EiABC
Ethiopian Institute of Architecture,
Building Construction and City Development
የኢትዮጵያ አርክቴክቸር፣ ህንፃ ግንባታ እና ከተማ ልማት ተቋም
Addis Ababa University
አዲስ አበባ ዩኒቨርሲቲ

Assessment of the Physical Integration of Public Transport Stations and Its Effect on the User:

The case of Mexico roundabout

Prepared by:

Nathnael Kefyalew

May 2021

Assessment of the Physical Integration of Public Transport Stations and Its Effect on the User

A thesis submitted to the school of graduate studies of Addis Ababa University, Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), in partial fulfilment for master's degree in Urban Planning

Author:

Nathnael Kefyalew

Advisor: Dr. Dipl.Eng. Berhanu Woldetensae

Ethiopian Institute of Architecture, Building Construction and City Development (EiABC)

Addis Ababa University

Addis Ababa, Ethiopia

May 2021

This thesis is submitted to Ethiopian Institute of Architecture, Building Construction and City Development (EiABC) and to school of graduate studies of Addis Ababa University in partial fulfillment of the requirements for the degree of Masters of Science in Urban Planning.

Title of thesis: Assessment of the Physical Integration of Public Transport Stations and Its Effect on the User: The case of Mexico roundabout

Author: Nathnael Kefyalew

ID NO: GSR/1455/11

Date:

Approved by Board of examiners

Berhanu Woldetensae (PhD)	_____	_____
Advisor:	Signature:	Date:
Dagnachew Adugna (PhD)	_____	_____
External examiner:	Signature:	Date:
Birhanu Girma (PhD)	_____	_____
Internal examiner:	Signature:	Date:
Dagnachew Adugna (PhD)	_____	_____
Chairperson:	Signature:	Date:
Dagnachew Adugna (PhD)	_____	_____
Graduate program director:	Signature:	Date:

Declarations

I, the undersigned declare that, this thesis is my own work and original work that has not been presented for a degree or diploma in any other institutions or university. All the sources of material used for the thesis have been duty acknowledged following the scientific guidelines of the institute.

Addis Ababa

May 2021

Author: Nathnael Kefyalew

Id No: GSR/1455/11

Signature

_____

Confirmation

I state that Nathnael Kefyalew Adugna has carried out this research work on the topic "Assessment of the Physical Integration of Public Transport Stations and Its Effect on the User "under my supervisions and it is sufficient for the partial fulfillment for award master's degree of in urban planning.

Berhanu Woldetensae (PhD)	_____	_____
Advisor:	Signature:	Date:

Acknowledgments

First, praises and thanks to the God, the almighty, for his blessings throughout the research work and for completing it successfully.

I would also like to express my deep and sincere gratitude to my research advisor, Dr Berhanu Woldetensae, Chair holder of Urban and Regional Planning at EiABC, for providing me with invaluable guidance throughout the research.

In addition, my acknowledgement goes for all who participated in this research for their great contribution. I would like to also express a sincere appreciation for my colleagues, classmates and friends for their support and ideas throughout the research. It is impossible to acknowledge all of them. I can do no more than indicate the major sources of inspiration, most of them fellow academics and researchers, whose paths crossed mines at various times.

Finally, I want to express my thankfulness for my family who had extraordinary influence in my success.

Abstract

Physical integrations of public transport aims to make the intermodal transit system accessible for all users by reducing discontinuities within the system. Enhancing the physical integration of public transport stations allows users to make travel decisions that enables them to save their time and money. The research was conducted to assess the physical integration of public transport stations and its effect on the public transport user. The study area was at Mexico roundabout, Addis Ababa and included the study of 20 public transport stations including the LRT stations and covered all the public transport modes present in the area. The study assessed the physical integration of the public transport stations of the area by assessing the transfer experience of the public transport users.it used survey method to capture the perception of the public transport users. The study also assessed the trip characters and modal usage of the public transport users. The findings revealed that more than 30% of respondents had to walk 400-500 meters to make a transfer to another mode of transport. Ordinal regression was used to analyze which parameters of the transfer experience had significant effect on the public transport users. The distance traveled to make a transfer, protection against weather while making a transfer, the increase in number of transfers a public transport user makes, safety security and conditions of sidewalk are amongst the significant parameters that affect the satisfaction towards the transfer experience. There is a strong institutional interest to enhance physical integration. However, concrete measure are not undertaken. The study recommends changing open spaces in the study area to interchange facilities and provision of longer routes to decrease discontinuities of trips. The study further recommends the city place public transport interchange facilities around transport hubs of the city to enhance physical integration of transport modes.

Key words: Physical integration, Public transport, User satisfaction

Table of Contents

List of Tables

List of Figures

Acronyms / Abbreviations

AALRT	Addis Ababa Light Rail Transit
APTA	American Public Transportation Association
BRT	Bus rapid transit
ENUTP	Ethiopian national urban transport policy
EU	European Union
LRT	Light rail transit
MRT	Mass rapid transport

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

According to Milller (2004) Physical integration is described as the planning of station, stops, transfer centers and facilities as well as their respective designs. In addition, physical integration also incorporates the reduction of conflict points between pedestrians and vehicles to create a safe environment for transferring users. Physical integration is also defined by UNDP (2010) as the joint use of equipment and transport facilities in order to achieve seamless mobility.

As stated by Saliara (2014) the planning of physical integration focuses on creating a system with a convenient path for walking, efficient station design and station amenities such that it increases the speed and security of transfers. In addition, it aims to make the intermodal transit system accessible for all users by reducing discontinuities within the system. Furthermore Nag, Goswami, & Bharule (2019) claims, enhancing the physical integration of public transport stations allows users to make travel decisions that enables them to save their time and money. Physical integration can also be described as an effort to "co-locate" various parts of the public transport system with the intent of facilitating transfers (ITDP, 2021)

Furthermore, (Nag, Goswami, & Bharule, 2019) claims, that true physical integration is possible when there are coordinated and seamless modal transfers. According to (UNDP, 2010) seamless mobility is the uninterrupted journey of users while still being able to roam across various transport modes.

As stated by, Monzón, Hernández, & Ciommo, (2016), the proper management of interconnection can come up with many benefits such as the time saving, reduced time for transfers and efficient travelling for users. In addition (Mbatta, Sando, & Moses, 2008) showed that Adopting a station area facility design which focuses on seamless movement of passengers, as they change their modes of transportation at the station would help accomplish safe and efficient movement of passengers as they access and egress the station area.

Addis Ababa the political and finance capital of Ethiopia has been undergoing continuous growth and change. Hence, as physical integration of public transport stations are important factors for effective mobility of goods and people, it is crucial to focus on the physical integration of the public

transport service of the city. In addition, it is significant to also understand how the public transport users perceive their transfer experience.

1.2 Statement of the problem

The matter of supply and accessibility to transport are at the heart of urban issues for a city experiencing rapid urban changes like the city of Addis Ababa (Nallet, 2018). Walking is still the most common mode of transport. Most journeys are carried out by public transport or walking (M.O.T, 2011).

Public transport is one of the significant components in the daily activities of Addis Ababa city dwellers (ESHETE, 2015). Presently there are various public and privately owned public transport operators in the city. However, there is lack of coordination and integration amongst them (TRANSIP, 2020). For a developing city with low level of car ownership, it is important to promote the transport modal share of public transport and non-motorized transport.

In an integrated public transport system, the users do not board a single line, but a whole system (Lee, 2013). The significant benefits of a user friendly integrated transport system is the development of a seamless transfer amongst the different transport modes (Luk & Olszewski, 2003). However, it is not the case for Addis Ababa; the city has a disintegrated transportation system with different service providers operating independently (GTZ, 2016).

Presently there are government owned public transport providers which are Anbessa, Sheger, light rail and PSETSE and privately owned service providers which are Code-1 minibus, Code-3 minibus, Higer-midibus and “Kitikit”- midibus (TRANSIP, 2020).

Physical integration of the different modes of public transportation such as the Mexico roundabout is low. The stations of the different public transport modes are located physically disintegrated. These forces users to have a delayed transfer time, walk a path, which requires them to cross-different roads, make a journey through uncomfortable spaces and walk a transfer path that lack sheltering facilities from the sun or rain.

The transport providers are various in number and type. However they have no input in routes assignments and are assigned with shorter routes which forces them to work on short round trip

which contributes to the discontinuities of the journeys and increase the physical disintegration of the public transport service.

The presence of an efficient and seamless public transportation system is important for the city dwellers to achieve their day-to-day activities (A.F.D, 2014). Hence, the physical integration of the public transport stations of the city of Addis Ababa needs to be assessed. An analysis that can identify the gaps and barriers in the physical integration of the different transport modes of the city's public transportation is required.

1.3 Research objectives

1.3.1 General objective

The objective of the research is to evaluate the physical integration of public transport stations and the effects it has on the users of the public transport service.

1.3.2 Specific objective

- To identify the effect of transfers on the public transport user by analyzing user satisfaction.
- To find the major variables that affect the perception of users in relation to physical integration.
- To identify the potential strengths and weaknesses of public transport stations of the city in relation to their physical integration and in creating seamless urban transportation by taking the example of Mexico major public transportation interchange.
- To suggest a possible recommendation for the improvement of the physical integration of the public transport stations of the city

1.4 Research questions

- How does the physical integration of public transport stations affect the users?
- What are the major variables that affect user satisfaction in relation to physical integration?
- What are the strengths and weaknesses of the public transport stations of Mexico interchange in relation to physical integration and creation of seamless transportation?
- What are the possible recommendations to improve the physical integration of public transport stations?

1.5 Significance of the study

It is essential to create a seamless public transport network. The aim of user-friendly integrated transport system is to develop “seamless” journeys, which are convenient and safe. As transfers are part of the network of public transport, it is important to understand and assess their roles in providing an efficient public transport system. Hence, it is important to understand the role of public transport transfers in increasing the quality of service in urban public transport.

The study contributes to the physical integration planning of the public transport system of the city. As stated by Monzón & Ciommo, City Hubs- sustainable and efficient urban transport interchanges , (2016) physically integrated public transport network plays a key role as one component of the transport network, which has the ability to facilitate and link the different transport modes of the city. This results in better time saving, improved transfer experience and a better satisfaction of public transport service.

1.6 Scope

The scope of the study focused on public transport transfer stations specifically in connection with the integration of Light rail stations of the city.

The study considered Anbessa city bus, Sheger city bus, LRT, Higer bus and minibus taxi stations for analysis of the physical integration among these modes of transport. The study was only conducted on Mexico roundabout.

1.7 Limitations of the study

The main limitations faced throughout the research was associated to the outbreak of Covid -19. It has restricted the frequent interaction with the informants.

1.8 Organization of the document

The study contains five chapters. Chapter one provides with an introduction part of the paper. The chapter includes background of the study, the problem statement, objective of the study, research questions, significance, scope, and organization of the paper. The second chapter will provide a literature review on the subject and how different literatures approaches assessing the subject matter. The third chapter will focus on the methodology of the study. Chapter four will focus on result and discussion. Chapter five will provide conclusion and recommendation.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides a detail review on urban transport, the different forms of public transport integration, physical integration of public transportation and its effect on the public transport users. The entire thesis and this review is done with the basic belief that assessment of the physical integration of public transport stations and understanding the effect it has on the users is crucial for the development of the public transport sector of the city.

The chapter starts with defining urbanization and basic concept of urban transport and the role of public transport in the development of urban areas. Then it reviews the successes and failures of the public transport sector and future prospects of the sector. In addition, the chapter follows with describing the different forms of public transport integrations and the contemporary best practices and solutions prescribed in enhancing the physical integration of the public transportation service.

2.2 Urbanization

According to World Bank (2017) the share of people living in cities has surpassed fifty percent and expected to reach 60 percent by the year 2030. In addition, European Union (2016) reports that despite urbanization, allegedly contributing to economic growth, it is out stripping the capacity of most urban centers to provide adequate services for their citizens and that it is essential to ensure a high quality of life in urban areas. Furthermore, Anastasia, et al. (2016) observes, it is certain that the economic prosperity of nations and urban areas is highly dependent on the efficiency of their transportations system.

