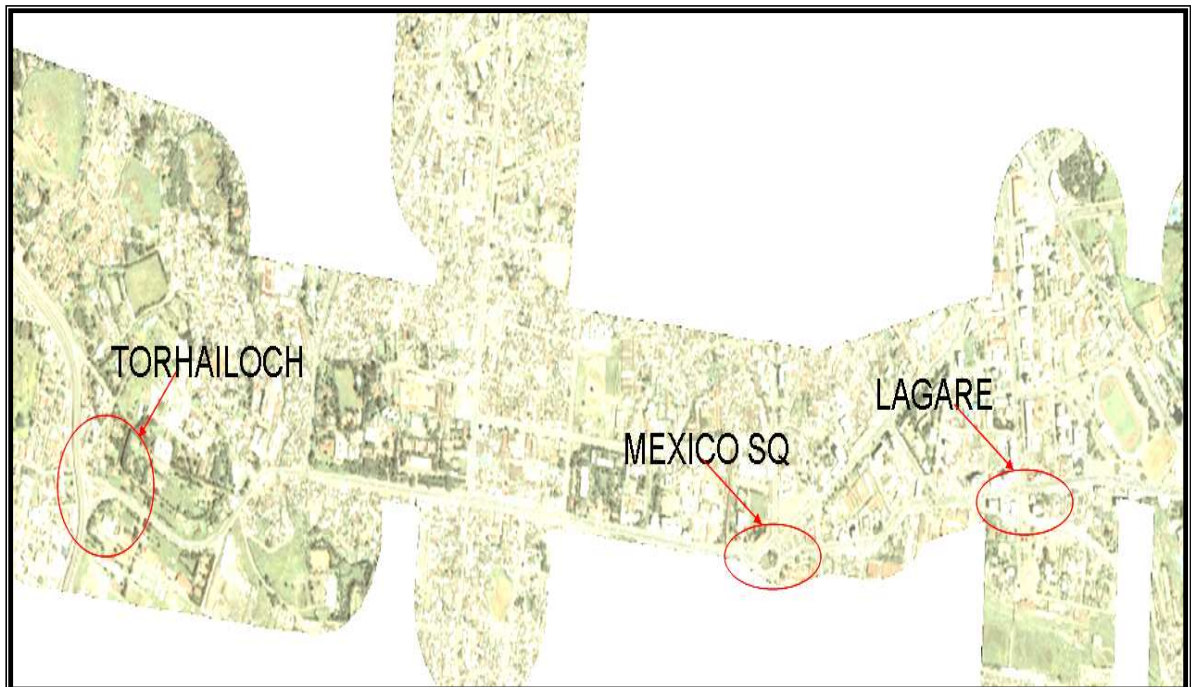


Figure 2.4 AALRT and Road Network (Bankable Feasibility Study for AA LRT Project 2009:29)

Intermediate (“emergency”) crossovers will be provided at approximately 2km intervals to enable “short working” journeys to be introduced in the event of an accident or delays. Three or four-track layouts may be provided at likely heavily used intermediate stations for more rapid boarding of LRVs, and for termination, or turn-back of services. Based on the Ethiopian Railway Corporation AALRT project plan, the Phase I construction of LRT is undergoing and it will be complete in E.C. 2007 (G.C. 2014/15).

2.2 Defining Integrated Road - Railway Transportation System

Integrated transportation that leads to sustainable mobility of passengers, goods and services has been defined as transportation that meets the social needs of today; that does not endanger public health or ecosystems; and which will be consistent with sustainable use and replacement of resources without compromising the ability of future generations to meet their needs. Integrated transportation system allows the basic access and development needs of individuals, companies and societies in a manner of consistency with human health and ecosystem balance promoting equality with and between successive generations.

Cities are places of change at a larger scale due to various social and economic activities, all of which are dynamic in nature. The complex processes propel the development of cities across both space and time. Transport is the engine of urban life that facilitates the day-to-day social and economic activities of cities and is driver of global economy at a larger scale, (Fantahun, 2012:10). In defining integration between road and rail, simply address and indicate accessibility and mobility as functions of urban transport system. Therefore, integrated and well planned transportation systems have played integral roles in shaping the

Urban form of cities, influencing the location of social and economic activities and are determinants of urban lives (Fantahun, 2012:10.). In line with this, integration between road and LRT from planning to operation enables different cities to have more accessibility and an effective urban transportation system. In addition, integration of transportation includes the successful blend of public, private, rail transit, and integrating circulation into the limited space available. (Peter H., 2000). Integration of urban transportation is essential not only for the current transportation system, but also for future transportation network and for continuous and unhindered growth of our desire for mobility. (Ibid)

2.3 Rationales of Creating Integration between Light Rail Transit and Road

According to the WAPC (2012), Transport and mobility are fundamental to the creation of a high standard of living. Transport system is a main component of a city's infrastructure. Transport influences and is influenced by the patterns of urban growth and development. Transport provides opportunities for the movement of people and goods, and connections between locations of living, work and activities. In the short-term; location of activities, jobs, services and where people live are largely fixed, and mobility is the main key to accessibility. Overall, as the price of oil continues to rise, accessibility through mobility will continue to be threatened by increasing transport energy costs. It is, however, important that people and businesses are actually aware of alternative options for transport like walking, cycling and public transport. In the long-term, people and businesses move around and change locations.

Transport technology plays an important role in defining urban form (Rodrigue, 2009, Newman and Kenworthy, 1999:189). Cities that strive to reduce auto-oriented development patterns must create transit spine along major urban corridors and direct the urban planning work to focus around the key urban nodes along the transit spine. Newman and Kenworthy (1999:189) remarks that 'sustainable city' of the future is one that promotes accessibility through the provision of integrated and balanced transport modes and mixed land use in a transit and walking oriented urban villages. Therefore, there are different reasons that the need of integration between road and rail sector is necessary. In any city, the necessity of integrated urban transportation system is unquestionable due to the dynamic movement of the public in the city. Therefore, some rationales for the integration are concluded as that, creating a sustainable, cost-effective, efficient, environmentally friendly, attractive and serviceable transportation system is the main objective of integration between road and light rail transit transportation system.

2.4 Challenges to Create Road - Rail Integration in Addis Ababa

The city of Addis Ababa does not have a well-designed urban framework in respect of light rail transit or high capacity transit corridors that can guide the development of the city in a controlled and planned fashion. Recent urban expansion in the city, which is characterized by massive single-family real estate projects, is an automobile demanding development path. Such development patterns need to be intercepted through densification schemes to protect the

city from further sprawling with consequences of reduced accessibility, increased travel distance, high energy and land space consumption. The replication of such urban development practices also makes the provision of public transport infrastructure costly and very difficult as it is usually accompanied by displacements that are not socially welcomed. The city has to be built inwards using the proposed and the newly started light rail transit (LRT) spines as backbone of the city structure and only then the city of Addis Ababa can begin to take an urban form that is compact and transit supportive. Given the high density of population (75 inhabitants/hectare) in Addis Ababa, it is plausible that a certain urban corridor can have an acceptable level of patronage, (Fantahun, T. 2012:20.). However, this can be strengthened by density-built environment of the inner city to better suit the demands of public transportation, so that it becomes cost-effective and more accessible. Densely built environments around public transportation networks will increase the level of patronage and have great potential of lowering the unit cost of providing decent quality of public transportation service (Newman and Kenworthy, 1999).

Development of first LRT into existing city streets and highways usually face different difficulties and problems. For example in Denmark, when they setup the first LRT into their city streets, they had faced the following problems, (SYSTRA Consulting, AARHUS LRT, DENMARK, 2012.).

- Scheduling and prioritization of services;
- Integration with an existing railway and highways;
- Integrating services operating at different maximum speed limits;
- Integration with proposed freight services on the tram-train routes; Complex technical requirements including:
 - ✓ Managing the wheel-rail interface integrating with existing rail and potential heavy freight loading;
 - ✓ The Client requirement to avoid catenary in the harbor area;
 - ✓ Managing options for either fully electrified rolling stock, or diesel operation on the existing lines;
- Regulatory requirements including:
 - ✓ Introduction of new rules and regulations for light rail and accommodation of existing regulations for classic rail,

- ✓ Integration with the existing road system requiring changes to road standards and safety regulations; and
- ✓ Stakeholders unaccustomed to light rail systems and their requirements.

The Government of Denmark faced the above listed challenges when they put LRT into the existing city streets. Similarly, Addis Ababa is constructing a LRT into the existing roads at grade crossings, elevated sections and tunneling, and the challenges discussed above may reveal for the Addis Ababa case partially or fully during planning, construction and operation.

2.5 Strategies to Establish Compatible Light Rail and Road Transport

Different cities have strategic transportation plans for effective and successful integration of road and light rail system. For example, the city of Edmonton in Canada has developed seven strategic goals to express the intent for the future of Edmonton's transportation system. These seven goals express the holistic, citywide, long-term vision for the future of the transportation system. They support and align with the City Vision and the City of Edmonton's 10 year Strategic Goals. These strategic goals in short are; Transportation and Land Use Integration, Access and Mobility, Transportation Mode Shift, Sustainability, Health and Safety, Well-maintained Infrastructure, Economic Vitality, [Transportation Master Plan, City of Edmonton (TMP, 2009:16).

The Transportation Strategic Goals were developed in coordination with city's Municipal Development (MDP) Strategic Goals to ensure that the goals of the TMP and MDP were mutually supportive towards the achievement of the City's Vision. From this, anyone can understand that for the achievement of the city's development, formulating short- and long-term strategy is undeniable. Therefore, the Transportation Master Plan and Municipal Development Plan's Strategic Objectives will guide and shape the transportation system and land use patterns to achieve sustainable, livable city that Edmontonians envisioned, (Ibid).

The strategies of the American Transportation Department (ATD), for their fiscal year strategic plan, have five goals and these are; Safety, State of Good Repair, Economic Competitiveness, Livable Communities and Environmental Sustainability (US Department of Transportation Fiscal Year Strategic Plan, 2012-16:3). In relation to this strategic plan, the prevalent secretary of US Department Transportation, LaHood R., stated that, 'People from across the political spectrum recognize that our transportation system must become safer,

more efficient, more outcome-based, cost-effective, and more environmentally sustainable. This strategic plan responds to these challenges and opportunities (Ibid, 2012:3.).

