PERFORMANCE EVALUATION OF ANBESSA CITY BUS SERVICE ENTERPRISE TRANSPORT SERVICE: THE CASE OF ADDIS ABABA-BISHOFTU CORRIDOR

MSc THESIS

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JUNE, 2018

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A THESIS SUBMITTED TO THE

DEPARTMENT OF CIVIL ENGINEERING,

FACULTY OF CIVIL AND BUILT ENVIRONMENT,

INSTITUTE OF TECHNOLOGY, SCHOOL OF GRADUATE STUDIES

HAWASSA UNIVERSITY

HAWASSA, ETHIOPIA

IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE

DEGREE OF

MASTER OF SCIENCE IN ROAD AND TRANSPORT ENGINEERING

JUNE, 2018

SCHOOL OF GRADUATE STUDIES

HAWASSA UNIVERSITY

ADVISORS' APPROVAL SHEET

This is to certify that the thesis entitled "**Performance Evaluation of Anbessa City Bus Service Enterprise Transport Service: The Case of Addis Ababa-Bishoftu Corridor**" submitted in partial fulfillment of the requirements for the degree of **Master's** with specialization in **Road and Transport Engineering**, the Graduate Program of the **Faculty of civil and built environment, Department of civil engineering**, and has been carried out by **Tamrat Berara Getu** Id. No **PGRO/037/08**, under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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We, the undersigned, members of the Board of Examiners of the final open defense by **Tamrat Berara** have read and evaluated his thesis entitled "**Performance Evaluation of Anbessa City Bus Service Enterprise Transport Service: The Case of Addis Ababa-Bishoftu Corridor**" and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree **Master** of Science in **Road and Transport Engineering.**

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ACKNOWLEDGEMENT

I would like to express my sincere thanks to **Prof. J.P.Narayan** for his constant guidance, encouragement and constructive comment during preparation of this research work.

I want to tank also Ethiopian Road Authority and Hawassa University Institute of technology, faculty of civil and built environment, and department of civil engineering for their support in every aspect. Finally my indebted best gratitude is given to my family and friend for their encouragement and support.

DECLARATION

I hereby declare that this MSc thesis is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

Name: **Tamrat Berara Getu**

Signature: _____

ABBREVIATIONS

ACBSE: - Anbessa City Bus Service Enterprise

APC: - Automatic Passenger Counters

AVL: - Automatic Vehicle Location

CSA: - Central Statistics Agency

D: - Dependent Variable

EC: - Ethiopian Calendar

GIS: - Geographic Information System

GPS: - Global positioning System

IV: - Independent Variable

LOS: - Level of service

M: - Mean

SD: - Standard Deviation

SPSS: - Statistical Package for Social Sciences

TCQSM: - Transit Capacity and Quality of Service Manual

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ABSTRACT

Providing and improving public transport service is becoming highly important to meet the demand of rapidly growing mass mobility due to high population growth and galloping urbanization in and around the city of Addis Ababa. Performance measurement is a popular activity in the transportation sector. Various studies on the performance of transportation systems with the utilization of data analysis have been common. In Addis Ababa-Bishoftu corridor public transport problem related to limited numbers of buses, insufficiency of bus routes, inadequacy of bus stops and operational deficiency are common. This research evaluate the performance of public transport service provided by Anbessa City Bus Service Enterprise (ACBSE) in the selected corridor. The study uses GIS techniques and Statistical (descriptive, correlation, factor and regression) analysis to assess the route network, travel speed, dwell time and passenger carrying capacity of the transport service. It has identified that there is route network gap for the town of Bishoftu and the current transport service in this corridor is poor. In addition to this the study assess the level of satisfaction of customers about the transport service provision of ACBSE in related to selected performance indicators such as frequency, travel speed, price, security, bus comfort, seat availability, vehicle overcrowding, punctuality and safety of the transport service. The study indicates that in the selected corridor there is very limited number of buses, there is high breakdown of buses and existing buses are not operating as per the schedule. Therefore, the service is found not reliable for travelers. Excessive waiting time and long walking distance to reach the service make it inconvenient. Moreover, high overcrowding and lack of seat inside the bus makes it uncomfortable. Correspondingly, the quality of the service is poor and customers are not satisfied about the transport service of ACBSE. In terms of LOS in most case the transport service operates at LOS D and lower. Thus to improve ACBSE transport service for Addis Ababa-Bishoftu corridor this research suggest that the extension of route network coverage for the town of Bishoftu, increase frequency of the transport service, upgrading the ticketing procedure, improving treatment of customers by bus operators and bus priority measures for high traffic congestion areas.

Keywords: Public Transport, Performance Evaluation, Performance Indicators, LOS, Customer Satisfaction, ACBS

1. INTRODUCTION

1.1. Background

Transportation moves people and goods from one place to another using a variety of vehicles across different infrastructure systems. It does this using not only technology (namely vehicles, energy, and infrastructure), but also people's time and effort; producing not only the desired outputs of passenger trips and freight shipments, but also adverse outcomes such as air pollution, noise, congestion, crashes, injuries, and fatalities (David L. et al., 2009).

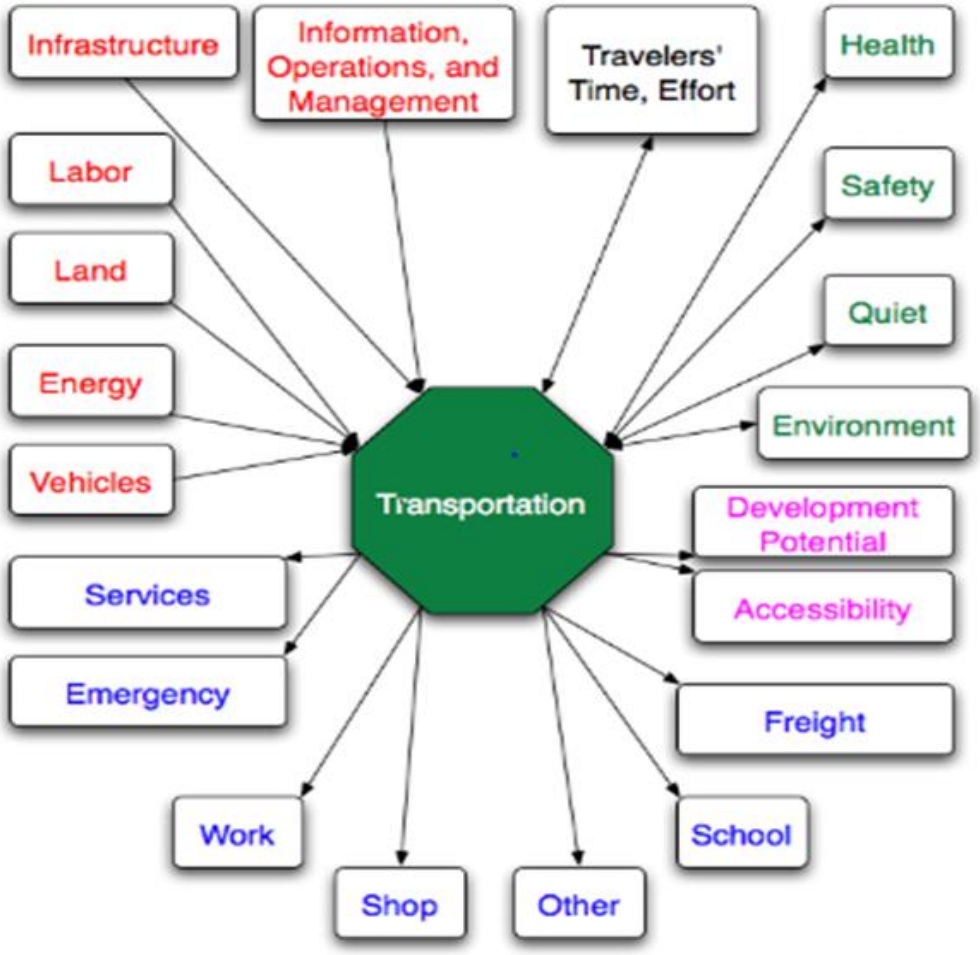


Figure 1.1: Transport inputs and outputs (Source: David L. et al., 2009)

Public bus transport system facilitates mobility of society in any Country. With an intention to offer public transport service in Ethiopia, Anbessa City Bus Service Enterprise (ACBSE) was started before 75 years after the Italian invasion.

Public transport also provides a change to people who would not be able to access private vehicles and create economic opportunities. Public transport shall, therefore, continuously meet the requirement of supply side for higher capacity and increasingly respond to demand side need of accessible, affordable, fast, and reliable mode.

Understanding public transport users' behavior and their meet and expectation for public transport service is an essential issue for establishing quality standards. Both transport operators and authorities need to understand which quality attributes are the most important that are perceived by current and potential users. However, the specification of a set of quality attributes for all developing cities is impossible as the needs and expectations of users vary significantly among different countries as well as different segments of the market (Quattro, 1998).

From Addis Ababa, which is the capital city of Ethiopia and the seat for African Union, to Bishoftu, which is resort and industrial area, transport service is being delivered to the public through publicly owned ACBSE and different privately owned vehicle. As a public enterprise, ACBSE has its own contribution to address the transport demands of the people (customers), particularly of the poor and daily commuters, who cannot afford other alternative modes of transportation.

1.2. Statement of the problem

Cities are the engines of economic growth in most developing countries, and that urban transport is the oil that prevents the engine from seizing up (World Bank, 2002). So on noted that, improvement in transportation can make cities much more efficient and productive. Public transportation is a shared passenger transport service which is available for use by the general public. Public transportation in the Ethiopia is a crucial part of the solution to the nation's passenger travel demand.

Mobility in the developing world is often characterized by travel demand that far exceeds supply (Darido, 2003). The city of Addis Ababa and its nearby areas are not an exception to this reality as far as it is the industrial, economic and political center of Ethiopia, the diplomatic center of Africa and the seat for many international organizations. Therefore, the role of transport in running economic, social and political activities smoothly could not be easily appreciated. Public transportation is an important element in day-to-day activities in Addis Ababa and the surrounding area because: It is a relatively affordable means of transportation. Even though the role of public transportation is notable, the service provision is not good enough as the demand is much greater than the supply. The significant increase in population and uncontrolled and rapid horizontal expansion in this corridor largely affect the public transport service. As the number of population and urbanization increases the numbers of passengers using public transport also increases. To accommodate the increasing numbers of passengers and rapid urbanization public transport service is expected to grow**.** However, the supply of public transport service is not proportional to the demand. In this corridor long line up of people at bus stop waiting for long time to get public transport service is the clear evidence of the public transport problem.

Recently, Addis Ababa and its nearby areas are facing with huge challenges emanating from years of poor coordination in its existing urban systems. Transport, one of these components of the urban system, which is responsible for bridging the gap between different areas, as well as creating a medium for spatial interaction. Lack of well-planned urban transport in Addis-Ababa and its surrounding is exhibited through public transport problem that is now observed in almost all of the corridors. ACBSE public transport service, which is increasingly becoming insufficient in Addis Ababa and the nearby area can be viewed as a function of various components of the urban transport service problems.

In terms of accessibility of the transport service; in different part of Addis Ababa and its surrounding areas people walks long distance to reach the service point and have to leave the service far from their destination. In many developing part of the city and the surrounding towns due to limited network extents the service is not available. There is no separate bus lane or bus priority measures, so it has to strive for space with other traffic in the busy and

narrow road network. The distance between bus stops is longer which makes the travel time large and the service less flexible. As the result of congested traffic on one hand and poor performance of the operators on the other hand the headway is longer hence travelers wait longer at the bus stops.

Due to limited numbers of buses (according to officials from the enterprise formerly 10 buses were assigned in this corridor but, due to vehicle break down and other problems currently only 5 to 7 buses are operational), insufficiency of bus routes (regardless of rapid increase in population and galloping urbanization in the study area bus routes in this corridor are without any significant adjustment in Bishoftu town since the beginning of the service in 1989 E.C), inadequacy of bus stops and operational deficiency most people who cannot afford other modes of transport are exposed to longer waiting and travel time than anticipated. Even with these prevailing problems the performance of public transport service in this corridor has never been evaluated. Therefore this study will emphasis on evaluating performance of ACBSE transport service the case of Addis Ababa-Bishoftu corridor.

1.3. Significance of the study

The outcome of this research document will be significant in terms of the following aspects:-

- The outcomes of this study can give a comprehensive overview of the limitations as well as the potentials that this transport system offers to the public.
- It can give for ACBSE awareness about strength and weakness of its service. Besides the enterprise can get ideas on how and where to improve the service.
- This study can be significant in terms of providing the necessary resource in light of the possibility of future public transport intervention projects that might be proposed or even carried out in the area.
- The outcome of this research can also be used as a trigger for further studies in the area.

1.4. Objective of the study

1.4.1. General Objective

The main objective of this research is to evaluate the performance of public transport service provided by ACBSE in Addis Ababa-Bishoftu Corridor.

1.4.2. Specific Objectives

The specific objectives of the study are:

1. To evaluate the bus transport network used by ACBSE in Addis Ababa-Bishoftu corridor.
2. To determine the LOS of the transport service provided by ACBSE in the selected corridor using different attributes.
3. To correlate between overall customer satisfaction and customer satisfaction due to selected public bus transport performance indicators along this corridor.

1.5. Research question

The major research questions that have been investigated in this study are:

1 What are the characteristics of route network in Addis-Ababa Bishoftu corridor?

2 At what level of service the transport service provided by ACBSE operates in the selected corridor?

3 Is transport service delivered by ACBSE in the selected corridor satisfies its customers?

4 How can customer satisfaction due to selected performance indicators be relate to overall customers satisfaction of ACBSE transport service in this corridor?

1.6. Scope of the Study

Between Addis Ababa and Bishoftu transportation is being delivered to the public through publicly owned ACBSE, different privately owned vehicles such as mini-bus, medium-bus

and alliance bus and company and organization transportation service to their workers. From these transport services medium-bus, alliance bus and company and organization transport services provide transport services only once or twice a day and without schedule. In this corridor there are two routes that connect Addis Ababa and Bishoftu, which are open to all service providers, via old road and via Addis-Adama expressway, and the transport service provided by ACBSE is deliver to the public every day on both routes.

However, due to financial and time constraints, the scope of this study will be limited only to ACBSE transport service in Addis Ababa-Bishoftu corridor through both routs on seven day data collected and analyzed through GIS and statistical method.

1.7. Limitation of the study

The major limitation of this research is it evaluate only ACBSE transport service in Addis Ababa-Bishoftu corridor and the analysis, conclusion and recommendations are only for ACBSE transport service. It does not consider other service providers (mini-bus, alliance bus and other company bus) performance and competitions. The population used in this study was based on CSA, 2007 population census on population density per square kilometer, which shows for a simplified assumption of homogeneous density as city level. During data collection period it was very difficult to collect the necessary data using GPS due to cloudy weather condition and lack of experience in using the instrument. Another problem encountered during this research time was some of the passengers are not willing to give their responses according to the questions and there was no well-organized and prepared data at the enterprise related to the transport service in the selected corridor.

1.8. Thesis outline

The thesis contains six main chapters.

Chapter 1, Introduction, gives a brief overview on the background of this study, statement of the problems, significance of the study, research questions, objectives, scope and limitation of the research.

Chapter 2, Literature Review, provides an overview on previous studies and literature published on the related thesis topic.

Chapter 3, Methodology, Case Study area Description, provides an overview of public transport service provided by ACBSE as well as describing the characteristics of route number 60 describes the different steps carried out in this project, data collection, and data analysis.

Chapter 4, Results and Discussions, the results of the data analysis are presented and discussed.

Chapter 5, Conclusions, based on the result and some recommendations for further developments of the service are presented.

2. LITERATURE REVIEW

2.1. Role of transportation

Transportation is a broad and universal field- important in a political, social, and economic sense. Everywhere you look, transportation is there. We commute. We drive to shop at the supermarket - and the goods arrived there by truck. We are impacted by the environmental consequences of transportation operations. Transportation is an integral part of our everyday life. Socially, politically, and economically, transportation is important throughout the world. It can be a major public policy lever. The public sector often makes important public policy decisions through transportation investments. Moreover, it provides connections to other metropolitan areas, to the nation, and to the world. Urban transportation planning and development is therefore a significant activity, both for promoting the efficient movement of people and goods in an urban area as well as for providing a strong supportive role in achieving other community objectives. (Beirao and Sarsfield-Cabral, 2007)

Bus transportation system, is one of the most common modes of public transportation in almost all developing countries. Existence of an intercity bus transportation system by considering its accessibility and cost for the passengers could be an efficient way to handle not only the citizens' needs, but to diminish the urban issues. Every action in which we can improve the adequacy of the system is highly helpful to either passengers or reducing the environmental pollutions. Therefore, paying more attention to the part of public transportation (especially bus networks) planning and development causes reduction of the level of personal intercity travels and increasing the capabilities of transportation services. Therefore, in order to achieve efficient development in public urban transportation management, the decision makers have to understand and implement the concept of sustainable transport. While understanding the concept is an effortless approach, adopting the sustainable transport and do materialize them is always become a problem (Mukhtarah, 2009).

Transportation is a non-separable part of any society. It exhibits a very close relation to the style of life, the range and location of activities and the goods and services which will be

available for consumption. Advances in transportation has made possible changes in the way of living and the way in which societies are organized and therefore have a great influence in the development of civilizations (Tom V. Mathew and K V Krishna Rao, 2007).

Transportation is responsible for the development of civilizations from very old times by meeting travel requirement of people and transport requirement of goods. Such movement has changed the way people live and travel. In developed and developing nations, a large fraction of people travel daily for work, shopping and social reasons. But transport also consumes a lot of resources like time, fuel, materials and land (Tom V. Mathew and K V Krishna Rao, 2007).

In general the role of transportation is persistent in all aspects of human activities. And it contributes to the economic, agricultural, industrial, trade and social development of a country**.** The importance of transport of a country is comparable to the veins in human body. Just as veins in the human body maintains health by circulation of blood to different parts of a body similarly means of transport keep the health of a nation in good conditions by keeping the goods and people moving from one place to other place. Transportation is vital for the all-road development of a nation or region since every commodity needs transport facilitates at all phases of economic activity; at the supply stage, at the production stage and as well as destination stage. Thus an economical, efficient, effective and adequate system of transportation is essential (Tom V. Mathew and K V Krishna Rao, 2007).

2.2. Urban Transport

Urban transport system forms the basis of the economic development community as a whole in an area (Murray, 2001). The public transport system was developed to be more competitive with other modes of transportation, by providing optimum service and increase the provision of facilities and infrastructure for urban transport system. In developing the public transport system, how to move people in large numbers in support of public mobility, in particular access to employment, trade, and education. Condition and capacity of public transport has not met the demand for public transportation is inadequate, poor road networks, and the high cost of travel for people using the public transport system (Armstrong et al., 1987).

Transportation system is a system that allows the movement from one place to another both natural either or artificial or engineering. Transportation system aims to move an object, whether inanimate objects, as well as living things like humans, animals and plants. In transportation system is the basic components that function in the transport system. Basic components of transport system consisting of a load is moved, vehicles move things, thing or vehicle movement paths consisting of segments and points, terminals for moving cargo from one point to another path, and management transport includes operating plans, information and control, and maintenance. The components of the transportation system are interrelated and influence each other. Good transport system required a transportation system planning techniques to find the most optimum combination of means of transport and method for its operation on a particular area (Marlok, E.K., 1991).

Urban transport system consists of a system of passenger transport and freight transport system. Furthermore passenger transport systems themselves are grouped according to their use and the manner of operation, namely: (1) personal transport, i.e. transport which owns and operated by and for the benefit of private infrastructure owners by using both private and public infrastructure. (2) Public transport, i.e. transport owned by the operator that can be used for the general to the specific requirements (Vuchic, Vuken. R., 1981).

2.3. Indicators for examining performance of public transport service

In the last few years, researchers showed great interest in customer satisfaction and service quality measurement, besides in the definition and implementation of service quality indicators which can be used by a transit operator in order to evaluate their performances. Primarily in the USA, the Transportation Research Board (TRB) was promoter of the Transit Cooperative Research Program (TCRP), from which some guidebooks and manuals were developed for measuring customer satisfaction in public transport (Transportation Research Board, 1999), calculating transit performance measures (Transportation Research Board, 2003), and evaluating transit capacity and quality of service (Transportation Research Board, 2003). Several reports and syntheses focused on specific transit bus service aspects, like bus route (Transportation Research Board, 1995), customer information (Transportation

Research Board, 1996; 1999), transit bus service line and cleaning functions (Transportation Research Board, 1995).

The quality of transport service can be measured against reliability, convenience, safety, security and comfort (Iles, 2005; Height and Cresswell, 1979). Speed, accessibility in time, reliability, and frequency are quality indicators of transport services (Wood and Johnson, 1989).

Starting from the various studies regarding quality determinants in public transportation the aspects mainly characterizing bus services are: service reliability, convenience, comfort, safety and security. Each of these aspects can be measured in many ways by considering different indicators. In the next subsections some of these indicators will be fully described, and some target values will be suggested.

- **Reliability**

Service reliability is one of the most investigated transit service aspects and it is considered as a very important aspect for the transit users. Beirao and Sarsfield-Cabral (2007), who state that the lack of control due to the uncertainty of the vehicle arrival makes the service unreliable. Unreliable service results in additional travel and waiting time for passengers (Strathman et al., 2003). As a consequence, service unreliability can lead to loss of passengers, while improvements in reliability can lead to attraction of more passengers (El-Geneidy et al., 2007). A study condacted by Eboli and Mazzulla (2010) confirmed that service reliability is one of the most important service aspect for the users.

Public transit agencies have developed multiple indicators to measure service reliability, but the three most common measures are on-time performance, headway regularity and running time adherence (Transportation Research Board, 2003).

On-time performance can be evaluated by considering the percentage of transit vehicles departing from or arriving to a location on time. The indicator is generally calculated as the ratio of the number of runs that come on time to the number of total runs. An indicator of on-time performance as the percentage of trips departing from all scheduled time points, not

including terminals, between 0 and 5 min after their scheduled departing time are suggested in TCRP Report 100 (Transportation Research Board, 2003). However, TCRP Synthesis 10 suggests to consider on-time the runs up to 1 minute early and up to 5 minutes late (Transportation Research Board, 1995).

Headway regularity can be defined as the evenness of intervals between transit vehicles. An indicator (expressed in %) is calculated as the ration of the average difference between the actual and the scheduled headway to the scheduled headway (Transportation Research Board, 2003). TCRP Report 100 (Transportation Research Board, 2003) defines Level-of-service ranges for headway adherence. Reliability of runs that come on schedule can be also easily evaluated on the basis of the runs removed from the daily schedule. An indicator can be calculated as the ratio of the number of runs executed in a period of data gathering to the number of runs scheduled for the same period. Running time adherence can be defined, analogously to the headway regularity, as the average difference between the actual and the scheduled running times compared to the scheduled running time.

The primary determinant of service reliability is the reliability of the vehicle itself. Availability of sufficient numbers of buses will attract more passengers to use buses for their daily traveling needs. Poor reliability within an operation is the result of several breakdowns, which in turn has adverse effect on vehicle availability and affects the quality and quantity of the overall services (Iles, 2005).

- **Convenience**

It comprises accessibility, waiting time, journey time, interchangeability between services, travel expenditure, ease of payment, and availability and accuracy of information as an important element, which determines the quality of the service (Iles, 2005).

Accessibility*:* It can be expressed in terms of the distance passengers have to walk starting from their home to the initial bus stops and from the final bus stops to their final destination (Iles, 2005). Walking distance is an indicator of the coverage of the service. High walking distance indicates small coverage. In dense urban areas the walking distance should range

from 300-500 meters. In low densely urban areas, 500-1000 meter is the acceptable distance that passengers may walk to and from bus stops (World Bank, 2002).

In TCRP Synthesis 10 (Transportation Research Board, 1995) route coverage was considered as the spacing distance between adjoining routings. Target values for spacing between bus routes were suggested as a function of such factors as the population density of an area, the proximity of an area to the central business district (CBD), and the type of bus services or routes in operation within an area (e.g., grid versus feeder, local service versus express service, and so on). Coverage can be also considered as a measure of the proportion of a metropolitan area, corridor, or population served by transit. TCRP Report 95 suggests the presence or lack of transit service within 400 meters as a rule-of-thumb indicator of coverage (Transportation Research Board, 2004). In TCRP Report 88 (Transportation Research Board, 2003) route coverage is expressed in terms of route miles per square mile, and some target values were suggested for these indicators.

Another indicator regarding route characteristics refers to the stop spacing, or the distance between adjoining service stops of a path. Transit operators have developed standards regarding bus stop spacing as a part of their effort to balance the trade-off between rider convenience (stops with easy walking distances) and speed. Examples of target values of stop spacing were suggested in TCRP Synthesis 10 (Transportation Research Board, 1995); also in TCRP Report 88 (Transportation Research Board, 2003) target values were suggested for local bus, automated guideway transit, light rail, heavy rail and commuter rail. Eboli and Mazzulla (2011) suggest as indicator of the bus stop location the walking distance (or time) from home to the access bus stop. In fact, the time spent in walking for reaching the bus stop defines the level of accessibility to the transit services. Therefore, a transit stop must be located within walking distance, and the pedestrian environment in the area should not discourage walking (Transportation Research Board, 2003a). As reported in TCRP Report 100, about 80% of the passengers walk 400 metres or less to bus stops; at an average walking speed of 5 km/h, this is equivalent to a maximum walking time of 5 minutes.

Among service characteristics, service frequency is the most distinctive aspect. Service frequency measures how often transit service is provided. It is an important factor in one's

decision to use transit; in fact, the more frequent the service, the shorter the waiting time when a bus or train is missed, and the greater the flexibility that customers have in selecting travel times (Transportation Research Board, 2003a). Also, in Eboli and Mazzulla (2008) service frequency resulted to be the attribute with the highest weight on the overall transit service quality. The indicator regarding service frequency can be calculated as average value of the number of runs scheduled for each hour of the day. Levels-of-service were suggested as a function of the average headway among vehicles expressed in minutes (Transportation Research Board, 2003b). The level-of-service thresholds reported in TCRP Report 100 (Transportation Research Board, 2003) can be adopted as target values for the service span.