As stated in Lhomelet et al. (2014) mobility is an essential tool required to maintain targets of increasing living standards. Hence, urban transportation is becoming a significant challenge for developing countries. As reported in UN (2016) urban transport has the ability to facilitate the movement of people and goods for efficient and sustainable cities. However, GTZ (2016) criticizes that in reality many cities lack affordable and reliable options for public mobility. This has become an obstacle for the economic development of regions and cities as new residential areas and jobs are being placed further away from each other.

This trend of "Rapid global urbanization" leads to an immense move of population from rural to urban areas (Haider et al., 2018). In addition, it is important to emphasize that the majority of this growth will happen in developing regions (World Bank, 2017).

Better health, education and employment opportunities are considered as the driving factors behind this phenomenon (UNDP, 2010). This trend is extreme especially in developing countries where it is difficult to provide people with better health and education facilities due to limitation of resources (Haider et al., 2018).

The rapidly increasing urban population leads to an increased pressure on urban infrastructure because it usually means an increase in number of commuters on roads, which creates immense stress on the urban infrastructure and demands for immediate improvements (Haider et al., 2018). Hence, the 'urban agenda' will ever more become a main concern for governments everywhere (UN Habitat, 2009).

It is certain that the urbanization process increases substantially the demand for urban services such as transport, on whose efficiency and availability, the successful and continued existence of urban society depends (ESHETE, 2015). According to Freeman & Jamet (1998) transport is a vital part of human life. Suitable transport links permit effective frequency of services, flow of passengers and commodity on (rail, roads, air, water) mode of travel. UN Habitat (2009) also considers as one of the important systems (Transport, water, sewerage, electricity and telecommunications) that play key roles in the development of efficient, healthy and sustainable cities.

2.3 Urban transport

As reported by World Bank (2017) for a rapidly urbanizing world, a well-functioning and well planned urban transport sector acts as an artery with the ability to facilitate the urban economy and link disadvantaged and poor people to services and opportunities. Similarly, M.O.T (2011) stated that urban transport serves as a vein to accelerate developments in Industry, trade, education, health and other services. ORAAMP (2010) Claimed, "Cities are the engines of growth in most developing as well as developed countries. More importantly, urban transport can be viewed as the oil that prevents this engine from seizing up."

Cities worldwide can be compared based on the efficiency of their transport system (GEORGE, 2017). People employed formally must be transported to work, and the ones in the commercial

sector have to transport their merchandise from source to the market, urban citizens in general need transport to get to the places of leisure (Dagnachew, 2007) and in addition, people are connected between cities and their rural homes by transport (Bogale, 2012).

According to George (2017) transport is vital for all aspects of urban life. Socially transport is the means of to access jobs, health, education and social services essential to the welfare of the city residents (World Bank, 2001). The prosperity of cities depend on the accessibility to markets and services (UN, 2015).

As claimed by A.F.D (2014) deteriorating transport conditions affect all city residents; they impact particularly the poor through a decline in public transport service levels, increased length of the journey to work and other essential services and the negative impacts on environment, safety and security that the poor are least able to mitigate. George (2017) argues that urban authorities should give priority to transport problems for them to achieve their development goals.

In order to provide the transport service that can uphold the residents' socio-economic development effort; it is vigorous to take necessary measures, which will have a positive impact in addressing complex problems observed in the sector (M.O.T, 2011). However, maintaining efficient urban transportation is becoming a major challenge for most developing cities (Clever, 1997).

As also reported by EU (2013) to improve living standards, urban transport mobility must not be hampered. As also, stated by APTA (2009), urban transport mobility is an important factor to nurture economic and social development for a developing nation. However, as argued by A.F.D (2014) approaches and solutions to improve urban transports are numerous and adapting them to fit each specific urban context is important.

According to UN (2015) Successful urban transport mobility is one that can satisfy the numerous and diverse requirements of the metropolitan mobility, including minimizing travelling time between various locations, while at the same time internalizes externalities to positively affect the well-being and the quality of life of the citizens of that area.

As stated by Fruin (1971), urban transport has three components private, public and non-motorized transport. The merging of these components can help in the creation of a balanced intermodal public transport system that can increase urban mobility (Saliara, 2014). According to Bok & Kwon (2016) Public transport should be given priority in urban areas as it has been hailed and promoted in recent

years for improving sustainability and the quality of urban life. The role of efficient public transport service has been vital as urban areas are increasing in sprawl and economic activity (Dagnachew, 2007). Hence, planning is faced with the challenge of addressing the many social, economic and physical problems, including, provision of public transport (UN Habitat, 2009).

2.3 Public transport

Public transport has long since received attention as a sustainable and environmentally sensitive transport form (Krygsmana et al., 2004). As also, emphasized by EU (2013), public transport symbolizes an alternate to car transport and is as such a significant element in of the sustainable transport policy. UN Habitat (2009) Observed cities that are able to create a sustainable system of public transport decreased their ecological footprints by reducing fossil fuel consumptions and decreased urban sprawl and automobile dependence of their residents.

Efficiently Connecting resources to destinations can improve economic and environmental performance of cities, meaning using mass mobility (Bok & Kwon, 2016). Public transport networks are recognized as a vital portion of urban morphology (Anastasia et al., 2016). Hence, the monitoring and assessment of public transit can be crucial to understand an urban system and its major function (Bok & Kwon, 2016).

Development of sustainable urban mobility and public transport networks leads by all means to radical improvement of citizens' quality of life (UN, 2015). It improves access to markets and job opportunities, to education, to health care services, to leisure, to the things citizens need in everyday life. According to UN Habitat (2009) cities planned with giving priority to public transport are socially sensitive and equitable in terms of providing services to both high income and low-income urban residents and overcoming spatial marginalization.

Public transport is an essential tool to "attract users to public and non-motorized transport by providing a safe and efficient public transport system" (Saliara, 2014). Still there is an increase seen in private car ownership and it is obvious that the availability of public transport, the increase in city size (i.e. distance from home or destinations) and the disutility (or inconvenience) associated with the non-seamless stages and connections that characterize public transport are very much to blame (Krygsmana et al., 2004).

According to UN Habitat (2009) cities with high density as most cities of the developing work are, if they do not have sustainable public transport system and allow too much traffic to develop in their roads, it can easily lead to the development of a dysfunctional transportation system. However, their density will always enable them to provide viable public transport solutions if they invest in them. As stated by EU (2016) effects of public transport enhancements are likely to be more significant in the longer – rather than the shorter-term.

In developing nations it is also important to combine informal public transport operators as they provide a vital service in areas where official public transport is either not provided or too costly for residents (UN Habitat, 2009). In addition, Conventional public transport services should be reorganized to feed, rather than to compete with, Light Rail and BRT systems (Ibrahim, 2003).

2.3.1 Modes of public transport

Public transport has a long history of existence by taking different forms and technologies assimilating and improving it through time (Transafrica, 2008). From the roman times of Emperor Augustus and Tiberius two and four-wheel wagons to 16th and 17th century European stagecoaches (Alan, 1995). The public transit has developed to "The Omnibus" in 1825 Paris, which had a bigger stagecoach with a larger seating capacity. Then to the development of horse drawn street railways in 1832 (Eshetie, 2015).

The development of engines benefited the public transport service as steam engines were placed on cable cars and use as public transport in San Francisco (ESHETE, 2015). The invention of electricity was also adapted for public transport use in the form of streetcars (A.F.D, 2014). According to Alan (1995) the most influential innovation for the growth of public transport was the development of the motor vehicle. Public transport vehicles running on motor engines and electric mass transit rails are the dominant forms of public transport in various contemporary cities (A.F.D, 2014).

Public transportation can be classified as demand responsive and fixed route services. Demand responsive passenger transport is characterized by flexible pick up and drop off locations that consist of smaller vehicles and adaptable routes tailored to passenger's needs (EU, 2018). Fixed route services are public transport systems that use predetermined routes and schedules. In addition, they use bigger vehicles such as buses or light rail systems (RHIHUB , 2020).

Tufa & Girma (2001) categorized public transport on the form of line systems they use. They are On street systems (Bus, trolley buses and trams), Mixed on street and Off-street systems (bus lanes, bus ways and light rail) and Off street systems.

2.3.1.1 Bus and trolley bus

As reported by Armstrong-Wright & Sebastian (1987) the 'Conventional bus" was the dominant mode for road based public transport in the developing world. Buses mostly use public streets in mixed traffic to operate but sometimes they have exclusive lanes or busways (ESHETE, 2015). It is also easier to implement as it has route flexibility with increased permeability in to surrounding towns and cities. In addition, bus transport has low initial and operational cost (Davison & Knowles, 2006). The service is known for its affordability to the urban poor (Vikash, 2003). However, the demand for the service is high while the service quality is low (Transafrica, 2008). The system is often described as severely over stretched, unreliable and uncomfortable (Anastasia et al., 2016).

Trolley buses are buses that also use fuel or electricity however; they are mounted on cables throughout their operation line (Tufa & Girma, 2001).

2.3.1.2 Light rail transit

Light rail can operate in both mixed traffic and exclusive rail systems (Tufa & Girma, 2001). They run on electric systems. The service can be found in tunnels or surface light rails (James, 2010). Light rails are known for bridging the gap between heavy rail or metro systems and the conventional city buses (Knutton, 2005). According to Agarana et al. (2016) light rail system is the best way for moving large populations in and out of urban areas.

2.3.1.3 Rapid rail transit (Metro, Subways)

Rapid rail transits operate on an exclusive lanes at high capacity and high speed (Tufa & Girma, 2001). It is different form other modes of transport because it operated on a closed system with no access to other vehicles or pedestrians (Agarana et al., 2016). They also require a high platform to board the system. Hence they cannot be operational on a normal road condition (GTZ, 2016).

According to Haider et al. (2018), public transport is still considered the best system and the most suitable solution for moving large masses of people from one place to another. Proper integrated public transport system is the need of the time, which can enhance public mobility by providing state of the art transport services to daily commuters (Ibrahim, 2003).

2.4 Intermodal Integration

As specified by Monzón et al. (2016) the significant tasks in trying to attain accessible urban transport is the integration of mobility and enhancing collective transport modes. Based on Haider et al. (2018) a properly integrated public transport system is timely and expected to enhance the mobility of the public by giving a "state of the art" public transport service. However, Nallet (2018) identifies that, in the global south, the urban transport sector has been an issue that was neglected. Pratelli & Brebbia (2010) further describes that with the ever-increasing level of urbanization, numerous scientific and technical works have addressed the issue of developing an effective urban transport strategy, especially in the developed countries' context. As stated by Transafrica (2008) in sub-Saharan Africa walking was the most common mode of transport next to public transport.

As attested by Luk & Olszewski (2003) there is significant determination in improving public transport connectivity across all transport modes and services. Furthermore, Monzón et al. (2016) shows the reason that is an increase in Multimodal trips in urban areas; hence, this is in turn decreases the attractiveness of public transport service. There is a need for integration in order to achieve effective seamless mobility. One dimension of integration is to reduce the disruption of transfer among modes.

Intermodal integration entails in providing a coordinated, smooth, convenient high quality public transport service with minimum interruption on interchanges (Saliara, 2014). Integration of public transportation can be described as holistic planning of services, which results in a rationally structured public transport service (Hussein, 2016). Integration of transport networks aims at making public transports more attractive than individual modes. An integrated public transport network undeniably has the ability to attract larger number of users (Berlepsch, 2018).

Public transport Integration can also be defined from a systems perspective, as a process of unifying the different modes in order to increase the quality of the service (Hussen, 2016). The development of intermodality, which can be understood as the combination of diverse types of transport modes during the same journey, greatly depends on integrated systems (A.F.D, 2014).According to UN, (2015) efficiency of urban transport for various transport modes depends on their integration.

In addition Monzón & Ciommo, City Hubs- sustainable and efficient urban transport interchanges (2016) argues, integration of the different modes is required in order to provide a seamless door to door transport service. Integration of the different aspects is beneficial for all parties involved as it

decreases competition and increases cooperation (A.F.D, 2014). Integration is important where there is presence of multiple modes of public transportation operators and they lack coordination, cooperation and interaction amongst each other (Saliara, 2014).