2.6 Practices and Discussions on Creating Integration between Road and Light Rail Transit System

2.6.1 Road-LRT Integration Practices in Some Developed Countries

In any research paper, it is better to include good practices and experiences related to the title of the study. Based on this, good practices of road and light rail integration practice of the city of Calgary in southern Alberta, Canada prepared by Hubbell J. and Colquhoun D. (2006:3-18) is discussed in the following section. Calgary has an exemplary integrated transportation system in the world with many light rail transit corridors, well organized road networks and balanced rail transit and road transportation with bus rapid transit system. Therefore, the researcher believes that it is better to present the experience here under.

City of Calgary “A Balanced Transportation Concept for the City of Calgary”

Its primary function was to develop a policy combining and coordinating transportation improvements. It also recommended a change in direction of transit planning toward consideration of options for an intermediate capacity, rapid transit system. With a population of less than 470,000, the Calgary city council could not support an extensive, grade separated rapid transit system. Instead, they began to look more closely at the surface-running street car and light rail systems in Europe as a model for implementing a higher capacity transit service in Calgary. To position the city for eventual implementation of a rapid transit system, a new “Blue Arrow” express bus service was recommended, paralleling the proposed rapid transit lines. The Blue Arrow expresses included complimentary park, ride, and feeder bus routes to mimic the characteristics of the future rapid transit system that was envisioned. The Calgary City Council had developed policy or principle for implementation of LRT in different corridor. This practice helps the Addis Ababa City Administration that before implementation of the LRT corridors formulating policy framework for the effective integrated transportation system is essential. Moreover, the LRT system needs well planned bus service along the implemented LRT line. The practice of Calgary city shows that, several studies and analyses undertaken to evaluate rapid transit options for the city and to analyze the

impact of transit versus roadway expansion. Based on the analyses the capital cost of a LRT and bus way system would be similar but that LRT offered significant advantages over the other options in regard to speed and service reliability, reduced operating costs, impact on the downtown road system and urban environment, and ability to achieve a more compact urban form, (Hubbell J. and Colquhoun D., 2006:5)

This practice shows that the city council was highly involved in the planning of city transportation. Moreover, the city council gives emphasis for appropriateness of the routes and cost before implementation.

One of the key policies of the Calgary Transportation Plan is that “The City investment in transit and roads will be approximately equivalent.” The proposed city capital budget for 2006 to 2015 includes 47 percent funding for roads and 53 percent funding for transit. Additional investments are planned to commence expansion of the LRT platforms to accommodate four-car train operation, construct a new LRT maintenance facility, expand the LRT fleet by 40 percent (40 cars) and the bus fleet by 42 percent (330 buses). Recent planning studies have identified that a network of six LRT lines will be necessary to accommodate a future city population of 1.5 million, (Hubbell J. and Colquhoun D, 2006:7). From the city of Calgary the following important points can be taken for the case of Addis Ababa

1. Strong and consistent support from senior administration and politicians is essential to long-term success. Government officials must be made aware of the benefits of investing in public transit and develop budget guidelines for appropriate funding levels for roads and transit expansion. Effective stakeholder engagement is essential to build and maintain public support for transit investment.

2. **Build the Right Project** - Develop “rock solid” ridership, cost estimate, and choose the appropriate transit technology. Strict adherence to a philosophy of using basic, proven technology (example, LRT cars are without automated diagnostics, automated passenger counting, air conditioning) and utilitarian design (example, primarily surface operation) has minimized the cost and risks associated with system development and has enabled the LRT extensions to be delivered on time and within budget.

3. **Build the Project Right** - Adhere to your vision for LRT development and take advantage of LRT design flexibility by developing surface operations wherever possible. Work with

Traffic Engineers to integrate surface LRT operations within road rights-of-way and determine an appropriate level of transit priority for LRT system. A comprehensive, integrated approach to transportation and land use planning, which Calgary has achieved through “uniCity” governance and administration, is critical to the success of LRT.

4. Identify and protect future land requirements - Long-range plans should be developed to protect LRT right-of-way, including station areas and land for park and ride, feeder bus facilities.

5. Develop the Corridor Concept - Use express buses or Bus Rapid Transit, park and ride to develop ridership in future LRT corridors.

6. Think 50 to 100 Years Ahead - Design, construct and maintain vehicles and infrastructure in consideration of life cycle expectations. Understand the logistics and impact of system maintenance and expansion during current operations.

7. Strategic Operating and Staffing Decisions - Understand that the skill sets and interests of planners, designers and builders are fundamentally different than operators and maintainers. Create separate position classifications and seniority for LRT and bus operators and mechanics. Minimize dependence on performing maintenance and system expansion during non-revenue hours. Learn to conduct right-of-way maintenance work under traffic.

TRANSIT ORIENTED DEVELOPMENT (TOD)

The City of Calgary has adopted many policies and guidelines that relate to transportation choices, transit use, quality of life and urban form. These contain policy directions to encourage transit use, make optimal use of transit infrastructure and improve the quality of the urban environment. The focus of these policies is to preserve a major employment center and to attract new high-density residential development within the downtown and within close walking distance of LRT stations and major bus corridors, (Hubbell J. and Colquhoun D, 2006:8). This strategy is aimed at moving jobs closer to residential areas and decreasing commute distances, encouraging greater use of walking, cycling and transit for work trips, and making more efficient use of the off-peak direction of travel on transit and roadways.

- 1. Plan an integrated policy solution.** Develop integrated land use, development (TOD), road, parking and transit policies. LRT has had a positive impact on increasing the

modal split for downtown work travel when supportive policies are working together to manage the supply of long term downtown parking, road capacity and transit service.

2. **Achievement of TOD requires political commitment and collaboration with private sector developers.** Proactive land acquisition and land banking by The City can facilitate development or protect future options for employment centers. In most cases, developed land uses are very long term, therefore, the cumulative impact of incremental, poor land use decisions is significant. It is critical that cities show leadership in supporting TOD by locating some of its business functions in these developments, expediting approval of TOD and consideration of financial incentives (i.e., business tax breaks for TOD tenants, Tax Increment Financing) , (Hubbell J. and Colquhoun D, 2006:12).

This experience of Calgary city indicates that, creating a major employment center and high-density residential development along the LRT corridor based on the policy framework is the key to integrate cities transportation system. To achieve these, different policies and guidelines should be prepared.

Transit Safety

Providing a safe journey for the customers is the number one priority of Calgary Transit. Calgary Transit has a rigorous program aimed at accident prevention and investigation. Reporting of all accidents is a requirement of all staff. Reports are completed each time that a transit vehicle makes contact with another vehicle, pedestrian or object. Passenger injuries (mostly trips, slips and falls while boarding or alighting) are recorded. In general, the safety record of the LRT system is more favorable than bus, (Hubbell J. and Colquhoun D, 2006:13).

Table 2.1 provides information on the rate of reported vehicle and pedestrian accidents. The rates of vehicle collisions per million kilometers of travel and the number of passenger injuries per million boarding's are very low. It should be noted that these data do not segregate accidents or injuries by severity. As shown on the table, the reductions were significant between 1995 between 1995 and 2005. In this regard, the average annual decrease in the cases of collision per million km in respect of bus and LRT were -2.5 and -0.9 percents respectively. Similarly, in the case of passenger accidents per million boarding in respect of bus and LRT were, -11.8 and -17.3 percent respectively.

Table 2.1 Calgary Transit LRT and Bus Collisions and Passenger Accidents

	1995	2005
Collisions per million km		
Bus Collisions	23.0	17.8
LRT Collisions	11.3	10.3
Passenger Accidents per million boardings		
Bus Passenger Accidents	5.6	1.6
LRT Passenger Accidents	.40	0.06

Based on, (Hubbell J. and Colquhoun D, 2006:14) the Calgary LRT safety practice shows that,

- Surface LRT operations can be safely and effectively integrated within city streets by using conventional traffic, pedestrian and railway controls.
- LRT signal pre-emption in arterial streets provides reduced transit travel time without compromising roadway safety.

Station Design

Regarding the station design, (Hubbell J. and Colquhoun D, 2006:15) that, the initial constructed stations were accessed by enclosed stairways and a single set of escalators. No provision was made in the station design for elevators or ramp facilities to accommodate persons with disabilities. However, in the other coming station design and construction there were a lot of improvements for the accessibility of all communities. the station design and location also considers the express bus station. Generally the station design is done by considering the following issues:-

- Minimize station access time where possible with grade level access to stations.
- Integrate the scale and design of stations with adjacent land uses.
- Design to the highest barrier-free accessibility standards possible.
- Invest time, effort and funds to ensure the station design function well, is intuitive, understandable and creates a “significant place” in the community from a customer perspective.

- Alternate end loading should be incorporated at successive centre-load stations to balance customer loads between buses and cars in the train consist and achieve more efficient use of available capacity..

ACCESS MODE PLANNING

Access mode planning for Calgary's LRT system accommodates a comprehensive range of access modes (that is, walking, cycling, auto, feeder bus); however, first priority is given to ensuring effective integration of feeder bus networks with the LRT. At some stations over 50 percent of customers typically access the LRT station by feeder bus. Together, the LRT system and connecting feeder bus network form a highly integrated system which services the demand for downtown work trips and cross-town travel to suburban employment, educational and shopping destinations. To allow reasonable opportunities for private vehicle access to the LRT stations, park, ride, and auto passenger drop-off facilities are provided at suburban stations. The amount of parking provided at LRT stations is set to comply with established policies which specify that 15 to 20 percent of projected ridership be accommodated by the park and ride access mode. The calculation of park and ride demand considers the number of residents living within the catchment area of the station; the number of transit trips made external to the community by the residents, the percent of transit trips that access the station by auto and the efficiency of the parking lot, (Hubbell J. and Colquhoun D, 2006:14).

CONCLUSION

As discussed above, LRT has become the backbone of the Calgary Transit system and ridership has grown dramatically over the past decade as a result of comprehensive, coordinated policies to manage urban form, downtown parking supply, and ensure balanced investment in roadway and transit infrastructure. Integration of the LRT system with other modes of travel has created an environment, which supports further development of the transit market. The experience of the City has demonstrated that LRT systems can be successfully integrated into the right-of-way of city streets. The City has adopted strategies which give priority to LRT vehicles in mixed traffic environments. Other lessons relating to station design and personal security have improved the safety and operation of the LRT system.