***Waiting time**:* It is the time passengers have to wait at bus stops for buses. Even though, their expectations may vary, most passengers are delighted with minimum waiting time. The shorter the waiting time is the greater the level of convenience and (Iles, 2005). To achieve a reasonable level of service, the average waiting time should be in the range of 5-10 minutes and the maximum waiting time should be in the range of 10-20 minutes (World Bank, 2002).

***Journey time**:* It is the time spent to reach a destination from a given origin. It include the walking time, waiting time and on vehicle time to the destination. It should not be more than two or three hours per day (Armstrong-Wright, 1993).

Dwell Time: According to TCQSM dwell time is proportional to the boarding and/or alighting volumes as well as the amount of time required to serve each passenger. There five main factors influencing dwell time are shortly described below (TCQSM, p. 4-3):

- Passenger Demand and Loading: The number of passengers that pass through the highest-volume door. Identified as a key factor in how long it will take for all passengers to be served. One of the determinants for the passenger load profile is the number of stops, which affects the number of boarding/alighting passengers. A small number of stops result in a greater number of passengers at each stop. However, a high number of stops could result in reduced travel speeds. Thus, there needs to be a balance between the planning of stop number and passenger walking times.

- Fare Payment Procedures: The fare payment system can have a major influence on the time needed to serve each passenger. Some systems allow boarding through more than one door.
- Vehicle Types: The time required to serve each passenger increases if ascending or descending is necessary.
- In-Vehicle Circulation: Boarding takes more time when standees are present onboard.

Interchangeability between services: It is the number of times a passenger has to change buses or other modes on a journey to or from work (World Bank, 2002). Passengers are more satisfied with a route network which enables them to complete their journey without having to transfer from one vehicle to another (Iles, 2005). The average interchanges between routes and services are determined to be in the range of zero to one and the maximum should not be more than two. At the same time, the number of passengers who interchange two times (i.e. the maximum interchange) should be less than 10% of passengers (World Bank, 2002).

Ease of payment: The service aspect regarding fare includes characteristics of the monetary cost of the journey by bus, like the cost of a one-way ride, the cost of a transfer, the availability of discounted fares (e.g. for students), the availability of volume discounts (e.g. for monthly passes), the cost of parking at bus stops. There is an extensive literature supporting the thesis that costs affect mode choice behavior of travelers. On the other hand, many studies about the attitudes toward transportation system alternatives found that the monetary travel cost does not constitute a salient factor in the modal-choice decisions. Beirao and Sarsfield-Cabral (2007) stated that public transport is generally perceived as cheaper than car and monetary cost does not appear as a key factor for changing to public transport, with the exception of the users with low income, who consider travel cost as a very important aspect. In Eboli and Mazzulla (2011) the average one-way ticket cost was adopted as indicator regarding ticket cost. The authors considered standard values corresponding to the average cost of the tickets for different typologies of service adopted by transit agencies operating in similar territorial contexts characterized by high standards of transit service quality.

Fare is another important element, which influence service convenience. A system which requires passengers to have the exact fare ready when boarding the bus and advance purchase of tickets from road side selling machines are common in most countries. Whatever the system of payment, it should be easy and more user-friendly than others (Iles, 2005).

Availability and accuracy of information: Another service aspect affecting public transport service quality is linked to the availability of information pertinent to the planning and execution of a journey. Passengers need to know how to use public transport service, where the access is located, where to get off in the proximity of their destination, whether any transfers are required, and when transit services are scheduled to depart and arrive. Without this information, potential passengers will not be able to use transit service (Transportation Research Board, 2003). Beirao and Sarsfield-Cabral (2007) found that several respondents think that the bus system is difficult to use and information is difficult to obtain; among bus users, the main problem occurs when bus companies change timetables or routes and do not provide enough information to users. In recent years, many public transport agencies have taken steps for increasing and improving transit service information. These steps reflect the growing awareness among transit agency managers that service information is important to transit users and can be effectively used to increase ridership by retaining existing riders and potentially attracting new riders to the transit system (Transportation Research Board, 1996). For designing and preparing information materials which will meet the needs of all transit customers, TCRP report 45 (Transportation Research Board, 1999) could be of interest to schedulers, transit planners and others. Ideally, passenger information should be available at every stage of the rider's transit trip. Pre-trip information helps the rider to plan routes and connections. Pre-trip information needs consist of the location of the nearest bus stop, routes that travel to the desired destination and transfer locations, fare, time of departure, and approximate duration of the trip. In-public transport information assists the rider at each decision point during the trip. In-public transport information needs consist of the identification of the correct bus to board at the departure point; identification of bus stops for transfers or disembarking on the bus; how to transfer to another route at transfer points; cost, time limits, and restrictions; identification of the correct bus to board; area geography (i.e., location of the final destination in relation to the bus stop); return trip information at the

destination (e.g., departure times and changes in route numbers). Supportive/confirming information repeats and reinforces data and decisions; it should be provided at any point during the trip when the rider may want to be reassured that he/she is progressing correctly and not getting lost.

In Eboli and Mazzulla (2011) an indicator of the attribute "availability of schedule/maps on bus, and announcements" was calculated as the ratio of the number of vehicles with functioning information device on board to the total number of vehicles sampled in a certain time period; a trained checker verifies the functioning of the information devices on different days. In addition, an indicator of the attribute "availability of schedule/maps at bus stops" was evaluated on the basis of a score assigned to each stop of a line, from a minimum value of 0 to a maximum value of 10. The minimum value was assigned to the stops without any kind of information device at the stop; the maximum value to the stops with schedule and maps. The indicator was calculated as average value of the scores assigned to all the line stops. Similar indicators can be calculated by considering other user information devices; TCRP Synthesis 17 (Transportation Research Board, 1996) provides a useful review of the types and tools of information at bus stops, with an indication of the relative costs.

- **Safety**

The aspect linked to safety indicates the degree of safety from crime or accidents and the feeling of security resulting from psychological factors; therefore, this aspect refers not only to safety from crimes while riding or at bus stops and from accidents, but also to safety related to the behavior of other persons and to the bus operation. Generally, the term "safety" is used to indicate the possibility of being involved in a road accident, while the term "security" refers to the possibility of becoming the victim of a crime. Safety during a journey may be considered as a not very relevant aspect in the modal choice decision; in fact, the probability of being involved in an accident or becoming the victim of a crime is not explicitly considered as a part of the choice mechanism. However, when explicitly queried about the importance of safety, this factor is given an extremely high rating of import by Eboli and Mazzulla (2010) who explicitly investigated safety and security on board. Nathanail (2008), safety during the trip was defined as the number of passenger fatalities, owing to the responsibility of the transit

operator. Passenger fatalities are collected and retained by the operator for the year of analysis, and compared to the average number of fatalities in the last five years. Also in Eboli and Mazzulla (2011) the indicator concerning safety and competence of drivers was calculated on the basis of the number of road accidents verified during the last year, but this value was compared with a standard value equal to the average number of road accidents verified during the last three years. Analogously, the indicators of the service aspect regarding security against crimes on board and at bus stops were calculated on the basis of the number of complaints registered during the last year, and compared with the average number of complaints registered during the last three years.

- **Security**

In many transport system, passengers are not secured from pickpocket both on buses and at bus stops and terminals. In some cases it is common that passengers are violently robbed. The way in which transport is operated determines the level of insecurity. While the presence of inspectors or conductors on the vehicles, good lighting on buses and at bus stops have a beneficial effect in reducing the opportunities for the crime of pick pocketing, overcrowding of buses and poor discipline at bus stops and terminals increases passengers vulnerability to pickpockets. On public buses particularly, stealing is common and people lose their wallets due to pick pocketing. These acts often create a sense of insecurity among passengers and diminish their satisfaction with public transportation services (Iles, 2005).

- **Comfort**

Comfort during the journey is important for public transport users, both the physical comfort regarding vehicles and comfort regarding facility conditions on board or at stops. Comfort on board means having soft and clean seats, comfortable temperature, not many people on board, smoothness of the bus ride, low levels of noise and vibrations, not nasty odors. These many factors are differently evaluated across different groups of users. Beirao and Sarsfield-Cabral (2007) found that habitual public transport users consider the new vehicles with air-conditioning and lower floor as “very good and very comfortable”, but the overcrowding on board at peak hours is considered a problem. Comfort at bus stops can be considered as a

function of the passenger facilities provided at the stops. Facilities include shelters, benches, vending machines, trash receptacles, lighting, phone booths, and so on. The effects of particular facilities on transit passengers are not well known. Some researchers have argued that the term "facilities" implies something extra and not necessarily required (Transportation Research Board, 2003).

In Eboli and Mazzulla (2011) the indicator was calculated on the basis of the number of passengers per run and the number of offered seats per run, by introducing a formula in which a quadratic relationship between the indicator and the ratio of the number of passengers to the number of offered seats is hypothesized; the indicator has values close to 10 when the number of passengers is small, and to 0 when the number of passengers is equal to or higher than the number of available seats. An indicator of the load factor is proposed by the TCRP Report 100 (Transportation Research Board, 2003), which provides separate Level-of Service thresholds for bus and rail. Passenger load LOS is based on two measures: passengers per seat when all passengers can sit, and standing passenger area, when some passengers must stand or when a vehicle is designed to accommodate more standees than seated passengers. The common indicator linked to air conditioning on bus can be calculated on the basis of the percentage of vehicles with functioning climate control systems; the indicator can be calculated as the ratio of the number of buses with the functioning air conditioning system to the total number of buses used for the line; a trained checker could verify the functioning of the air conditioning in different days of the same time period.

Eboli and Mazzulla (2011) propose a methodology for evaluating the availability of furniture at bus stop based on a score assigned to each line stop on the basis of the various available facilities (e.g. shelter or benches, or both, et cetera). The indicator varies from a minimum value of 0 to a maximum value of 10; the minimum value was assigned to the stops without any kind of furniture; the maximum value to the stops with all the furniture identified in a previous step.

2.4. Level of service analysis on public bus transport service

Assessing public bus transport service performance is important to improve the quality, reliability, efficiency and effectiveness of the system. Service quality is not only can be measured from the aspect of operation and management but also through the perception and expectation of the passengers. The level of service (LOS) assessment is a tool to measure the quality of service based on specific attributes. The passengers' satisfaction assessment can help to improve the level of service, the quality and performance (Zakaria et al., 2010).

Passengers' satisfaction survey is a tool to measure the performance and quality of bus service that sequentially useful as a benchmark or indicator to enhance the efficiency and effectiveness of bus service delivery and operations (Dell'Olio, Ibeas & Cecin, 2011; Rojo et al., 2015). It is also defined as a judgment from the passengers that relates to the pleasurable level of consumption (Ismail et al., 2012; Lai & Chen, 2011).

Research on service quality and passengers' satisfaction identified attributes that usually be measured such as waiting time, reliability, service information, comfort, travel time, convenience, safety, security, affordability and frequency of service (Ismail et al., 2012). According to Parasuraman, Zeithaml and Berry (1988), service quality lies around the aspect of intangibility, heterogeneity and inseparability, and can be defined as the degree and direction of discrepancy between consumers' perceptions and expectations (Parasuraman, Zeithaml & Berry, 1988). It is the key component in measuring the bus services from the view point of passenger (Transportation Research Board, 2013). Even though there exist no specific standard to measure bus service quality, the attributes in LOS and passengers' satisfaction study are considered as sufficient for service quality assessment (Ismail et al., 2012).

In terms of passenger expectation Shreya Das and Debapratim Pandit (2013), developed threshold values for determining LOS using customer satisfaction based on selected performance indicators such as delay in total journey time, bus stop nearness, vehicle Crowding, seat availability, no. of mode transfers, on time performance, boarding-alighting time and service hours.

2.5. Geographic information system (GIS)

The incorporation of information technology has renewed attention on performance measurement techniques. Specifically, in-vehicle GPS technology provides the possibility of using public transport vehicles as probes for evaluating network performance more accurately (Storey and Holtom, 2003).

Geographical information systems is the assessment of broad scale regional policies or link specific capacity, GIS are providing to be valuable transportation management and modeling platforms (Murray et al., 1998). It represents the real world on a computer similar to the way maps represent the real world on Paper. A GIS with its roots intertwined in geography, cartography and computer science is (at a very basic level) computer software that is designed to answer questions that relate to locations, patterns, trends, and conditions (ESRI, 1996).

Many advantages of using GIS for evaluating performance of transportation service have been identified by researchers. The primary advantages include speed, analytical capabilities, visual power, efficiency of data storage, integration of spatial databases, and capabilities for finer-grained spatial analysis (Bamford and Robinson, 1978).

2.6. Regression analysis

The purpose of regression analysis is to assess the relative importance of each factor and to test the overall explanatory power of the battery of factors as a whole. In the regression model, the factors serve as the independent variables (IV), whereas overall satisfaction, or SQ, serves as the dependent variable (DV). Regression analysis results in a best-fitting model in the form of an equation that expresses the DV as a combination of the IV. Several models of regression have been proposed to study satisfaction or SQ (Juan de Oña and Rocío de Oña, 2014).

The most widely used methods of regression analysis are simple and multiple linear regression model (Kim et al., 2011; Weinsten, 2000). In the majority of applications, the response of an experiment can be predicted more adequately not on the basis of a single independent input variable but on a collection of such variables. Indeed, a typical situation is

one in which there are a set of, say, k input variables and the response Y is related to them by the relation.

2.6.1. Simple Linear regression analysis

The case of simple linear regression considers a single repressor or predictor x and a dependent or response variable Y. Suppose that the true relationship between Y and x is a straight line and that the observation Y at each level of x is a random variable. As noted previously, the expected value of Y for each value of x is

$$E(Y|X) = \beta_0 + \beta_1 X_1 \quad \ldots\ldots (2.1)$$

where the intercept β_0 and the slope X are unknown regression coefficients. We assume that each observation, Y, can be described by the model

$$Y = \beta_0 + \beta_1 X_1 + e \quad \ldots\ldots (2.2)$$

where e is a random error with mean zero and (unknown) variance σ^2. The random errors corresponding to different observations are also assumed to be uncorrelated random variables. (Douglas C. Montgomery and George C. Runger, 2002).

2.6.2. Multiple Linear regression analysis

Many applications of regression analysis involve situations in which there are more than one repressor variable. A regression model that contains more than one repressor variable is called a multiple regression model. As an example, suppose that the effective life of a cutting tool depends on the cutting speed and the tool angle. A multiple regression model that might describe this relationship is

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + e \quad \ldots\ldots (2.3)$$

Where X_j , j = 1, . . . , k is the level of the j^{th} input variable and *e* is a random error that we shall assume is normally distributed with mean 0 and (constant) variance σ^2. The parameters $\beta_0, \beta_1, \ldots, \beta_k$ and σ^2 are assumed to be unknown and must be estimated from the data, which we shall suppose will consist of the values of $Y_1, \ldots, Y_n$ where Y_i is the response level

corresponding to the k input levels $x_{i1}, \ldots, x_{i2}, \ldots, x_{ik}$. That is, the Y_i are related to these input levels through. If we let $B_0, B_1, \ldots, B_k$ denote estimators of $\beta_0, \ldots, \beta_k$, then the sum of the squared differences between the Y_i and their estimated expected values. The least squares estimators are those values of $B_0, B_1 \ldots$, and Bk that minimize the foregoing (Sheldon M. Ross, 2004).

3. MATERIALS AND METHODS

3.1. Introduction

In this chapter the researcher presents description of the study area, over view of ACBSE, route number 60; the research approach used in this study includes research design, sample selection methods, data collection methods, and data analysis methods. At the end of this methodology part of validity and reliability issues will be discussed to follow the quality standard of the research.

3.2. Description of Study area

In this thesis the researcher was tried to examine the performance of ACBSE transport service between the two neighboring cities namely Bishoftu and Addis Ababa.

3.2.1. Bishoftu town

Formally known as Debre Zeyit, it is located 47 km southeast of the capital city Addis Ababa. It was established around 1917 with the starting of Ethio-Djibuti railway. It is home to several beautiful lakes and also the location for the country's finest resorts. Since the city found in great rift- valley the topography of the city ranges from hilly to deep valleys. Its average altitude is 1920m above mean sea level. According to 2007 census by central statistical agency of Ethiopia the city has a population of 99,928. For administrative purpose the city divided in to 9kebeles as shown in Fig. 3.1.

Now a days the city is a center of trade, industry and a great destination for any special activities like training and meeting.

3.2.2. Addis Ababa City

Addis Ababa is the capital of Ethiopia. It is the diplomatic center of Africa and the seat for several diplomatic communities and international organizations. Being the center of the country it has a wide role in economic, social, political and administrative outlooks. The topography of the city ranges from hilly to rolling with steep gradient and deep valleys. Its altitude varies between 2000 to 2500m above mean sea level.

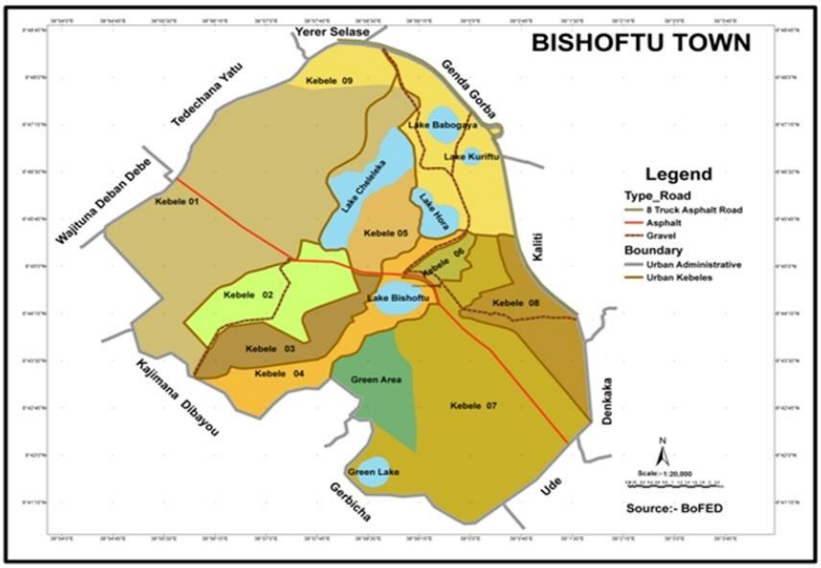


Figure 3.1: Map of Bishoftu town with kebeles (Source: Wikipedia, 2017)

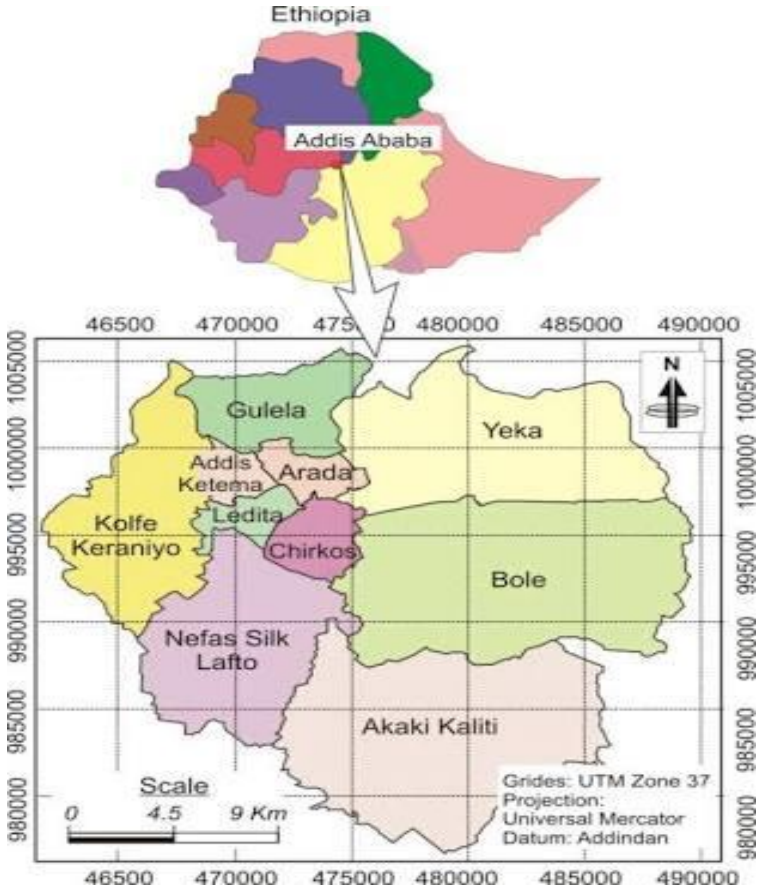


Figure 3.2: Map of Addis Ababa city with the sub-cities (Source: Wikipedia, 2017)

According to 2007 census by CSA of Ethiopia the city has a population of 3,384,569 with growth rate of 3.8%. Addis Ababa city administration extends over 527 km2. For administrative purpose the city divided in to 10 sub-cities which are further subdivided in to 99 kebeles as given in Fig. 3.2.

The road transportation network between Addis Ababa and the rest of the country has developed by the five regional roads, from Dessie, Bishoftu, Jimma, Ambo, and Gojam joining in to Addis Ababa. From the above routs Bishoftu to Addis Ababa rout is characterized by a dense flow of passengers using different public transport systems having a distance of 47 km apart.

3.3. Over view of ACBSE

In developing countries, most trips are carried out using some form of public transport. In most developing countries conventional buses and small buses supplemented by a mass of Para-transit vehicles such as mini-bus are very common modes of public transport (Armstrong-Wright, 1993). According to Johnson and Tengstrom (2005), bus services are flexible, cost effective and equitable mode of transport that can satisfy the needs of middle income and low-income groups.

Between Bishoftu and Addis Ababa there is always active transportation need, so most people use ACBSE transport service to meet their needs.

Anbessa City Bus Enterprise began operation in 1935 E.C with 10 buses and spare parts which were left by the invading Italian force. Before the number of service routes was increased to 14 in 1952 E.C., there were only four service routes with two buses on each route (ACBSE, 2001). Anbessa is financially dependent on the subsidy of the City Government of Addis Ababa. It does not have the freedom to set its own prices to maximize profit because the government focuses on affordability of the service rather than profit maximization. Despite the fact that the income of the enterprise increases due to the expanding service, it is still unable to cover its expenditures. Currently, there are 124 routes operating in Addis Ababa and its surrounding.

The service starts at 6AM and continues until 9PM. Most of these routes are operated towards the central business districts of the city, especially towards Merkato. The three main terminals at which administrative and light maintenance services are available are Merkato (Addis Ketema), Giorgis (Menelik Square), and Legehar. The enterprise also operates 4 routes in Jimma town and its surrounding.

Most of the routes originate at the suburbs and end up at the business centers of the city, the following 14 routes connect the city business centers with nearby towns by moving out from Addis Ababa in 5 directions.

- ✓ Service route 7: from Megenagna to Legettafo, Legedady, Sendafa, Beke
- ✓ Service route 24: from Paisa to Burayu
- ✓ Service route 26: from Merkato to Alemgena, Sebeta
- ✓ Service route 30: from Merkato to Sululta
- ✓ Service route 43: from Merkato to Burayu, Gefersa, Tattek, Menagesha
- ✓ Service route 44: from Merkato to Legettafo, Legedady
- ✓ Service route 60: from Legehar to Akaki, Dukem, Bishoftu
- ✓ Service route 85: from Merkato to Burayu, Gefersa, Tattek, Menagesha, Holeta
- ✓ Service route 88: from Merkato to Sululta, Chancho
- ✓ Service route 89: from Merkato to Legettafo, Legedady, Sendafa
- ✓ Service route 91: from Merkato to Alemgena, Sebeta, Tefki
- ✓ Service route 97:from Megenagna to Legetafo
- ✓ Service route 98: from Saris Abo to Dukem
- ✓ Service route 111: from Paisa to Burayu, Dere Soliya

All Anbessa routes have schedule timetables, but the timetable information is available for the public at very few major terminals. The schedule is based on the distance between stops and is the same for each trip irrespective of the time of the day and the direction of the trip. The time of the day affects the timetable in such a way that delays happen at peak hours (IBIS, 2005).

The study by IBIS, (2005) on urban public transport characteristics of Addis Ababa shows that only 5 routes provide service frequency of 6 or more per hour, 26 routes provide 3 to 4 services, 31 routes provide 2 services and 18 routes only 1 service per hour. The operation frequency of routes operating outside the cities peripheries ranges from 1 in one half to three hours. The normal standard for urban bus service is 6 or more services per hour (IBIS, 2005).

The urban transport study reported that the passenger carrying capacity of Anbessa can approach 40,000 per day. The average number of passengers per trip is estimated to be 110 which could rise to 150 or even more during peak hours (IBIS, 2005).

3.4. Route number 60

This route was intended to offer transport service from Legehar to Bishoftu via old road and recently via Addis-Adama expressway. The buses in this corridor are both rigid and articulated and take more passengers than other public transport service providers. Articulated bus has seats for 48 passengers and it can carries up to 160 travelers. Rigid bus has 30 seats and it can transports around 100 passengers.

In this corridor the buses are operating without the support of technologies like GIS, AVL and APC. According to the officials from the enterprise the reasons for not using this technologies are lack of awareness about the benefit of this technologies, shortage of skilled man power and financial limitation. There is no information indicators at bus stops for passengers.

According to information gathered from the enterprise currently on average 2000 passengers use this transport service. The service operates between the two terminals: Legehar and Silsa-

Mazoria. Through old road the transport service has 35 stops and 32 stops via expressway. The route network and all stops on bus route in this corridor are shown in the Fig. 3.4.