Public transport system does include an integrated network of Bus Transit and Rail Mass Transit making (Haider et al., 2018). However, Integration requires to have the right combination between the various motorized individual or collective/public and non-motorized transport modes, as well as easy transfers between them to meet the mobility demand (UN, 2015). According to Hussen (2016) "Developing a framework for integration requires identification of preconditions for integration, barriers for integration, policy instruments for integration, forms of integration and institutions" to assert the integration.

As categorized by Saliara (2014) public transport integration can be categorized in to three forms "physical, operational and organizational integration". However Hussen (2016) categorized public transport integration into five; "physical integration, network integration, fare integration, information integration and institutional (operational) integration".

According to Saliara (2014) organizational integration focuses on contracts and arrangements amongst the different public transport operators to ensure their commitments in improving the service. While operational integration focuses on day to day planning and management intended to provide a smoother and continuous service.

According to Liu, R, & S (1997) the accessibility of opportunities for direct trips when using public transport is becoming a scarce reality, and for this reason, the majority of trips require transfers between transport modes. In addition, Lee (2013) elaborated that there is a need for public transport integration, the various transport modes are planned and operated independently. The lack of intermodal linkage has created in convenience for public transport users. Berlepsch (2018) Suggests the physical integration of the various transport modes would decrease the inconvenience. Further explains that the close proximity amongst the different operating transport modes would ensure easier accessibility for the users.

Furthermore, Luk & Olszewski (2003) stated that the significant benefits of a user friendly integrated transport system is the development of "seamless" transfer among different transport services. In addition, Maxwell (2003) observed that, an easy transfer will assist users in accessing

a holistic public transport network, making transfers a beneficial part of the public transport journey as supposed to something to avoid during the trip.

As claimed also by Zimmerman & Fang (2015) public transport has a rising customer satisfaction if it is efficiently planned and operated as a seamless integrated system. Moreover, ITDP (2021) notes, one of the significant part of Successful public transport integration is the physical planning of terminals and stations. For the purpose of the study, the literature will focus on physical integration of public transport.

2.5 Physical integration of public transport

It is the planning of stations, stops and facilities in order to create a safe environment for transferring users (Milller, 2004). It also embraces the coordination of vehicle movements for transfers to be safe without any conflicts between pedestrians and vehicles movement (Saliara, 2014).

Physical integration can also be described as an effort to "co-locate" various parts of the public transport system with the intent of facilitating transfers (ITDP, 2021) . According to Krygsman & Dijst (2004), the weakest part of a public transport service is the access and egress stages (together with wait and transfer times) or simply put transfers. In addition, CTPS (1997) shows that transfers are considered the "necessary evils" of public transport even though they make it possible to access a hierarchical and multimodal service with an enlarged network.

Transfers are known to reduce the satisfaction of public transport users (Lam & Xie, 2002). In addition, they can affect the customer's perception in use and path choice (Hine & Scott, 2000). Furthermore, they can be disruptive and have a travel disutility, which deters users from public transport (CTPS, 1997).

According to (EU , 2016) , to increase the efficiency of multimodal public transport network it is import to focus on decreasing distance amongst the train stations, bus stops and non-motorized transport modes. According to (A.F.D, 2014) efficiency of a multimodal public transport network can be increased by physically integrating the various modes of transport in a closed or open system of facility.

It is crucial to make sure the "connected" public transport services do not have a poor quality or are too expensive and can be reliable, as the success of the integration will also depend on those characters of the transit (EU , 2016).

2.5.1 Benefits of physically integrated public transport

Physical integration can reduce the cost incurred while making transfer convenient by providing comfortable transfer walking space, reducing transfer time and offering comfortable transfer environment (Krygsmana et al., 2004). Similarly, Berlepsch (2018) observed that physical integration is a good intervention to increase convenience and ensure accessibility for the commuters.

In addition, one of the major benefit of a physically integrated transit system is that the diversity of the modes integrated allows merging different types of travel needs and services (Milller, 2004). Furthermore, Physical integration has the ability to speed up and secure transfers by improving accessibility while facilitating movement of the users and decreasing discontinuities of the transfer (Saliara, 2014).

Physical integration can also be applied without making major changes to the existing public transport network. This makes it more convenient and cost effective to apply for a developing country (Milller, 2004).

2.5.2 Physical integration: the institutional dimension

Integrating a multimodal transport network is a very difficult task. It will require a strong cooperation and coordination amongst different institutions and stakeholders (Hussen, 2016). It should be done with advanced financial and institutional framework (A.F.D, 2014). There needs to be an impartial “umbrella authority” which has the ability to unify the different institutions and stakeholders with autonomous metropolitan authority (Saliara, 2014).

2.5.3 Challenges for physical integration

There are a number of problems that will be encountered in the implementation of physical integration through the provision of interchange facilities and services. Multimodal public transport integration is difficult to achieve when there are numerous private operators as in the many cities in Developing countries. The fewer the operators and the modes, the easier it will be to integrate the existing mode of transports (Rivaspalta, 2008).

Multimodal stations, which facilitate intermodality, have to be integrated within a larger urban project (A.F.D, 2014). Physical integration can also become a hard task when it requires free spaces

to build interchange facilities. Because the facilities need to be placed along city centers and it is a hard task to find free space or pay compensation for occupied space in inner cities (Hussen, 2016).

2.6 Interchanges

The development of smart urban interchanges can promote urban integration, minimization of transfer time, better access to information better use of waiting time and can provide clean, safe and seamless transport service (Tsami et al., 2013). During a person's day to day trips comfort has become one of the crucial elements next to security and reliability. Interchange facilities have the ability to add comfort to basic transport functions (Monzón et al., 2016). In addition to this transport interchanges, can act as "open gates" to a cities system and society by enhancing activities and events (Tsami et al., 2013).

Urban transport interchanges can be important measures to promote use of public transport and enhance modal redistribution (Lambas et al., 2010). As Terzis & Last (2000) highlighted the location of interchange development should focus on spaces with large number of public transport modes and with high volumes of transferring users. The design of interchanges is also vital to promote accessibility to all passengers and is a crucial part of providing a seamless door-to-door transport service. However, EU (2013) highlighted that every interchange design should fit the areas context and there is no one optimal solution for all.

Interchanges based on their functions can be large and might consider and consist of various components in their designs like a rail station, a metro station and a bus terminal (Monzón et al., 2016). In addition, Terzis & Last (2000) showed that transport interchanges should focus on delivering efficient transport function and be perceived as attractive by the users because both "physical and psychological reactions" of users are crucial. The success and failures of an interchange can only assessed by the satisfaction of the users (Lambas, E, & Monzon, 2010).

According to EU (2013) the development of interchanges is the next logical step towards enhancing physical integration of public transport stations. However as Lee (2013) observed that it is important to take in to account the users perception towards various elements of the transfer to ensure the development of the interchange can satisfy the traveler's needs. As Lam & Xie (2002) stated traveler surveys can assist in better understanding and become efficient tools in the development of interchange facilities.

Interchanges are the way forward for improving the physical integration of public transport stations. The design and management of interchanges should be a collaborattive effort amongst all the stakeholders. The most crucial element in the design of interchanges is understanding and integrating the needs and preferences of the travelers.

2.7 Approach in assessing physical integration of public transportation and its effect on the user

2.7.1 Approach

There are Various literatures that tried to formulate methodologies in assessing public transport experiences of users. (Hernandez et al., 2016) used a survey method to understand user preference and satisfaction towards different elements of a transfer. The elements were categorized in to 8 such as travel information, wayfinding, time, movement, comfort and convenience, attractiveness and safety and security. Respondents used a five scale likert scale to rate their satifaction towards the elements.

Cascetta & Cartenì (2014) used a comparative quantitative analysis of two rail station where the only major difference was the quality of architecture. Out come of the research shows architectural quality has a huge influence on travel choice especially on the female gender. Silva & Bazrafshan (2013) applied structural equation model to analyze user satisfaction data of 8 transport interchanges. Results show user satisfaction increased with increase in guidance signs and decrease with presence of litter or graffiti.

Similarly attempts were made to understand perception of users towards their transfer experience by Iseki & Taylor (2010) who formulate an importance satisfaction analysis with ordered logistic regression at Los Angeles transfer stations. The result dictates the highly influential determinants of satisfaction where not physical integration of stops and stations but access to safe enviroment and reliable public transport service. Further more Cherry & Townsend (2012) used the same methodology to assess the intermodal connection between metro and bus services in thailand. The surveyed users show high dissatisfaction rates towards all parameters.

The assessment of the physical integration of public transport stations will require quantitative and qualitative assessment of the transfer experience of the users. The mixed method approach uses both qualitative and quantitative data forms for analysis (Creswell, 2009). Based on the various literatures which attempted to understand and assess the physical integration of public transport

stations. it is observed that the research needs Qualitative analysis for understanding trip character, influences of transfer path and examining effects related to proximity of stations.

According to Cascetta & Cartenì (2014), surveying user satisfaction will also require quantitative analyis with use of regression models to understand which elements of a transfer are more influencial in affecting user satisfaction or dissatisfaction towards elements of the transfer. It is also important to formulate indicators which can help in assessing which elements are more significant in evaluating the physical integration of public transport stations.

Mixed methods of research is an approach to data inquiry, which has the ability to combine and connect both quantitative and qualitative forms of data. The approach is constructed with philosophical assumptions in which the use of qualitative and quantitative approaches, and the mixing of both approaches in a study is critical for the analysis of the data. (Creswell, 2009).

According to Creswell (2009) the process of this approach of research involves emerging questions and procedures. Data typically collected in the participant's setting. The data analysis inductively builds from particulars to general themes. In addition, the researcher will make further interpretations by analyzing the data further and clarifying the meaning of the data.

2.7.2 Indicators

An indicator in the perspective of evaluation and monitoring is a quantitative tool which can give information on how to measure performance of a service or project (UN, 2000). Indicators have the ability to simplify complex data, assisting the understanding and measuring the progress of numerous transportation systems, hence they can be tools to help analyze urban spaces in the access to transit stations (Fernanda B. Monteiro, 2012).

It is problematic in dealing with issues related to the quality of urban spaces since it is a hard task finding measuring instruments that have the ability to measure and evaluate the transfer space (Fernanda B. Monteiro, 2012). For assessing pedestrian space, Fruin (1971) stated different methodologies for characterizing side walk service by quantifying elements such as; human anatomy, field of view, comfortable distance between bodies depending on the relationship to the other person, walking down stairs and psychological perception of urban space.

According to Fernanda B. Monteiro (2012) , the indicators to assess the quality of transfer paths are the continuity of paths, the attractiveness and convenience of routes, the distance to be traveled, the

slope of the track, the conditions of sidewalks, the straightness of the route and any other factor to facilitate walking.

Hernandez et al. (2016) used the indicators such as ; "Availability of quality information ,Safety and Security, Services (toilets, ticketing, luggage check and so on) ,Shops and Coffees, Easy transfers between transport modes and Access to interchange facility" to assess urban interchanges.

The common indicators used by the different literatures that can help assess the transfer path of a public transport service are the slope of the transfer path, safety and security of the transfer path , attractiveness of the transfer path, convenience of the transfer path, conditions of sidewalk , straightness of the transfer path , continuity of the transfer path.

2.7.2.1 The influence of slope on walking activity and transfers

According to Meeder et al. (2017) , the effect of elevation differences and slopes on pedestrians has been well researched in biomechanics. Stated or revealed preference survey researchers have linked objectively measured characters of the path traveled by participants' to walking a certain path. Accordingly Cervero et al. (2003) highlighted that there is a negative correlation between increase in walking time due to slope of the terrain that discourages people form walking.

In the field of transportation engineering the effects of the slope on transferring travelers has hardly been researched (Olszewski & Sony, 2005). Still, there are exceptions that can be found, the results confirm that the slope of a path traveled can deter people from choosing and walking a certain path (Cervero et al., 2003).

According to the study of Meeder, Aebi, & Weidmann (2017) "the effect of a walkway's slope on walking attractiveness", the study was done by using a logit model. It suggests that, a 1 percent increase in walking makes the experience 10 percent less attractive. This shows that slope has a very huge role to play in order to increase the attractiveness of a pedestrian walkway or transfer route to the public transport user.