The success of Calgary's LRT system is best reflected by the fact that LRT expansion and increased capital investment in transit is consistently a top-of-mind request in all Citizen

Satisfaction Surveys which the City has undertaken in the last decade. City Council has responded by committing significant funding to undertake an aggressive LRT capital program that will focus on four initiatives:

1. Complete the primary LRT network by extending the existing LRT networks.
2. Increase network capacity by expanding the LRT fleet and begin expansion of platforms to accommodate four-car train operation.
3. Develop future LRT corridors by expanding Bus Rapid Transit service parallel to future LRT routes.
4. Sustain current LRT fleet and infrastructure by undertaking critical life cycle maintenance of major system components.

Switzerland

Urban Roads with LRT - Urban Quality!

According to Peter Hotz (2000:50), the success of a transport policy depends both on a successful blend of public and private forms of transportation, and the integration of all circulation into the limited space available. The placement of light rails into urban roads is a solution with clear advantages. It is cost-effective, space saving and puts public transport in the actual center of traffic flow. A light rail system must comply with the restrictions of the urban environment. It must use a minimum of space, minimize energy consumption, effectively reduce the amount of car traffic overall, and increase pedestrian and bicycle circulation. The success of a light rail system running in the urban roads depends on its attractiveness to the users.

Undoubtedly, a tram system running entirely in its own lanes - with temporal and local separation would be technically speaking the ideal solution for public transportation problem. However, we must not forget that this is a service provided for people living in a city, and not an end in itself. The reconstruction of a city into nothing more than the setting for a model train will hardly meet with acceptance. Wherever possible, public transportation must prove its compatibility with the urban entity as a whole. The cities in Switzerland have been able to maintain the luxury of a highly accessible in-road light rail system with a good deal of public support. This has required a continuous process of compromise between the operational needs of the light rail system and the urban situation as a whole. It also requires a real marketing

skill to provide continually exactly the services to the customers need, (Hotz, 2000:50). This practice of Switzerland helps the Addis Ababa city Administration to understand the efforts to be made for the reliable, and acceptable light rail system in city streets.

England

Improving Public Transport through Light Rail Transit

Light rail systems are not fully integrated with other forms of public transport systems. Public transport systems are more likely to be regarded as attractive alternatives to the car if they operate in a joined-up, integrated way. Integration involves co-ordination between services, physical proximity allowing ease of interchange at stations, and through-ticketing and widespread availability of passenger information about routes, fares and timetables. Passengers consider the level of integration to be the least satisfactory aspect of light rail. Integration with bus services has been poor to moderate on many lines and bus and light rail services have been in competition with one another on the same routes. Light rail has had a limited impact on road congestion, pollution and road accidents, (John B. 2004:4).

The Transportation Department of England envisaged that light rail schemes would help to reduce urban road congestion, pollution and accidents by bringing about a shift away from cars (John B. 2004:4). Although there has not necessarily been an easing of road congestion or a reduction in pollution or road accidents. As people leave their cars and travel by public transport, some are replaced by other motorists using the free road space that they have vacated. Light rail cannot, by itself, reduce congestion significantly over the long term. Other complementary measures, such as park and ride schemes, are needed. There has been limited use of such measures, however, by local authorities with light rail systems in their areas, (Ibid, 2004:4).

Western Australia

Integrated Transport Planning

Based on WAPC(2012:19-20); in 2003, the Australian National, State and Territory Ministers for Transport and Ministers for Planning endorsed a Charter for Integrated Land Use and Transport Planning. The Charter commits to an agreed set of practices and cooperation to achieve better outcomes for land use and transport planning at national level. The Charter aims

for greater integration of land use and transport planning across agencies, jurisdictions and government levels to facilitate effective and sustainable urban and regional development across Australia, through:

- Reducing the need to travel;
- Reducing the length of journeys;
- Making it safer and easier for people to access services;
- Reducing the impact of transport on communities;
- Improving freight access to key terminals and freight flows;
- Providing efficient distribution of goods and services to business and community;
- Providing a choice of travel modes; and
- Ensuring flexibility to meet the demands of a changing economy and market environments.

The Charter states that land use and transport planning must withstand changes in technology, social conditions, values, resource constraints and other key factors. It states the following nine aims on integrated planning and outcome areas of integrated land use and transport planning;

1. Integrated and inclusive processes;
2. Linked investment decisions;
3. Increasing accessibility by widening choices in transport modes and reducing vehicle travel demand and impacts;
4. Making better use of existing and future infrastructure and urban land;
5. Protecting and enhancing transport;
6. Creating places and living areas where transport and land use management support the achievement of quality life outcomes;
7. Increasing opportunities for access in both the present and longer term;
8. A safer and healthier community; and
9. Recognizing the unique needs of regional and remote communities.

Responsibility for implementing the Charter's main objectives rests with each State, Territory and the Federal Government. Local governments play a central role in land use and transport planning for areas within each State and Territory. The above presented practices show that

there were different issues related to the integration of the LRT to the road transport system. Different cities faced various challenges and gains benefits from the implementation of LRT. They raised various issues based on their existed practice. So, it is better to summarize the integration practices by dividing into planning, construction and operation management based on these practices and experiences, interviewee responses and other literatures considering the existed conditions of Addis Ababa.

2.6.2 Planning Integration

Planning for our purpose could be defined as the determination of future course of action to achieve desired goals. It means deciding in advance what to do, how to do it, when to do it and who is to do it. Planning guides the action in an organization for the achievement of the desired goals and fills up the gap between what is the desired state of transportation today and what is the desired state of transportation in the future. Planning of the rail and road network, identification of source of budget for construction, setting the way of construction with a minimum interruption of existing transport, looking for short-term and long-term service shall be done with integrated manner before coming into action. For example the evaluation of the Calgary city administration integrated transportation plan (2006), states that, the first 25 years of LRT development and operations have been a significant public transit success story, and the next 25 years will focus on life cycle maintenance of the fleet and infrastructure, and expanding the role of LRT in Calgary. Additionally, the LRT has become the backbone of the Calgary Transit system and ridership has grown dramatically over the past decade as a result of comprehensive, coordinated policies to manage urban form, downtown parking supply, and ensure balanced investment in roadway and transit infrastructure. Integration of the LRT system with other modes of travel has created an environment, which supports further development of the transit market, (John Hubbell and Dave Colquhoun, 2006:18.). From above statements of Calgary about integration, anyone can understand that integrated transportation planning leads to a successful and effective urban transportation. Therefore, from this experience the researcher can conclude that integrated transportation is coming from the comprehensive, coordinated and integrated transport policies to manage urban form, and ensuring the balanced investment in roadway and rail transit.

According to, (WAPC, 2012:38), integrated transportation plan is a tool for the comprehensive analysis of existing and future transport system requirements within an area defined by a

single local government or grouping of several jurisdictions. That has significant transport and access issues in common and informs decision makers on ways to manage the transport system and land-use to address these needs. It aims to do this in a way that sustains economic growth, conserves the environment and supports the quality of life of current and future generations. It provides an overall framework for a holistic planning approach to resolving emerging transport issues at regional, sub-regional and local levels. The integrated transport plan is part of a larger process to build meaningful partnerships between all levels of authority in the delivery of an integrated transport system. Local governments can use their respective integrated transport plans to support funding requests to local, State and federal sources for transport infrastructure improvements.

Based on the WAPC (2012:6), good land use and integrated transport planning and appropriate incentives, improves accessibility and reduce travel costs and time. Land use patterns and urban form are major factors affecting mobility and accessibility. Urban planning directions encourage compact and mixed-use land developments, integrated planning between different transport modes like light rails and bus networks, will create active travel options and use of public transport to reduce dependence on private motor vehicle.

An integrated transport plan requires consideration of all transport modes, and how they interconnect. A focus on only one local transport issue without regard for other elements of the transport system and the adjoining land uses does not constitute an integrated transport plan. Careful planning is critical to the integrated transport plan's overall success and the community and stakeholders should be engaged at the outset. The key steps in the integrated transport planning process are, (WAPC, 2012:54).

1. Define the project;
2. Outline a vision for the integrated transport plan;
3. Identify key drivers;
4. Develop specific objectives and strategic targets;
5. Document and analyze issues and needs;
6. Review challenges and opportunities presented in the plan;
7. Devise strategies to achieve outcomes;
8. Assign actions and targets to achieve the objectives;
9. Assess and monitor the efficacy of the plan when it is implemented.

2.6.3 Integration in Operation and Management

As we discussed in the above sections, after the implementation of integrated light rail transit and road network plan to the ground, the next activity that is left is, operating and managing in an organized, coordinated, and integrated manner of all transportation modes, that is road (bus network, individual automobiles, motors, bicycles, and walking modes) and light rail transit trains.

Operation of urban transportation and applying a management structure, that fits local conditions and respective national framework, helps to assign or split the tasks and duties. The objective of integrated operation and management system is to minimize the costs of operation and maintenance, (PROCEED, 2009:162). For example, the United States Department of Transportation have developed management and operation guidelines that helps to create an integrated approach to optimize the performance of existing and programmed transportation infra-structure through the implementation of multi-modal, intermodal, and often cross-jurisdictional systems, services and projects, (US Department of Transportation, 2006.)

2.7 Benefits of Integrating Light Rail Transit over Road Transportation

Integrated transport planning aims to ensure that there is a suitable, safe and interconnected transport infrastructure for different transport modes such as private car, freight, public transport, walking and cycling, which results in improving the community's accessibility to jobs, services, recreation and other daily activities. Generally, integrating the road and light rail transit transportation gives economic, social, environmental advantages. For example the WAPC, (2012:19.), classifies the benefits of integrated transportation as follows;

Social Benefits: To promote social inclusion by connecting remote and disadvantaged communities and increasing accessibility to the transport network for all Australians.

Safety: To provide a safe transport system that meets Australia's mobility, social and economic objectives with maximum safety for its users.

Environmental Benefits: To protect the environment and improve health by building and investing transport systems that minimizes emissions and consumption of resources and energy.

Economic Benefits: To promote the efficient movement of people and goods in order to support sustainable economic development and prosperity. In addition, it promotes effective and efficient integration and linkage of Australia's transport system with urban and regional planning at every level of government and with international transport systems.

2.8 Integrated Planning for Sustainable Urban Transport Systems

Based on the WAPC (2012:38), sustainable transport has been defined as transportation that meets the mobility needs of today; does not endanger public health or ecosystems; and meets the need for access consistent with sustainable use of resources used and resources replaced, without compromising the ability of future generations to meet their needs.