Figure 3.3: Number 60 Anbessa bus at Legehar station

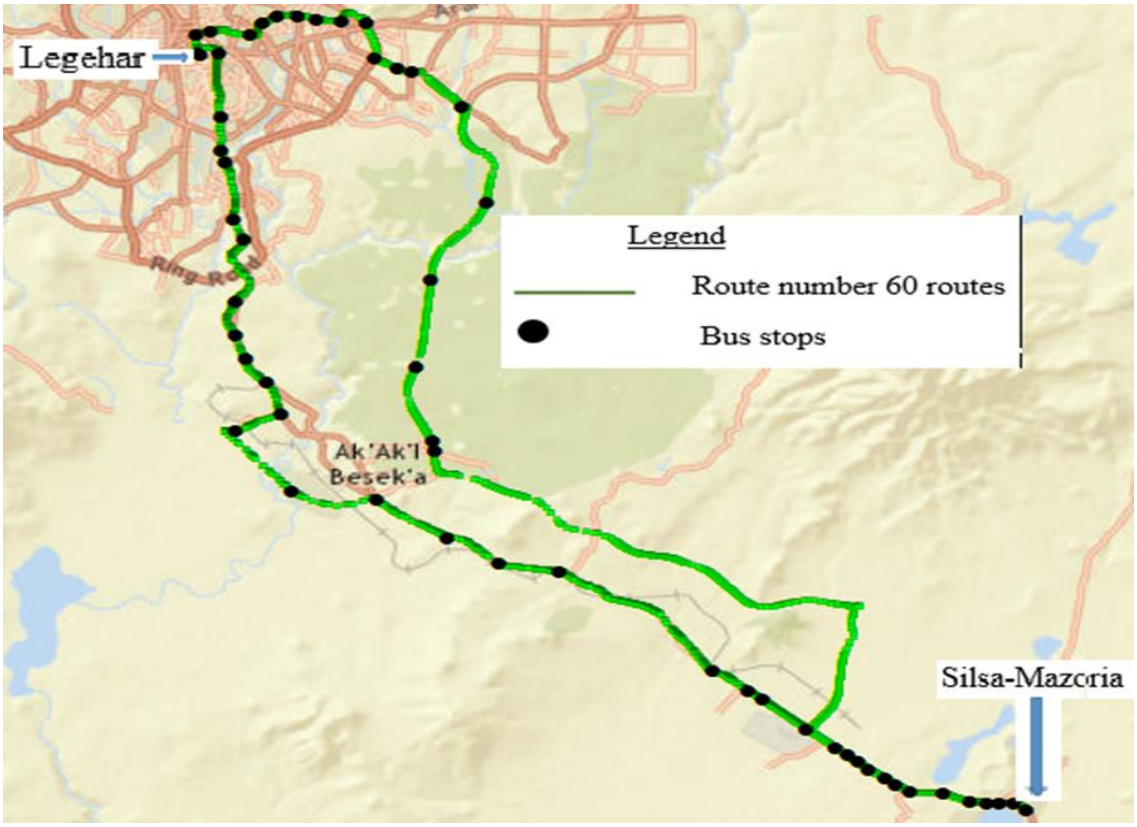


Figure 3.4: Route number 60 bus routes and bus stops

3.5. Research design

In this research the researcher used Geographic Information System, Descriptive statistics and inferential statistics design in order to evaluate the performance of ACBSE transport service in this corridor.

3.5.1. Geographic Information System

In relation to public transport, researchers have used GIS technology to measure accessibility of public transport, creating public transport routes, identifying optimum routes, optimizing bus stops and spatial analysis of service level measuring spatial equity and public transport management. Generally, at present GIS application in public transport planning and management has increased. Its demand spatial analysis and network analysis capabilities make it attractive tool for this research. Hence, in this study GIS software together with descriptive and inferential statistical techniques was used.

3.5.2. Descriptive statistics

In descriptive study information and data was collected from the field and analyzed through tables, charts, figures etc. and offer valuable insight that compliment and expand the general truth which gathered from the respondents.

3.5.3. Inferential statistics

In inferential statistics, unlike descriptive statistic, use a random sample of data taken from population to describe and make inference about the population.

The dependent variable used in this study is overall satisfaction with ACBSE bus transport service. Independent variables is specific service quality attributes which consist of service frequency, travel speed, fare affordability, security, vehicle crowdedness, seat availability, bus comfort, punctuality, and safe from accident.

3.6. Methods of Data collection and Analysis

In this research the research has followed three successive stages in order to gather relevant data and to analysis those data for successful completion of the study. The pre-field work stage, field work stage and post field work stage.

3.6.1. Pre-Field work study

In this stage the researcher has executed three main tasks.

First, the parameters and data required for this study were identified through intensive literature review and also potential sources of data and key contact persons were identified.

The second task was preparing data collection tools. It refers to tools used for gathering specific information required for providing relevant information needed for this study.

The major survey instrument used for collection of primary data were GPS and a structured and unstructured questionnaire. The questionnaire was designed to collect relevant data and information intended to address the objectives of the study. In this regard, the questionnaire included questions properly set to collect information required for writing this final research report.

- Interview: This tool was employed to gather information by conducting face to face interview from various respondents. Semi-structured interview questions was prepared for transport officials.
- Questionnaire: A list of questions was prepared and distributed to randomly selected respondents as one of the tool for collecting relevant information from selected respondents for the purpose of this research.

The questionnaire was divided into three parts: (1) Demographics, the questioner item correspondent to city they live, age, sex, occupation and reason for using this transport

service (2) Information about transport service provided by ACBSE in this corridor which includes waking distance, waiting time, availability of set at bus stop and inside bus, reliability of the service and major difficulties not to entertain the service (3) Information about traveler's satisfaction level with things measuring satisfaction with frequency, travel speed, fare affordability, security, vehicle crowdedness, seat availability, bus comfort, punctuality, and safe from accident.

The questionnaire was developed based on previous study in Tanzania (Kundi, 2013) and in Addis Ababa (Abreha, 2007). In addition to personal information and information related to the quality of service provided by ACBSE respondent were asked to rate their satisfaction to the item of overall satisfaction and nine items in specific quality attribute for public transport. Likert-type scale rate ranged from strongly disagree, disagree, neutral, agree and strongly agree.

- Observation: This was used in order to observe on how the public transport is organized and scheduled by ACBSE with regard to effective service provision to its customers.

As the last part of the pre-field work stage gathering the field work material and practice with them was carried out by the researcher and data collectors. The material used for this research on the field work was GPS.

3.6.2. Field work

During this stage both primary and secondary data were collected for this study. In order to know the views held by officials about public transport sector, discussions was held with some ACBSE officials.

3.6.2.1. Primary Data

For this research primary data was collected through GPS survey on the rout, interview, questioner, and observation. Due to limited time and financial resources, the study were adopted random sampling techniques. The sample was selected from passengers and ACBSE staff members and officials. The random sampling was employed during selection of respondents. In this study 400 and 4 respondent was selected from passengers, and ACBSE officials respectively by taking 20% of passengers using this transport service per day based on different previously performed researches and investigation on this matter.

According to information gathered from ACBSE currently in average 2000 travelers' travels per day in Addis Ababa-Bishoftu corridor using ACBSE transport service.

For the first objective both routs was navigated with GPS in order to collect primary data. Track points were recorded and the bus stop locations were noted. The purpose of this navigation is in order to show and evaluate:

- Route network,
- Route accessibility or proximity of the service,
- Bus stop location and average bus stop spacing,
- Average speed of the service,
- Average travel time of the service and
- Dwell time of the service at bus stops.

This GPS navigation was carried out for about seven days from March 19 to March 25 starting from 6:00 a.m. up to 9:00 p.m. During this navigation the number of passenger boarding and alighting was also recorded.

For the second objective using interview questions, questioner and by observation the researcher tried to collect data that shows the performance of ACBSE service in the study

area. In this study the performance of ACBSE service was be measured using the following variables:

- Distance the traveler walked to reach at the bus stop (Accessibility),
- Duration they spend at the bus stop before obtaining service (Waiting time),
- Seat availability,
- Travel time and
- Reliability of the existing public buses.

For the last objective primary data was collected from passengers using questioners in order to determine the correlation between traveler's satisfaction with ACBSE transport services and performance of ACBSE transport service in this corridor. Travelers were asked to respond in related to identified public transport performance indicators. These indicators include service frequency, travel speed, fare affordability and security. Other indicators were vehicle crowdedness, seat availability, bus comfort, punctuality and safe from accident.

3.6.2.2. Secondary data

This information was obtained from various sources like books, journals, newspapers, internet and other documents which are relevant to this research objectives. For this research demographic data, socio-economic data and maps was collected from different secondary data sources.

3.6.3. Post-Field work

In this stage both data preparation and data analysis has been carried out.

3.6.3.1. Data preparation

The first duty in the post field work was preparing the collected data for the analysis. The major task that performed in this phase were converting data format, defining projection and coordinate transformation and filtering the GPS data.

The data collected from customer, officials of ACBSE and field observation has been inspected before being used in order to ensure that they are reliable and valid. The collected data was refined to identify missing information, removing duplications, detecting entry errors and checking for inconsistencies such as outliers.

3.6.3.2. Data analysis

The collected and prepared data has been analyzed qualitatively and quantitatively. The tools for data analysis vary depending on distinct objective and the type of data collected.

For the first objective through GIS software, by using data from GPS and other relevant secondary data sources the route network, route accessibility, bus stop location, average bus stop spacing, speed of the service, travel time of the service and dwell time of the service at bus stops has been analyzed.

For the second objective descriptive statistical analysis was performed in order to examine performance of transport service provided by ACBSE in terms of accessibility, Waiting time, seat availability, travel time and reliability of the existing public buses using SPSS software.

For the last objective inferential statistics has been implemented. The study used simple and multiple linear regression analysis to examine the relationship between satisfaction level of customers due to selected performance indicators of ACBSE transport service and customer satisfaction due to overall transport service. In regression analysis overall customer satisfaction was taken as dependent variable and customer satisfaction due to selected performance attribute like service frequency, travel speed, fare affordability, security, vehicle overcrowding, seat availability and comfort were be used as independent variables.

3.7. Reliability and Validity of Data

3.7.1. Reliability

Reliability is defined as the quality of consistency or reliability of a study or measurement. Measuring instrument is reliable if it provides consistent results (Kothari, 2004). That means if the same or different researcher repeats the study it should produce more or less the same

results. This improves reliability by standardizing the conditions under which the measurement took place, thus external sources of variation such as boredom and fatigue were minimized. Furthermore, the researcher used design direction for measurement with no variation from group to group, and by asking similar questions to sample respondents. SPSS software will use to offers “reliability analysis statistic” .The Reliability Analysis procedure calculates a number of commonly used measures of scale reliability and also was provided information about the relationships between individual items in the scale.

3.7.2. Validity

This is the most critical criterion and indicates the degree to which an instrument measures what it is supposed to measure (Kothari, 2004). In order to achieve validity the researcher ensure the measuring instrument provides adequate coverage of the topic by containing adequate representative sample. Numbers of different steps was taken to ensure the validity of the study: Data was collect from the reliable sources, from respondent who has experiences in using public bus transport.

4. RESULTS AND DISCUSSION

This section presents the results of all the data analysis. It is divided into two subdivisions. The first section deals with analysis using GIS to evaluate the transport service provided by ACBSE in terms of Service Coverage; Route Length and Bus Stop Spacing; Frequency and Bus Operating Speed; Dwell Times and Bus Capacity (Boarding, Alighting and Load). The second section is Statistical analysis using SPSS, encompasses descriptive, correlation, factor and regression analysis were used to investigate the performance of ACBSE bus transport service in this corridor based on customers opinion about the transport service.

4.1. GIS analysis

4.1.1. Service coverage

The spatial coverage of public transport is an important factor to measure the easiness at which service can be reached at different location. This gives way to measure spatial equity in transport service provision and can be achieved through the use GIS. The use of GIS give a possibility to describe areas for which public transport demand is covered and how best to represent potential demand spatially using different technics such as buffering operation (Horner and Murray, 2004).

In buffering two main issues are involved, namely the feature or reference of measurement being either bus stop or routes, and the size of the buffer to define the threshold. Though, bus stop offer a more appropriate basis than routes for estimating service area coverage because bus stops are the actual locations where public transport users access the service (Bhat et al. 2006).

For densely populated urban area the travelers has to serve within 500 m of bus stop, up to 1000 m may be acceptable in low-density urban areas (World Bank, 2002).

According to population census in 2007 by central statistics agency of Ethiopia population density of Addis Ababa city is 5165 person per square kilometer. By buffering analysis of the bus stops in this city using 500 m buffer distance it cover about 25.55 km^2. From this

analysis only 131,971 of the total population of the city get the service with acceptable distance of 500m to travel to/from Bishoftu town using ACBSE's transport service. This result shows that around 96 % of the population of Addis Ababa have to walk more than 500m or they have to use another Anbessa bus or transport service provided by providers in order to travel to Bishoftu or from Bishoftu using ACBSE transport service.

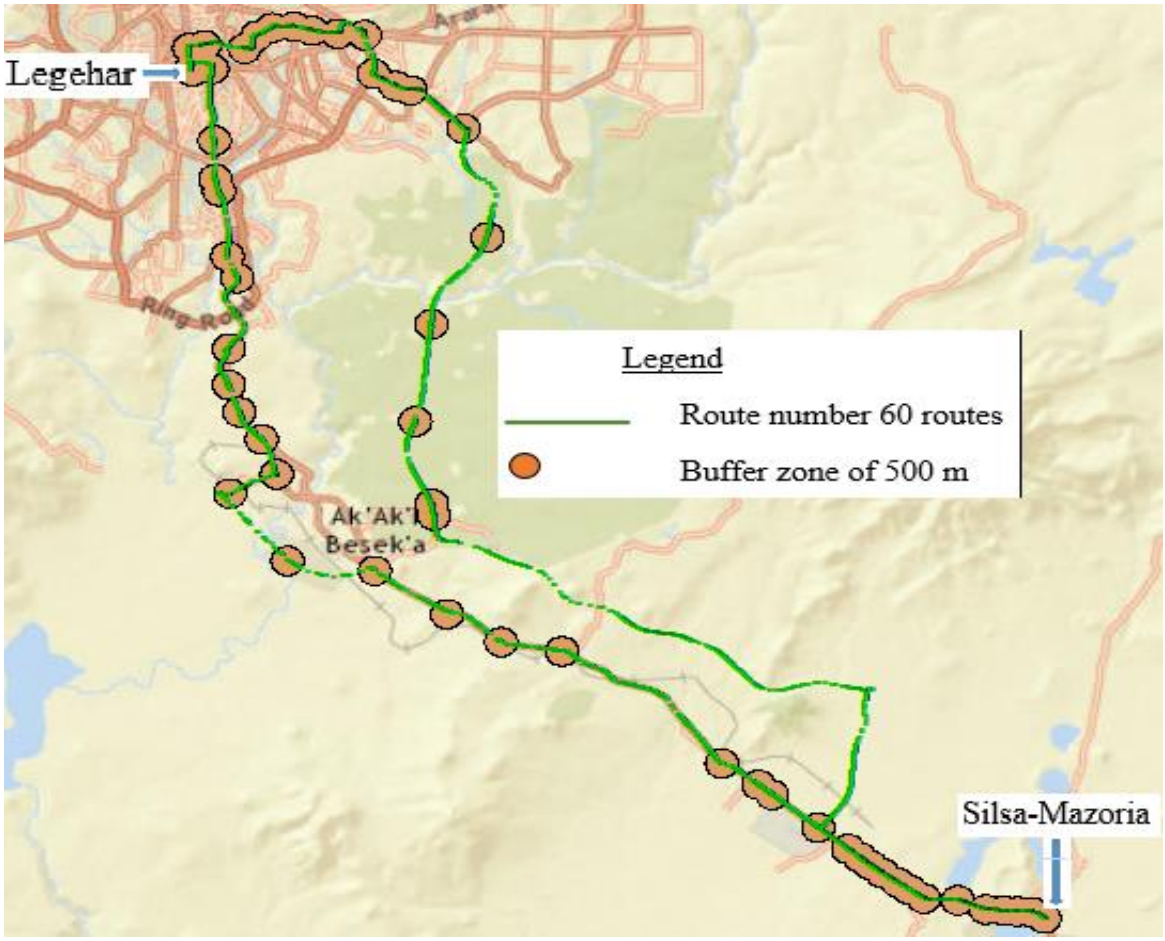


Figure 4.1: Buffer zone of 500m around existing bus stops

From central statistics agency of Ethiopia population census in 2007 the density of population, in Bishoftu, average 2097 persons per square kilometer. By using GIS software and buffer application through buffering from bus stop in this town only 15.7% of the population are serve within 500 m buffer distance. From this result, more than 84 % of the population living in Bishoftu have to walk more than 500m or they have to use minibus-taxi or Bajaj to travel from Addis Ababa or to Addis Ababa using ACBSE transport service.

For the town of Gelan population density per square kilometer is 952 based on central statistical agency of Ethiopia and by using 1000m buffer distance since the town is moderate population density. The transport service delivered by the enterprise give service for all most populations in this town within the acceptable buffer distance.

Dukem town has population density of 1020 person per square kilometer (CSA, 2007). From buffering analysis using 1000 m buffer distance, since the town is in moderate population density, all most all the resident of the town can get this transport service within 1000 m buffer distance.

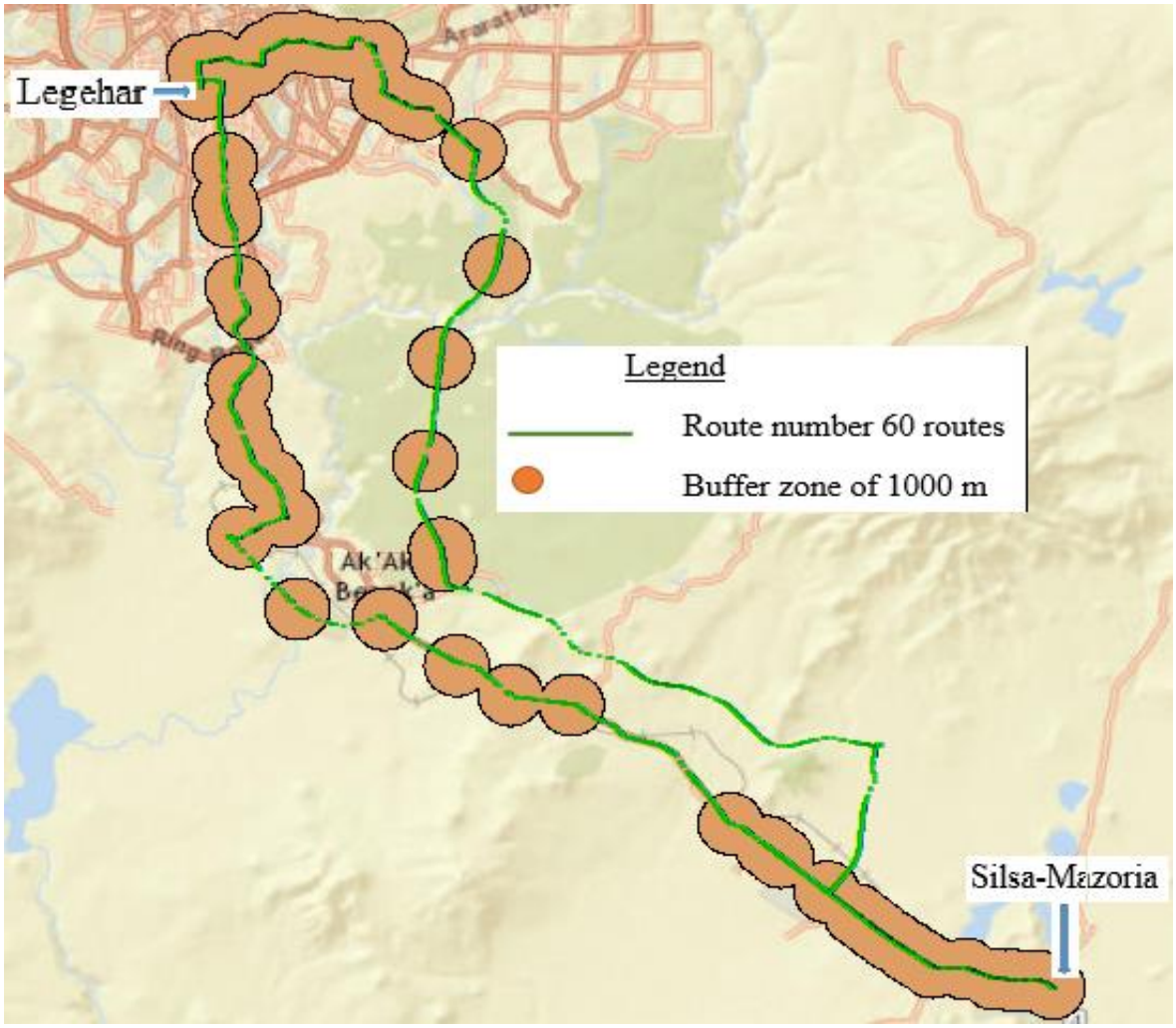


Figure 4.2: Buffer zone of 1000m around existing bus stops

Table 4.1: LOS Threshold value based on service coverage (source: TRB, 2004)

LOS Category	LOS Thresholds (%)
A	90 – 100
B	80 – 89.9
C	70 – 79.9
D	60 – 69.9
E	50 – 59.9
F	<50

Using the above threshold value developed by TRB and research result in terms the service coverage for the city of Addis Ababa and for the town of Bishoftu the level of service of the transport service provided by ACBSE operates at LOS F.

4.1.2. Route length and bus stop spacing

The route length defines the travelled distance by bus service to link end-terminals. The route length in this corridor is 55.32 km via Addis-Adama expressway and 48.7 km through Dukem, which is the longest from all routes provided by the enterprise.

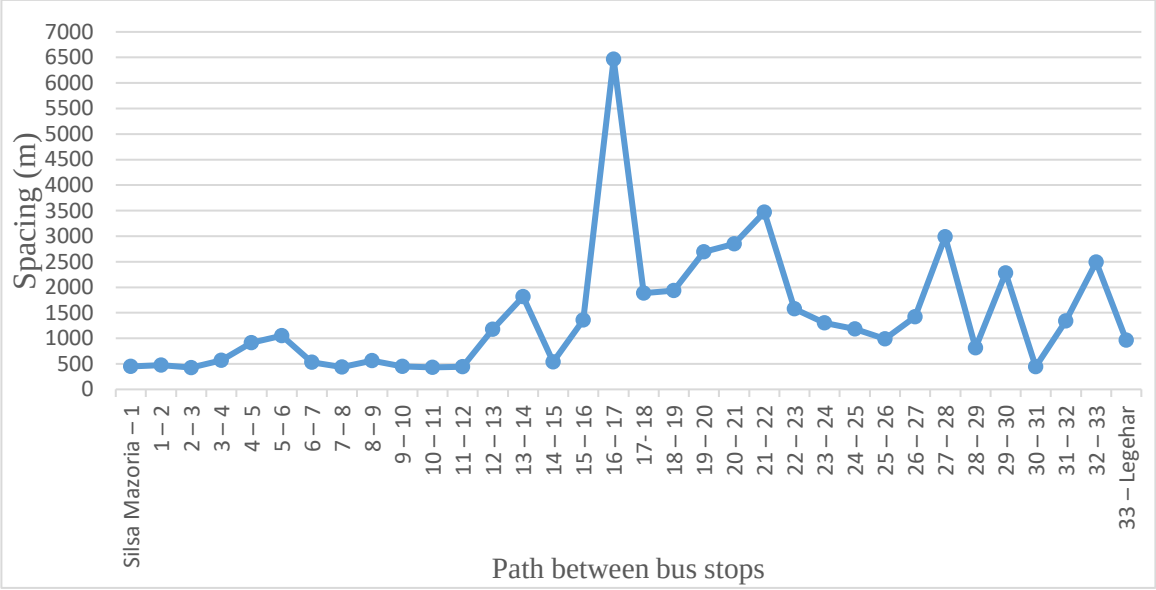


Figure 4.3: Bus stop spacing from Bishoftu to Legehar via old road

In addition to bus routes, the location and spacing of bus stops are decisive element of public transport service, since these are points at which travelers access this transport service. The average bus stop spacing along the route indirectly interpret whether the bus stops are redundant or insufficient. Redundant bus stop would increase the total travel time. However, insufficient bus stop would result in poor service coverage.

As shown in Fig. 4.3 and Fig. 4.4 the maximum bus stop spacing in this corridor, which is 4.3 km, without considering the path on the route through Addis-Adama expressway, between station 12 and station 13, the reason for not including this long bus stop spacing is there is no bus stops on the expressway. On the old road the maximum bus stop spacing is 6.5 km between Gelan and Dukem. The smallest bus stop spacing for both route is 0.43 km, which is in the town of Bishoftu around circle.

In order to determine the LOS by excluding bus stop spacing outside the city of Addis Ababa and the town of Bishoftu the average bus stop spacing in this route is 1186.5 m.

The average bus stop spacing through old road is about 1.4 km with standard deviation of 1.2 km. Through Addis-Adama expressway the average bus station spacing is 1.1 km with the standard deviation of 1.0 km.

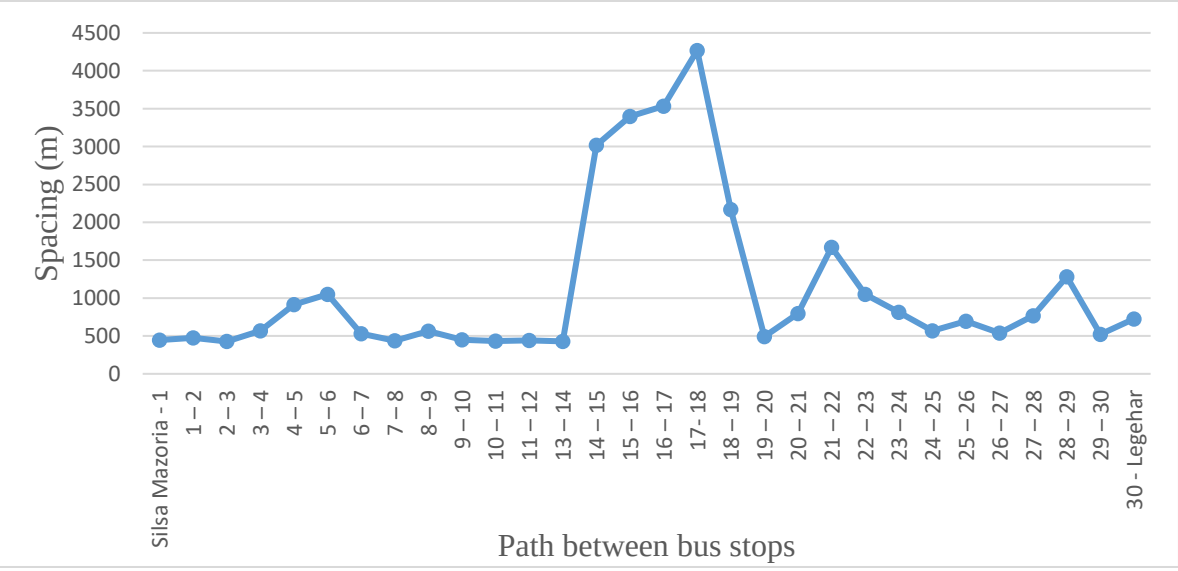


Figure 4.4: Bus stop spacing from Bishoftu to Legehar via Addis-Adama expressway

Through Addis-Adama express way to determine the level of service by excluding bus stop spacing outside the city of Addis Ababa and the town of Bishoftu the average bus stop spacing in this route is 1062.5 m.