2.7.2.2 The influence of Continuity of path

Paying more attention to the physical location where the transfer happens and increasing comfort, safety and security perception during public transport use will be key factors for attracting additional users of intermodal trips (Lee, 2013). Sidewalks play an essential role in transportation, as they provide a safe path for people to walk along that separated from the motorized traffic. It is

a description of the quality of the path's surface. The continuity of the pedestrian facility is significant for the pedestrian with disability and of old age. Since, the reason behind not preferring the walkway indicates that street vendors, discontinuity of sidewalk and surface quality are affecting the pedestrian safety (Meeder et al., 2017).

According to Alemgena et al. (2018) the majority of the respondents in the study did not prefer using the sidewalks due to different variables introduced in the sidewalk such as; reduced quality of sidewalk , discontinuity of sidewalk and street vendors respectively. This implication is that the continuity of path has a strong influence on the perception of a path traveled to make a transfer.

2.7.2.3 The effect of time in public transport

Daily commuters have a certain route and modal choice with a specific time for their trip (Kieu et al., 2004). User's perception of time saving and use is a huge influencer for the continued use of public transport in an intermodal trip (Mackie et al., 2001). In addition Stradling (2002) also observed travel time saving as one of the influencers in making public transport attractive.

As Chowdhury et al. (2013) highlighted commuters are more lenient in making transfers on attractive routes. According to Stradling (2002) users describe an attractive route as a cost effective and time efficient route. However Nowadays, passengers often use more than one traffic mode or service to complete the trip.

Accordingly, the total travel time includes all supplementary travel times between the origin and destination such as wait time, walking time, etc. studies using a pure utility approach show that transfer time is perceived as negative and as a disutility (Mackie et al., 2001).

Time has a huge effect on the daily trip of a traveler. The first step is walking from origin to transport station, second it might be bus to a Mass Rapid Transit (MRT) station, then drop off and walk to the office. The trip consists of three transport modes such as "walk, bus and MRT, with five trip stages, first mile, first main haul (bus), transfer stage, second main haul (MRT), and last mile". The time perspective of the trip can be considered as the out-of-vehicle-time and in-vehicle time. The out of vehicle time consists of transfer time and walking time (Mahardhika et al., 2018).

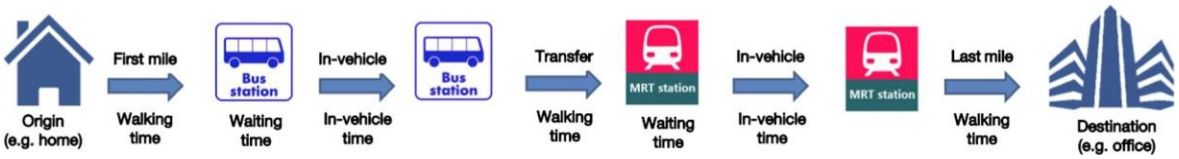

Figure 2. 1 Trip stages and travel time in multimodal public transport trip

Source: (Mahardhika et al., 2018)

The planning and operation of a public transport system should consider perceived travel time as it has a huge role to play in affecting travelers satisfaction towards a public transport service.

2.7.3 Origin Destination Flows

According to Alsger, et al. (2015) for improving a public transport service understanding of the origin destination flows of the commuters is important. In addition Transit Laboratory (2020) highlighted that the use of Origin destination data is crucial for the improvement of the operation and management of a public transport service.

Table 2. 1 Basic origin destination matrix

Origin -i / destination -j	1	2	3	4	5
1	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}
2	T_{21}				
3	T_{31}				
4	T_{41}				
5	T_{51}				

Source: (Transit Laboratory, 2020)
Where: T_{ij} = trips from origin *i* to destination *j*. Note that the practical value of trips on the diagonal, e.g. from zone 1 to zone 1, is zero since no intra-zonal trip occurs.

2.7.4 User perception of public transport transfers

Many researchers have tried to use user perception as a form of assessing the quality of public transport service. They believe Understanding passengers' points of view is essential for the efficient design and management of public transport (Iseki & Taylor, 2010). Travelers tend to use public transport based on their personal travel needs and perceptions (Berlepsch, 2018). Hence, user perception is considered when assessing public transport and thus very crucial to understand users' opinions (EU, 2013).

It is commonly accepted that the design and operation of a public transport service may influence the physical experiences and psychological reactions of a traveller, and thus an efficient design and

operation should attract travelers and be linked to the sustainability of public transport (Saliara, 2014). One of the aspects of a public transport journey that leave a negative impression on users is a transfer. It is important to understand the effect of transfers on the perception of the public transport user (A.F.D, 2014).

Understanding the user's perception and satisfaction towards the transfer experience can help in identifying potential weak points that can assist in improving the service (Eboli et al., 2018). However, the transport agencies have not given focus to improve the convenience of intermodal transfers (F.T.A, 1996). It is important to give attention to the customer's perception of transfers as they feel it is an inconvenient and time-consuming part of their journey (Guo & Wilson, 2011).

2.8 Best practices of physical integration of multimodal public transport

Best practices are projects, which have shown better outcomes in the measures they have taken. The development of an intermodal exchange station is one of the most successful measure to increase the physical connection between a subway system and a conventional bus service (Monzón et al., 2016). Recently many projects worldwide have tried to improve the physical integration of their multimodal public transport service. The selection process was based on what is perceived as a better service and improvement in providing a physically integrated public transport network.

The Moncloa interchange in Madrid Spain is one of the successful projects in addressing issues of physical interchange. It has decreased journey time for both users and transport operators. It is found in the northern part of Madrid and serves an estimate of more than 280,000 people per day. During peak hour, buses an metro depart every five to 10 minutes. The goal of the interchange is to link buses and metro stations. Travelers have shown increased satisfaction towards the interchange. They have a reported short transfer time.

The analysis of the case study of the Avenida de America interchange has positive outcomes in gaining between 3 and 7.5 minutes per trip for conventional bus services. Both travelers and operators have saved their travel times. This resulted in an increase of profit for the interchange owners as both the operators and travelers increased their use the interchange.

Interchange development is the current best practice to improve the physical integration of public transport stations.

2.9 Summary of literature review and identified research gaps

2.9.1 Summary of literature review

The literature reviews that focus on assessing quality of public transportation and the method and approaches used by them have been summarized in the table 2.2 below.

Table 2.2 Summary on Benefits of physical integration of public transport station and assessment of public transportation

Summary on benefits of physical integration of public transport stations				
Author	**Author's thoughts on benefits of physical integration**			
(Krygsman & Dijst, 2004)	Physical integration can provide comfortable transfer walking space, reduce transfer time and offer comfortable transfer environment.			
(Berlepsch, 2018)	Physical integration is a good intervention to increase convenience and ensure accessibility for the commuters.			
(Millller, 2004)	Physical integration is a convenient and cost effective measure to apply for a developing country.			
Summary on Assessing public transportation				
Author	**Location of study**	**Variables measured**	**Method**	**Result**
(Hernandez, Monzon, & Oña, Urban transport interchanges: methodology for evaluating perceived quality, 2016)	Madrid, Spain	8 Variables	Survey method using five scale Likert scale to rate satisfaction of users and a regression tree model and importance-performance analysis.	Strengths of the interchange are found to be information provision and the internal design of interchanges
(Cascetta & Cartenì, 2014)	Naples, Italy	11 Variables	Comparative quantitative analysis of two-rail station using binomial logit model.	Architectural quality of interchanges has a huge influence on travel choice especially on the female gender
(Iseki & Taylor, 2010)	Los Angeles	4 Variables	Importance satisfaction analysis with ordered logistic regression	Access to safe transfer enviroment and reliable public transport service are the influential determinants of satisfaction

(Source: organized by the author)

2.9.2 Research gap

There are different practices and literatures in multimodal integration and development of interchange facilities in the western world nonetheless there is limited knowledge when it comes to the characters of small demand response transport services like the minibus and midi-bus transport modes and how to integrate them with existing fixed route services like the LRT and the Bus routes.

In addition to the above stated matter there is limited research done on transfer experiences of public transport users in the sub-Saharan Africa. There is also lack of standards for designing public transport transfers in the local context. According to the author's knowledge, there is no study that tried to assess the perception of public transport users in relation to physical integration, in the city of Addis Ababa.

This research tried to fill the gap by including the small demand responsive services and the fixed transport services in the study. It also attempted to assess the transfer experience of public transport users in relation to physical integration.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Study area

It is a roundabout in Addis Ababa, Ethiopia named after the country of Mexico. It was named after the country of Mexico preceding Second Italo-Ethiopian War, as the country was the one of the five countries to refuse Italy's annexation of Ethiopia. The Addis Ababa Light Rail system has an overpass over Mexico roundabout. In 2013, much of the square was demolished to make way for the LRT Project. The site is also classified as future central business district and major high-rise buildings are being constructed at a near distance of 800-meter radius. It is expected to continue serving as a public transport hub of the city as the future flow of the population will be pulled to that area. Hence, the Mexico roundabout is chosen for the study, as it fulfills the criteria that the research requires.

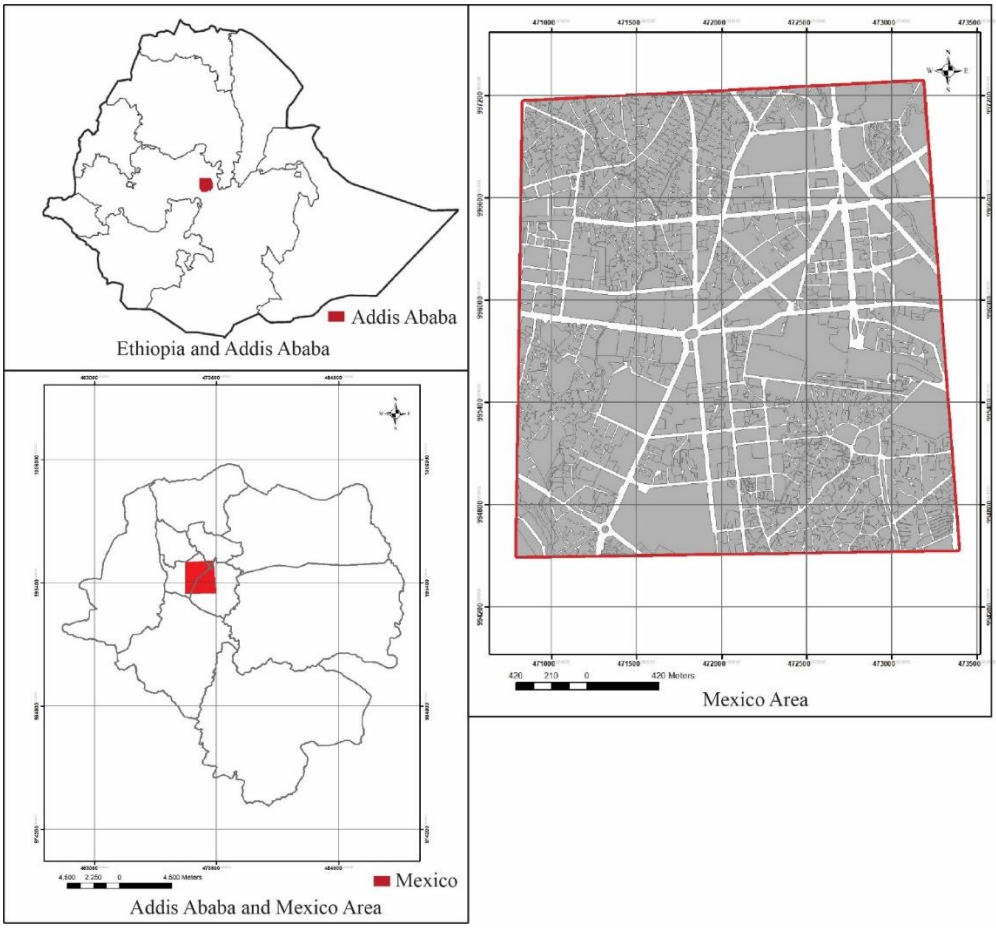

Figure 3. 1 Map of the study area

(Source: organized by the author)

3.2 Study area selection

The study is conducted in Addis Ababa. The reason that Addis Ababa is chosen as the study area is because the city is the primate city of the country and is showing signs of congestion and increase in private car ownership and the city has different public transport options that are disorganized compared to other cities of the country. There is presence of different modes of public and private public transport operators.