A sustainable transport system is one which:

- allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equality within and between successive generations;
- is affordable, operates fairly and efficiently offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development.

Sustainable transportation planning with integration assumes limits for emissions and waste within planet's ability to absorb them. It uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimizing the impact on the use of land and the generation of noise.

In practical terms, sustainable transport is often used to refer to the lower impact and active transport modes of walking, cycling and public transport. Encouraging and funding transport infrastructure provision at local government level is equally important for all transport modes as the aim is to provide a transport system that caters for all transport needs of the community and business services in the local area, (WAPC, 2012:41.).

An integrated transport plan should facilitate appropriate balance between economic, social and environmental outcomes and between the local and regional functions of transport. Many urban communities will need to accommodate both regional and local travel, but it is vital that

regional movement, especially where it involves heavy traffic flows or heavy commercial vehicles, does not excessively damage communities through which it passes, (Ibid).

In general, sustainable transportation comes from the integrated plan of transportation and it should address three areas- Society, Economy, and Environment.

2.9 Principles to Develop an Integrated Transport

Cities have their own principles of integrating transportation; however, most of them have developed similar principles, with little variation. For example department of transportation in Perth, Australia have addressed six key principles during preparation of integrated planning, which are; (WAPC, 2012:54).

Safety - the transport system should be safe for all users;

Efficiency - the transport system should be provided, operated and used efficiently (functioning in the best possible method with minimum waste of time and effort);

Effectiveness - the transport system overall should provide effective access and movement for all persons and business for employment, health, education, commercial, service, social, leisure and freight purposes;

Environmental responsibility - the transport system should be provided and used in an environmentally responsible manner;

Social responsibility-the transport system should provide equitable travel and transport opportunities for residents and businesses, with social benefits and costs being shared by all beneficiaries; and

Robustness,-the transport system must provide service in the face of ongoing and largely predictable during the coming 35 years and must be able to respond to and take advantage of unpredictable economic, social, technological and other changes.

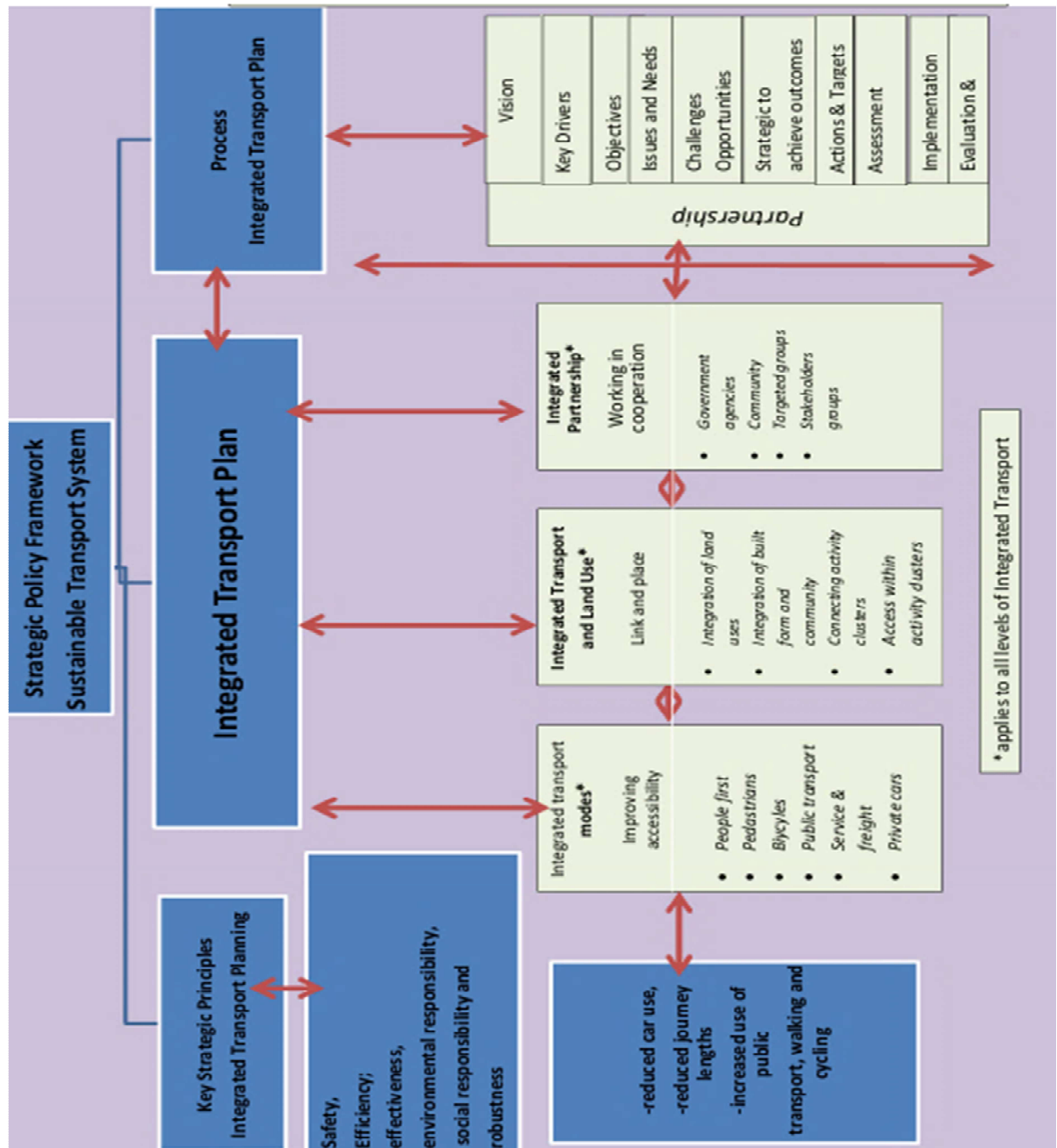


Figure 2.5 Shows **Principles and process for integrated transport plans** as provided by (WAPC, 2012:55)

2.10 Community Relations

Creating awareness about the coming of LRT into existing road transportation system and discussing its positive and negative impacts with communities will lead to successful operation and management of the public transportation in general and LRT in particular. In this regard, practice of city of Jerusalem and Sydney is presented under here.

The City of Jerusalem

According to Daniel and Render (2004:779), Jerusalem is a patchwork of neighborhoods, ethnically and religiously, and often physically distinct. The magnetism, mystique, and beauty of the city drew its residents here; but in many ways, there is little other common ground between them. It is a welcome surprise that the light rail project has met with only minimal objection and has garnered impressive support from all sides, down to the grass roots level. This achievement did not come about by chance. A concerted community relations program, administered by the project's management, has accompanied all stages of the plan and execution of the project. The main elements of this effort include:

- The establishment of Neighborhood Transportation Committees in conjunction with community centers and other local institutions along the LRT route. All plans are presented and discussed in these local forums; residents bring their requests and complaints here for resolution.
- Establishment of a dedicated websites, multimedia presentations, pamphlets, and exhibitions, all available in high profiles at public events, museums, and festivals.
- Distribution of special explanatory materials to individual homes near work sites.
- Extensive meetings and presentations to community groups, schools, associations, business groups, etc.
- Press briefings, tours, and promotions that keep the light rail in the public mind before the actual appearance of trains or tracks.
- Placement of explanatory construction signing at all work sites.
- Meetings with special needy groups such as the disabled to check designs.
- Thanks to these efforts, the optimism accompanying the development of the Jerusalem light rail project has weathered stormy times and remains strong. If the project succeeds in achieving the ambitious goals it has set for revitalization of the city and increasing the level of accessibility for the city's residents, it will be in no small part due to the efforts to include community relations and input as an integral part of the planning process.

From the practice of Jerusalem, someone can understand that, how the input of stakeholders and communities is influential on the route selection and priority of LRT. Therefore, giving consideration for the input of the community on the design, route selection, etc. helps for the acceptable implementation of LRT in the city. Generally, the above-stipulated practices of community participation in Sydney's LRT implementation could possibly be fully applied or partially for the city of Addis Ababa and its positive impacts may be revealed.

The City of Sydney

As stipulated in Sydney's Light Rail Future (2012:20-21), the development of Sydney's Light Rail Future has drawn on extensive research and stakeholder consultation, which has been carefully considered. The following points are discussed from Sydney's LRT practice:

Sydney Light Rail Round Table

The Sydney Light Rail Round Table and its working groups have engaged in discussion and information exchange on topics related to the development of Sydney's Light Rail Future.

Forming the Round Table, this enables stakeholders to have input to the development of Sydney's Light Rail Future. The Minister invited representatives and organizations located in, or associated with, the Study Area to be members of the Round Table. They included councils, health and education providers, events and recreation precincts, as well as government organizations and select representative organizations. The Round Table was the primary forum for engaging with key stakeholders, bringing together executive level members of relevant agencies and institutions to provide regular updates on the progress of the project, and to receive local expertise and feedback at key project milestones. The Round Table was supported by a series of Technical Working Group meetings. The Sydney Light Rail Round Table influenced a number of elements of the project, including:

1. **Project objectives:** Feedback was received on the draft policy aims and project objectives at multiple meetings, which subsequently informed the development of the final project objectives, and criteria against which route options were assessed.
2. **Customer needs:** Organizations provided detailed information outlining current and anticipated travel needs, which helped to inform Sydney's Light Rail Future.

3. **The Study Area:** Stakeholders offered advice about their plans for future development, which were taken into account.
4. **The long list of route options:** Stakeholders provided feedback and input to the long list of route options considered.
5. **Refinement of route options:** Some route options were amended or added based on stakeholder discussions. An additional route segment option was added.

The above practice shows that, giving consideration for the community, these may be different organizations and business groups enables for right and accepted LRT implementation. Some of the stipulated practices of Sydney could possibly be fully applied and some others partially for the city of Addis Ababa. Therefore, the public officials should give attention and due regards to the concerns of subject societies in deciding preferable routes so that optimum operation and management goals may achieve. Based on this, AACRA and ERC have respective responsibility in organizing forums of discussions and procedures to create this type of environment among concerned communities. In general, efficient operation and management of integrated road and LRT system will achieve through discussion and sharing of ideas with representatives of concerned communities' right from planning to implementation stages of LRT.