Table 4.2: LOS Threshold value based on bus stop spacing (source: TRB, 2004)

LOS Category	LOS Thresholds (meters)
A	<70
B	70 - 200
C	200 - 700
D	700 - 1500
E	>1500

Therefore, using Table 4.2, which is threshold developed by TRB, and the average bus stop spacing on both route the transport service by ACBSE operates at LOS D.

4.1.3. Frequency and bus operating speed

The fleet size of the enterprise in this corridor is10 buses per day but, currently only 5 to 7 buses give transport service daily. According to the enterprise the proposed frequency of service in this corridor was 75 per day as shown in Appendix-A.

Table 4.3: LOS Threshold value based on Frequency (source: TRB, 2004)

LOS Category	Number of vehicle per hour
A	>6
B	5 – 6
C	3 – 4
D	2
E	1
F	<1

In resent time, due to vehicle break down and other operational and management problems the frequency of the transport service by ACBSE is limited to 20 up to 24 trips per day and there is no sign of improvement instead the frequency of the service decline each day rapidly in contrast to this fact the travel demand in this corridor increase rapidly.

Based on the threshold value proposed by TRB for public transport service based on number of bus service per hour the transport service provided by ACBSE in the selected corridor operates at LOS F.

According to information gathered from the enterprise the scheduled average headway in this corridor was about 20 minutes but, the actual average headway was more than 90 minutes. Thus, in terms of headway the transport service is in bad condition.

Operating speed achieved in public transport is influenced by vehicle and alignment speed as well as by stopping at passenger stops and general traffic conditions. Operating speed is the average speed of buses travel along bus route with spacing. It is the speed travel offered to the public. During this research field work the speed along both routes were recorded using GPS devices.

Table 4.4: Average Travel Time

Route	Time of service	Route Length(km)	Average Travel Time (hr)
Old road (Legehar to Silsa-Mazoria)	Peak Hour	48.7	2:40
	Off-Peak Hour		2:10
Addis-Adama expressway	Peak Hour	55.32	2:00
	Off-Peak Hour		1:40

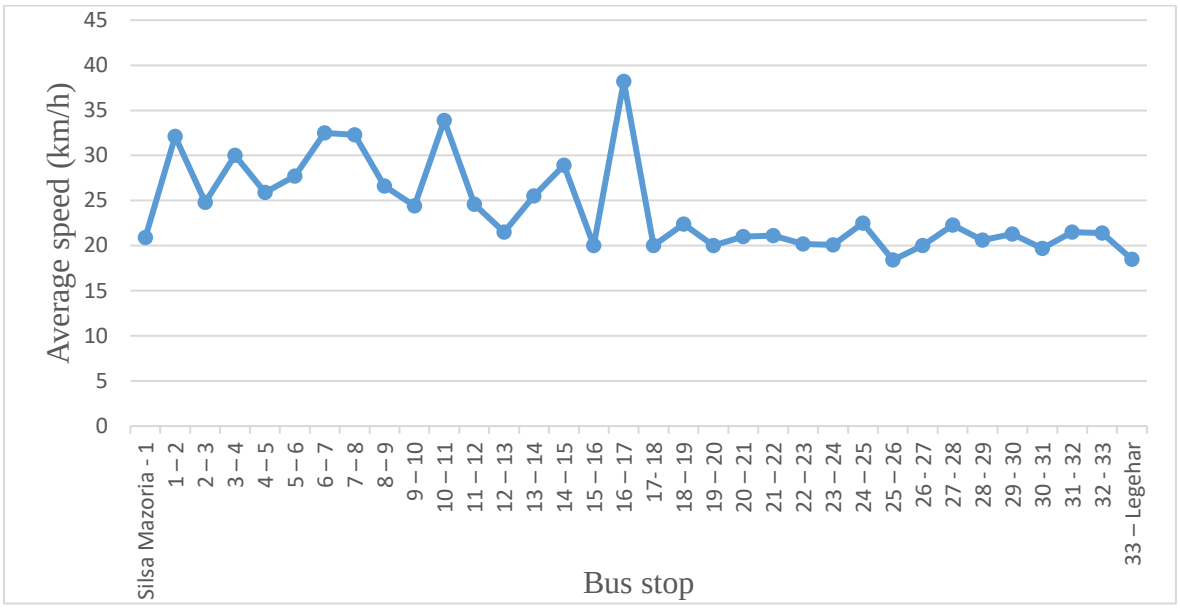


Figure 4.5: Average speed between each consecutive bus stops via old road

Based on Fig. 4.5 the average speed is 24.4 km/h with standard deviation of 5.0 km/h. The maximum and minimum speed through old route is 38.2km/h and 18.4 km/h respectively.

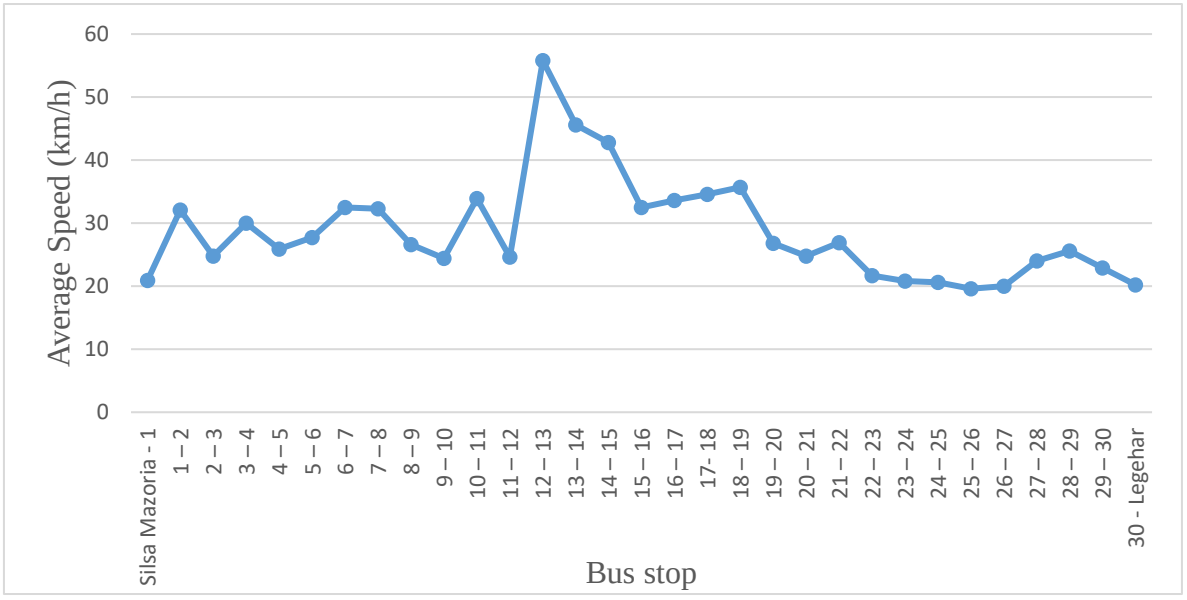


Figure 4.6: Average speed between consecutive bus stops via Addis-Adama expressway

As shown in the Fig. 4.6 the maximum and the minimum bus speed via Addis-Adama expressway are 55.8 km/h and 19.6 km/h respectively. 28.7 km/h is the average travel speed in this route. The standard deviation in this route is 8.2 km/h.

Armstrong-Wright et al. (1987) recommended that public bus transport system should operate with a minimum of 10 to 12 km/h operating speed for dense areas with mixed traffic. Despite the length of transport service via old route is much less than through Addis-Adama express way the average travel time is greater on old road. Table 4.1 shows the average travel time in this corridor.

The average operating speed in this corridor is 26.55 km/h, which shows this speed exceeds the threshold value propose by Armstrong-Wright et al. Thus, the operating speed in this corridor is good enough.

4.1.4. Dwell times

Dwell time is defined as "the time in seconds that a transit vehicle is stopped for the purpose of serving passengers. It includes the total passenger service time plus the time needed to open and close doors." (Dueker et al., 2004).

Dwell time is a term used to describe how long buses dwell at each stop. Service time is used to describe the time duration a bus stays at a particular stop due to passenger boarding and alighting processes. In addition to that, dwell times at all stops could be greatly affected by fare payment procedure and unexpected traffic condition.

The average dwell time at each bus stop on both directions, during peak hour and off-peak hour, are shown in the next eight consecutive Figures (note: the origin and end terminals do not have any dwell time and are therefore not included). The average dwell time was calculated both for the off-peak period and for the peak period. In this corridor bus transport service from Silsa Mazoria to Legehar through old route during peak hours had the longest average dwell time (75 sec) and the highest standard deviation take place in transport service from Bishoftu to Legehar through Addis-Adama expressway during peak period (9.2 sec).

Based on Fig. 4.7, ACBSE transport service from Legehar to Bishoftu through old road has the longest dwell time of 55 sec at bus stop six during peak hour and 40 sec at bus stop six in the course of off-peak hour. The standard deviation in this route is 6.5 sec and 3.5 sec during peak and off-peak period respectively. The average dwell time from Legehar to Bishoftu via old road is 35.6 sec and 30 sec during peak and off-peak period. The total time spent due to loading and alighting of passengers in this direction is 20 minute and 16 minute in peak and off-peak period correspondingly.

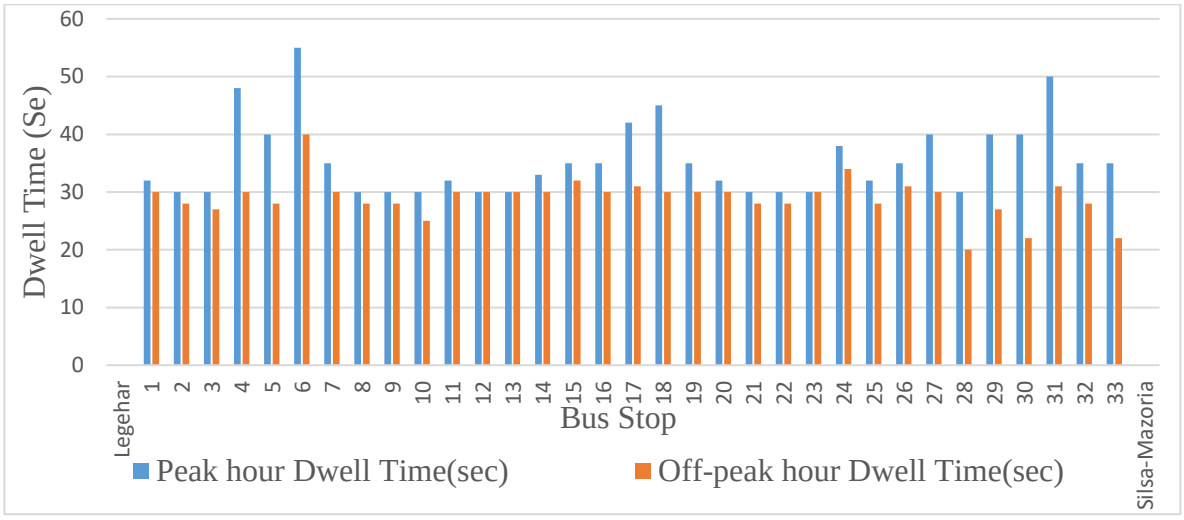


Figure 4.7: Average dwell time at each bus stop from Legehar to Silsa-Mazoria via old road

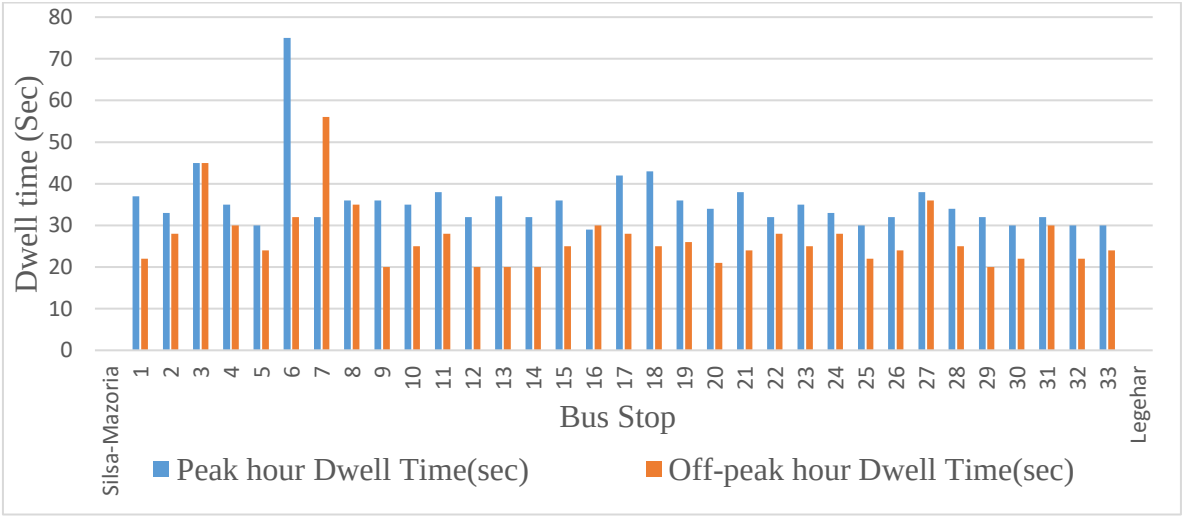


Figure 4.8: Average dwell time at each bus stop from Bishoftu to Legehar via old road

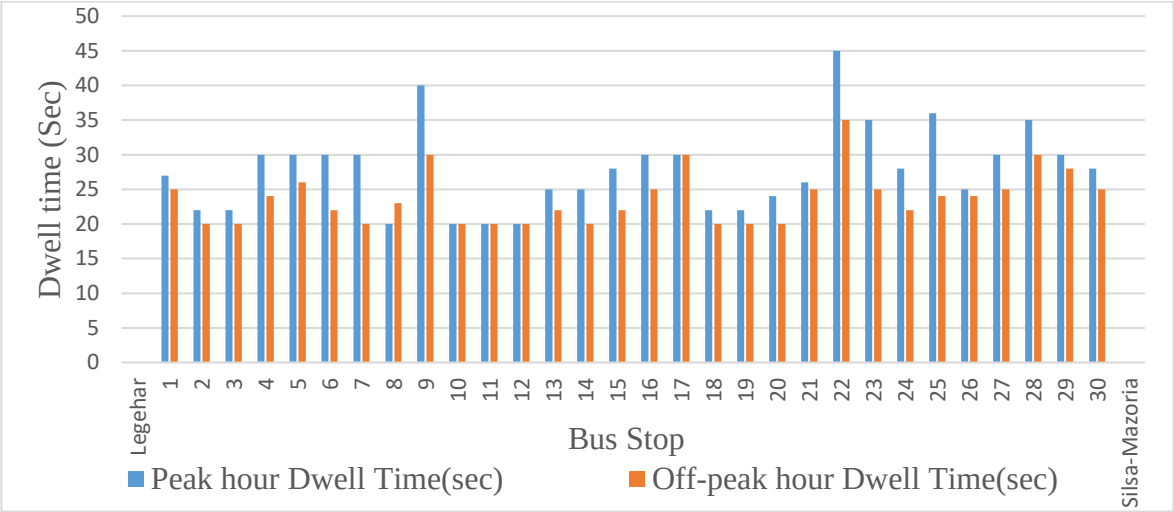


Figure 4.9: Average dwell time at each bus stop from Legehar to Bishoftu via Addis-Adama expressway

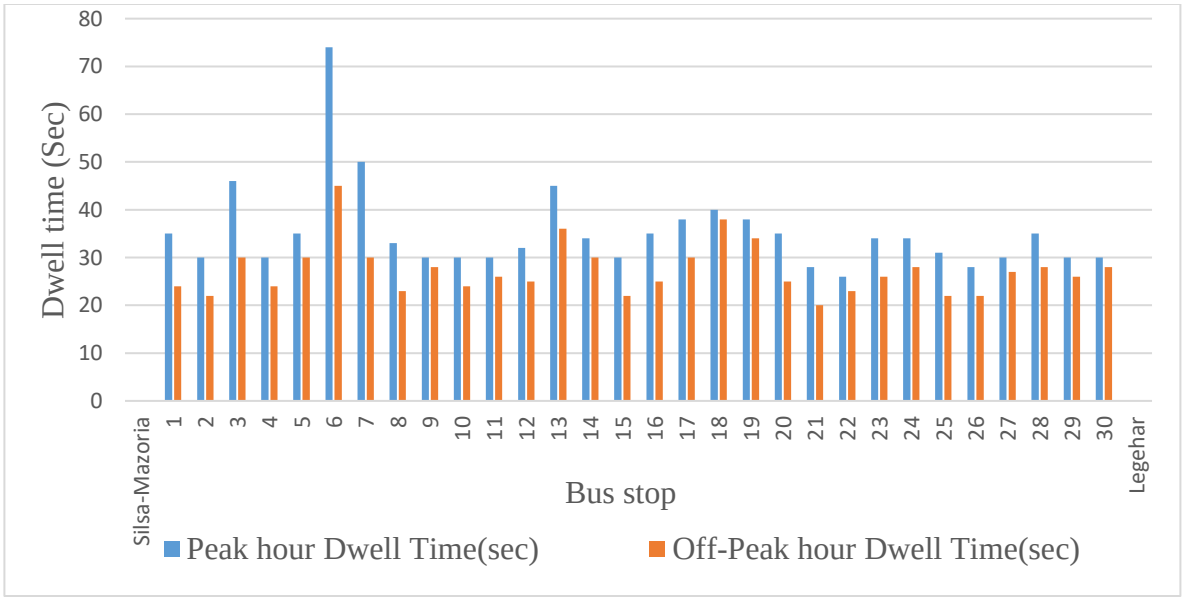


Figure 4.10: Average dwell time at each bus stop from Bishoftu to Legehar via Addis-Adama expressway

As shown in Fig. 4.8, ACBSE transport service from Bishoftu to Legehar through old road has a total dwell time of 20 minute. In this route in peak hour the highest dwell time is 75 sec

which is the largest from all. The average dwell time in this path and time was around 35.7 sec with standard deviation of 8 sec.

From Bishoftu to Legehar via old road for the time of off-peak period, as designated in Fig. 4.8, the longest dwell time occurs at bus stop 7, which is 55 sec. The average dwell time in this route at off-peak period is around 27 sec with standard deviation of 7.5 sec. In addition to this the total dwell time during this period was 15 minute.

Fig. 4.9, shows that dwell time due to transport service from Legehar to Bishoftu through Addis- Adama expressway during peak hour. For this service the average dwell time is approximately 28 sec with standard deviation of 6 second. The highest dwell time on this route is 45 sec and 14 minute is the total dwell time to travel from Legehar to Bishoftu during peak period.

From Legehar to Bishoftu via Addis-Adama expressway at the time of off-peak period, as per Fig. 4.9, the longest dwell time is 35 sec at station 22. The total dwell time in this route is 12 minute. The average dwell time in this path at this particular period is 23.7 sec with standard deviation of 3.9 sec.

As per Fig. 4.10, ACBSE transport service from Bishoftu to Legehar through Addis-Adama expressway has the longest average dwell time 74 sec at bus stop 6 during peak hour and 45 sec at bus stop 6 in the course of off-peak hour. The standard deviation in this route is 9.2 sec and 5.4 sec during peak and off-peak respectively. The average dwell times in this route is 35.2 sec and 27.4 sec during peak and off-peak period. The total time consumed due to loading and alighting of customers in this route is about 18 and 14 minute in peak and off-peak period respectively.

According to Shreya Das and Debapratim Pandit the minimum and desirable LOS of the average dwell time are 1.7 and 2.5 minutes respectively. The result of average dwell time on both route, on both time period and on both direction shows that less than the minimum acceptable LOS. So, the service operates at poor condition.

4.1.5. Boarding, Alighting and Load of passengers

On average the passenger loading via old road from Legehar during peak hour, from Legehar during off-peak hour, from Bishoftu during peak hour and from Bishoftu during off-peak hour is 7.8, 4.8, 7.4 and 3.9 passengers per bus stops respectively. This applies for Addis-Adama expressway as well, on both time periods. For peak periods from Legehar the average loading is 9.7 passengers, while for the off-peak period it is 5.2 passengers. From Bishoftu to Legehar passenger loading through the expressway is 6.8 during peak period and 5.1 passengers during off-peak hour.

The average number of alighting passengers per stop is 7.1 from Legehar to Bishoftu through old road for peak period, 4.4 for the off-peak hour service. From Bishoftu the average number of travelers alighting per stop is 10.8 and 5.7 for peak and off-peak periods. On average the passenger alighting per stop through the expressway from Legehar to Bishoftu during peak hour, from Legehar to Bishoftu during off-peak hour, from Bishoftu during peak hour and from Bishoftu during off-peak hour is 9.3, 5, 10 and 5.1 passengers respectively.

All Figures from 4.11 to 4.18 clearly shows, as expected, how the majority of the passengers board at the beginning of the transport service and alight at and near by the terminating station. There are some stops that stand out having higher average number of boarding and/or alighting passengers. Peak time transport service from Legehar to Bishoftu through old road has 10 and more than 10 boarding and/or alighting passengers at bus stop 6, 17, 20, 21, 22, 23, 27 and 31 in addition to starting and terminating station. Off-peak period service from Legehar to Bishoftu via old road has 10 and more than 10 boarding and/or alighting passengers only at starting station. From Bishoftu to Legehar via old road has 10 and more than 10 boarding and/or alighting passengers at bus stops 5, 6, 16, 17, 22, 23, 24, 25, 26, 27, 29, 30, 31, 32 and 33 during peak hour, on the other hand only bus station 6 and 31 has 10 and more than 10 boarding and/or alighting passengers for off-peak period in addition to Silsa-Mazoria and Legehar stations.