In addition the study will be based around physical integration of public transport stations and as the LRT route of the city is only found on the North-South and East-West part of the city. The site selected will be to make sure that the LRT route will be included as part of the study. The LRT route of Addis Ababa has total length of 34.25 km (North-South line 16.9 km and East-West line 17.35 km) two lines (i.e. North-South and East-West lines) use common track of about 2.7km. The Addis Ababa transport system structural plan also shows future directions for a BRT and MRT network development.

The study will focus on the transportation system, specifically around the physical integration of different modes and station closeness and proximities among different modes, at a specific site. The selection criteria is

- Connectivity of the area to the other parts of the city
- The area should have an agglomeration of public transport stations
- In addition, the presence of LRT stations in the area.
- it should also be an inner city area which is considered as a major transport node
- a site which serves a huge number of people per day
- Future central business district area.
- An area which gives multimodal transport service

Based on the above criteria Mexico roundabout is selected for the study.

The roundabout also has many different public transport stations located surrounding it. They are composed of different modes of private and public operators of public transport and two LRT stations that serve both the East-West and North-South corridor.

3.3 Research design

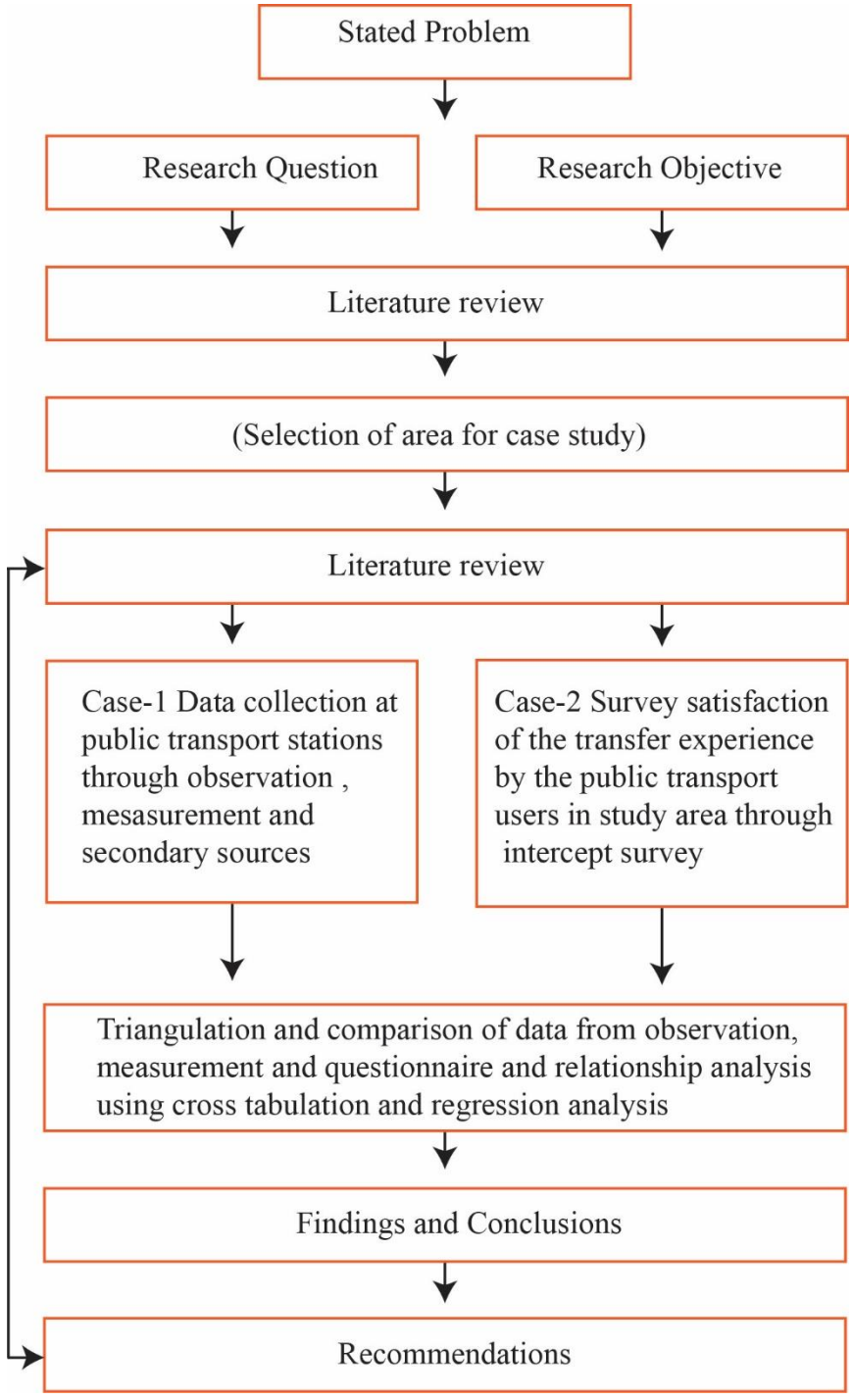

Figure 3. 2 Research Design

(Source: organized by the author)

3.4 Data types and sources

Both primary and secondary data have been used in the research. The primary data consists of questionnaires, interviews and base maps. The secondary data includes results from different literature works, policy and manuals from different government and non-governmental institutions.

3.5 Data sources

The source of the primary data were surveys from the respondents, base maps prepared from sources such as satellite maps from official web sites including Google Earth and interviews with transport operators and providers.

Secondary data was collected from different local and international literature works, offices such as the ministry of transport and Anbessa city bus services.

3.6 Sampling design

The research used different type of sampling methods to conduct the study. Stratified sampling was used to make sure equal number of sample is taken from all the public transport stations present in the study area. Random sampling was used in the intercept survey to choose people to be engaged in the survey from each public transport station.

3.6.1 Population of the study

Based on data from four months (September – December 2018) the center and operation control of ticketing division of AALRTs office the average passengers per day is greater than 105,760. This coupled with the transport users of minibus taxis, which serve more than 1,000,000 per day and the Anbessa bus that serves more than 600 thousand people per day it is for sure that the study area serves more than 100,000 people per day.

3.6.2 Sample size and techniques

In the process of the sample size selection, simple random and stratified sampling (for the station) is used. The first step was to calculate sample size out of the total public transport users in the area including the LRT users. Because the population size is unknown, the Cochran formula was used to determine the minimum sample size. The Cochran formula is majorly used when a population size is greater than 100,000. Accordingly the minimum sample size for a larger population greater than 100,000 at 95% confidence interval, with 0.5(50%) degree of variability and +\- 5% precision is 384.

Depending on this figure, the researcher has collected a survey of 700 passengers to get a more sound and representative size for the study. Even though the Cochran formula is 384 enough sample size. The next was to proportionally divide the sample size to the number of stations present in the study area.

3.7 Data collection techniques

The primary data is collected using intercept surveys that integrate origin destination matrix in the survey. There are 20 public transport stations in the area and as such 35 sample respondents were collected from each public transport stations. The secondary sources of data were collected from different local institutions and journals.

3.7.1 Intercept survey

Public intercept surveys are a straightforward and direct method for gathering data on public perceptions or other locally relevant information. It is one of the methods that can help analyze the perception or satisfaction of users on a certain product or service. The method helped analyze the satisfaction of user towards the public transport transfers they make. The survey method can help gather information from a sampled sub group of population and acquire a holistic picture of a larger population.

User surveys can highlight elements which haven't been taken adequately into account. An intercept survey approach was used to capture pedestrians, question, and ask them about their travel patterns, their mode of choice and perception of their transfers to other modes. The survey included several questions about intermodal and unimodal travel behavior and assessment criteria for the transfer path. The respondents were asked whether they combined different means of transport on one trip. The users were also asked to rate their satisfaction of the different aspects of their transfer.

3.7.2 Origin destination matrix

The study will require the collection of quantifiable primary data. The primary technique that will be used is origin-destination matrix, which is crucial in Understanding passenger origin-destination (OD) flows and a tool to improve the planning and operation of transit systems and enhancing passenger satisfaction. The intercept survey will include a tracking question of the users origin and destination along with the modes of transport used for the trip.

3.8 Data presentation

The data analysis and result is presented using graphs, charts, tables, figures and map. This assisted in simplifying and clearly showing the results of the data collection and analysis.

3.9 Data analysis

Quantitative data is numerical and will be collected in a number of forms. Statistical analysis is used to summarize and describe quantitative data and graphs or tables are used to visualize present raw data.

3.9.1 Intercept survey analysis

The intercept survey is used to interact and ask the public transport users on route to make a transfer about their transport mode of choice, perception of their transfer path and the whole transfer experience.

3.9.2 Pedestrian trip analysis

Walk distances and Walk times is analyzed by conducting analysis on the path of transfer from drop off station to egress station. This helps to know which stations posed the longest and shortest travel distance and time to the public transport users.

3.9.3 Presentation techniques

The data analysis and result is presented using graphs, charts, tables, figures and map. This assisted in simplifying and clearly showing the results of the data collection and analysis.

3.9.4 Ordinal regression

Ordinal regression is a form of regression method used to predict an ordinal dependent variable given one or more independent variables (Lared Statistics, 2020). Ordinal regression is a method used by the study to identify the major variables that can affect the perception of users towards their transfer experience. This regression can help identify which parameters of the transfer are more crucial in affecting users perceptions of the transfer.

3.10 Variables

Independent variables are those that (probably) cause, influence, or affect outcomes. They are also called treatment, manipulated, antecedent, or predictor variables. The independent variables of the study are composed of the demographic, trip and modal character of the respondents.

Dependent variables are those that depend on the independent variables; they are the outcomes or results of the influence of the independent variables. The dependents variables are the physical integration of the public transport stations and the satisfaction of public transport users towards their transfer experience.

The survey was based on 15 survey questionnaires, which consist of 27 variables. The variables consisted of the demographic character of the respondents (gender, age), the occupation of the respondents, the trip purpose, the trip rate, trip time of the respondents. The variables also include the origin and destination route of the respondents. Furthermore, the transport mode used to enter the site and egress the site is included in the variables. The number of transfers throughout the day a respondent makes is also included in the transfer. Finally, the 14 parameters of a transfer are included in the variables with a five-scale Likert measurement of the satisfaction of respondents towards the parameters. The measurements ranged from very satisfied to very dissatisfied. This form of measurement was introduced to analyze the perception of the public transport users towards the transfer experience.

The questionnaires are self-administered close-ended questions with only one open-ended question. The open-ended question was included for the respondents to recommend different viewpoints on how to improve their transfer experience.

Based on the above statements the variables that the research will focus on are listed below.

Table 3. 1 Variables of the study

No	Name of variables	Type of Variable	Analysis of the variables	Analysis method
1	Distance between urban transport stations	Independent variable	Origin Destination matrix	Cross tabulation and ordinal regression
2	Age	Independent variable	Descriptive statistics	
3	Gender	Independent variable	Descriptive statistics	
4	Occupation	Independent variable	Descriptive statistics	
5	Trip reason	Independent variable	Descriptive statistics	
6	Trip rate	Independent variable	Descriptive statistics	
7	Entry mode of transport	Independent variable	Descriptive statistics	
8	Exit mode of transport	Independent variable	Descriptive statistics	
9	Origin route	Independent variable	Descriptive statistics	
10	Destination route	Independent variable	Descriptive statistics	
11	Transfer rate	Independent variable	Descriptive statistics	
12	Time of transfer	Independent variable	Descriptive statistics	
13	Physical Integration of public transport stations	Dependent variables	Descriptive statistics and inferential statistics	
14	Users perception of the transfer	Dependent variables	Descriptive statistics and inferential statistics	

(Source: organized by the author)

Indicators are a tool that enables monitoring and feedback. Indicators can alert and reveal the key areas where policies and measures need to be put in place to make improvements. Such a system can also highlight status, performance, progress and efficiency. In wider context indicators can be an important tool for building capacity since they might foster understanding of what factors facilitate or hinder good practice. The indicators used to measure the perception of the transfer amongst users was a Likert scale satisfaction survey of the different parameters of a transfer.