CHAPTER THREE

THE RESEARCH DESIGN AND METHODOLOGY

In order to evaluate the integration of the rail and road sub-sectors in Ethiopia/Addis Ababa, an appropriate research methodology has been designed in this research. This chapter discusses procedures and activities to be undertaken, research design, interviews development and data collection, data analysis and interpretation.

3.1. The Research Procedures and Activities Undertaken

Evaluation of rail and road sector integrations in planning, construction, maintenance, traffic network and flow plan (Case study of Addis Ababa), encompasses many activities such as proposal development, literature review, research design, interview development, data collection, finding appropriate references, visiting of sites and discussing with managers and engineers, data analysis obtained from interview.

3.2. Research Design and Methodology

The research design enables the researcher to answer the basic research questions. The choice of the research design depends on the objectives of the study, the available data sources, the cost of obtaining the data and the availability of time. The purpose of this research is evaluating the coordination between the railway and roadway offices in the case of the Addis Ababa LRT considering the current conditions and then proposes preferable practices for adaptation by using qualitative data. Therefore, an exploratory research method has been employed since it was presumed to fulfill the purpose of the study. The research is conducted to gain background information and for better understanding of the problems and to provide insight into a given situation.

3.2.1. Sample and Sampling Techniques

The Federal Democratic Republic of Ethiopia (FDRE); MoT, ERC, AALRT Project Office and the AACRA were selected for interviews to acquire appropriate data through effective conduct of the survey procedure. It is believed that tangible, responsible and clear information

would be obtained within a short period resulting in a viable report, which will satisfy the concerned office for road-rail integration in Ethiopia in general and in Addis Ababa in particular.

3.2.2. Instruments of Data Collection

The issues discussed under the Literature Review and research questions were used as a guideline for the development of an interview.

The questionnaire designed, administered and used were semi-structured; that is, the questions were developed in a particular order. In addition, it was envisaged that discussions would be carried out with interviewees based on their responses; expecting to acquire better qualitative data on the issue.

The interview questions were designed in English and it was conducted both in Amharic and English languages based on the interviewee's willingness and interest. This helps to create proper rapport and to gain better responses from the interviewees.

3.2.3. Methods of Data Collection

It was believed that the use of two or more independent sources of data or data collection methods helps to substantiate the findings in the study. Therefore, the study employed both primary and secondary methods of data collection.

Primary Data Collection

In order to answer the basic research questions and to realize the intended objectives; the researcher gathered primary data from the concerned rail and road sector Engineers, Officials and Managers through face-to-face interviews. The interview method of data collection provided an opportunity of getting reliable data from the respondents. It also provided chances to the interviewer and interviewees to have better interaction, clarification of issues and getting details on the questions and answers. Tape recorder was used to capture all information orally provided by the interviewees; this has helped the researcher to give full attention to the respondent. Additionally, site observations were conducted.

I. Secondary Data Collection

The study employed secondary data collection method at the Federal Ministry of transport, ERA, ERC and AACRA documents, AALRT Preliminary design documents, International standards and manuals, other countries' experiences, browsing websites. Besides, books, journals, published and/or unpublished research papers, government plan documents were reviewed to make the research reliable and dependable.

3.2.4. Method of Data Analysis

Data analysis is the application of reasoning to understand the data that have been gathered from respondents; and the appropriate analytical technique of the analysis mainly determined by the characteristics of the research design and the nature of the data gathered (Saunders et al. 2009). For this study, qualitative research method is employed, therefore the data collected from primary and secondary sources were systematically organized and summarized with proper description.

3.2.5 Validity of Instruments

Validity is the soundness or rationality, whether the findings are really about what they appear to be or the degree to which results obtained from the analysis of the data actually represents the phenomena under study. The validity of data gathering instrument is confirmed by the ability and willingness of the respondents to provide the information requested. In order to make the interviews valid, relevant and objective to the problem; it was properly commented by the advisor, and were corrected and refined.

Lastly, the improved interview questions was used for primary data collection. The designed interview can help to evaluate the Road-LRT integration currently and in the future. It also enables to mention the way and benefits of the sub-sectors' integration.

3.3. Ethical Considerations

All the research participants included in the study were clearly informed about the purpose of the study and their willingness before the beginning of conducting the interview. Regarding the right to privacy of the respondents, the study maintained the confidentiality of the identity

of each participant. In all cases, names were kept confidential and instead, collective names such as 'the respondents', 'the participants', 'the interviewees', etc., were used in the study.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1. Introduction

This section discusses the results of the study based on the research tools presented in preceding sections of the report. The purpose of this study is to evaluate the rail and road sector integrations in planning, construction, maintenance, operation and management for the case of Addis Ababa. Primary data were obtained from concerned officials, managers based on semi-structured interview and the secondary data (books, standards, procedures, practices of other cities, documentations, and internet) were collected from concerned organizations.

4.2. Characteristics of the Interviewees

Characteristics of the interviewees mainly focus on the demographics of the respondents such as sex, education, sector experiences. In this regard, the selection of the interviewees was based on their profession and responsibility in their respective offices. Table 4.1 depicts details on interviewees.

Table 4.1 Characteristics of Interviewees

No.	Organi- zation	No. of people interviewed	Year in the Organization		Educational Qualification		Sex	
			Below 2 Years (%)	Above 2 Years (%)	BSc & below (%)	MSc & above (%)	Male (%)	Female (%)
1	Moot	2	-	100	50	50	100	-
2	AACRA	6	16.6	83.4	16.6	83.4	83.4	16.6
3	ERC	2	50	50	-	100	100	-
4	AALRT Project Office	4	75	25	75	25	100	-
	Total	14	35.4	64.6	35.4	64.6	95.8	4.2

The study mainly focuses on the current condition of the rail and road integration in Addis Ababa, thus, clear and reliable responses were required from the officials and professionals in their respective positions and offices. In this respect, the interviewees were taken from four organizations namely, the AACRA, the ERC; the AALRT Project Office, and the MoT. Their educational statuses and positions are important for description. In line with this, most of the interviewees are holders of M.Sc. and some have BSc in engineering and others have adequate experiences in the fields. Therefore, this combination of academic qualifications and professional positions will help to acquire reliable and reasonable data about the issues.

4.3. Infrastructure Integration Practices in General

This section would summarize the general infrastructural integration practices in Addis Ababa based on the actual conditions. Basically, infrastructure includes the road, rail, telecom, electric, sewer and etc.. In this case, it should be stressed that infrastructural integration does not mean the services; rather, it is the construction and installation process of these components. It can be observed that different excavation activities in Addis Ababa are carried out at the centers and across the roads for infrastructural utility purposes. For example digging and excavating, erecting electric poles very close by the roads or on the walkway, cutting the asphalts after roads have been open for services; installing telecom lines, and inserting water and sewerage pipelines are common and easily observable. This problem may have different reasons, but the major factor is lack of integration among government stakeholders. Especially, the road sub-sector offices have direct responsibilities related to the roads reliability, sustainability, safety, serviceability and environmental friendliness. Therefore, to avoid or minimize the undermining of road utility, different proactive and retroactive measures should be taken by the custodian bodies.

In many countries, there are standards and rules to consider provisions for other infrastructural utility installations during road design and construction. Moreover, these rules and standards are prepared by involving concerned bodies based on their short-term and long-term plans and programs. Integration in all infrastructural dimensions like; road, rail, telecom, electric, water, etc., have direct and important impacts on the economy of the country and social values of the affected communities. Therefore, integration of public infrastructure regarding roads, rails and utilities could be overcome by changing the current weak attitudes and by building strong

integration habits. Generally, creating this integrated infrastructural environment, especially in transportation sector requires tremendous efforts and it should be one of the most important responsibilities of ERA in general and AACRA in particular. Finally, it needs to be commended that the ongoing construction of LRT make provisions for installation of electric and telecom tubes, open culverts for future water and sewer pipes along the corridor lines with defined spacing for the purpose of future infrastructural utility. This enables utilization of the infrastructure without any digging and cutting activities to cross the road, rather installing or inserting the wires or the pipes in the provided openings.

4.4. Integrating Light Rail Transit into the Roads of Addis Ababa

4.4.1. Planning

In relation to the planning of Light rail transit and road network in integrated manner, this paper tries to find written documents likemagazines, brochures and feasibility studies regarding AALRT. In addition to the written documents, semi-structured interviews were done with officials and professionals of the Federal Democratic Republic of Ethiopia (FDRE) MoT, AACRA , ERC, and AALRT. Findings in this regard are presented below.

Short-term Plan

Short-term plan of transportation in most countries is a plan set to solve the existing transportation problem or to do counter measures to prevalent transportation problems. In this regard, the Ethiopian Government decided to construct the Addis Ababa Light Rail Transit Project to alleviate the current traffic congestion. At this time, the LRT construction has progressed above 70%. During data collection, the main challenge was to obtain a document that contains this short-term plan of the AALRT project. Even though the project is included in the Growth and Transformation Plan (GTP) of the Federal Government, it is not possible to access the document since it was not readily available. Hence, to overcome the problem, interviews were carried out. As the responses displayed, there was a big gap in integrating the road and rail network plans. Based on the responses, the destruction of newly built roads for example; the middle lanes of the roads from Meskal Square to Kality and from Meganagna to CMC were destroyed. It seems it was not foreseen that the AALRT construction would come into action within this short period. However, the AACRA had information on the coming of AALRT; that is why the middle lane was constructed with single asphalt layer considering the

short period service. Nevertheless, the AALRT Project started implementation before the expected time, and this condition caused the destruction of the middle road within the provision of little service. Here, it can be presumed that if there was a short-term plan of LRT, the AACRA would have never built the road in the first place but rather the place will be reserved for future LRT construction.

During this research, it was found that AACRA has a short-term plan until 2017, but ERC has not a plan in relation to light rail project. As the interviewees have confirmed it, the ERC is constructing light rail project based on the AACRA interest of mass transportation route direction, rather than planning in harmony. However, the experiences of other countries reveal that, they have one unit/department that creates integration of route networks, selection of mode of transport, operation and management of transportation system and implementation of integration plans. These enable to avoid or minimize plan variations in road and LRT construction.