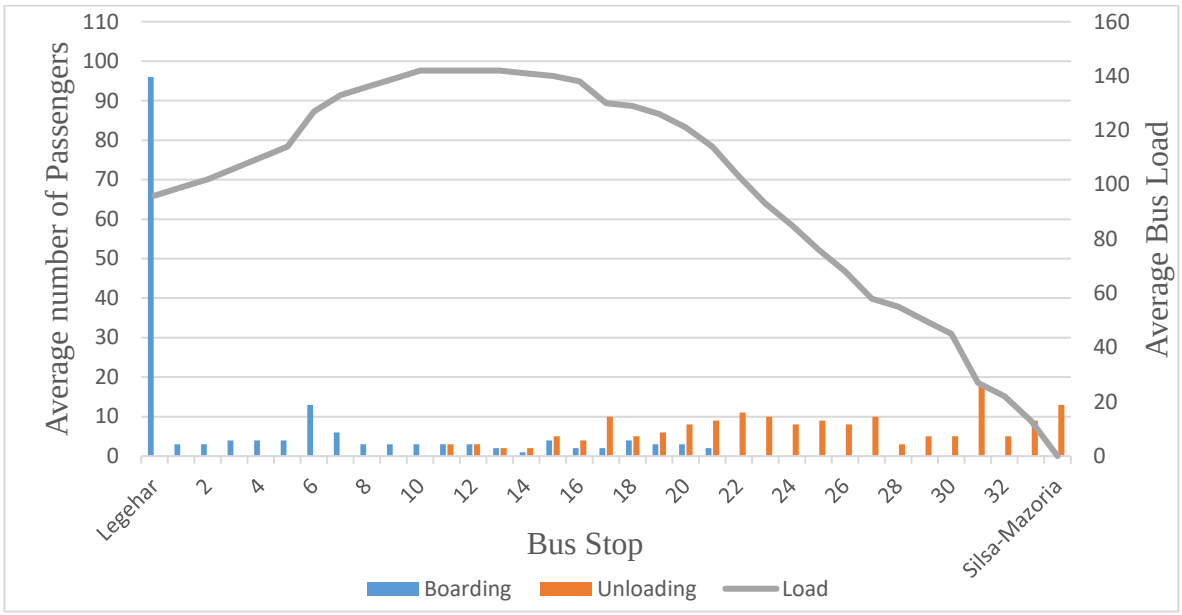


Figure 4.11: Average number of passenger loading, alighting and load at each bus stop from Legehar to Bishoftu via old road for peak period

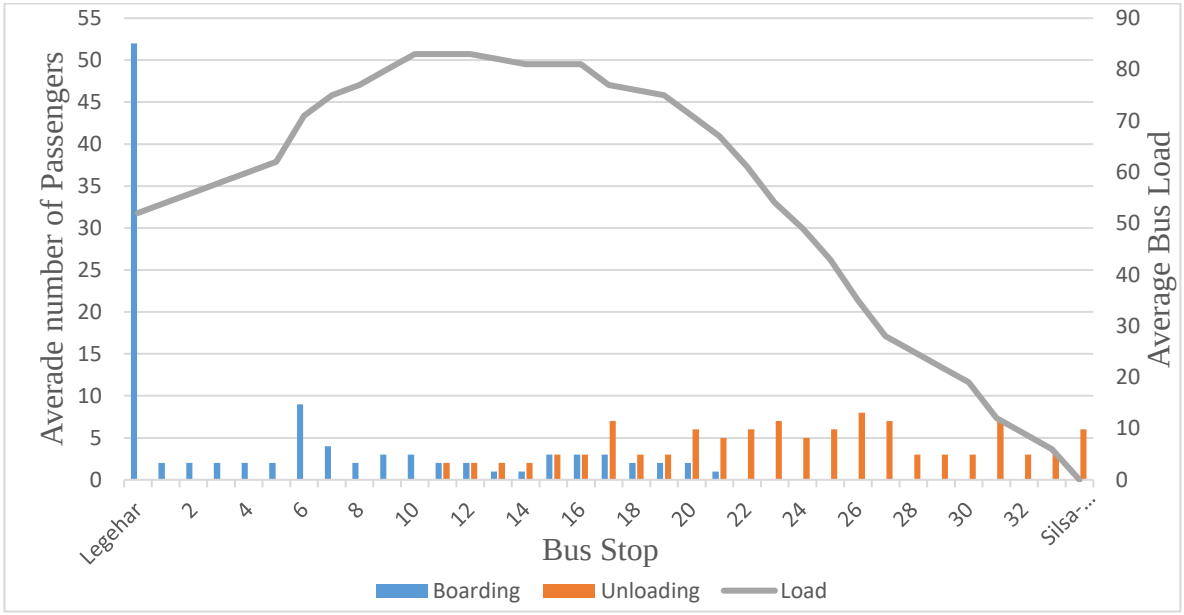


Figure 4.12: Average number of passenger loading, alighting and load at each bus stop from Legehar to Bishoftu via old road for off-peak period

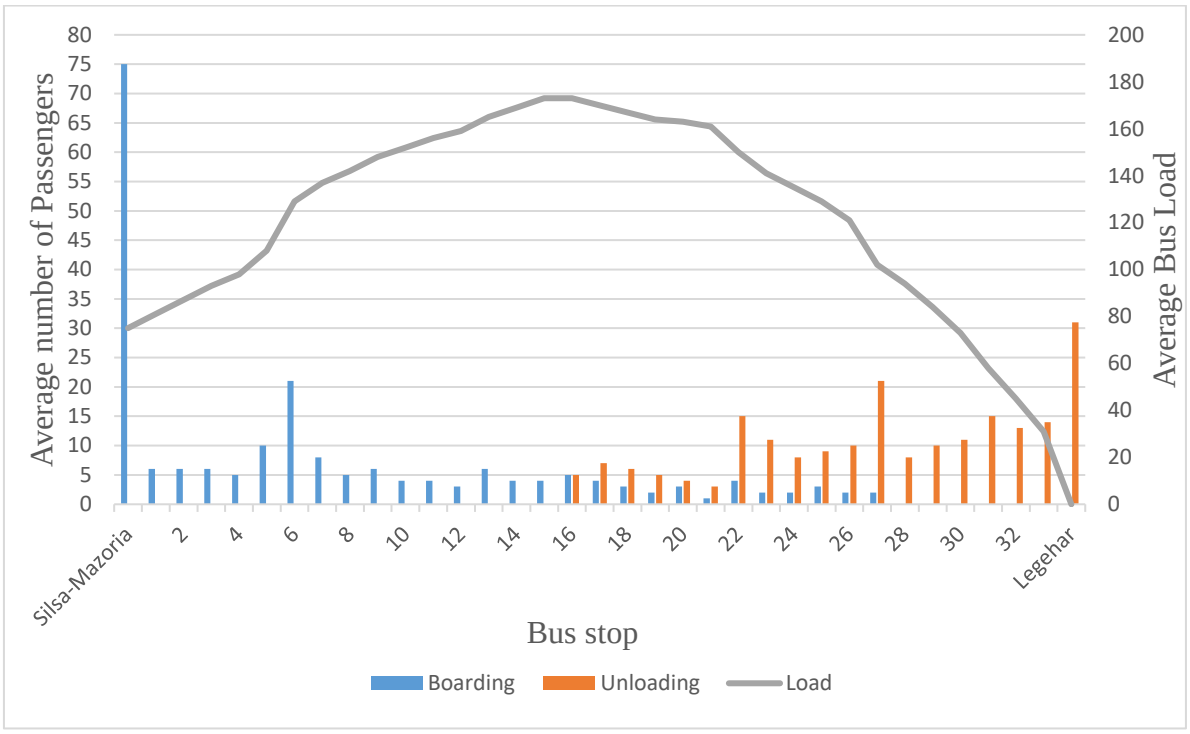


Figure 4.13: Average number of passenger loading, alighting and load at each bus stop from Bishoftu to Legehar via old road for peak period

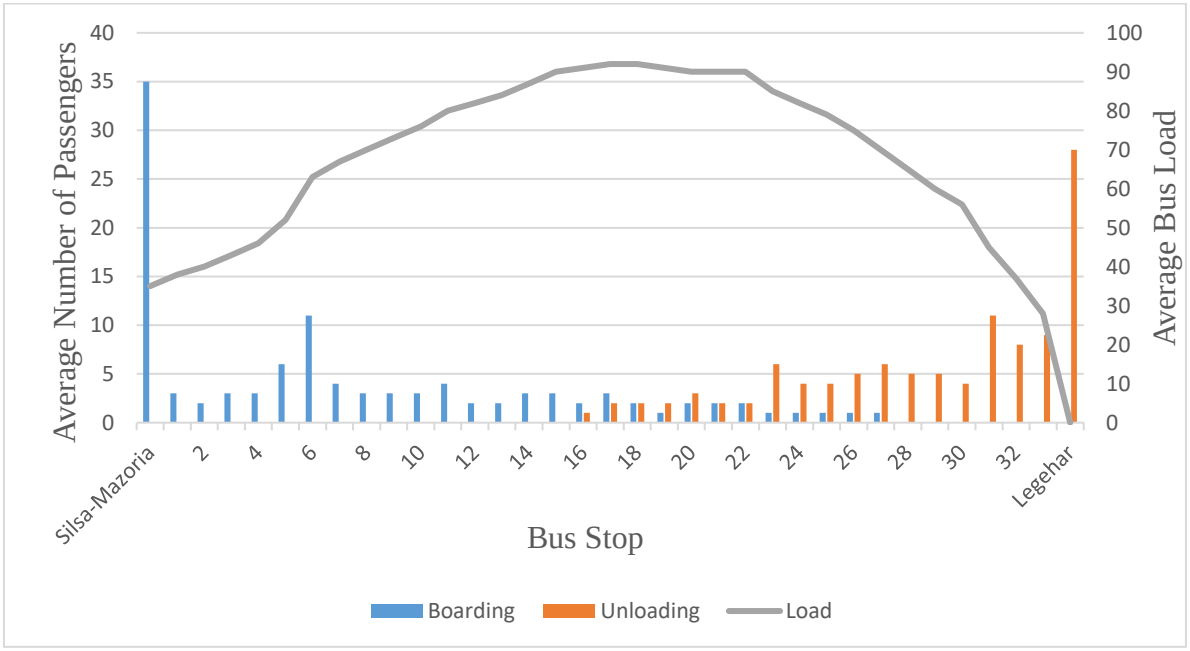


Figure 4.14: Average number of passenger loading, alighting and load at each bus stop from Bishoftu to Legehar via old road for off-peak period

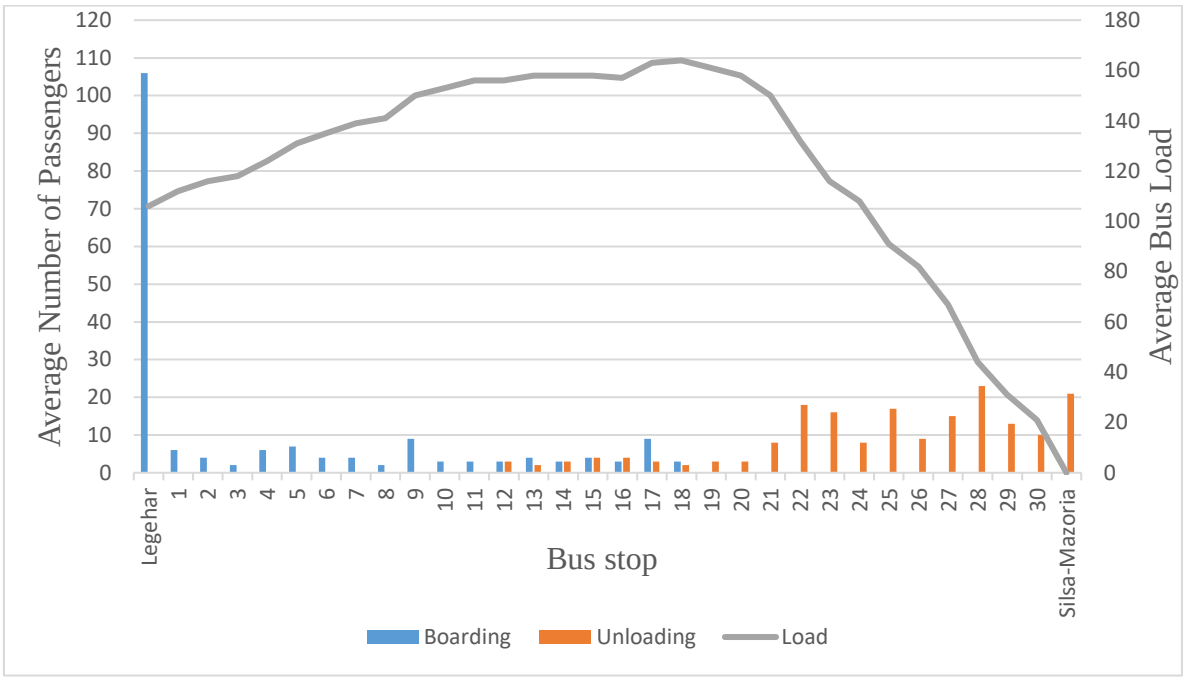


Figure 4.15: Average number of passenger loading, alighting and load at each bus stop from Legehar to Bishoftu via Addis-Adama expressway for peak period

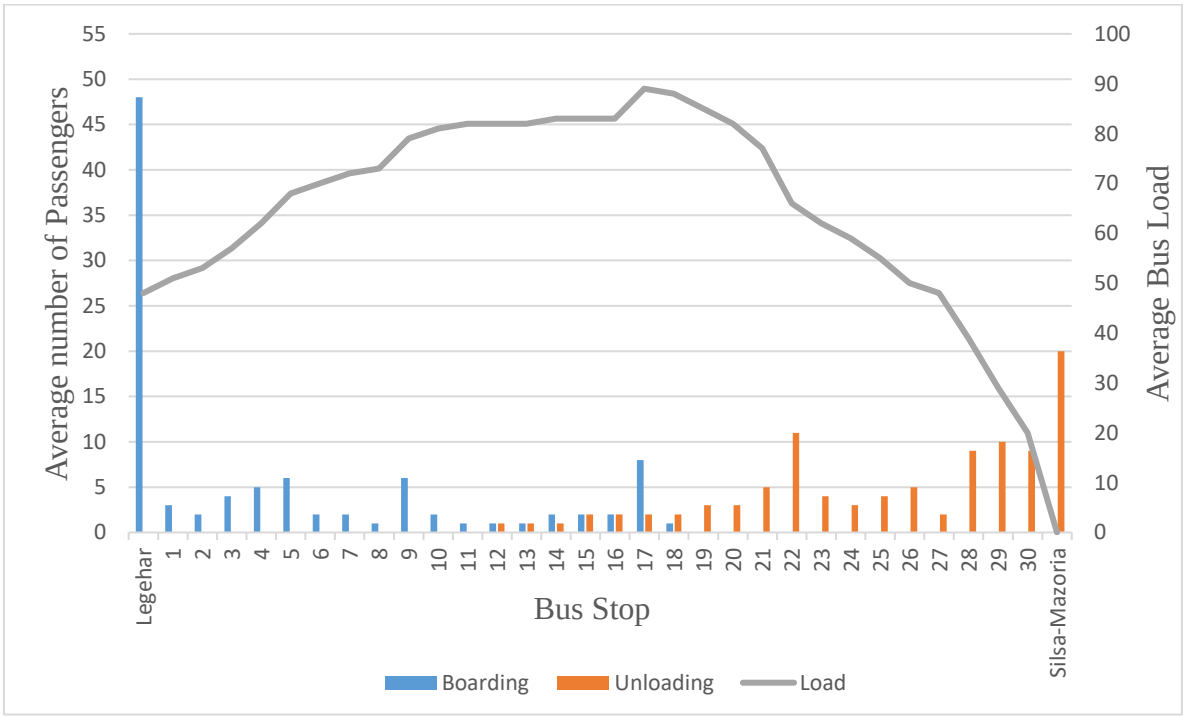


Figure 4.16: Average number of passenger loading, alighting and load at each bus stop from Legehar to Bishoftu via Addis-Adama expressway for off-peak period

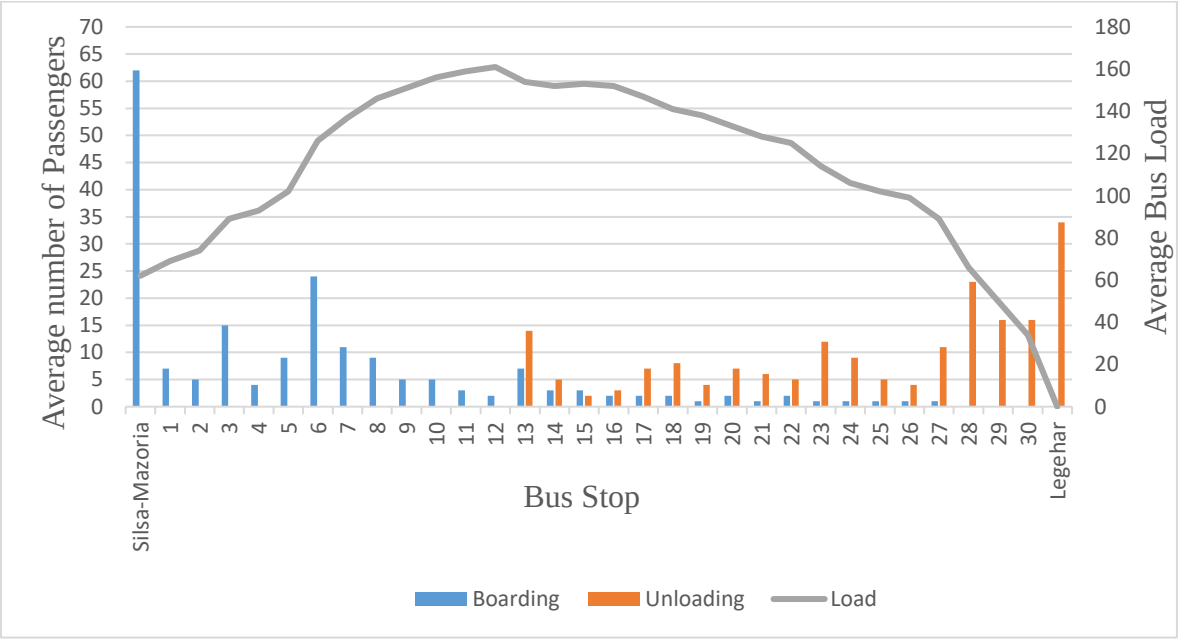


Figure 4.17: Average number of passenger loading, alighting and load at each bus stop from Bishoftu to Legehar via Addis-Adama expressway for peak period

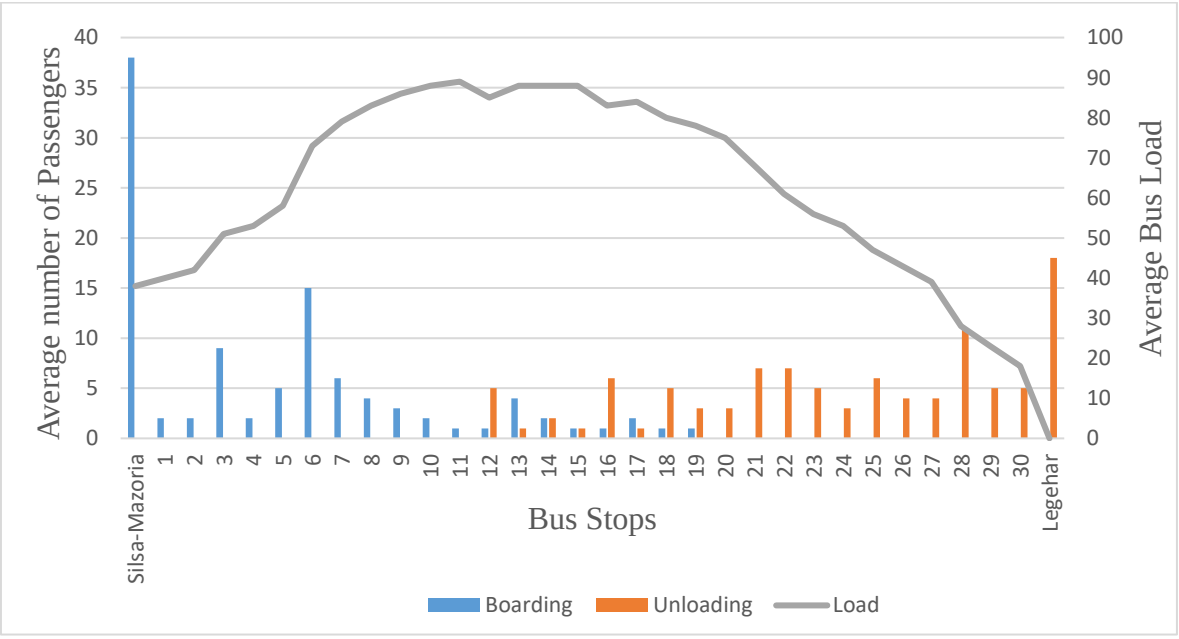


Figure 4.18: Average number of passenger loading, alighting and load at each bus stop from Bishoftu to Legehar via Addis-Adama expressway for off-peak period

Peak time transport service from Legehar through the expressway has 10 and more than 10 boarding and/or alighting passengers at bus stop 17, 22, 23, 25, 27, 28, 29 and 30 in addition to starting and terminating station. Off-peak period service from Legehar via the expressway has 10 and more than boarding and/or alighting passengers only at station 22 and 29 in addition to starting and terminating stations. From Bishoftu to Legehar via this route the service has 10 and more than 10 boarding and/or alighting passengers at bus stops 3, 6, 7, 13, 18, 23, 24, 27, 28, 29 and 30 during peak hour, on the other hand only bus station 6 and 28 has 10 and more than 10 boarding and/or alighting passengers for off-peak period in addition to Silsa-Mazoria and Legehar stations.

The average load differs substantially between the routes, directions and time period. For Legehar to Bishoftu transport service via old road it is 99 and 55.7 passengers with a standard deviation of 42 and 25.8 during the peak and off-peak hour correspondingly. For the peak and off-peak period through old road from Bishoftu the average load is 120.9 and 67 passengers and a standard deviation of 45.3and 23 respectively. For the peak and non-peak period the average load is 120.5 and 64.3 passengers with a standard deviation of 45 and 21.2 for transport service from Legehar via Addis-Adama expressway. On this route from Bishoftu to Legehar during peak and non-peak period the service had an average load of 112.8 and 61.4 passengers, with standard deviation of 41.2 and 24.4 respectively.

Table 4.5: LOS Threshold value based on Average Passengers Load (source: TRB, 2004)

LOS Category	LOS Thresholds (Passengers/seat)
A	<= 0.3
B	0.31 – 0.90
C	0.91 – 1.50
D	1.51 – 2.30
E	>2.30

The ratio of passenger load to number of seats are 2.54, 1.43, 3.10, 1.72, 3.09, 1.65, 2.89 and 1.57 for Legehar to Bishoftu during peak hour via old route, for Legehar to Bishoftu during off-peak hour via old route , for Bishoftu to Legehar during peak hour via old route, for

Bishoftu to Legehar during off-peak hour via old route, for Legehar to Bishoftu during peak hour via expressway, for Legehar to Bishoftu during off-peak hour via expressway, for Bishoftu to Legehar during peak hour via expressway and for Bishoftu to Legehar during off-peak hour via expressway respectively.

From this result and using threshold value developed by TRB all direction peak hour service operates at LOS of E, off-peak hour service for Legehar to Bishoftu via old route operates at LOS C and the remaining three transport service, which are Legehar to Bishoftu during off-peak hour via old route, Bishoftu to Legehar during off-peak hour via old route and Legehar during off-peak hour via expressway respectively operates at LOS D.

4.2. Statistical analysis

400 questionnaires were distributed randomly and filled out by Anbessa bus travelers and 387 questionnaires were accepted for further analysis. The respondent consisted of 259 men and 128 women. 204 respondents from Bishoftu and 183 respondents from Addis Ababa. From 387 passengers 12.66% of the respondents were students, 70.03% employees, 4.9% were retired persons, 6.5% were unemployed and 5.9% were others.

Many respondents commuted frequently (78.6%). Of the respondents, 54.9% use Anbessa bus transport on a daily basis or at least 5 days per week, 35.5% use Anbessa bus transport 2 to 4 times a week and 9.5% of the respondent use Anbessa bus once every week.

4.2.1. Descriptive analysis

4.2.1.1. Average distance from home to the nearest bus stop

As indicated in Fig. 5.23, only 23.5% of the respondents responded that the average walking distance from their home to initial bus stop is less than 500 meters. 34.6% responded that the walking distance to initial bus stop is between 500-1000 meters. The rest 41.9% responded that they walk above 1000 meters to reach to the nearest bus stop to get the bus transport service.

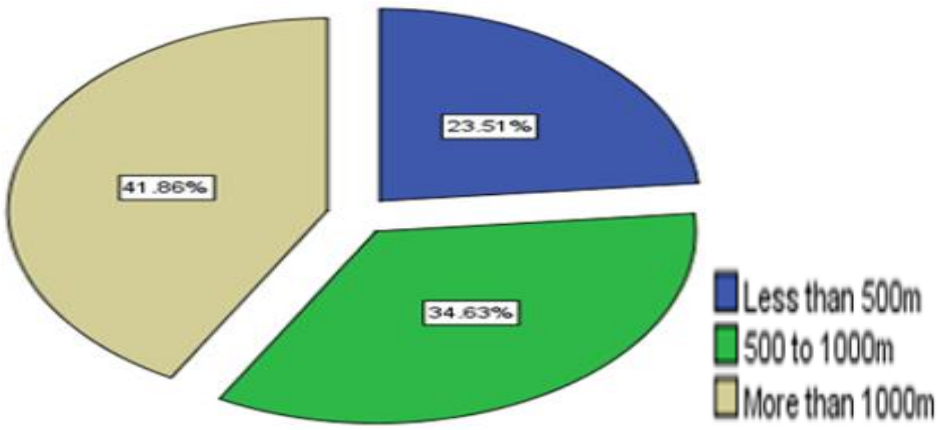


Figure 4.19: Average distance from home to the nearest bus stop

This result substantiates that 76.5% of the passengers travel by walk or use other mode of transport from their home to bus stop beyond the recommended standard of densely populated urban area (i.e. 300-500 meters). Thus, the service coverage in this corridor is very poor.

4.2.1.2. Average distance from bus stop to their destination

Table 4.6: Average distance from destination to the nearest bus stop

Distance(m)	Frequency	Percent	Cumulative Percent
Less than 500	59	15.2	15.2
500 to 1000	95	24.5	39.8
More than 1000	233	60.2	100.0
Total	387	100.0	

Table 5.2 shows that 15.2% of the commuters responded that walking distance from final destination to the nearest bus stop is less than 500 meters. 24.5% reacted that the distance is between 500-1000 meters. The rest 60.2% responded that they walk above 1000 meters to reach to their destination from the nearest final bus stop.

From this data there are significant numbers of travelers (84.7%) who walk or use other mode of transport from bus stops to their final destination ahead of the recommended walking

distance for densely urban areas. Hence, the service coverage of ACBSE in this corridor is very poo

4.2.1.3. Waiting time

From the Table 4.7 all of the respondents wait for bus more than 10 minutes which is the threshold value for achieving reasonable level of service. 81.7% and 11.1% of the respondent wait for bus a minimum of 30 minutes and a minimum of 15 minutes respectively. Only 7.2% of the respondent wait for time less than 15 minutes.

Table 4.7: Average waiting time at bus stop

Waiting time (minutes)	Frequency	Percent	Cumulative Percent
Less than 5	0	0	0
5 to 10	0	0	0
10 to 15	28	7.2	7.2
15 to 30	43	11.1	18.3
More than 30	316	81.7	100.0
Total	387	100.0	

This data shows that how extremely long the waiting time is as compared to the threshold value proposed by World Bank. All of the respondent wait for bus away from the threshold value and more than 80% wait bus more than the 30 minutes which is also greater than the maximum threshold value which is 20 minutes.

Long waiting time was pointed out by 28.9% of the respondents as primary problem for discouraging from using ACBSE transport service. According to ACBSE officials the reasons for this extreme long waiting time in this corridor are insufficient number of buses, due to mechanical breakdown of buses, lack of spare parts, and lack of skilled person to maintain the buses, congestion and poor condition of the road on old road.