The parameters used to measure the satisfaction of users on the transfer are listed in the table below.

Table 3. 2 Physical integration Parameters of public transport transfer used to measure the satisfaction of users

No	Physical integration Parameters used to measure the satisfaction of users on the transfer	Analysis of the variables	Analysis method
1	Satisfaction of distance traveled to make a transfer	Ranked data by Likert scale of five points which is from very satisfied to very dissatisfied	Cross tabulation and ordinal regression
2	Satisfaction of the continuity of path traveled to make the transfer		
3	Satisfaction of the convenience of path traveled to make the transfer		
4	Satisfaction of the attractiveness of path traveled to make a transfer		
5	Satisfaction of the slope of the track traveled to make a transfer		
6	Satisfaction of the straightness of route traveled to make the transfer		
7	Satisfaction of the time taken to walk from drop off station to exit station		
8	Satisfaction of the number of streets crossed to make a transfer.		
9	Satisfaction of the conditions of sidewalk while making the transfer		
10	Satisfaction of safety and security while waking the transfer path		
11	The perception of easy transfer		
12	The satisfaction of provision of necessary requirements to make the transfer		
13	The satisfaction of making the transfer during any weather conditions		
14	The satisfaction of making the transfer during any time of the day		

(Source: organized by the author)

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Results

4.1.1 The socio-economic description and modal usage and trip characteristics of respondents

An entire of 700 questionnaires were distributed to public transport users around Mexico roundabout to gather information about the Physical Integration of Public Transport Stations and Its Effect on them. Out of the 700 questionnaires distributed, 668 usable responses were obtained with a response rate of 95.42%.

The data extracted from the above questionnaires was coded for entry and entered in to statistical package for social science (SPSS) and analyzed by using descriptive and inferential statistics.

4.1.1.1 socio-economic description of respondents

4.1.1.1.1 Gender and Age of respondents

It is observed that out of the 668 usable respondents, which filled out the intercept survey, 58.2% of the respondents are male and 41.8 % of the respondents are female.

Table 4.1 Gender and Age of respondents

Gender of Respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	389	58.2	58.2	58.2
	female	279	41.8	41.8	100.0
	Total	668	100.0	100.0	
Age of Respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 15 years	2	.3	.3	.3
	15-20	64	9.6	9.6	9.9
	21-30	359	53.7	53.7	63.6
	31-40	146	21.9	21.9	85.5
	41-50	60	9.0	9.0	94.5
	51-60	29	4.3	4.3	98.8
	61-70	7	1.0	1.0	99.9
	above 70	1	.1	.1	100.0
	Total	668	100.0	100.0	

(Source: organized by the author)

The age category of respondents shows that more than 80% of the respondents are under the age of forty and above the age of 20 which shows that majority of the respondents that favor the area are young, with 53.7% falling in the age range of 21-30 and 21.9% in the age range of 31-40. Even though it is lower in number people in the age range of 41-50 consist of 4.3 of the population followed by people above sixty years of age with only 1% of the respondents being categorized in this age range.

4.1.1.1.2 Occupation of respondents

From table 4.7 it is observed that 15.9% of the respondents are students. However, the majority of the respondents are full time employed consisting of 68.9% of the respondents and 7.3 % falling under part time employed and only 4% unemployed with house maker and retired following with 2.4 % and 1.3 % respectively. The table 4.7 shows that the majority of the respondents that use public transport stations around Mexico roundabout are fulltime-employed people, which means they make the transfer at a fixed schedule and at a fixed rate making the transfer to another mode is done as efficiently and as fast as possible for them.

Table 4.2 Occupation of respondents

Occupation of respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student	106	15.9	15.9	15.9
	Full time employed	460	68.9	68.9	84.7
	Part time employment	49	7.3	7.3	92.1
	Unemployed	27	4.0	4.0	96.1
	House Maker	16	2.4	2.4	98.5
	Retired	9	1.3	1.3	99.9
	Other	1	.1	.1	100.0
	Total	668	100.0	100.0	

(Source: organized by the author)

4.1.1.2 Modal share of transport used by respondents

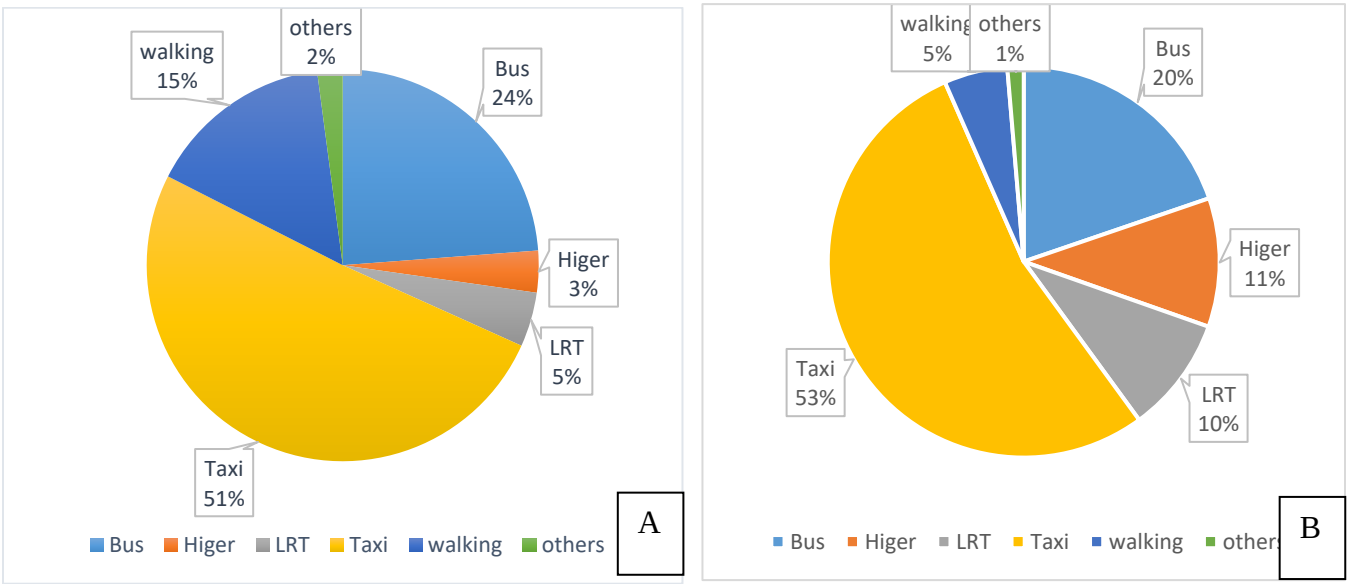

Figure 4. 1 Graph showing modal share of transport used by respondents to enter (A) and egress (B) the Mexico area

(Source: organized by the author)

it can be observed that 51% of the public transport users that come to the area use minibus taxis. The second preferred transport mode amongst the respondents is the city bus, which consist of 24% of public transport used. Walking is also another major mode of choice, which consist of 15% of modal share. From the respondents response it has been understood that only 5% of the public transport users used the LRT to enter the area. The Higer bus has only 3% of the respondents use this public transport service.

4.1.1.2.1 Entry mode of transport with Exit mode of Transport

The data reveals that 72.6% of respondents who entered the site with Minibus taxi have used the same mode of transportation to exit the site, While 6.8% used LRT, 7.4% used Higer bus, 9.1% used Bus and 2.9 % used walking to exit the site. 47.2% of the Respondents, which used Bus to enter the site, used the same mode of transportation to exit the site, while 28.9% used Mini bus taxis, 12.6 % used Higer bus, 10.1% used LRT and 1.3% used walking to exit the site. Looking at the data of the respondents, which used Higer bus, to enter the site, 43.5% of them used the same mode of transportation to leave the site while 30.4% used Minibus taxi, 21.7% used Bus and 4.3% used LRT to exit the site. In addition observing the data of respondents which use LRT to enter the site 50% used the same mode of transportation to exit the site, in addition 26.7% used taxi, 10%

used walking, 6.7% used the Bus transport, 3.3 % used the other forms and 3% used Higer bus. Similarly, 16.5 % of the respondents who walked in the site used the same mode to leave the site, in addition, 40.8% used minibus taxi, 14.6% used Higer Bus 18.4% used Bus and 8.7% used LRT to exit the site. Lastly, respondents who used other form of transportation, 57.1% used taxi, 14.3% used walking and 28.6% used other forms of transportation.

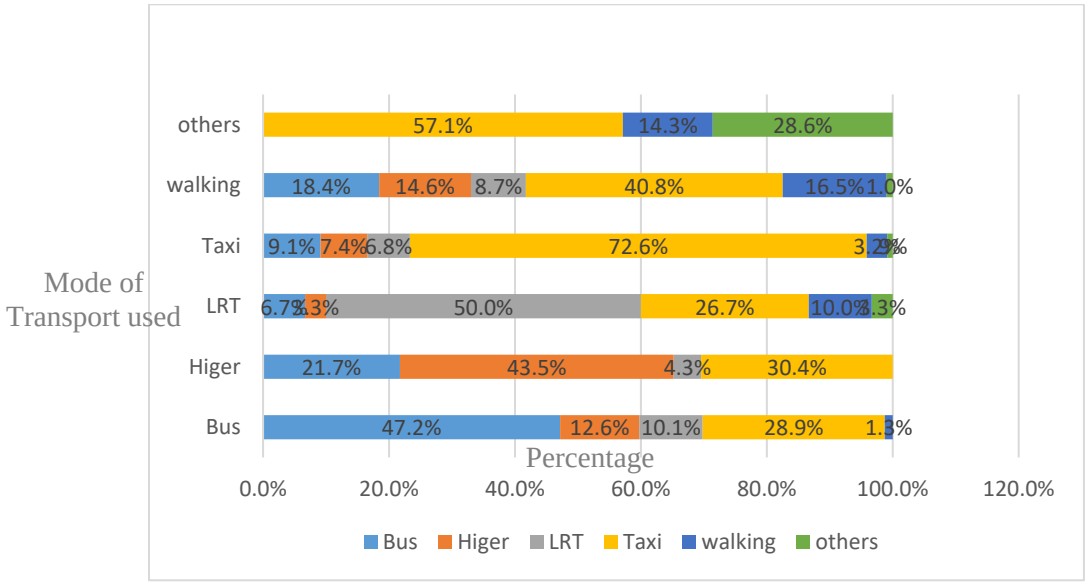

Figure 4. 2 Graph showing the respondent's Entry mode of transport with Exit mode of transportation

(Source: organized by the author)

4.1.1.1.3.2 Age of respondents with Entry Mode of transport use

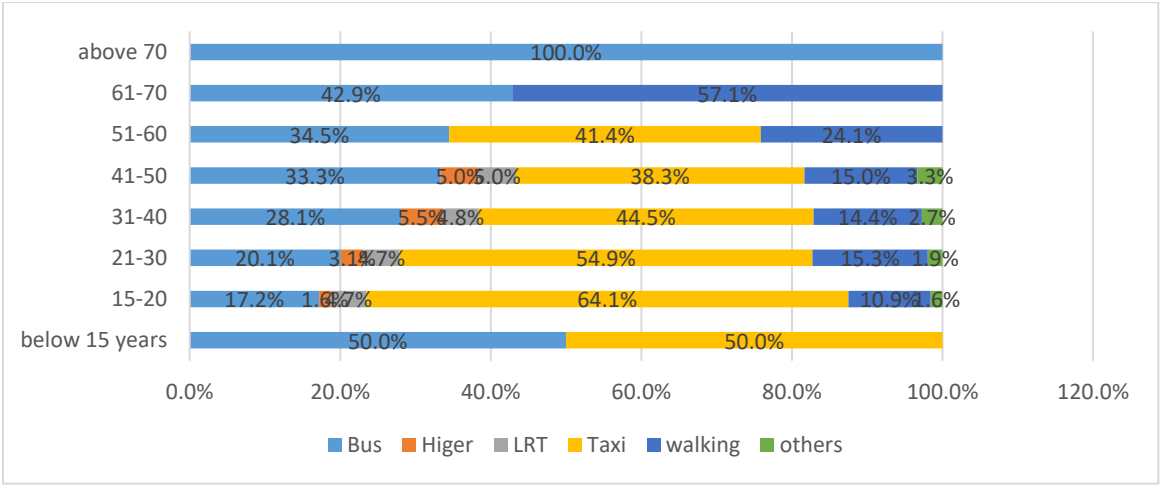

Figure 4. 3 Graph showing Age of respondents with Entry Mode of transport use in percentage

(Source: organized by the author)

The entry mode of transportation crossed with Age group can be observed. It is observed that 64.1% of 15-20 age groups use Minibus taxi followed by 17.2% for Bus and 10.9% walking as a form of transport to entry the study site. In addition, 54.9% of 21-30 age group use minibus taxis to gain entry to the site followed by Bus with 20.1% and walking taking a 15.3% share of transport mode used by the age group. More over the 31-40 age group modal choice to enter the site is majorly by minibus taxis (44.5%) with slight increase seen in Bus usage with 28.1% and walking taking similar shares of 14.4%. Similarly the 41-50 age group the minibus taxi usage is 38.3% , followed by bus usage at 33.3% and walking at 15% with other transport services being less than 5% each. Likewise, the 61-70 age group is dominated with bus usage with 42.9 % and a huge increment in walking with 57.1%.