According to the responses of AACRA officials and professionals, the study of implementing the operation of the BRT system is on the process. The Mayor of Addis Ababa gave a statement, “the B2 BRT corridor should be completed by September 2016” (PMU, 2014:1). However, another challenge may happen since the AALRT is under construction, and it will be completed before the construction and implementation of the BRT corridor is finalized. From this, it can be presumed that there might be difficulties in the near future to integrate the B2 BRT with the LRT system, especially in station design and location. In this regard, the researcher believes that the planning and construction of LRT and BRT should be done in integrated manner for effective, efficient and sustainable transportation; at least, the implementation of LRT should consider the upcoming of BRT corridor and thus provide and establish the necessary requirements.

Long-term Plan

Long-term plan of transportation indicates that the planning of transport routes and modes should consider social, economic and cultural changes based on population and development forecasting. It is optimum to plan with the integration of different private and government offices and organizations. The long-term plan of road and rail network in Ethiopia will require communication and cooperation with the: Central Statistical Agency to get population forecasts; City Land Use Administration to reserve right-of-ways; City Urbanization and

Development Offices to know future settlement places; and ERC and AACRA Offices to plan and determine road and rail routes and to reserve right-of-ways for LRT construction.

Most cities in other countries have integrated long-term plans of transportation systems. This helps them to get reserved areas or to avoid further expansion and construction of buildings and homes within the road and LRT right-of-ways due to urbanization. In view of the above, any further construction should consider cities' road and rail network right-of-ways. However, based on the interviewee's responses, neither AACRA nor ERC has a long-term plan in relation to the AALRT transportation services or no source has been found in this regard.

In view of the foregoing, it seems that there were weaknesses in preparations of integrated road and light rail transit plan for AALRT implementation. To improve this, the city administration of AA should put a direction of integrating the two sectors for the preparation of well-studied and integrated short-term and long-term plans of the city's transport system.

4.4.2 Design

If there is planning integration between road and LRT, then it, eases integrated design and construction of road and light rail. Since the design considers the plan and the construction implements the design to the ground. According to the interviewee from the AACRA and AALRT project office for alleviating traffic problems at interchanges and crossovers the two sectors has established integration. Even if there is no long-term plan related to the integration between the road and light rail, they have designed in common at the interchanges and overpasses. Especially, around the interchanges and bottleneck areas the road and rail sectors design together for better serviceability.

This integrated design at special areas help AACRA to construct the road side by side along the construction line of LRT. This has been observed that construction of road is underway along the implementation section of LRT and the main construction part is completed in most sections. Even though there is a gap of planning in integration, the current construction of road and LRT line at the same time and in integrated manner helps to minimize the economic and social losses. The following pictures taken during the site observation, partially shows this condition.



Figure 4.1 Integrated road and LRT design

4.4.3. Construction

Construction is an implementation of a plan into the existing ground and it should always come after the plan and before the operation. Construction of road or rail corridors, especially in cities, results in interruptions of existing transportation systems at different degrees. In relation to this, due to the current LRT construction activities, various types of problems were observed regarding the road transportation operations. To corroborate this, on the road sections from Kaliti to Gottera and from Megenagna to CMC, vehicles were facing challenges to return on the opposite direction within a short distance since the turning points were closed for LRT construction. Extra travels to get returning places cause increases in

vehicle operating costs (fuel consumption, spare parts, tire wears, depreciation, etc.) of the vehicles. Based on observations, these costs were estimated as follows:

- the average forward and return distance at Saris location is 3.6 km;
- average daily number of vehicles returning at that point is 2244; the data collection is based on the following table.

Table 4.2 Number of vehicles at turning points (counted for 30 minutes 15 before and 15 after the mentioned time)

counting time		no of all types of cars	average	30min average	daily (12hrs) average (12hr*2/hr)*1.35*average no of 30 min
	at				
Morning	7:00:00	57	66.75	69	2243.7
	8:00:00	75			
	10:00:00	64			
	12:00:00	71			
afternoon	14:00:00	70	71.75		
	16:00:00	77			
	18:00:00	81			
	19:00:00	59			

- taking a medium car as a representative vehicle, the average operating cost of this vehicle is about Birr 5.70 per km (using the average operating cost from different models);
- the total amount of daily operating costs of vehicles returning at this point becomes $(5.7\text{birr/km/car} \times 2244\text{car/day} \times 3.6\text{km} = 46,046\text{birr/day})$. If the condition at this point continues for a month it costs about one and half million Birr and any addition of such point results in doubling or tripling of the costs.

These incremental costs results in decreasing the income of road users and the country to provide hard currency for importation of fuel and spare parts. To minimize these problems, ERC and AACRA should effectively coordinate to come up with joint solution and direction.



Constructed road, Bridge and LRT at Urael



Constructed round about road and over pass LRT Bridge at Mexico



Constructed road and LRT line from Urael to 22

Figure 4.2 Road and LRT Construction

According to the interviewees and observations, it was also found that there are weakness and strengths in integration during construction of the LRT and roads. Starting from the strengths, there were construction of roads side by side along the LRT construction corridor, especially at the interchanges and overpasses, the road and rail lines are jointly designed the AACRA and AALRT project professionals and construction is undertaking at the same time by their respective contractors. The other strength seen during these construction is, the AACRA's decision to solve the right-of-way problem permanently along the LRT corridor, keeping the road width to be 40m. When coming to the weakness, during construction of road and LRT corridor side by side, inability to finish construction of the road in line with the LRT construction results in exacerbation of the traffic problem around that area.

4.4.4. Operation and Management

Operation and management department of transportation system have a mandate on the activities of maintaining road and LRT lines, monitoring and controlling traffic flow, taking measures during accidents, protecting the right-of-way of the road and LRT lines. According to (Ezzedine et al, 2009:2), the crucial element of successful integrated transportation system is the result of managing and operating in an organized manner for all types of transport modes.

This Study has tried to gather the current directions regarding the operation and management of the forthcoming dual Road and LRT public transport system. The interviewees from both sides (AACRA and ERC) responded that, the operation and management system of the LRT is under study. According to the LRT Project Progress Report (2014), the construction of LRT will be completed in January 2015 just after 5 months. Other countries' experiences show that the plan and direction of operation and management system for the public transportation should start at the design completion and commencement of construction. However, inability of finalizing the operation and management system may reveal that the concerned body is not giving full attention or it may show lack of empowerment.

Since the above weaknesses have been manifested in Addis Ababa projects, AACRA and ERC should be prepared to provide an acceptable and modernized public transport system for the passengers. The comfort and attractiveness of passenger transport systems depend largely upon the quality of transfers at interchanges between public transport vehicles and private cars. So, the crucial element of successful integrated intermodal transport system is the coordination of travel schedules, and synchronization of arrival and departure times between modes as much as possible to minimize passenger travel and waiting times. Concerning this, Ezzedine et al (2009:2) states that the impressive advances made in computer technology, telecommunications, decision support tools and methods are playing a crucial role in the promotion of public transport. Arrangement for informing travelers about existing transport possibilities in order to allow them to define and plan their movement, giving access to information and quality infrastructure to find out what mode of transport is available, and arranging reserved parking places contribute to a successful integrated transport system. The previous description shows that integrated transport systems are customer-oriented that makes them attractive. Nevertheless, to offer citizens comprehensive seamless mobility, advanced

operation and management systems are required combining different decision and informational support, especially to help the operator that is responsible for the traffic regulation. Due to these and other reasons, ERC and AACRA or the City's administration body might need a common discussion and decision to minimize future operation and management challenges and ambiguities.

The AACRA and ERC interviewees feared that, if the construction is completed based on the current progress, the operation and management would face inescapable challenges. It takes time to organize, direct and train the operation and management department staffs and in relation to these and other weaknesses, some interviewees responded that there might be a chance that the city administration might outsource the operation and management of LRT, which is currently on the way of discussion.

4.5 Community Relations

Creating awareness about the coming of LRT into existing road transportation system and discussing its positive and negative impacts with communities will lead to successful operation and management of the public transportation in general and LRT in particular. However, both ERC and AACRA have not decided on any direction of doing this issue. The AACRA and ERC have respective responsibility in organizing forums of discussions and procedures to create clear figures among communities. In general, efficient operation and management of integrated road and LRT system will achieve through discussion and sharing of ideas with representatives of concerned communities' right from planning to implementation stages of LRT. The practice of Jerusalem and Sydney discussed in chapter two strengthens this issue.

4.6 Challenges/Barriers of Integrating the Road and LRT System in Addis Ababa

During data collection and document review, different barriers that inhibit to integrate the LRT into the city streets were identified and some of these barriers are presented and described here under.

Unavailability of experienced professionals: - Since the implementation of LRT is new in Ethiopia, no professionals were trained on intermodal and integrated transportation system. This situation obliged the ERC to hire external consultants and contractors to develop

planning, designing and construction documents but with lower interference of local professionals. This action did not even give much opportunity for knowledge transfer to local professionals.

Lack of standards and specification:- In other countries, there are standards and specifications for any new road or LRT plan that a city should fulfill. This helps to plan and build LRT and adjoined roads in accordance with the standards avoiding the destruction of existing infrastructures during implementation. This practice is nonexistent in the Country.

Weak planning habit: - During conducting interviews and document collection, it was found that the practice of planning with consideration of the future is low. The discussions with the Interviewees revealed that, planning by considering tomorrow's transportation and technology demand is not adopted, rather doing what is currently required is the common practice. This creates problem when the new system is to be integrated with the existing transportation system. Consequently, correcting the problem will be costly or leaving the way it is will be wastage of resources.

Separated organizational structure of LRT and road system:- Other cities have responsible bodies regarding urban public transportation. This body usually has a responsibility of planning, identifying appropriate public transportation mode, integrating the road and LRT networks, setting objectives and goals for the future by considering all types of transport modes, controlling traffic flow systems, etc. However, the case in Addis Ababa is, roads are owned and administered by AACRA while LRT is planned and supervised by ERC, with little or no synchronization of planning and operation of the City transportation system. This condition creates communication gap in integrating the LRT into the existing the Addis Ababa road transportation system.

Absence of local consultants and contractors in the sector:- Regarding the current LRT implementation practices, the main consultant and the contractor are from abroad. These companies may not be so concerned as local companies on sustainability and the effectiveness of the implementation; rather, they focus on maximizing their financial benefits and advantages. Moreover, they implement what is decided by the government without detailed investigation of the impact of the implementation on future development of the city. This issue was raised by both AACRA and LRT as a drawback to the countries envisioned technological advance.

Political Leader's ability:- In this regard, the interviewees explained that there are weaknesses in directing and arranging the way forward in developing cities in Ethiopia in general and Addis Ababa in particular, including the preparation of a transportation master plan. That is why, the preparation of the long-term plan of the road and LRT network of Addis Ababa has not been materialized yet, except putting phase II LRT general route direction.