4.2.1.4. Availability of seat and shelter at bus stop

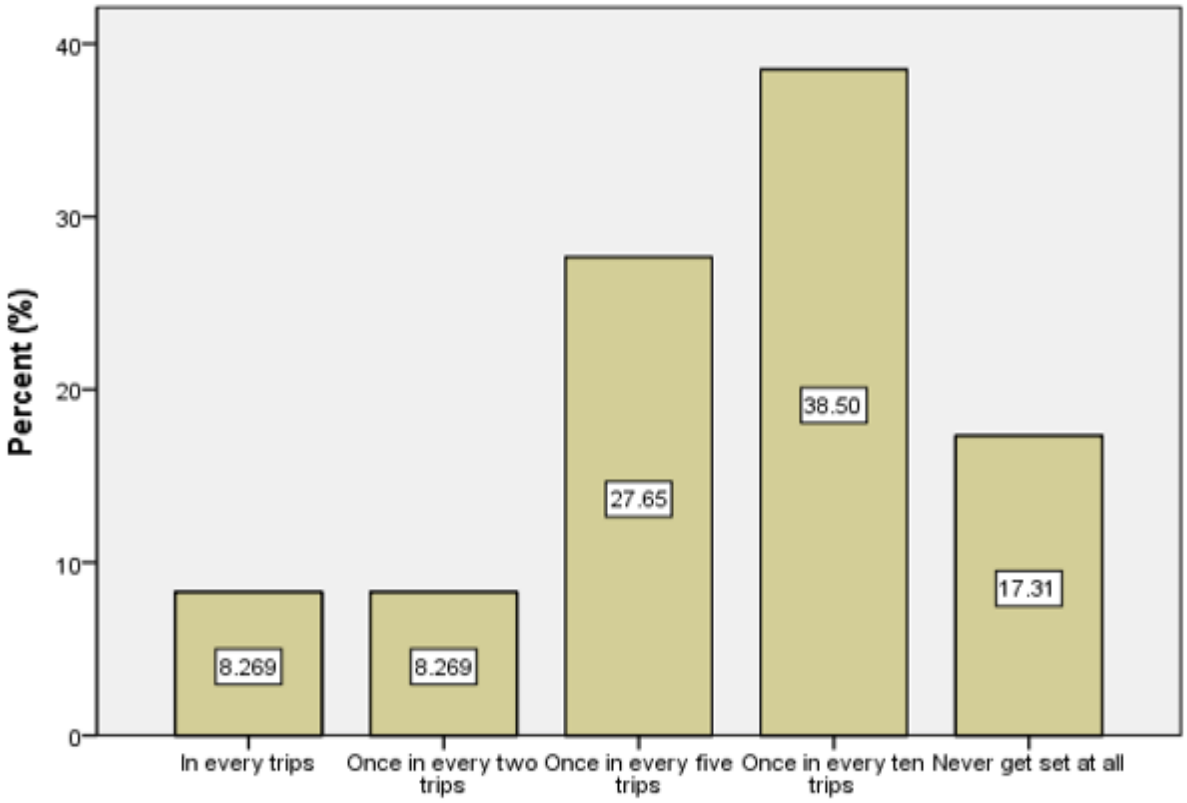


Figure 4.20: Availability of seat and shelter at bus stop

Fig. 4.20 signifies that only 8.3% of the respondents replied that they get shelter and seat at bus stop in their every trip. 8.3% % reacted that they get once in every two trip. 27.6% and 38.5% act in response that they get set and shelter once in every five trip and once in every ten trip respectively. The rest 17.3% of travelers respond that they never get seat and shelter at bus stop.

From this result and by visual inspecting this corridor most bus stops do not have proper shelter and seat. During this research time few bus stops in Addis Ababa are under reconstruction and establishment of shelter however only one bus stops has shelter and seat in Bishoftu side which is in bad condition.

4.2.1.5. Availability of seat inside the bus

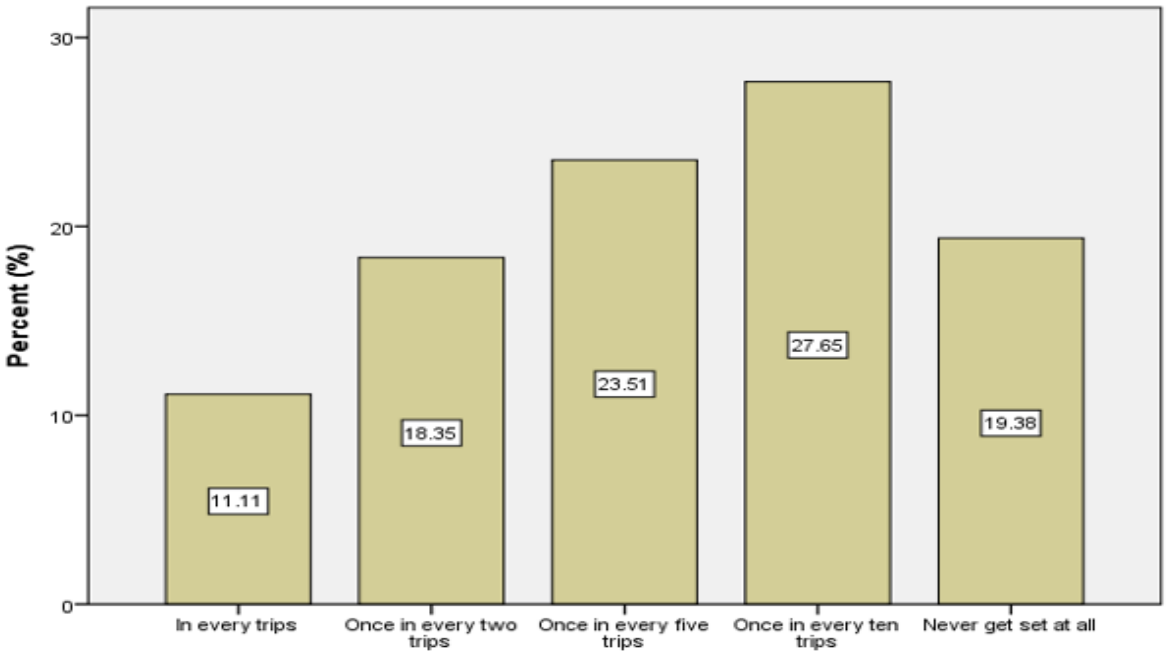


Figure 4.21: Availability of seat inside the bus

As indicated in Fig. 4.21, 19.4% of the respondents replied that they never get seat in bus at all. 27.6%, 23.5% and 18.3% responded that they get seat in bus for an average of once in every ten trip, once in every five trip and once in every two trip correspondingly. Only 11.1% of the respondent respond that they get seat in bus regularly.

More than 40% of the travelers responded lack of availability of seat as primary and secondary problem that discourage from using ACBSE transport service.

4.2.1.6. Reliability of the service

For this research customers were asked to rate the reliability of the transport service provided by ACBSE in Addis Ababa-Bishoftu corridor and the result is presented in Table 4.8. This Table depicts that only 16.3% of respondents were responded that the transport service provided by ACBSE is reliable. None of them reacted that the service is most reliable. On the other hand, 49.1% and 34.6% of the passengers responded that the transport service is less reliable and poor respectively.

Table 4.8: Reliability of the service

Response type	Frequency	Percent	Cumulative Percent
Poor	134	34.6	34.6
Less Reliable	190	49.1	83.7
Reliable	63	16.3	100.0
Most Reliable	0	0	
Total	387	100.0	

The passengers have specified that failure of the enterprise to give service according to the schedule and bus overcrowding are the two major problems that discourages theme to use this transport service (53.75% aggregate response). Delay of the service lead by 28.94% and bus overcrowding followed by 24.81%. Poor treatment by operators and lack of seat in bus also identified by the respondent as main discouraging factor i.e. 20.41% and 16.54% of the respondents respectively. Inside the bus robbery, non-uniform speed and number of interchange cover the remaining 9.3% respondents as primary factor that discourage using ACBSE's transport services along this corridor.

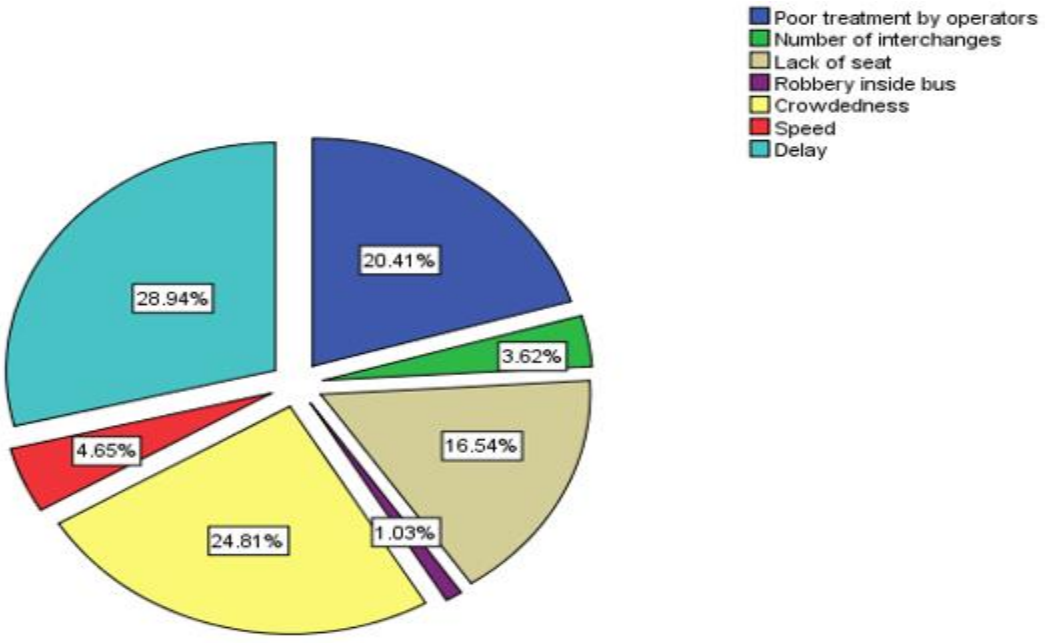


Figure 4.22: Major discouraging factors

4.2.1.7. Customer satisfaction level

In recent times all organization have come to understand the importance of customer satisfaction. It is widely understood that it is far less costly to keep existing customers than it is to wind new ones. For many organizations in the public sector, customer satisfaction will itself be the measure of success.

According to Oliver (1997), customer satisfaction is defined as the customer's fulfillment. It is a judgment that a product or service feature, or the product or service itself, provided (or is providing) a pleasurable level of consumption-related fulfillment, including levels of under- or over-fulfillment. Need fulfillment is a comparative processes giving rise to the satisfaction responses. Any gaps lead to disconfirmation; i.e., Positive disconfirmations increases or maintain satisfaction and negative disconfirmation create dissatisfaction. Service quality (Parasuraman et al. 1988; Gronroos 1984) is defined as a comparison between customer expectation and perception of service. Service quality in general consists of five distinct dimensions: tangibles (Physical facilities, equipment, and appearance of personnel), reliability (ability to perform the promised service dependably and accurately), responsiveness (willingness to help customer and provide prompt service), assurance (knowledge and courtesy of employees and their ability to inspire trust and confidence), and empathy (caring, individualized attention the firm provide its customer).

The transport service provided by ACBSE in Addis Ababa-Bishoftu corridor customer's response with the level of satisfaction in terms of the selected indicators was presented and discussed in the following part of the document.

As Fig. 4.23 designates, concerning frequency of transport service, 23.00% and 48.84% of the respondents are highly dissatisfied and dissatisfied respectively. On the other hand, only 3.36% of the respondents are satisfied and none of the travelers responded that they are highly satisfied with the frequency of the transport service. The rest 24.81% have rated their level of satisfaction as average.

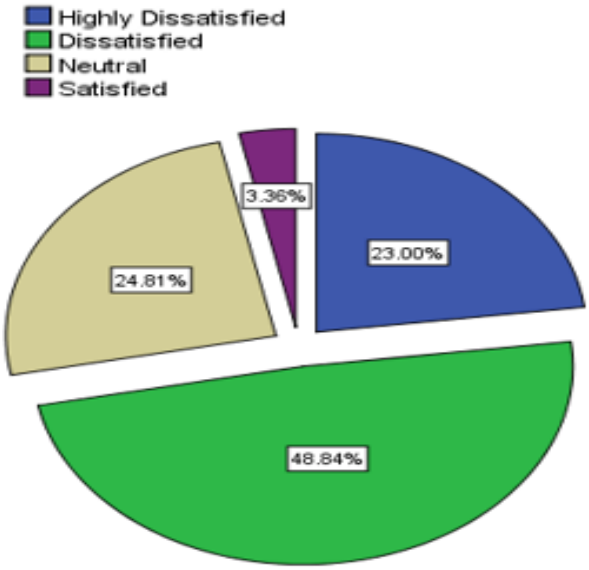


Figure 4.23: Customer satisfaction with frequency of the transport service

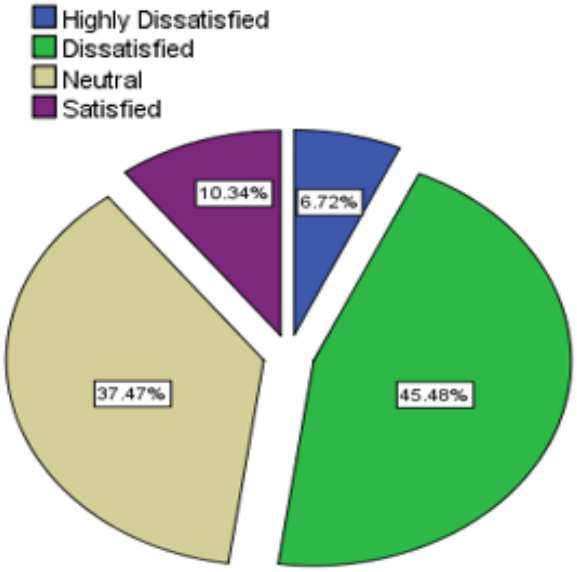


Figure 4.24: Customer satisfaction with travel speed

As can be seen from the Fig. 4.24, among 387 respondents more than half of them are dissatisfied (6.72% are highly dissatisfied and 45.48% are dissatisfied) with regard to travel speed. In contrast to this, no one responded that they are highly satisfied and 10.34% are satisfied about the speed of the service. Moreover, 37.47% rated that their degree of satisfaction is average.

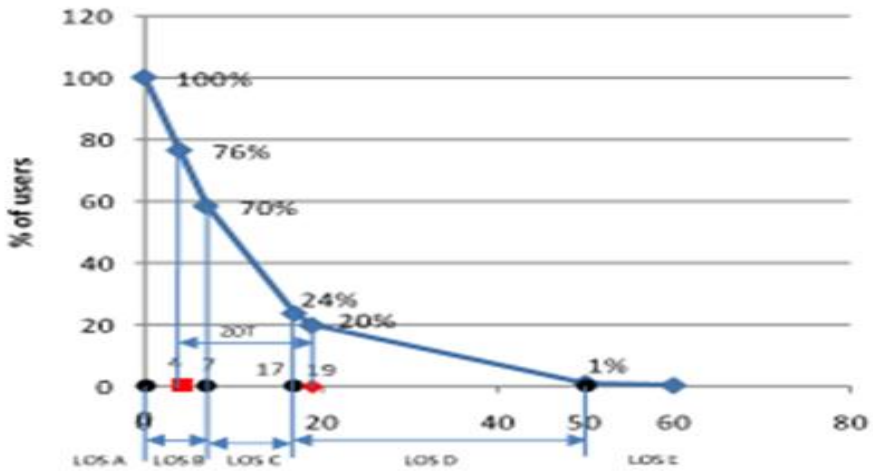


Figure 4.25: Level of service range due to travel speed (source: Sherya D. and Debapratim P., 2013)

Table 4.9: LOS Threshold value based Frequency (source: TRB, 2004)

LOS Category	LOS Thresholds (%)
A	100
B	99.9 – 70.0
C	69.9 – 50.0
D	49.9 – 10.0
E	<10

From the threshold value developed by TRB, Sherya D. and Debapratim P. for developing countries based on customer satisfaction due to frequency of the transport service and travel speed the level of service are LOS E and LOS D respectively.

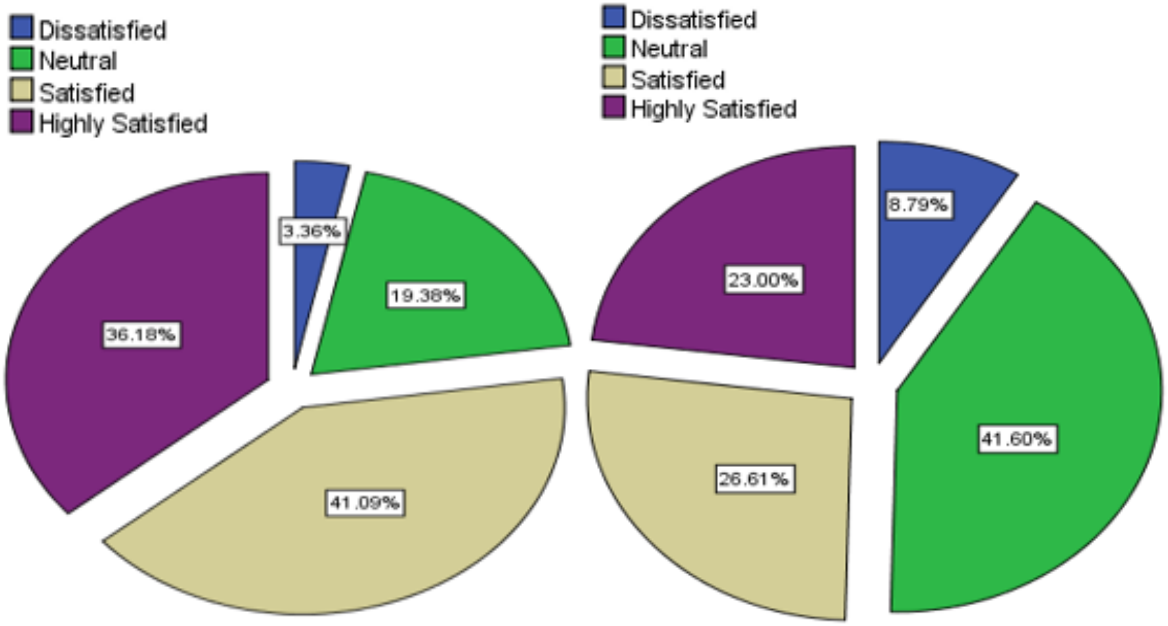


Figure 4.26: Customer satisfaction with price

Figure 4.27: Customer satisfaction with security

Fig. 4.26 depicts that more than 77% of respondents are satisfied (36.18% are highly satisfied and 41.09% are satisfied) regarding the bus fare of the service. On the other hand, only 3.36% of the respondents are dissatisfied. The remaining 19.38% of the respondents have rated their level of satisfaction as average about the fare of the service.

From this result, it could be possible to infer that the fare is affordable. Furthermore, according to the information gathered from officials of ACBSE, due to very minimum service fare, old buses which have high oil, fuel and lubricant consumption, and high maintenance costs, the Enterprise is running the buses under loss. The performance of buses and revenue is declining. And also average daily passengers are declining in this corridor.

As Fig. 4.27 displays, 8.79% and 41.60% of the respondents are dissatisfied and neutral with regard to security from being robbed in bus, at bus stops and terminals. On the other hand, 23% and 26.61% of the respondents were highly satisfied and satisfied in this regard.

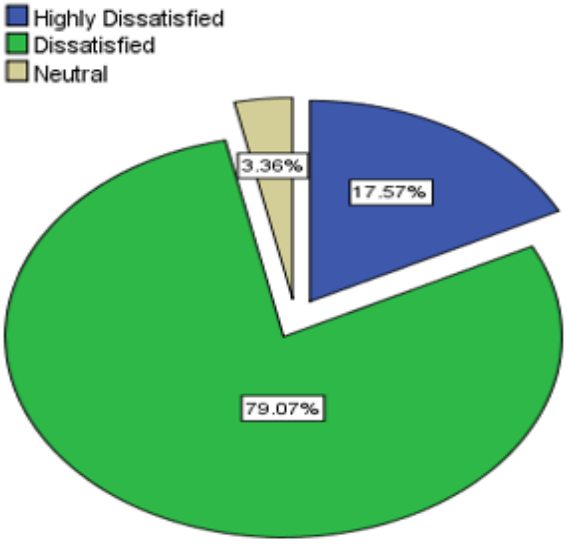


Figure 4.28: Customer satisfaction with vehicle overcrowding

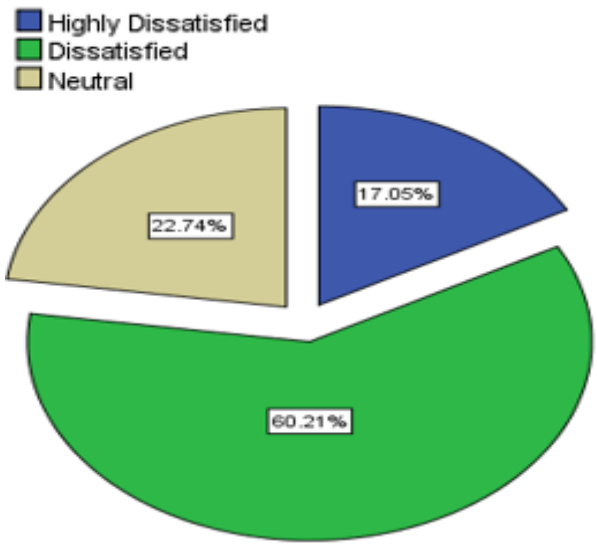
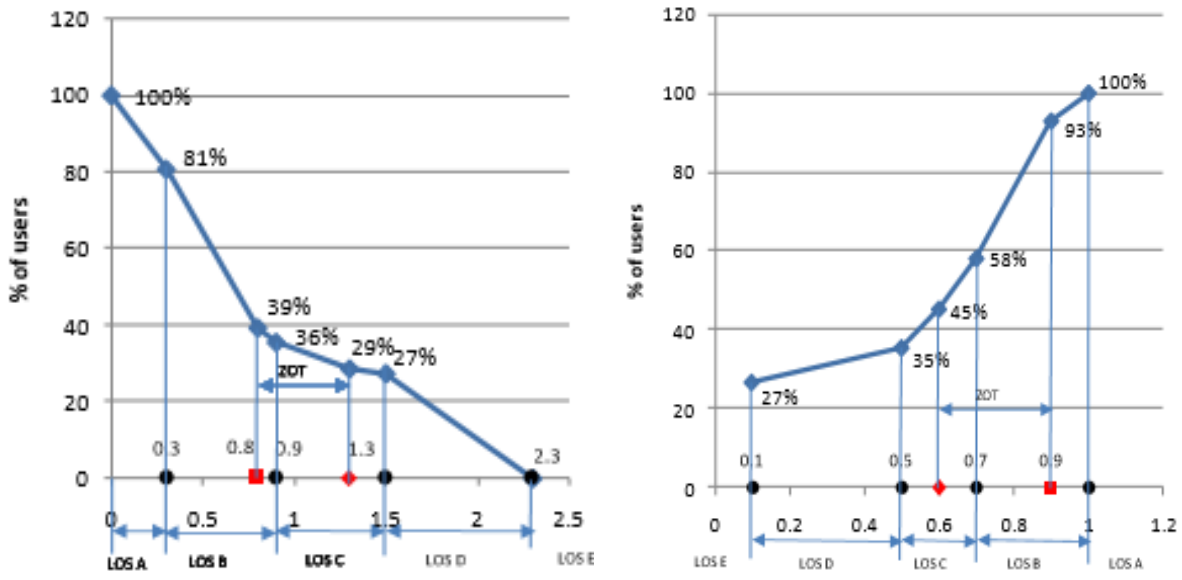


Figure 4.29: Customer satisfaction with respect to availability of seats

In related to vehicle overcrowding as seen from Fig. 4.28, among 387 respondents more than 95% of them were dissatisfied (17.57% are highly dissatisfied and 79.07% are dissatisfied). Moreover, only 3.36% responded that their degree of satisfaction regarding vehicle crowdedness is average.

Fig. 4.29 shows concern about availability of seats in the bus, 17.05% and 60.21% of the respondents are highly dissatisfied and dissatisfied respectively. The rest 22.74% have rated

their level of satisfaction as average. On the other hand, no one responded that they were neither highly satisfied nor satisfied with the service related to availability of seats.



(a) (b)

Figure 4.30: (a) Level of service range due to bus crowdedness; (b) Level of service range due to availability of seat inside bus (source: Sherya D. and Debapratim P., 2013)

ACBSE's officials have indicated that the capacity of a rigid bus is 100 (30 seating and 70 standing) and during peak period a bus can carries up to 160 passengers. In addition to this articulated bus has capacity of 160 (48 seating and 110 standing) and can carry 210 passengers during peak hour. This shows that at peak period the seating to standing ratio is about 1:6. The researcher also observed that there is high level overcrowding at peak hours (from 6:00AM-9:00AM and from 4:30PM-7:30PM).

From the threshold value developed by Sherya D. and Debapratim P. customer satisfaction by bus crowdedness and availability of seat inside the bus the public transport service provided by ACBSE in the selected corridor operates on both condition at LOS E.

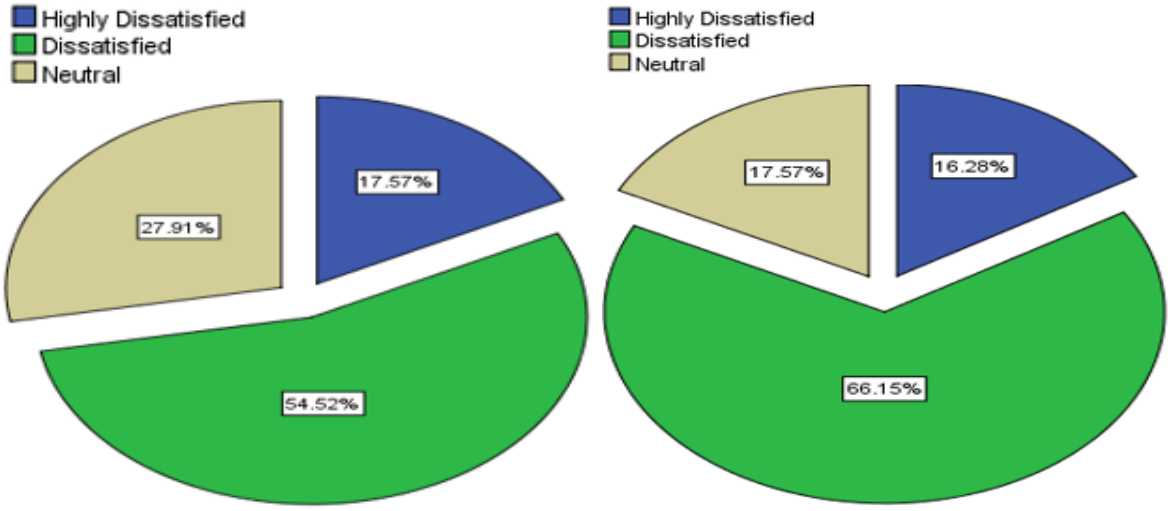


Figure 4.31: Customer satisfaction with bus comfort

Figure 4.32: Customer satisfaction with punctuality

As can be seen from the Fig. 4.31, more than half of respondents are dissatisfied regard to comfort of buses. In addition to this 17.57% of the respondents are highly dissatisfied. On contrary no one responded that they were neither highly satisfied nor satisfied with the service related to bus comfort. About 28% of the passengers replied that their degree of satisfaction regarding vehicle comfort is average.