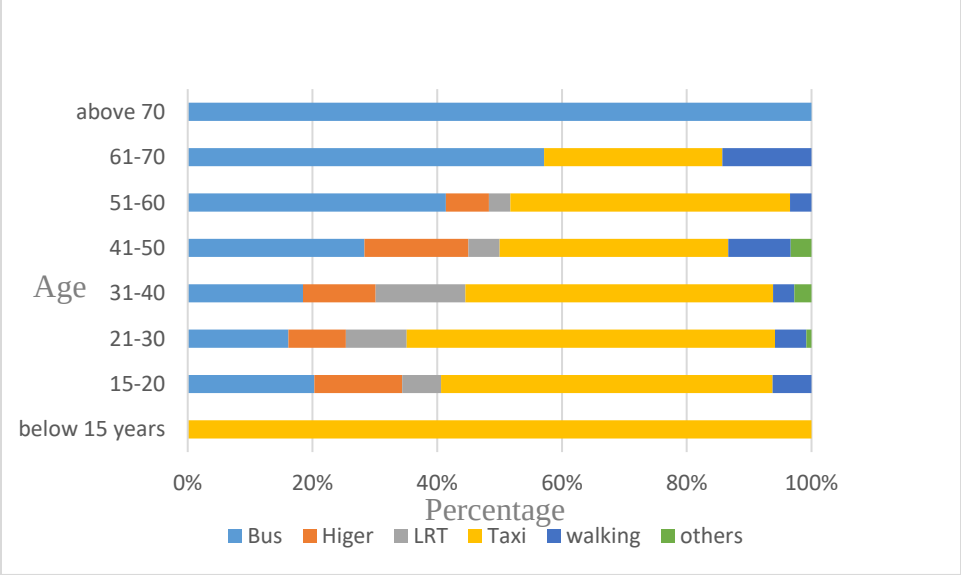

Figure 4. 4 Graph showing the respondent's age with exit mode of transportation

(Source: organized by the author)

On the other hand when the data of mode used for entry and exit from the area is 41-50 years of age use cross with age it is clear to observe that the majority of the youth respondents in 15-20 years of age being 53.1% and 21-30 being 59.1% using minibus taxis as a mode of transportation. While the percentage shows decrease in the older age groups it is still a significant share of transport mode used. Hence, 41-50 year age groups 36.7%, 51-60 age group 44.8% and 61-70 age group being 28.6 % for using minibus taxis as a mode of transportation to exit the site. Bus takes 20% of transport mode used in 15-20 Age group, 16% in 21-30 Age group, 18.5% in 31-40 age groups, 28.3% in 41-

50 Age group, 41.4% In 51-60 Age group and 51.7% in 61-70 age group and a significant dominance in above 70 age group.

4.1.1.3 Trip characteristics of the respondents

4.1.1.3.1 Trip purpose of the respondents

The trip purpose of the respondents was included in the survey to understand the specific reason behind the present trip they were making. From the data we are able to observe that , 60% of the respondents were making a trip which is intended for work. As there are numerous number of reasons people make trips the most redundant and the most repeated form of trip purpose is the work commute and it is mostly consisted of people who make the same trip at least twice a day every day except weekends. It is the most dominant and significant trip that people make in the same location and route daily.

Table 4.3 Trip purpose of the respondents

Trip purpose					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	For Work	401	60.0	60.0	60.0
	For education	63	9.4	9.4	69.5
	For leisure	20	3.0	3.0	72.5
	Visiting Family	44	6.6	6.6	79.0
	others	140	21.0	21.0	100.0
	Total	668	100.0	100.0	

(Source: organized by the author)

The above table shows that 60 percent of the respondents were making the work trip followed by the education trip purpose, which is consisting of 9.4 percent of the respondents. The educational trip purpose has the same characteristics as the work trip however; it is more flexible than the work trip in terms of specific time and day.

The other form of trip purposes included in the survey are trips made for the purpose of leisure and for the purpose of visiting family. Which are 3% and 6.6% respectively of the respondents answer on the reason they are making the trip. From the above data, it is clear to see that most of the trips made by the respondents consists of work trips and educational trips, which are characterized by day to day twice a day round trips.

4.1.1.3.2 Trip repetition of the respondents

In order to understand how often the passengers make the trip a question was included to the survey. it has been observed that from the sampled respondents 50% of the respondents make the trip on a daily basis and 15% of the respondents make the trip very often. In addition to the above respondents 34% of the respondents claim they make the ascertained trip sometimes while only 1% responded that they rarely make the trip.

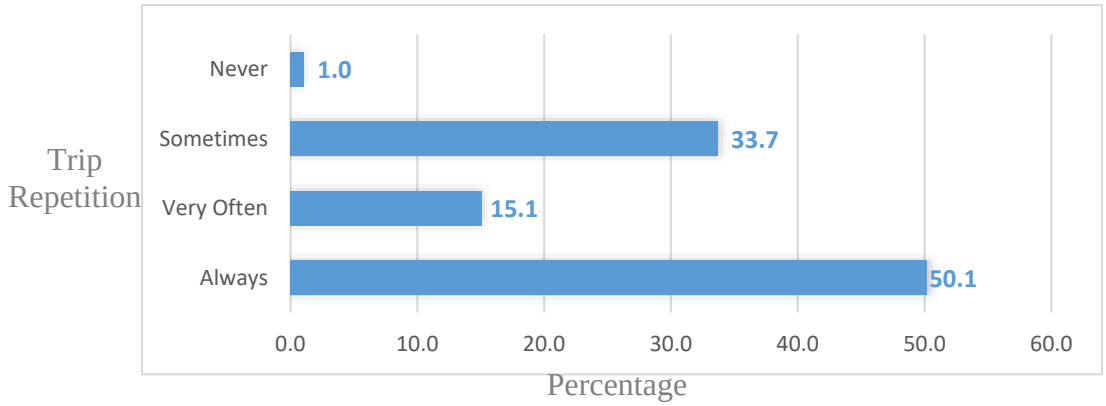

Figure 4. 5 Graph showing the trip repetition of the respondents

(Source: organized by the author)

4.1.1.3.3 Transfer Rate per day of the respondents

As the study focuses on public transport transfers it was important to identify how many times a day a transfer was required to complete their trip. A question was incorporated to find out with 1-2, 3-5 , 6-8 or 8-10 transfers a day. The data reveals that from the sampled respondents 51% of them make 3-5 transfers per day. While 42% of respondents answered that, they make 1-2 transfers a day. In addition to the above respondents 4.3 % of the sampled respondents make 6-8 transfers and 1.9 % make 9-10 per day.

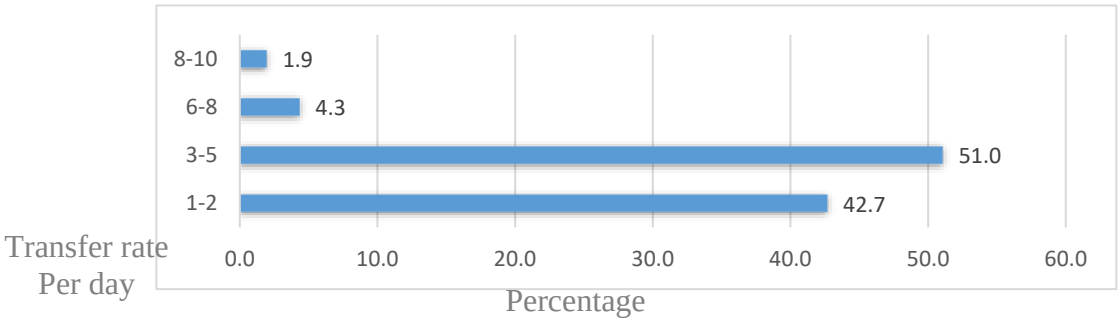

Figure 4. 6 Graph showing the transfer rate per day of the respondents

(Source: organized by the author)

4.1.1.3.4 Transfer time of the respondents

The respondents were asked two time windows where they pass through or make a transfer through the study area 72% of the respondents picked 6:00-9:00 am as first time they make their transfer 10.8% make their transfers during 09:00-12:00, 14.8% make their transfers during 12:00-02:00 pm. The second transfer time the respondents gave 10.3% is during 02:00-04:00 pm, 60.5% is during 04:00-7:00 pm and 20.8% is during 7:00-9:00 pm.

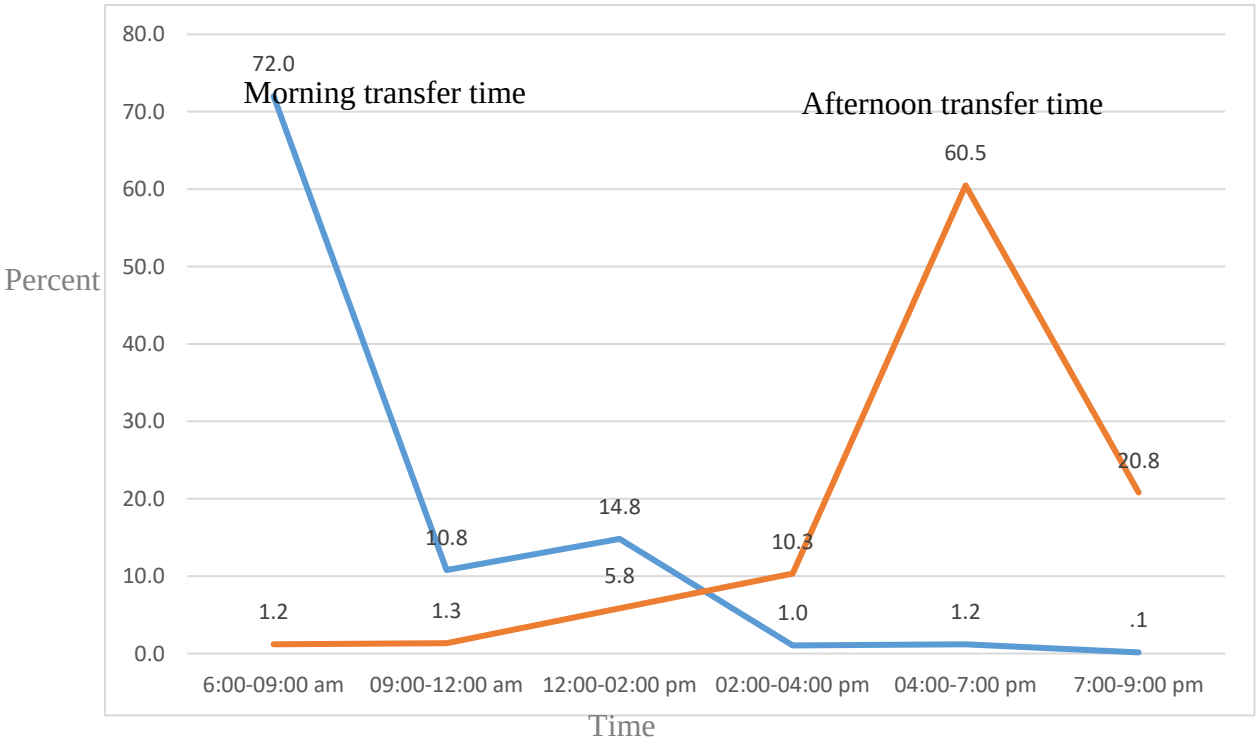

Figure 4. 7 Graph showing the transfer time of the respondents

(Source: organized by the author)

4.1.1.3.5 Origin route of respondents

The data reveals that most of the respondents come from Sarbet, Mekanisa , Jemo Garment area (26.2 %) followed by respondents from the torhayloch ayer tena and kara area (21.1 %). In addition to the above similar number of respondents (16.8 and 16.6% respectively) coming from the Kera , Mebrat hayl Cherkos and Megenagna 22 stadium area route. Other routes are not consisting of more than six percent.