4.7 Benefits Due to the Presence and Losses Due to the Absence of Integration.

4.7.1. Benefits

Integrating LRT and the Addis Ababa road system has tremendous advantages in the provision of the City's transportation services. According to WAPC (2012:60), integration of mobility system will enable the provision of safe transportation scheme, integrated transport and land use planning, recommend solutions for managing congestion within acceptable levels, reducing greenhouse gases emissions, minimizing environmental pollution and negative effects of climate change. Besides, they could contribute to the economic growth and wellbeing of the community, contribute to air quality and other quality of life in the city, improve transport infrastructure by providing economical transport solutions and minimizing cost to the users. For these reasons, integrating the LRT into the road transportation system of Addis Ababa is highly likely to minimize the current traffic congestion and public transportation problem and it may improve the appearance of the city.

4.7.2 Losses

There are quantifiable and unquantifiable losses.

Quantifiable Losses

If there is no coordination between ERC and AACRA, the destruction of already implemented infrastructure could happen. For example, the construction of the road around Lideta Supreme Court area was completed around 2011. Similarly, the roads from the Meskal Square to Kalitiy and from Megenagna to CMC were completed between 2009 and 2010. All these sections had served less than four years. Normally, asphalt roads have a minimum service life of 10 or above years. However, all the center lanes (around 7m width) of the above section roads were destroyed beginning 2012. These sections had cost the country millions of Birr

without giving the expected services. To explain this clearly, the average construction cost of one km of asphalt road with 7m width is 8-10 million Ethiopian birr. For example, the length of destroyed section from Maskal square to Kality is about 10km. Therefore, the total cost of this destroyed section is estimated at about ETB 90 million. It should be emphasized that costs are accounted for not only for construction but also for destruction.

The exact estimation of detailed losses is difficult since getting the construction unit rates of the time was not possible and these costs vary based on the topography, type of soil, etc. Even though calculating such costs is difficult, listing the main quantifiable cost may help readers to deduce the losses due to lack of integration. Hence, some of these losses are costs of construction, costs to destruction, costs to dispose the destructed material, and fuel and other variable costs of the vehicles due to the interruption of traffic flow during construction and destruction.

Unquantifiable Losses

Regarding the unquantifiable losses, these are directly related to the economic, social and political aspects. The financial costs incurred on the destruction of the infrastructure could have been used for social well-being such building of schools and health centers. In addition, during the construction and destruction of the infrastructures there were noise pollution, time loss, degradation of neighborhood social amenities, repetitive construction on the same segment disrupting social mobility, etc. are some of the unquantifiable losses due to lack of planning and effective infrastructural integration.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, conclusions and recommendations are presented based on the findings of the study.

5.2 Conclusions

This study was carried out for the evaluation of the integration between the road and LRT system in Addis Ababa in respect of planning, construction, operation and management. The study has dealt with demographic and professional profiles of the study participants such as; present designation, year of service in the organization, educational qualification and sex. Infrastructural integration practices in other countries in general and in Addis Ababa in particular were discussed. In this respect, integrating LRT into the Roads of Addis Ababa, community inputs in integrating road to LRT system, challenges and benefits of integrating the two sub-sectors and quantifiable and unquantifiable losses have been also discussed.

The AACRA interviewees know/accept the integration between all types of infrastructural units is necessary for sustainable transportation system in Addis Ababa, even though they recognize their weakness to do this.

The findings of this study revealed that long-term planning is not adopted within AACRA. This causes for the destruction of built roads without giving the expected services. ERC mainly focused on the planning, design and construction of AALRT along the AACRA proposed lines. However, integrating the LRT stations with the existing and future bus stations is not done in common. In addition, joint discussions regarding grade crossings and traffic flow management were not carried out.

According to the respondents, the implementation of LRT within a short period was immediate and unexpected for the AACRA professionals. This is one of the cause for the destruction of newly built 7m width middle asphalt road from Kaliti to Meskal Square and from Megenagna to CMC.

Based on practices obtained from other cities, implementation of an infrastructure should be in line with long-term plan. This means, current infrastructural implementation practices should consider tomorrow's plans by referring to long-term plans. Planning of road and LRT networks and stations were not undertaken in an integrated manner. In addition, there were also weaknesses in integration between the current LRT construction and the existing road system.

Regarding the An office or enforcing body for the operation and management of LRT is still not determined, even though the construction of LRT will be completed after five months that is by January 2014. The establishment of a body that will operate, manages and maintain the LRT line should have been done before completion of the construction. If the construction is completed based on the plan, the operation and management will face inescapable challenges. It will take time to establish an office, and train the required staffs. According to the interviewees, the city administration is on the way of outsourcing the operation and management of AALRT and discussion is ongoing even though it is too late now but "better late than never"..

Assessment of other world cities' experiences show that, any implementation of LRT infrastructure should consider upcoming new road infrastructures. For the case of Addis Ababa, the implementation of current LRT does not consider the coming of BRT B2 corridor. Hence, inconsideration of the upcoming BRT with LRT implementation indicates shortcomings of long-term plan. Consequently, this failure exposes the BRT B2 corridor implementation to different challenges and difficulties especially, in station design and location when integrating into the LRT station.

Finally, lack of integration between the road and LRT system may result in quantifiable and unquantifiable losses. Regarding quantifiable losses, the destruction asphalt road, haulage of unusable destructed materials, etc. will cost a significant amount of money. There are also unquantifiable costs such as noise pollution during construction and destruction, time taken to construct and destruct, etc. These losses indicate that before implementation of any type of infrastructural facility, especially road and rail corridors ensuring the sustainability of the infrastructure is crucial.

5.3 Recommendations

Integrating the LRT into the existed city transportation system is advantageous and unquestionable; however, it needs a coordinated and an organized implementation system. Thus, in line with the findings of the study, recommendations are forwarded as follows:

1. The integration practice of the responsible infrastructural institution is weak compared to other countries. So, emphasis should be given to integration of all types of infrastructures.
2. The AACRA and ERC are responsible for the construction of roads and LRT in Addis Ababa respectively. However, giving all planning activities related to cities road network and LRT corridor implementation to one body is highly commendable. Most cities in the world have this type of transportation department with the responsibility of planning, identifying corridors for implementation, proposing short- term, long- term and integrated master plan of the city's transportation system based on traffic forecasting.
3. The AACRA, ERC or any other concerned governmental bodies should give emphasis to do the long-term plan of the city roads and LRT corridors. This can minimize the economic, social, and other losses, since all implementation uses the long-term plan as a guideline.
4. In most other cities, there are standards and specifications to satisfy minimum requirements of road or LRT implementation. . This avoids the right-of-way issues and different disruptions for utility purposes after the road or LRT construction has been finalized. Therefore, preparing standards and specifications by organizing the sub-sector offices is advisable.
5. Investigation of quantifiable and unquantifiable losses due to lack of integration, helps to understand the benefits of integrating the system and it initiates the concerning bodies or the planners to give emphasis on the integration of road and LRT system. So, investigating the losses and benefits due to the absence or presence of road-rail integration is important and thus recommended.

6. Based on assessment of other cities' experiences on transportation modal integration, they have established a mandated department that plan, operate, manage and implement transportation systems. Therefore, the Addis Ababa City administration should have to investigate other cities' experiences and establish an appropriate organizational structure for achievement of an effective and efficient operation of integrated transportation systems.
7. According to the findings of this study, there is a shortage of knowledge and experienced personnel to integrate the LRT operation and the road transport system. Therefore, AACRA and ERC should initiate means of acquiring well-trained and experienced professionals through local or overseas trainings.
8. Outsourcing the operation and management of LRT is highly commendable. However, planning, programming and policy formulation should be the responsibility of the proposed department within ERC. Moreover, this may create a chance to the Ethiopian professionals to develop and gather experiences for the future.
9. The document review reveals that, different cities give emphasis for community participation in different aspects of integrated transport implementation, and they have benefited from this. This shows that the concerned body for transportation system in Addis Ababa should give attention for community inputs and thus highly recommended.
10. Finally, making intensive research works on integrating all modes of the City's transportation system is crucial and it enables to generate and provide broad recommendations.

5.4. PROPOSED FUTURE RESEARCH AREAS

The focus area for this study was on evaluation of the integration of the road and LRT infrastructure and operation systems. Hence, future research works could focus on integration of all types of the city transport infrastructures and come up with specific findings that will contribute to effective integrated urban transportation system and alleviation of outstanding integration problems and issues. With this understanding, the following research areas are proposed for future studies:

1. Preparation of guidelines for establishment of integrated transport infrastructures and provision of effective, efficient, sustainable and environmentally friendly operational services ;
2. Potential challenges in integrating the AA Transportation Infrastructures and operational services;
3. Rational organizational structures to facilitate an integrated and sustainable transportation services in AA;
4. Preparation of integrated BRT and LRT station design parameters;
5. Preparing an integrated operation and traffic management strategies for AA transportation operations; and
6. Identifying the positive and negative impacts of LRT technology in Ethiopia in general and in Addis Ababa in particular.