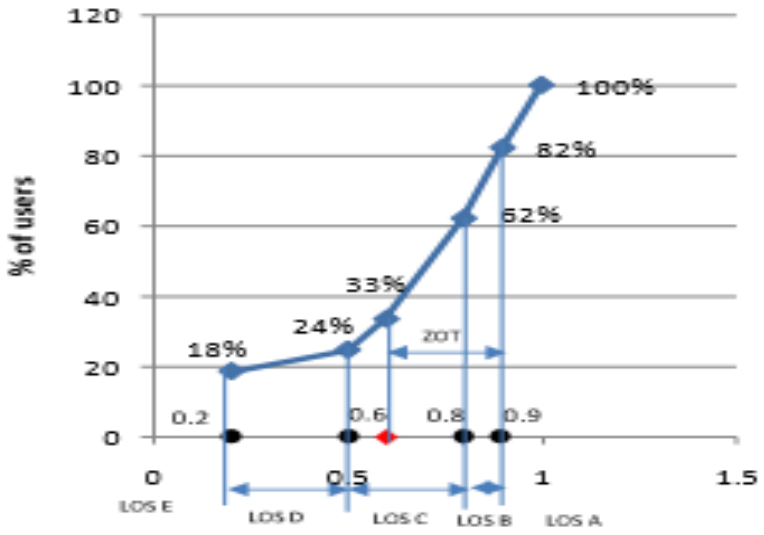


Figure 4.33: Level of service range due punctuality (source: Sherya D. and Debapratim P., 2013)

Regarding punctuality of the transport service delivered by the enterprise as shown in the Fig. 4.32, 16.28% and 66.15% of the respondents are highly dissatisfied and dissatisfied respectively. On the contrary, no one responds that they are very satisfied or satisfied with punctuality of the service. About 17.57% of the respondents were neither satisfied nor dissatisfied about on time arrival of buses.

Based on the threshold value developed by Sherya D. and Debapratim P for developing countries as shown in Fig 4.33 for punctuality of transport service and customer satisfaction the service operates at LOS E.

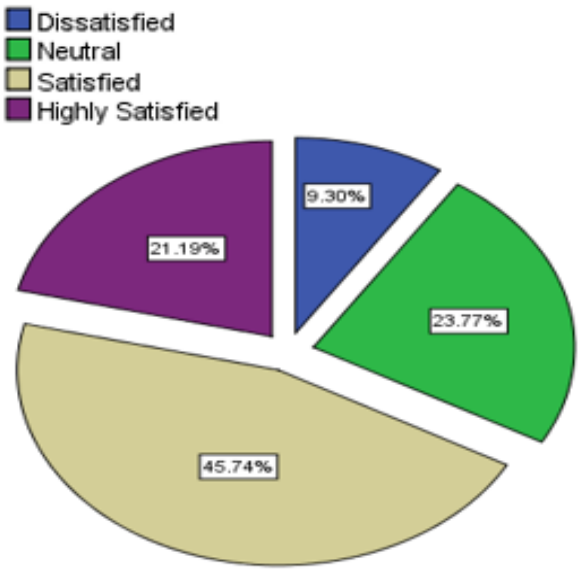


Figure 4.34: Customer satisfaction with safety

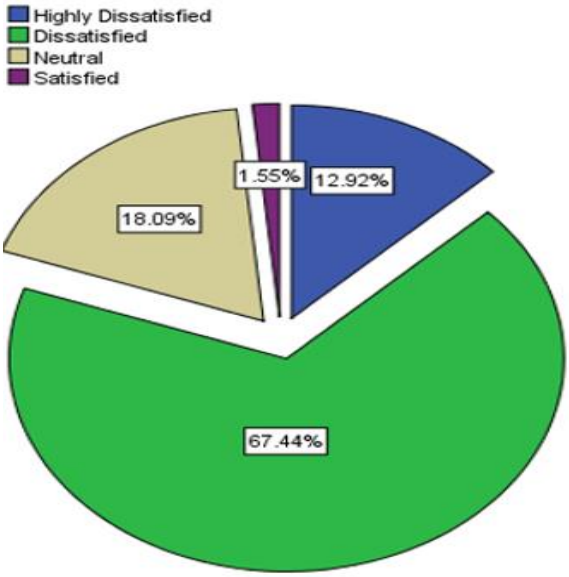


Figure 4.35: Overall customer satisfaction

Fig. 4.34 shows that, 21.1% and 45.74% of the respondents are highly satisfied and satisfied with safety of the service delivery respectively. Conversely, 9.3% are dissatisfied. The rest 23.77% of the respondents have rated their level of satisfaction as average.

As shown in Fig. 4.35, more than 80% of respondents are dissatisfied (12.92% are highly dissatisfied and 67.44% are dissatisfied) regarding to overall transport service provided by the ACBSE. On contrast to that only 1.55% of the customers are satisfied and no one said that they are very satisfied. The remaining 18.09% of the respondents have rated their level of satisfaction is average in terms the overall transport service delivered by the enterprise.

In general, the transport service of ACBSE in Addis Ababa-Bishoftu corridor is not satisfactory from customer's perspective. The two main complaints of the travelers were delay (long waiting time) and overcrowding of buses. According to the customers the main source for these complaints is due to poor operational management. As per travelers the problem is buses do not run as per the schedule and headway. The enterprise also acknowledged the above problem but due to bad condition of the road on old route, traffic congestion, continuous and unexpected breakdown of vehicles on the road and shortage of spare parts makes the problem difficult to solve.

4.2.2. Correlation analysis

Correlation analysis was performed in order to understand how the specific service quality attributes relate to overall customer satisfaction and each other. Correlation coefficient between observed variable are presented in the Table 4.10.

As per Table 4.10, the associated means of service quality attributes such as frequency of the service, travel speed, vehicle crowdedness, seat availability, bus comfort and service punctuality demonstrated that costumers were dissatisfied with transport service delivered by ACBSE ($M < 3.0$). Only by price of the service, security and safety from accident the means of the response of customers were satisfied ($M > 3.0$).The mean of overall satisfaction also indicate that customers are not satisfied with bus transport provided by the enterprise in Addis Ababa Bishoftu corridor ($M = 2.08$, $SD = 0.61$).

From 387 respondents, only 6 customers claimed that they were satisfied with the service. No travelers responded that they were highly satisfied with the service. This correlation result also shows that all specific service quality attributes have a significant positive relation with overall satisfaction ($p < 0.01$). This means that when satisfaction with a specific service quality attribute increases, overall satisfaction also increases too and vice versa.

Table 4.10: Correlations between specific qualities attributes, Mean (M) and Standard Deviation (SD)

	Overall Satisfaction	Frequency (X_1)	Travel Speed (X_2)	Price (X_3)	Security (X_4)	Vehicle Crowdedness (X_5)	Seat Availability (X_6)	Bus Comfort (X_7)	Safe from Accident (X_8)	Service Punctuality (X_9)
Overall Satisfaction	1									
Frequency	.441**	1								
Travel Speed	.370**	.441**	1							
Price	.310**	.273**	.195**	1						
Security	.315**	.278**	.314**	.485**	1					
Vehicle Crowdedness	.644**	.212**	.311**	.054	.230**	1				
Seat Availability	.655**	.402**	.325**	.208**	.278**	.625**	1			
Bus Comfort	.595**	.417**	.365**	.202**	.248**	.470**	.813**	1		
Safe from Accident	.508**	.320**	.249**	.303**	.329**	.326**	.376**	.380**	1	
Service Punctuality	.820**	.392**	.413**	.342**	.405**	.610**	.769**	.677**	.454**	1
M	2.08	2.09	2.51	4.10	3.64	1.86	2.06	2.10	3.79	2.01
SD	0.61	0.78	0.77	0.83	0.93	0.44	0.63	0.67	0.88	0.58

**. Correlation is significant at the 0.01 level (2-tailed).

Customer Satisfaction with punctuality of the service (r = 0.820, p = 0.000), satisfaction with availability of seat on bus (r = 0.655, p = 0.000), satisfaction with vehicle crowdedness (r = 0.644, p = 0.000) and satisfaction with bus comfort (r = 0.595, p = 0.000) has the highest relation to overall satisfaction. Thus, these quality attributes have a strong and high relationship with overall customer satisfaction.

Customer satisfaction by safety from accident (r = 0.508, p = 0.000), with frequency of the service (r = 0.441, p = 0.000) and due to travel speed (r = 0.370, p = 0.000) has moderate relation to overall satisfaction. Furthermore, as shown in Table 5, travelers satisfaction by security (r = 0.315, p = 0.000) and price of the service (r = 0.310, p = 0.000) has the lowest correlation to overall satisfaction when compared to the other attributes.

4.2.3. Factor analysis

Factor analysis is a statistical tool to explore the structure of the perceived service quality. The identified dimensions (factors) define broader areas for planning and action. The general purpose is to find a way to summarize the information contained in a number of composite dimensions. Principal component analysis with VARIMAX rotation and selection of factor based on the Kaiser normalization was carried out.

Principle components analysis was used because the primary purpose was to identify and compute composite coping scores for the factors underlying the short version of the Attributes service quality. The analysis resulted in two factor solution, which explained 60.334% of the variance. The eigenvalues for those factors were 4.126 and 1.304. All factors have reliability (cronbach's alpha) greater than 0.7. The factor loading matrix for final solution is presented in Table 4.11.

The first factor summarizes attributes such as seat availability, bus comfort, service punctuality and vehicle overcrowding. The second factor includes quality attributes such as price, security, frequency of the service, safety from accident and travel speed.

Table 4.11: Rotated Component Matrix grouping service quality factor

Attributes	Component	
	1	2
Seat Availability	0.898	
Bus Comfort	0.830	
Service Punctuality	0.797	
Vehicle Overcrowding	0.789	
Price		0.827
Security		0.778
Frequency		0.501
Safety from Accident		.487
Travel Speed		.435

Internal consistency for each of the scales was examined using Cronbach's alpha. The alphas indicated a high reliability (0.884) for the first quality factor and moderate (0.7) for the second quality factor. No substantial increases in alpha for any of the scales could have been achieved by eliminating more items.

4.2.4. Regression analysis

4.2.4.1. Simple linear regression

To determine the values of dependent variables of overall customer satisfaction model, the following regression models have been generated by considering each attributes of public bus transportation individually with overall customer satisfaction. To start with regression analysis customer satisfaction due to frequency of the service, customer satisfaction due to travel speed, customer satisfaction due to fee of the service, customer satisfaction due to security, customer satisfaction due to safety, customer satisfaction due to seat availability, customer satisfaction due to bus comfort, customer satisfaction due to vehicle crowdedness and service punctuality of transport service were taken into consideration. The dependent variable y, customer satisfaction fixed with different independent variables.

The following models have been calibrated:

1. Customer Satisfaction due to frequency of the service: $Y = f(X_1)$
2. Customer Satisfaction due to travel speed: $Y = f(X_2)$
3. Customer Satisfaction due to fee of the service: $Y = f(X_3)$
4. Customer Satisfaction due to security: $Y = f(X_4)$
5. Customer Satisfaction due to vehicle overcrowding: $Y = f(X_5)$
6. Customer Satisfaction due to seat availability: $Y = f(X_6)$
7. Customer Satisfaction due to bus comfort: $Y = f(X_7)$
8. Customer Satisfaction due to safety: $Y = f(X_8)$
9. Customer Satisfaction due to service punctuality: $Y = f(X_9)$

From Pearson's correlation it can observed that customer satisfaction due to frequency of the service, due to travel speed, due to fee of the service, due to security, due to safety, due to seat availability, satisfaction due to bus comfort, satisfaction due to vehicle overcrowding and service punctuality shows predominantly positive correlation with overall customer satisfaction of the transport service. Table 4.12 shows the results of One-variable regression analysis.

Table 4.12: One variable regression models

Model	Equation	R^2
Customer Satisfaction due to frequency of the service	$Y = 1.368 + 0.343X_1$	0.193
Customer Satisfaction due to travel speed	$Y = 1.351 + 0.291X_2$	0.135
Customer Satisfaction due to fee of the service	$Y = 1.151 + 0.227X_3$	0.094
Customer Satisfaction due to security	$Y = 1.339 + 0.204X_4$	0.097
Customer Satisfaction due to vehicle crowdedness	$Y = 0.419 + 0.896X_5$	0.414
Customer Satisfaction due to seat availability	$Y = 0.788 + 0.630X_6$	0.427
Customer Satisfaction due to bus comfort	$Y = 0.948 + 0.539X_7$	0.352
Customer Satisfaction due to safety	$Y = 0.762 + 0.349X_8$	0.256
Customer Satisfaction due to service punctuality	$Y = 0.367 + 0.852X_9$	0.672

Where, Y= Overall satisfaction, X_1= Frequency of the transport service, X_2= Travel Speed, X_3= Charge of the service, X_4= Security, X_5= Vehicle Crowdedness, X_6= Seat Availability, X_7= Bus Comfort , X_8= Safe from Accident, X_9= Service Punctuality.

From the above simple linear regression analysis, it can be seen that 19.3% the variation in the overall customer satisfaction has been explained by frequency of the transport service; bus travel speed explains 13.5% of the variance in the overall customer satisfaction; only 9.4% and 9.7% of the variation in the overall customer satisfaction has been explained by price and security of the service respectively; 41.4% the variation in the overall customer satisfaction has been explained by vehicle crowdedness; 42.7% and 35.2% of the variation in the overall customer satisfaction has been explained by availability of seat in the bus and bus comfort respectively; 25.6% of the variation in the overall customer satisfaction has been explained by safety with respect to accident and significantly 67.2% of the variation in the overall customer satisfaction has been explained by punctuality of the transport service provided by ACBSE in the corridor.

Based on the above nine models and R^2 values customer satisfaction due to service frequency, travel speed, service charge, security and safety from accident on overall customer satisfaction has low prediction precision. Customer satisfaction due to vehicle crowdedness, inside bus seat availability, bus comfort and service punctuality has moderate prediction precision on overall customer satisfaction.

4.2.4.2. Multiple linear regression

Multiple linear regression analysis is a well-known statistical technique for fitting mathematical relationships between dependent and independent variables. The multiple linear regression models express the mean of the response variable as a straight-line relationship of two or more predictor variables. In this research multiple linear regression analysis is done by using SPSS Statistical software.

The satisfaction scales were summed up and averaged to yield two factor indices corresponding to Factor 1 and Factor 2. Multiple Linear Regression analysis was then

performed with the purpose to predict values of the dependent variable (overall satisfaction) from public bus quality indicators such as frequency of the service, travel speed, fee of the service, security, safety, seat availability, bus comfort, vehicle crowdedness and service punctuality of transport service provided by ACBSE in Addis Ababa Bishoftu corridor.

The result from SPSS software was presented in the Table 4.13 and equation that demonstrate the relation between dependent and independent variables was generated from the result.

Table 4.13: Multiple linear regression models for customer satisfaction

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.041	.110		.373	.709
Functional factor	.610	.034	.641	17.956	.000
Weak factor	.237	.036	.238	6.665	.000

($R = 0.767$, $R^2 = 0.588$, Adjusted $R^2 = 0.586$)

In Table 4.13 Overall satisfaction scores were regressed on two factors of service quality. The slope of the regression line was significantly greater than zero, indicating that overall satisfaction tend to increase as factors increased. [y = 0.610 * (FUCTIONAL FACTORS) + 0.237* (SOFT FACTORS) +0.041]. Based on research condacted by Ngoc, A.M a, Hung, K. Vb Tuan, V.A on similar issue, these two predictors accounted for over half of variance in overall satisfaction ($R^2 = 0.586$), which was highly significant. For these data factors quality have a positive beta value indicating positive relationships. Both factors demonstrated a significant effect on overall customer satisfaction with public transport in the selected corridor ($p < 0.05$). The unstandardized regression coefficients showed that the Functional factor was the strongest predictor than the Weak factor.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

This thesis aimed at evaluating the performance of ACBSE transport service in the case of Addis Ababa-Bishoftu corridor. ACBSE transport service in this corridor face multiple challenges stemming from a mismatch between the demand and supply of transport service.

The current ACBSE transport service in this corridor is constrained because of limited number of buses, operational and management deficiencies and insufficient utilization of the existing road network in Bishoftu town. These limit the range and spatial distribution of the transport service. ACBSE provide its service to only 16% of the population for Bishoftu town and for population of 131,971 in Addis Ababa with a walking distance of 500m. Within this buffer distance the population gets this service are only those who aligned along the major roads. Thus, it can concluded that people living away from the major road and in the newly emerged residential areas are underprivileged.

The type, quality and number of buses available for the service are factor which control the service frequency, headway, travel speed, waiting time, bus overcrowding and seat availability. The average number of buses in this corridor is six with the average headway of 90 minutes. The average bus travel speed in this corridor is 27 km/h. In addition to this the average bus stop spacing in this corridor is 1.4 km and 1.8 km on old road and Addis-Adama expressway respectively.

The dwell time analysis showed that higher average dwell time during peak hour than off-peak hour for both direction and routes. From the result of average number of passengers loading and alighting passengers at peak and off-peak time period showed that service starting station, which is Legehar or Silsa-Mazoria, has the most extreme station for loading. From the plot of average number of loading and alighting, it can be concluded that most of the passengers alighting from the buses around terminating station on both directions and routes. In this corridor the average maximum load occurs at station 18 to 19 through old road when traveling from Bishoftu to Legehar during peak hour.

In this study, the researcher has also assessed the quality of the service and customer satisfaction using quality indicators of bus transport service as parameters. In the analysis it is found that the existing transport service of ACBSE in the selected corridor is constrained by capacity limitations. Consequently, the quality of the service is poor and the basic quality of service indicators formulated by World Bank was not met and the majority of customers are not satisfied with most of the selected service attributes. Most of the respondents do not have positive feelings about the transport service of ACBSE in this corridor. Therefore, ACBSE is not meeting the requirements of customers in the study area.

From the questionnaire survey results, respondents are not satisfied with all the quality attributes except price, security and safety. This indicates that the quality of ACBSE bus transport in this corridor is below the travelers' expectation of the service. Correlation analysis suggest only one attribute has the strongest relationship with overall customer satisfaction, which is service punctuality, and attributes that has moderate relationship with overall satisfaction on seat availability, vehicle crowdedness, comfortable travel experience and safe from accident. The remaining four attributes have no strong relation with the overall customer satisfaction. In the case most attributes used to determine the LOS of the transport service delivered by ACBSE in this corridor the transport service operates at LOS D or lower, except passenger load during off-peak hour service from Legehar to Bishoftu via old route operates at LOS C.

The factor analysis conducted to reduce numbers of factor that correlated to overall customer satisfaction to simplify the decision maker to make an improvement, instead looking on specific items. From the nine single services quality attributes that were observed to investigate customer satisfaction in ACBSE bus transport, the factor analysis suggest simplifying them into two factors called factor 1 and factor 2. The factor analysis grouped together seat availability, bus comfort, service punctuality and vehicle crowdedness as one factor that was interpreted as a functional factor of public bus transport and on the other hand, soft factor of public bus transport service quality consist of price, security, frequency of service, safe from accident and travel speed. The functional factor has a strong influence on customer satisfaction and need a higher attention to improve customer satisfaction. Seat

availability, bus comfort, service punctuality and vehicle crowdedness are the crucial factors that are responsible in bringing higher level of customer satisfaction.

In this research, simple and multiple linear regression models were developed to generate equations that will be significant for predicting overall customer satisfaction using customer satisfaction as a result of different performance indicators such as frequency of the transport service, bus travel speed, fee of the service, security, safety, seat availability, bus comfort, vehicle crowdedness and service punctuality. From simple linear regression customer satisfaction due to service frequency, travel speed, service charge, security and safety from accident on overall customer satisfaction has low prediction precision. Customer satisfaction due to vehicle crowdedness, inside bus seat availability, bus comfort and service punctuality has moderate prediction precision on overall customer satisfaction. Multiple linear regression shows that the slope of the regression line was significantly greater than zero, indicating that overall satisfaction tend to increase as factors increased.

5.2. Recommendations

Public bus transport should become the solution for sustainable transport in the future, to increase customer satisfaction. High quality public bus transport not only keep customer to continue using public bus transport to fulfill their travel demand but also attract potential customers.

Based on the results from the collected data and observations, the researcher arrived at the following recommendations.

- The major challenges of the enterprise in this corridor is resource limitation. Thus, ACBSE need to invest to increase the number and quality of buses. That is the number of supply should be increased so as to meet the emerging demand of public bus transport in this corridor.
- The performance of current transport service provided by ACBSE in this corridor is poor. Thus to improve this transport service, the frequency of the transport service should be increase; the ticketing procedure should be upgraded; the treatment of

customers by bus operators should be improved and the condition of bus stop should be developed.

- This research suggest that the extension of route network coverage for the town of Bishoftu. Since, there are a number of road networks and areas that are not optimized by this service in this town a study on the optimization of bus routes including bus stops is recommended.
- Traffic congestion within the city, especially in Addis Ababa, make the enterprises' operation tough. So, priority measure like giving priority for buses crossing and turning movements at junction should be implemented.
- Listen the voice of customer is a common and effective way to identify the customer need and the way to satisfy them. Hence, the researcher recommended to conduct periodic survey in order to gather information about the view of the customers about the service.
- For future research within this area one should consider other transport service providers (mini-bus, alliance bus and other company buses) performance and competition among the service providers.

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APPENDIX A: BUSES SCHEDULE DATA FROM ACBSE

Table A1: Route number 60 buses schedule

BUS	Time and Location		
	START	REACH	TEA BREAK
60A	5:45	7:25	
	Bishoftu	Legehar	
	7:25	9:05	
	Legehar	Bishoftu	
	9:05	10:30	10:30 – 10:40
	Bishoftu	Legehar	
	12:00	13:40	
	Legehar	Bishoftu	
	13:40	15:20	15:20 – 15:35
	Bishoftu	Legehar	
	15:35	17:15	
	Legehar	Bishoftu	
	17:15	18:55	
	Bishoftu	Legehar	
	18:55	20:35	
	Legehar	Bishoftu	
60B	6:00	7:40	
	Legehar	Bishoftu	
	7:40	9:20	9:20 – 9:35
	Bishoftu	Legehar	
	9:35	11:15	
	Legehar	Bishoftu	
	11:15	12:55	
	Bishoftu	Legehar	
	12:55	14:35	14:35 – 14:50
	Legehar	Bishoftu	
	14:50	16:30	
	Bishoftu	Legehar	
	16:30	18:10	
	Legehar	Bishoftu	
	18:10	19:50	
	Bishoftu	Legehar	
	6:10	7:50	
	Bishoftu	Legehar	
	7:50	9:30	
	Legehar	Bishoftu	
	9:30	10:55	10:55 – 11:10
	Bishoftu	Legehar	
	12:25	14:05	

60C	Legehar	Bishoftu	
	14:05	16:00	15:45 – 16:00
	Bishoftu	Legehar	
	16:00	17:40	
	Legehar	Bishoftu	
	17:40	19:20	
	Bishoftu	Legehar	
	19:20	21:00	
	Legehar	Bishoftu	
60D	6:35	8:15	
	Bishoftu	Legehar	
	8:15	10:10	9:55 - 1010
	Legehar	Bishoftu	
	10:10	11:50	
	Bishoftu	Legehar	
	13:15	15:10	14:45 – 15:00
	Legehar	Bishoftu	
	15:10	16:50	
	Bishoftu	Legehar	
	16:50	18:30	
	Legehar	Bishoftu	
	18:30	20:10	
	Bishoftu	Legehar	
	20:10	21:50	
	Legehar	Bishoftu	
60E	7:00	8:40	
	Bishoftu	Legehar	
	8:40	10:20	10:20 – 10:35
	Legehar	Bishoftu	
	10:35	12:15	
	Bishoftu	Legehar	
	13:30	15:10	15:10 – 15:25
	Legehar	Bishoftu	
	15:25	17:05	
	Bishoftu	Legehar	
	17:05	18:45	
	Legehar	Bishoftu	
	18:45	20:25	
	Bishoftu	Legehar	
	20:25	22:00	
	Legehar	Bishoftu	
	7:00	8:40	
	Legehar	Bishoftu	
	8:40	10:20	10:20 – 10:35

60F	Bishoftu	Legehar	
	10:35	12:15	
	Legehar	Bishoftu	
	12:15	13:55	
	Bishoftu	Legehar	
	13:55	15:20	15:20 – 15:35
	Legehar	Bishoftu	
	15:50	17:30	
	Bishoftu	Legehar	
	17:30	19:10	
	Legehar	Bishoftu	
	19:10	20:50	
	Bishoftu	Legehar	
60G	7:25	9:05	
	Bishoftu	Legehar	
	9:05	10:45	10:45 – 11:00
	Legehar	Bishoftu	
	11:00	12:40	
	Bishoftu	Legehar	
	12:40	14:20	14:20 – 14:35
	Legehar	Bishoftu	
	14:35	16:15	
	Bishoftu	Legehar	
	18:15	20:00	
	Legehar	Bishoftu	
60H	7:35	9:30	9:30 – 9:45
	Bishoftu	Legehar	
	9:45	11:25	
	Legehar	Bishoftu	
	11:25	13:05	
	Bishoftu	Legehar	
	14:55	16:35	16:35 – 16:50
	Legehar	Bishoftu	
	16:50	18:30	
	Bishoftu	Legehar	
	18:30	20:15	
	Legehar	Bishoftu	
60I	6:15	8:00	
	Legehar	Bishoftu	
	8:00	9:40	9:40 – 9:55
	Bishoftu	Legehar	
	11:15	12:25	
	Legehar	Bishoftu	
	12:25	14:35	14:35 – 14:50

	Bishoftu	Legehar	
	14:50	16:30	
	Legehar	Bishoftu	
	16:30	18:10	
	Bishoftu	Legehar	
	18:10	19:50	
	Legehar	Bishoftu	
60J	6:30	8:10	
	Legehar	Bishoftu	
	8:10	9:50	9:50 – 10:05
	Bishoftu	Legehar	
	10:05	11:45	
	Legehar	Bishoftu	
	11:45	13:40	
	Bishoftu	Legehar	
	13:40	15:20	
	Legehar	Bishoftu	
	15:20	17:00	17:00 – 17:15
	Bishoftu	Legehar	
	17:15	19:00	
	Legehar	Bishoftu	
	19:00	20:40	
	Bishoftu	Legehar	