REFERENCES

- Addis Ababa City Road Authority (AACRA), (2014), Special Edition Magazine, Addis Ababa: AACRA Publications
- Winder, A. & Morin, J. (2009) Transport Research Knowledge Center: European Commission Bankable Feasibility Study for Addis Ababa Light Rail Transit (AALRT) Project, 2009
- Barr y, M. (1991) Through the Cities: The Revolution in Light Rail, Frankfort Press
- Daniel, R. and Render, M. (2004) Transportation Research Circular E-C058: 9th National Light Rail Transit Conference
- DIMTS, (2014) Delhi Integrated Multi-Modal Transit System, Feasibility and Operational Planning Study of Bus Rapid Transit (BRT), B2 Corridor, Addis Ababa
- Ethiopian Railway Corporation (ERC), (2013), Babur magazine, Volume 1, No. 1
- Ethiopian Roads Authority (ERA), (2008), Rural Transport Infrastructure, Addis Ababa.
- Ezzedine, H., Bonte,T., Kolski, C. & Tahon, C. (2009) Integration of traffic management and traveller information systems: basic principles and case study in intermodal transport system management. (University of Valenciennes)
- Fantahun Tesfaye (2012) Integrating Public Transport Networks and Built Environment: The case of Addis Ababa and experiences from Stockholm, Stockholm
- GINN, S. (1998) Overview of Light Rail Technology and Its Potential Within Australian Environment, Prepared for Western Australian Planning Commission
- Government of India Planning Commission, New Delhi, 2006
- Green light for light rail, (2011) Transport Department, London, [Online], Available: <http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c3en.html>
- Hotz, P. (2000) Integration of Light Rail in the Limited Space of Urban Roads
- Ibrahim Worku (2011) Road Sector Development and Economic Growth in Ethiopia

- John B. (2004) Improving public transport in England through light rail, Report by the Comptroller and Auditor General (RCAG), HC 518, Session 2003-2004: 23 April 2004
- Hubbell, J. and Colquhoun, D. (2006) Light Rail Transit in Calgary, The First 25 Years Presented at the 2006 Joint International Light Rail Conference; St. Louis, Missouri: 2006 April 8 – 12
- Microsoft Encarta Premium: 2009
- Newman, P. and Kentworthy, J. (1999) Sustainability and Cities: Overcoming Automobile Dependence, Island Press: Washington DC
- Official Website of Ethiopian Railway Corporation, Ethiopia, [Online], Available: (<http://www.erc.gov.et>)
- PMU, (2014) Feasibility and Operational Planning Study of BRT B2 corridor
- PROCEED, (2009) Principles of Successful High Quality Public Transport Operation and Development
- Public Transport for Perth, Department of Transport: Western Australia Perth, 2011.
- Rodrigue, J., Comtois, C. & Slack, B. (2009) Geography of Transport Systems, Second Edition; New York: Routledge
- SYDNEY'S LIGHT RAIL FUTURE Expanding Public Transport, Revitalizing Our City: December 2012
- SYSTRA Consulting, Aarhus LRT, Denmark: 2012, [Online], Available: <http://www.systra.com>
- The Benefits of Light Rail, 2014, [Online], Available: (<http://www.ottawalightrail.ca>)
- The Guidelines for Preparation of Integrated Transport Plans, Western Australian Planning Commission, 2012.
- Tibest Tefera (2012) Addis Ababa Transport Overview, Presentation on Regional Workshop on Promoting Sustainable Transport Solutions for East Africa, August 2012, UNEP Head Quarters, Nairobi, Kenya

Transportation Master Plan, City of Edmonton (TMP, 2009)

William W. (1977) Introduction to Transportation Engineering, 2nd edition

UN HABITAT/ PMU (2014) Feasibility and Operational Planning Study of BRT B2 Corridor
for Addis Ababa

US Department of Transportation: Fiscal Year Strategic Plan (2012)

APPENDIX

INTERVIEW QUESTIONS

1) For ERC and AALRT Officials and Professionals

- 1.1 What is the reason for AALRT implementation into city streets?
- 1.2 Is there any prepared plan before of implementing LRT before coming to action? What about the practice of short and long term plan in your office?
- 1.3 Is there any guidelines and standards for planning and implementation of LRT?
- 1.4 How your office and AACRA integrate the plan of your LRT line and road line? Is there any guidance or procedure to plan cooperatively?
- 1.5 Does your office have short term and long-term plan?
- 1.6 How is the current design and construction of AALRT and road undertaken? Especially at the interchanges and overpasses, how you two communicate and coordinated?
- 1.7 We have seen that, nearly built asphalt roads were destructed. Why it was happened? Why the area was not reserved for the coming LRT?
- 1.8 Who is responsible for the operation and management of LRT in AA? Are there any guidelines prepared for this purpose?
- 1.9 Is there enough preparation to handover new technology of LRT?
- 1.10 Is there any possibility that LRT and road system can be under the management of unit office?
- 1.11 Do you have any important idea regarding to the issue?

2) For AACRA Officials and Professionals

- 1.1 How did you get the coming of LRT into the city roads?
- 1.2 Do you have short-term and long-term plan? Is the coming of LRT is based on your short Long- term plan?
- 1.3 We have seen that, nearly built asphalt roads were destructed. Why it was happened? Why the area was not reserved for the coming LRT? Did you have not any information or direction when your office construct on the railway wright-of-way?
- 1.4 Is your office estimated the losses due to destruction of the road for LRT construction? How much? If not why?
- 1.5 How the road and LRT system is integrated in the current implementation of LRT into the city road? What about tomorrow's?
- 1.6 Is there any mentioned integration activities in planning, design and construction of road and LRT between your office and ERC?
- 1.7 Are there any guidelines and standards for integrated road and LRT planning and implementation?
- 1.8 How your office and ERC integrate the plan of your road line and LRT line? Is there any procedure of integrated planning?
- 1.9 How is the current design and construction of road and AALRT undertaken? Especially at the interchanges and overpasses,
- 1.10 Who will be responsible for the operation and management of LRT in AA? Are there any guidelines prepared for this purpose?
- 1.11 Are there any weaknesses you believe about the integration of these two transportation system?
- 1.12 Is there any possibility that LRT and road system can be under the management of unit office?
- 1.13 Do you have any important idea regarding to the issue?

3) For MoT Officials and Professionals

- 1.1 What is the main responsibility of your office regarding to the Addis Ababa road and LRT?
- 1.2 What is the main reason for the coming of LRT to the Addis Ababa city?
- 1.3 How is the coordination between AACRA and ERC on implementation of LRT to the city streets?
- 1.4 Is there any guideline of sustainable transportation system that helps for integrated planning of road and LRT system? How the road and LRT system is integrated in the current implementation of LRT into the city road? What about tomorrow?
- 1.5 We have seen that, nearly built asphalt roads were destructed. Why it was happened? Why the area was not reserved for the coming LRT? Are there any direction put to minimize future destruction?
- 1.6 Is there any prepared integrated transport network that guides the current implementation of infrastructure?
- 1.7 Is there any prepared standards road and railway implementation? If not, why you fail from preparing it?
- 1.8 Do you have any important idea regarding to the issue?

Summary of the responses for the interview questions

This summary of response is prepared by collecting similar questions and responses together. Because putting statements each interviewee speaks is bulky and difficult to write here. Since the issue is integration between the road and LRT infrastructure implementation, it is better to gather similar response ideas from different offices under similar questions, hence, it is summarized as follows based on what they want to say.

What are the reasons for AALRT implementation into city streets?

- Solving the city traffic congestion,
- overcoming the public transportation problem
- It may add/create additional beauty in the city

Do you have short-term and long-term plan? Is the coming of LRT is based on your short Long- term plan?

- AACRA have short-term plan, and didn't consider the coming of LRT in its short and long-term plan, ,
- ERC have general plan, simply they have a plan of extending the implemented LRT Corridor, they mentioned their age of establishment as a reason for their shortcoming of the detailed long-term plan.

Reasons for the absence of this type of plan,

- Weak habit of good planning,
- lack of well experienced planners,

Is there any guidelines and standards for planning and implementation of LRT?

- No guidelines, no standards

How ERC and AACRA integrate the plan of the LRT line and road line? Is there any guidance or procedure to plan cooperatively?

- No such good integration, but they are trying to do in common at least around at intersection, interchanges, crossovers.
- They have made common discussions on the interchanges and overpass design.

- They form a committee called PMU (Project Management Unit) to solve such difficult areas under the supervision of AACRA
- They have not determined guidance/procedure rather they communicate when the issue arise.
- Some of the interviewees mentioned that integration habit between governmental office is weak at country level.

We have seen that, nearly built asphalt roads were destructed. Why it was happened? Why the area was not reserved for the coming LRT?

- The coming of LRT is not known before starting construction of the road
- Coming of LRT is known at the middle of asphalt road construction, the only solution taken at that time is making the asphalt layer single.
- Implementation of LRT is unexpected and immediate after its thinking
- Not enough experience or knowledge about the LRT corridor to leave enough space.

Who is responsible for the operation and management of LRT in AA? Are there any guidelines prepared for this purpose?

- Not known still, not determined, some interviewees responded that it is under study, the others replay shows that it may be outsourced.
- No any guideline or procedures related to this purpose.
- They believe it is too late, they don't have clear picture on who is responsible for the operation and management.

Is there any possibility that LRT and road system can be under the management of unit office?

- They believe that it should be managed under one office. Since it is to fulfill cities transportation demand, either the road or the LRT system should be directed and managed under one body.

Is there any estimation of the losses due to destruction of the road for LRT construction?

How much? If not why?

- No, knowing the loss may be good but they didn't do it.
- Construction cost of the demolished road might be known, but it gave some service, so the loss may need some calculation, they didn't calculate it.
- Some interviewees asked that, the loss may be in million, but, what the importance of knowing such past things is.

How the road and LRT system is integrated in the current implementation of LRT into the city road? What about tomorrow's?

- No such good integration between the road and LRT.
- The LRT It is designed separately and implemented, however, at the interchanges and round about the design is revised by the LRT and AACRA consultants by common discussion.
- Regarding tomorrow's integration, nothing is known in formal way between these offices.
- AACRA interviewees responded that LRT has general Plan of extending the LRT corridors, due to this it is not possible to good consideration of the coming of LRT.
- "Giving the LRT planning, implementing and operation may solve this integration barrier" said one of the interviewees from AACRA.

Are there any weaknesses you believe about the integration of these two-transportation systems?

- Yes, many problems are existed. No common discussion, low habit of well-studied planning, implementing considering the current problem without long term planning,
- Two bodies (AACRA and ERC) for one city transportation system, it creates difficulties for integrated design and implementation of road and LRT.
- Implementing the road without considering what infrastructure comes tomorrow, similarly LRT is implementing without identifying what will be the coming

transportation system. For example, BRT B2 corridor is under study on the side of AACRA, but ERC have no idea about this.

- Generally, the offices believe that long-term plan of city transportation system should be done with great attention of city administration to avoid such conflict of accountability.

Additional responses,

- The contractor is foreign; it is difficult to modify the design or comments.
- No Experiences of LRT transport system before in the city, i.e. learning from error is common, for the future, it may be improve.
- BRT B2 corridor is under study for the next implementation, LRT station design didn't consider BRT station, it's location and capacity.
- Operation and management of the LRT with other public transportation should be managed under one enforcing body and it is not determined yet.

DECLARATION

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of and support of the research advisor. All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or full to any other higher learning institution for earning any degree.

Name

Signature

Addis Ababa University

Institute Of Technology, Addis Ababa

June 2014