APPENDIX B: BUS STOP SPACING AND AVERAGE SPEED

Table B1: Bus stop spacing on both routes

Bus stop spacing from Silsa Mazoria to Legehar via old road		Bus stop spacing from Silsa Mazoria to Legehar via Addis-Adama expressway	
Path	Spacing (m)	Path	Spacing (m)
Silsa Mazoria – 1	447	Silsa Mazoria - 1	447
1 – 2	476	1 – 2	476
2 -3	427	2 -3	427
3 – 4	566	3 – 4	566
4- 5	913	4- 5	913
5 – 6	1048	5 – 6	1048
6 – 7	531	6 – 7	531
7- 8	435	7- 8	435
8 – 9	562	8 – 9	562
9 – 10	448	9 – 10	448
10 – 11	432	10 – 11	432
11 – 12	440	11 – 12	440
12 – 13	1176	12 – 13	21855
13 – 14	1814	13 – 14	430
14 – 15	538	14 – 15	3020
15 – 16	1357	15 – 16	3400
16 – 17	6465	16 – 17	3535
17- 18	1885	17- 18	4268
18 – 19	1937	18 – 19	2170
19 – 20	2691	19 – 20	490
20 – 21	2851	20 – 21	797
21 – 22	3472	21 – 22	1670
22 – 23	1577	22 – 23	1050
23 – 24	1304	23 – 24	812

24 – 25	1183	24 – 25	568
25 – 26	988	25 – 26	693
26 – 27	1423	26 – 27	539
27 – 28	2989	27 – 28	768
28 – 29	814	28 – 29	1282
29 – 30	2280	29 – 30	521
30 – 31	446	30 - Legehar	726
31 – 32	1340		
32 – 33	2495		
33 – Legehar	962		

Table B2: Average speed between bus stops

Average Speed via old road		Average Speed through Addis-Adama expressway	
Bus stops	Speed (km/h)	Bus stop	Speed (km/h)
Silsa Mazoria – 1	20.9	Silsa Mazoria - 1	20.9
1 – 2	32.1	1 – 2	32.1
2 -3	24.8	2 -3	24.8
3 – 4	30	3 – 4	30
4- 5	25.9	4- 5	25.9
5 – 6	27.7	5 – 6	27.7
6 – 7	32.5	6 – 7	32.5
7- 8	32.3	7- 8	32.3
8 – 9	26.6	8 – 9	26.6
9 – 10	24.4	9 – 10	24.4
10 – 11	33.9	10 – 11	33.9
11 – 12	24.6	11 – 12	24.6
12 – 13	21.5	12 – 13	55.8
13 – 14	25.5	13 – 14	45.6

14 – 15	28.9	14 – 15	42.8
15 – 16	20	15 – 16	32.5
16 – 17	38.2	16 – 17	33.6
17- 18	20	17- 18	34.6
18 – 19	22.4	18 – 19	35.7
19 – 20	20	19 – 20	26.8
20 – 21	21	20 – 21	24.8
21 – 22	21.1	21 – 22	26.9
22 – 23	20.2	22 – 23	21.7
23 – 24	20.1	23 – 24	20.8
24 – 25	22.5	24 – 25	20.6
25 – 26	18.4	25 – 26	19.6
26 - 27	20	26 – 27	20
27 - 28	22.3	27 – 28	24
28 - 29	20.6	28 – 29	25.6
29 - 30	21.3	29 – 30	22.9
30 - 31	19.7	30 - Legehar	20.2
31 - 32	21.5		
32 - 33	21.4		
33 – Legehar	18.5		

APPENDIX C: DWELL TIME, PASSENGER LOADING, ALIGHTING AND LOAD AT EACH BUS STOP

Table C1: Dwell time, Boarding, Alighting and Load of passengers from Legehar to Bishoftu through old road during peak hour

Bus stops	Dwell Time(sec)	Boarding	Unloading	Load
Legehar		96		96
1	32	3		99
2	30	3		102
3	30	4		106
4	48	4		110
5	40	4		114
6	55	13		127
7	35	6		133
8	30	3		136
9	30	3		139
10	30	3		142
11	32	3	3	142
12	30	3	3	142
13	30	2	2	142
14	33	1	2	141
15	35	4	5	140
16	35	2	4	138
17	42	2	10	130
18	45	4	5	129
19	35	3	6	126
20	32	3	8	121
21	30	2	9	114
22	30		11	103
23	30		10	93
24	38		8	85
25	32		9	76
26	35		8	68
27	40		10	58
28	30		3	55
29	40		5	50
30	40		5	45
31	50		18	27
32	35		5	22
33	35		9	13
Silsa-Mazoria			13	0

Table C2: Dwell time, Boarding, Alighting and Load of passengers from Legehar to Bishoftu through old road during off-peak hour

Bus stops	Dwell Time(sec)	Boarding	Unloading	Load
Legehar		52		52
1	30	2		54
2	28	2		56
3	27	2		58
4	30	2		60
5	28	2		62
6	40	9		71
7	30	4		75
8	28	2		77
9	28	3		80
10	25	3		83
11	30	2	2	83
12	30	2	2	83
13	30	1	2	82
14	30	1	2	81
15	32	3	3	81
16	30	3	3	81
17	31	3	7	77
18	30	2	3	76
19	30	2	3	75
20	30	2	6	71
21	28	1	5	67
22	28		6	61
23	30		7	54
24	34		5	49
25	28		6	43
26	31		8	35
27	30		7	28
28	20		3	25
29	27		3	22
30	22		3	19
31	31		7	12
32	28		3	9
33	22		3	6
Silsa-Mazoria			6	0

Table C3: Dwell time, Boarding, Alighting and Load of passengers from Bishoftu to Legehar through old road during peak hour

Bus stops	Dwell Time(sec)	Boarding	Unloading	Load
Silsa-Mazoria		75		75
1	37	6		81
2	33	6		87
3	45	6		93
4	35	5		98
5	30	10		108
6	75	21		129
7	32	8		137
8	36	5		142
9	36	6		148
10	35	4		152
11	38	4		156
12	32	3		159
13	37	6		165
14	32	4		169
15	36	4		173
16	29	5	5	173
17	42	4	7	170
18	43	3	6	167
19	36	2	5	164
20	34	3	4	163
21	38	1	3	161
22	32	4	15	150
23	35	2	11	141
24	33	2	8	135
25	30	3	9	129
26	32	2	10	121
27	38	2	21	102
28	34		8	94
29	32		10	84
30	30		11	73
31	32		15	58
32	30		13	45
33	30		14	31
Legehar			31	0

Table C4: Dwell time, Boarding, Alighting and Load of passengers from Bishoftu to Legehar through old road during off-peak hour

Bus stop	Dwell Time(sec)	Boarding	Unloading	Load
Silsa-Mazoria		35		35
1	22	3		38
2	28	2		40
3	45	3		43
4	30	3		46
5	24	6		52
6	32	11		63
7	56	4		67
8	35	3		70
9	20	3		73
10	25	3		76
11	28	4		80
12	20	2		82
13	20	2		84
14	20	3		87
15	25	3		90
16	30	2	1	91
17	28	3	2	92
18	25	2	2	92
19	26	1	2	91
20	21	2	3	90
21	24	2	2	90
22	28	2	2	90
23	25	1	6	85
24	28	1	4	82
25	22	1	4	79
26	24	1	5	75
27	36	1	6	70
28	25		5	65
29	20		5	60
30	22		4	56
31	30		11	45
32	22		8	37
33	24		9	28
Legehar			28	0

Table C5: Dwell time, Boarding, Alighting and Load of passengers from Legehar to Bishoftu through Addis-Adama expressway during peak hour

Bus stop	Dwell Time(sec)	Boarding	Unloading	Load
Legehar		106		106
1	27	6		112
2	22	4		116
3	22	2		118
4	30	6		124
5	30	7		131
6	30	4		135
7	30	4		139
8	20	2		141
9	40	9		150
10	20	3		153
11	20	3		156
12	20	3	3	156
13	25	4	2	158
14	25	3	3	158
15	28	4	4	158
16	30	3	4	157
17	30	9	3	163
18	22	3	2	164
19	22		3	161
20	24		3	158
21	26		8	150
22	45		18	132
23	35		16	116
24	28		8	108
25	36		17	91
26	25		9	82
27	30		15	67
28	35		23	44
29	30		13	31
30	28		10	21
Silsa-Mazoria			21	0

Table C6: Dwell time, Boarding, Alighting and Load of passengers from Legehar to Bishoftu through Addis-Adama expressway during off-peak hour

Bus stop	Dwell Time(sec)	Boarding	Unloading	Load
Legehar		48		48
1	25	3		51
2	20	2		53
3	20	4		57
4	24	5		62
5	26	6		68
6	22	2		70
7	20	2		72
8	23	1		73
9	30	6		79
10	20	2		81
11	20	1		82
12	20	1	1	82
13	22	1	1	82
14	20	2	1	83
15	22	2	2	83
16	25	2	2	83
17	30	8	2	89
18	20	1	2	88
19	20		3	85
20	20		3	82
21	25		5	77
22	35		11	66
23	25		4	62
24	22		3	59
25	24		4	55
26	24		5	50
27	25		2	48
28	30		9	39
29	28		10	29
30	25		9	20
Silsa-Mazoria			20	0

Table C7: Dwell time, Boarding, Alighting and Load of passengers from Bishoftu to Legehar through Addis-Adama expressway during off-peak hour

Bus stop	Dwell Time(sec)	Boarding	Unloading	Load
Silsa-Mazoria		38		38
1	24	2		40
2	22	2		42
3	30	9		51
4	24	2		53
5	30	5		58
6	45	15		73
7	30	6		79
8	23	4		83
9	28	3		86
10	24	2		88
11	26	1		89
12	25	1	5	85
13	36	4	1	88
14	30	2	2	88
15	22	1	1	88
16	25	1	6	83
17	30	2	1	84
18	38	1	5	80
19	34	1	3	78
20	25		3	75
21	20		7	68
22	23		7	61
23	26		5	56
24	28		3	53
25	22		6	47
26	22		4	43
27	27		4	39
28	28		11	28
29	26		5	23
30	28		5	18
Legehar			18	0

Table C8: Dwell time, Boarding, Alighting and Load of passengers from Bishoftu to Legehar through Addis-Adama expressway during peak hour

Bus Stops	Dwell Time(sec)	Boarding	Unloading	Load
Silsa-Mazoria		62		62
1	35	7		69
2	30	5		74
3	46	15		89
4	30	4		93
5	35	9		102
6	74	24		126
7	50	11		137
8	33	9		146
9	30	5		151
10	30	5		156
11	30	3		159
12	32	2		161
13	45	7	14	154
14	34	3	5	152
15	30	3	2	153
16	35	2	3	152
17	38	2	7	147
18	40	2	8	141
19	38	1	4	138
20	35	2	7	133
21	28	1	6	128
22	26	2	5	125
23	34	1	12	114
24	34	1	9	106
25	31	1	5	102
26	28	1	4	99
27	30	1	11	89
28	35		23	66
29	30		16	50
30	30		16	34
Legehar			34	0

APPENDIX D: QUESTIONNAIRE AND INTERVIEW QUESTION

HAWASSA UNIVERSITY

INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL ENGINEERING

QUESTIONNAIRE SURVEY FOR PASSENGERS

Dear respondents:

This questionnaire is designed to gather data on the performance of ACBSE transport service: The case of Addis Ababa-Bishoftu corridor. To achieve this purpose and to deeply investigate the case, your response to the questions given below has a crucial value. Therefore, you are kindly requested to read the questions carefully and give accurate and real information which exists on the ground. The response that you reply will not be used for any other purpose other than this research work, so be free and give your honest and genuine response.

Thank you for your Cooperation!

Instruction: please response all question by putting "X" on the space provided.

Part I) Information about the passenger.

1. Gender:

   Female ☐ Male ☐

2. Occupation:

   Student ☐ Unemployment ☐ Employee ☐

   Retired ☐ Other ☐

3. Did you use this transport service frequently?

   Yes ☐ No ☐

4. If your answer is yes, how often did you use this service?

   5 to 7 days per week ☐ 2 to 4 days per week ☐

   Once every week ☐

Part II) Information about transport service provided by ACBSE in this corridor.

1. How far is your home from the nearest bus stop?

   Less than 500m ☐ 500 to 1000m ☐ more than 1000m ☐

2. How far is your destination from the final bus stop?

   Less than 500m ☐ 500 to 1000m ☐ more than 1000m ☐

3. In average how long do you wait at bus stop to get service?

   Less than 5 minutes ☐ 5 to 10 minutes ☐ 10 to 15 minutes ☐

   15 to 30 minutes ☐ more than 30 minutes ☐

4. How many time do you get seat and shelter at bus stop?

   In every trip ☐ once in every two trip ☐ once in every five trip ☐

   Once in every ten trip ☐ never get set at all ☐

5. How many time do you get seat in bus?

   In every trip ☐ once in every two trip ☐ once in every five trip ☐

   Once in every ten trip ☐ never get set at all ☐

6. How do you rate the reliability of the service?

   Poor ☐ Less Reliable ☐ Reliable ☐ Most Reliable ☐

7. Which difficulties discourage you from using ABCSE transport service in this corridor? (Give rank)

   Crowdedness ☐ Poor treatment by operators ☐

   Delay ☐ Risk of accident ☐

   Lack of seat ☐ Speed ☐ Number of interchange ☐

   Robbery inside the bus ☐

Part III) Information about traveler's satisfaction level with the existing bus transport service.

1. In related to service frequency:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

2. In related to travel speed:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

3. In related to fare affordability:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

4. In related to security:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

5. In related to vehicle overcrowding:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

6. In related to set availability:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

7. In related to bus comfort:

   Highly Satisfied ☐ Satisfied ☐ Neutral ☐

   Dissatisfied ☐ Highly Dissatisfied ☐

8. In related to punctuality:

Highly Satisfied ☐ Satisfied ☐ Neutral ☐

Dissatisfied ☐ Highly Dissatisfied ☐

9. In related to safe from accident:

Highly Satisfied ☐ Satisfied ☐ Neutral ☐

Dissatisfied ☐ Highly Dissatisfied ☐

10. In related to overall transport service:

Highly Satisfied ☐ Satisfied ☐ Neutral ☐

Dissatisfied ☐ Highly Dissatisfied ☐

INTERVIEW QUESTION TO BE ANSWERED BY ACBSE OFFICEALS

I) General Information.

1. What is the vision, mission and goal of ACBSE?
2. How do you rate your service in this corridor?
3. In average how many travelers travel using this transport service per day?
4. Do you use technologies like GIS, automatic vehicle location systems (AVL), and automatic passenger counters (APC)? Yes/No
5. If no, why?
6. Do you conduct performance study? Yes/No
7. If your answer is yes, how often do you measure it?
8. How do you measure it?
9. Who measure it?

II) About service coverage.

1. Do you think your service meet the demand of your customer in this corridor?
2. In which attribute your service serve well?
3. In which attribute your service is poor?
4. What are the reasons for poor service?
5. What future plans do you have to improve your service in this area?

III) Vehicles condition.

1. What is the fleet size in this corridor?
2. Are they all operational? Yes/No
3. If your answer is No, how many are operational?
4. What are the reasons for those not in operation?
5. How many are in maintenance?
6. How many are totally out of service?
7. What is the capacity of each bus?
8. What is the average number of passenger per bus per trip?

IV) About Route, bus stop and travel time.

1. Do you have digital route map?
2. How does route extension carried out?
3. How far bus stops are spaced in this corridor?
4. How do you identify bus stop location?
5. What is the frequency of your service in this corridor?
6. What is average waiting time in this corridor?
7. What is average walking distance in this corridor?
8. Do you provide service on time according to the schedule?
9. If not, how much delay is tolerated?
10. What is the average travel time per trip in this corridor?

ሀዋሳ ዩንቨርሲቲ ቴክኖሎጂ ኢንስቲቱት የሲቪል ምህንድስና ትምህርት ክፍል

<u>ለተጓዦች የተዘጋጀ መጠይቅ</u>

የተከበሩ ተሣፋሪ

ይህ መጠይቅ የተዘጋጀው የአንበሳ አውቶቢስ መጓጓዣ አገልግሎት ብቃት በቢሾፍቱ አዲስ አበባ መስመር ለመመዘን ስለሆነ የእርሶ እውነተኛ መልስ ወሳኝ ነው። ስለዚህ እባከ ጥያቄዎቹን በትግስት አንብበው ትክክለኛ ነው ብለው የሚያምኑትን መረጃ እና መልስ እንዲሰጡኝ በትህትና እጠይቃለሁ። እርሶ የሚሰጡን መረጃ ለጥናትና ምርምር ስራ ብቻ እንደሚውል ተገንዝበው ያለምንም ፍርሃት እና ማመንታት ትክክለኛውን መረጃ እንዲሰጡኝ በትህትና እጠይቃለሁ።

ከአክብሮት ጋር

መመሪያ፡ እባኮን ለጥያቄዎቹ የ “X” ምልክት በሳጥኑ ውስጥ በማድረግ መልስ ይስጡ።

ክፍል I) ስለተሳፋሪው ጠቅላላ መረጃ።

1) ጾታ?

ወንድ ☐ ሴት ☐

2) የስራ ሁኔታ?

ተማሪ ☐ ስራ ፈላጊ ☐ ሌላ ☐

ሰራተኛ ☐ ጡረተኛ ☐

3) ይህን የትራንስፖርት አገልግሎት በተደጋጋሚ ይጠቀማሉ?

አዎ ☐ አይ ☐

4) መልሶ አዎ ከሆነ ፡ ፡ ምንያህል ጊዜ ነው ይህን የትራንስፖርት አገልግሎት የሚጠቀሙት?

ከ 5 እስከ 7 ቀን በሳምንት ☐

ከ 2 እስከ 4 ቀን በሳምንት ☐

በሳምንት አንዴ ☐

ክፍል II) በዚህ መስመር ላይ ከአንበሣ አውቶቢስ ስለሚያገኙት አገልግሎት በተመለከተ።

1) የእርሶ ቤት በቅርብ ከሚገኘው አውቶቢስ ማቆሚያ ምን ያህል ይርቃል?

ከ500ሜ ያነሰ ☐ ከ500ሜ እስከ 1000ሜ ☐

ከ1000ሜ በላይ ☐

2) የመጨረሻ መድረሻዎ ምን ያህል ከመጨረሻው አውቶቢስ መውረጃዎ ይርቃል?

ከ500ሜ ያነሰ ☐ ከ500ሜ እስከ 1000ሜ ☐

ከ1000ሜ በላይ ☐

3) በአማካኝ ምን ያህል ጊዜ በአውቶቢስ ማቆሚያ ላይ አውቶቢስ ይጠብቃሉ?

ከ5 ደቂቃ ያነሰ ☐ ከ10 እስከ 15 ደቂቃ ☐ ከ30 ደቂቃ በላይ ☐

ከ 5 እስከ 10 ደቂቃ ☐ ከ15 እስከ 30 ደቂቃ ☐

4) በአማካኝ ምን ያህል ጊዜ በአውቶቢስ ማቆሚያ ላይ መቀመጫ ያገኛሉ?

በሁሉም ጉዞዎቼ ☐ አንዴ በየሁለት ጉዞዎቼ ☐

አንዴ በየአምስት ጉዞዎቼ ☐ አንዴ በየአስር ጉዞዎቼ ☐

ምንም ጊዜ አግኝቼ አላውቅም ☐

5) በአማካኝ ምን ያህል ጊዜ በአውቶቢስ ውስጥ መቀመጫ ያገኛሉ?

በሁሉም ጉዞዎቼ ☐ አንዴ በየሁለት ጉዞዎቼ ☐

አንዴ በየአምስት ጉዞዎቼ ☐ አንዴ በየአስር ጉዞዎቼ ☐

ምንም ጊዜ አግኝቼ አላውቅም ☐

6) የአንበስ አውቶቢስ መጓጓዣ አገልግሎት አስተማማኝነት እንዴት ይመለከቱታል?

ደካማ ☐ ዝቅተኛ አስተማማኝ ☐

አስተማማኝ ☐ በጣም አስተማማኝ ☐

7）የትኛው ችግር ነው የአንበሳ አውቶቢስን መጓጓዢያ እንዳይጠቀሙ የሚገፋፋዎት（እባኮን ደረጃ ይስጡኝ ）

ደካማ የሆነ የሰራተኞች አገልግሎት አሰጣጥ ☐ መጨናነቅ ☐

ወደሚፈልጉት ቦታ በቀጥታ አለመድረስ ☐ ለአደጋ ተጋላጭ መሆን ☐

የመቀመጫ ማጣት ☐ ፍጥነት ☐

የባስ ውስጥ ስርቆት ☐ መዘግየት ☐

ክፍል III）ከአንበሳ አውቶቢስ በሚያገኙት አገልግሎት የእርሶ የእርካታ ደረጃን በሚመለከት።

1）በቀን ውስጥ በሚያገኙት የመጓጓዣ ድግግሞሽ።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐ በጣም አልረካሁም ☐

ረክቻለሁ ☐ አልረካሁም ☐

2）በአውቶቢሱ ፍጥነት።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

3）በሚከፍሉት ክፍያ።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

4）ከደህንነት አንጻር።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

5）አውቶቢስ ውስጥ ከሚኖረው መጨናነቅ አንጻር።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

6）አውቶቢስ ውስጥ መቀመጫ ከማግኘት አንጻር።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

7）ከምቾት አንጻር።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

8）ከአደጋ ከመጠበቅ አኳያ።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

9）አውቶቢሶቹ በታቀደላቸው ሰአት አውቶቢስ ማቆሚያ ቦታ ላይ ከመድረሳቸው አንጻር።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

10）በጠቅላላው በሚያገኙት የመጓጓዣ አገልግሎት።

በጣም ረክቻለሁ ☐ መካከለኛ እርካታ ☐

ረክቻለሁ ☐ አልረካሁም ☐

በጣም አልረካሁም ☐

ለአንበሳ ባስ የስራ አላፊዎች የተዘጋጀ ቃለ መጠይቅ

I) አጠቃላይ መረጃ

1) የዚህ ተቋም ተልዕኮ ዕራይ እና ጐል ምንምን ናቸዉ?

2) ከለገሐር ደብረ ዘይት ባለው መስመስመር ላይ ያለው የአንበሳ ባስ የመጓጓዣ አገልግሎት በተቋሙ መስፈርት መሠረት በምንደረጃ ላይ ነው የሚገኘው?

3) በቀን በአማካኝ ምንያህል ተጓዢች ናቸው በዚመስመር ላይ የሚጓጓዙት?

4) በዚህ መስመር ለይ በሚሰጠው የመጓጓዣ አገልግሎት ላይ GIS AVL እና APC የመሣሰሉ የቴክኖሎጂ ውጤቶችን ይጠቀማሉ?

5) የማይጠቀሙ ከሆነ ለምን?

6) በዚመስመር ላይ ያለውን የመጓጓዣ አገልግሎት ብቃት እና አፈፃፀም የሚያሣይ ጥናት ተካሂዶ ያውቃል?

7) ተካሂዶ የሚያውቅ ከሆነ ምንያህል ጊዜ ነው የተካሄደው?

8) በምን መልኩ ነው ጥናቱ የተካሄደው?

9) በማንነው ጥናቱ የተካሄደው?

II) በዚመስመር ላይ ስላለው የመጓጓዣ ሽፋን

1) በእርሶ እይታ በዚመስመር ላይ ያለው የመጓጓዣ አገልግሎት የደንበኞቹን ፍላጐት ያሟላ ይመስሎታል?

2) በየትኛው የህዝብ መጓጓዣ አገልግሎት ጥራት ማሣያ ነው በዚመስመር ላይ በጥሩ ሁኔታ ለደንበኞቹ አገልግሎት እየሰጠ ያለው?

3) በየትኛው የህዝብ መጓጓዣ አገልግሎት ጥራት ማሣያ ነው በዚመስመር ላይ በደካማ ሁኔታ ለደንበኞቹ አገልግሎት እየሰጠ ያለው?

4) ለዚህ ደካማ አገልግሎት ምክንያቱ ምንይመስሎታል?

5) ለወደፊቱ በዚመስመር ላይ ምን የታቀደ ነገር አለ?

III) ባሶቹ ስለሚገኙበት ሁኔታ

1) ምንያህል ባሶች ናቸው በዚመስመር ላይ የተመደቡት?

2) ሁሉም አገልግሎት እየሰጡ ይገኛሉ?

3) ምንያህሉ ናቸው አገልግሎት እየሰጡ ያሉት?

4) ምንያህሉ ናቸው ከአገልግሎት ውጪ የሆኑት?

5) አገልግሎት የማይሰጡት በምንምክንያት ነው?

6) እየተጠገኑ ያሉት ምንያህሉ ናቸው?

7) እያንዳንዳቸው ባሶች ተሣፋሪ የመያዝ አቅማቸው ምንያህል ነው?

8) በአማካኝ በእያንዳንዱ ጉዞ ምንያህል ተሣፋሪ ያጓጉዛሉ?

IV) በዚመስመር ላይ ስላለው መንገድ የባስ ማቆሚያ እና ስለሚወስደው የጉዞ ጊዜ

1) ዲጂታል የመንገድ ካርታ አለ?

2) የመስፈር ማስፉፊያ እንዴት ነው የሚከናወነው?

3) በዚመስመር ላይ ባስ ማቆሚያ በአማካኝ በምን ያህል ርቀት ላይ ነው የሚገኘው?

4) ባስ ማቆሚያዎች በምን መስፈርት ነው የሚመረጡት?

5) በቀን ውስጥ ምንያህል ጊዜ ነው በዚመስመር ላይ የመጓጓዣ አገልግሎት ያለው?

6) በአማካኝ ባስ ማቆሚያ ላይ ተጓዦች ምን ያህል ደቂቃ ባስ ይጠብቃሉ?

7) ባስ ለመሣፈር በአማካኝ ተጓዦች ምንያህል ርቀት በእግር ይጓዛሉ?

8) በዚመስመር ላይ ባሶቹ በታቀደላቸው ጊዜ ከባስ ማቆሚያ ይነሣሉ እና ባስማቆሚያ ላይ ይደርሣሉ?

9) በአማካኝ በዚመስመር ላይ የጉዞ ጊዜው ምን ያህል ነው?