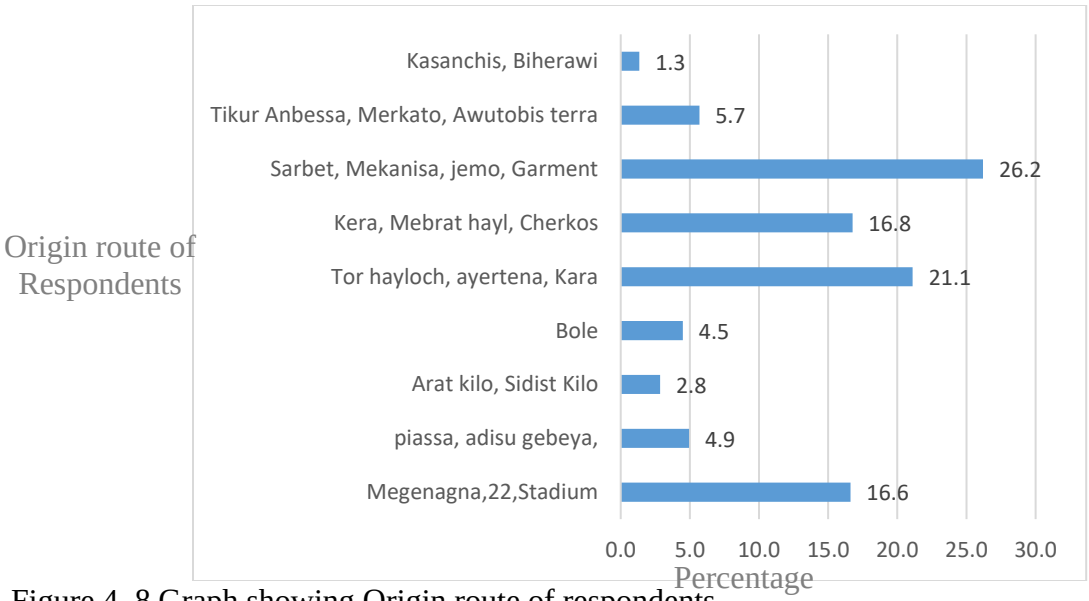

Figure 4. 8 Graph showing Origin route of respondents

(Source: organized by the author)

The origin route data with the transport mode used data shows that respondents from the Kasanchis Biherawi area 77.8% of them use Minibus Taxis while the rest rely of the city bus to enter the study area. Following on the data of the Tikur Anbessa, Merkato, Awutobis terra respondents the data reveals that 44.7% of the respondent use Minibus taxis while 18.4% use the Bus ,5.4% use the Higer Bus, 2.3% use the LRT and 23% of the respondents use walking to enter the site from the area. However, slight increment is seen in Bus usage on respondents coming from the Sarbet Mekanisa, Jemo Garment area with 33.7% of the respondents using this transport mode, 52% still rely on Minibus taxis, 2.9% rely on Higer Bus and 6.3% on walking. Similarly 42.9% of respondents from Kera Mebrat hayl area dominantly use minibus taxis with, 16.1% use Bus and 37.5% use walking to enter the study area.

In addition the respondents from Tor hayloch, Ayer Tena ,Kara have parallel characteristics with 56.7% using Minibus taxis ,16.1% use Bus , and 12.8% use walking. Furthermore, the respondents from the Bole area dominantly use Minibus taxi with a 73.3% of respondents entering the site with this transport mode followed by 6% in Bus and 6.7% in walking other modes have very small shares. Moreover, respondents which originated from the Arat kilo, Sidist kilo use 42.1% minibus taxi followed by Bus with 42.1% and 5.3% Higer Bus. It can also be further seen that the respondents coming from Piassa , Adisu gebeya use significantly use Minibus Taxis at 48.5%, Bus at 33.3% and the LRT at 5.8%. Finally the data also reveals that the respondents originating from

“Megenagna” “22” “Stadium” have similar characteristics with 45% using Minibus taxis followed by Bus with 20.7% and LRT with 17.4% using to enter the study area.

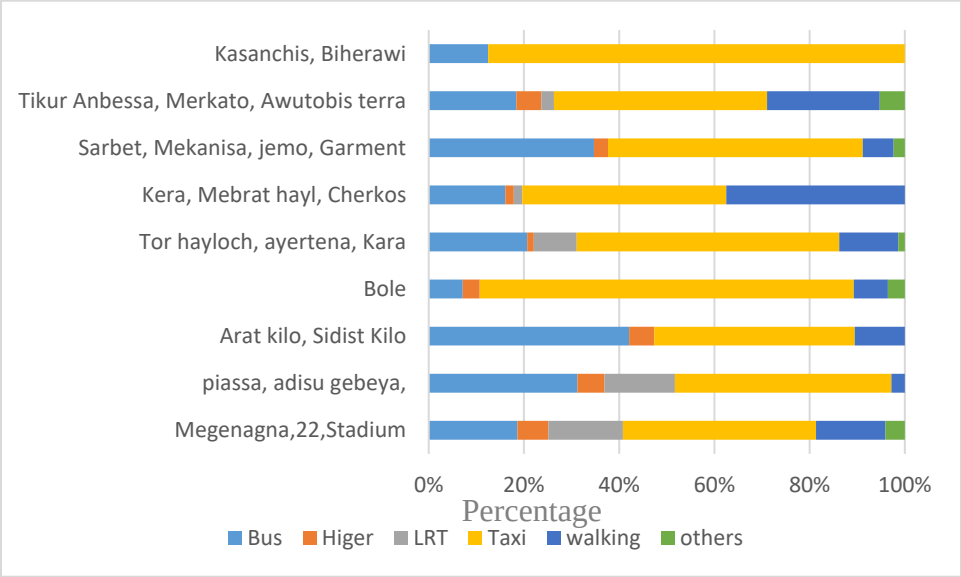

Figure 4. 9 Graph showing origin route of respondents with mode of transportation used (Source: organized by the author)

4.1.1.3.5 Destination route of respondents

The destination route response from the sampled public transport user shows that the megenagna 22 stadium route is the major route for destinations of the respondents consisting of 22.2%. The following most favored route is the sarbet mekanisa jemo garment route with 18.3% of sampled respondents making their trip to that area. Similarly Tor hayloch, Ayer Tena , Kara consists of 14.2% of the respondents destinations. In addition the other routes also have a role to play as they significant shares as 9.9 % each for the Kera Mebrat hayl and Piassa Addisu Gebeya route. With other routes having minor shares like the kasanchis route and aratkilo route with 3.4% and 5.7 % respectively.

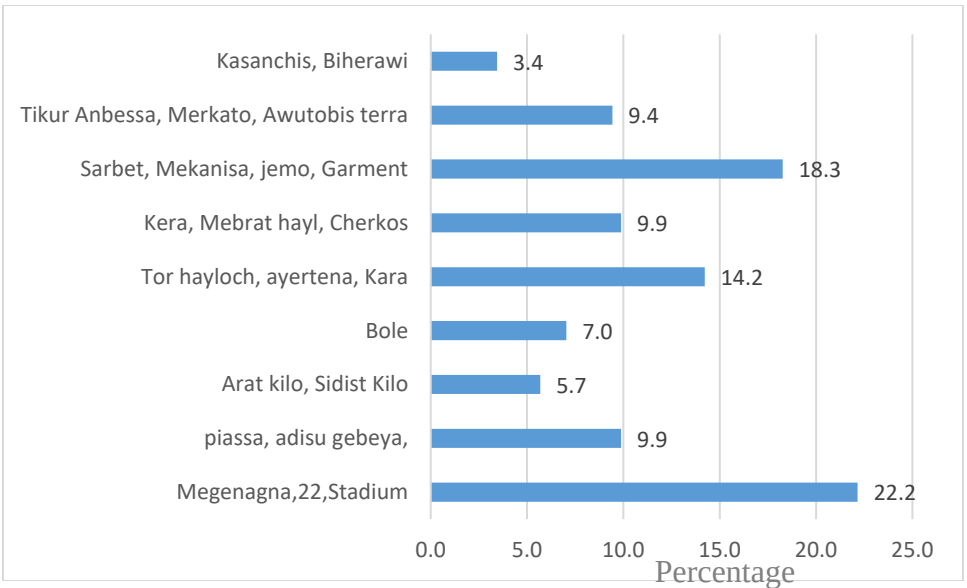

Figure 4. 10 Graph showing Destination route of respondents

(Source: organized by the author)

On the other hand observing the data cross tabulation of destination of the respondents and transport mode used to leave to their destination, it is seen that respondents heading to Kasanchis Biherawi area 91.3% used Minibus taxis, while others preferred walking. 58.7% of Respondents heading to Tikur Anbessa, Merkato, and Autobis Tera area used Taxi, 17.5% used LRT,17.5% used Bus and 1.6% used Higer ,1.6% used walking and 3.2% used other for of transportation to exit the site. In addition respondents heading to Sarbet, Mekanisa Jemo Area replied as 51.6% used Bus, 4.1% Higer Bus, 32.8% used Minibus taxi, 4.9% used walking to exit from the site.

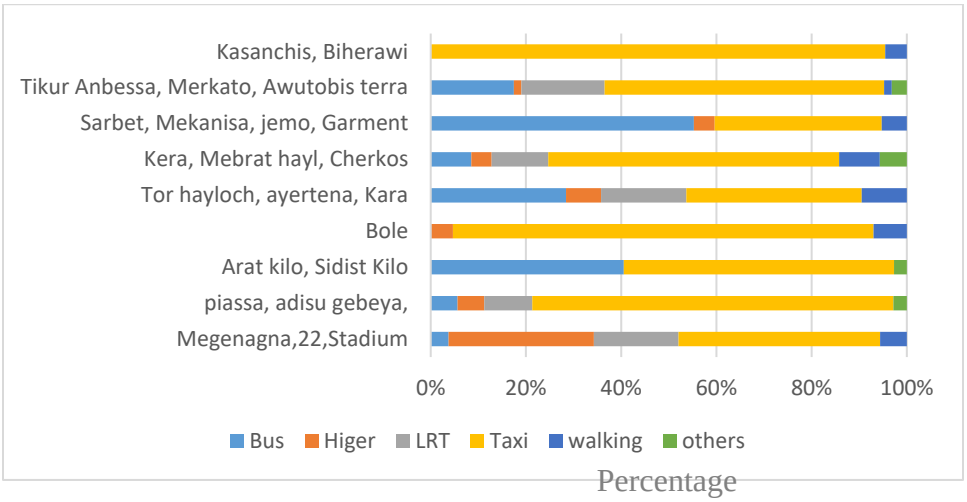

Figure 4. 11 Graph showing destination route of respondents with exit mode of transportation

(Source: organized by the author)

The assessment of origin and destination routes of the respondents helps analyze which paths are mostly walked for transfer and which routes lack connection. Hence, the figure 4.10 below shows from which routes the respondent access the study area and to which routes the respondents egress. The data reveals that the majority of the respondents that came from Megenagna area egress to Sarbet Mekanisa area and Torhayloch. While similarly the respondents from Sarbet Mekanisa area majorly egress to Megenagna (30%) and Torhayloch area (21%) . This interpretation does not include the people that work in the Mexico area and head back the same route. The respondents coming from the Torhayloch area also egress majorly to Megenagna area (26%) and Sarbet Mekanisa area (12%) followed by Bole route (10%) and Kera route (11%).

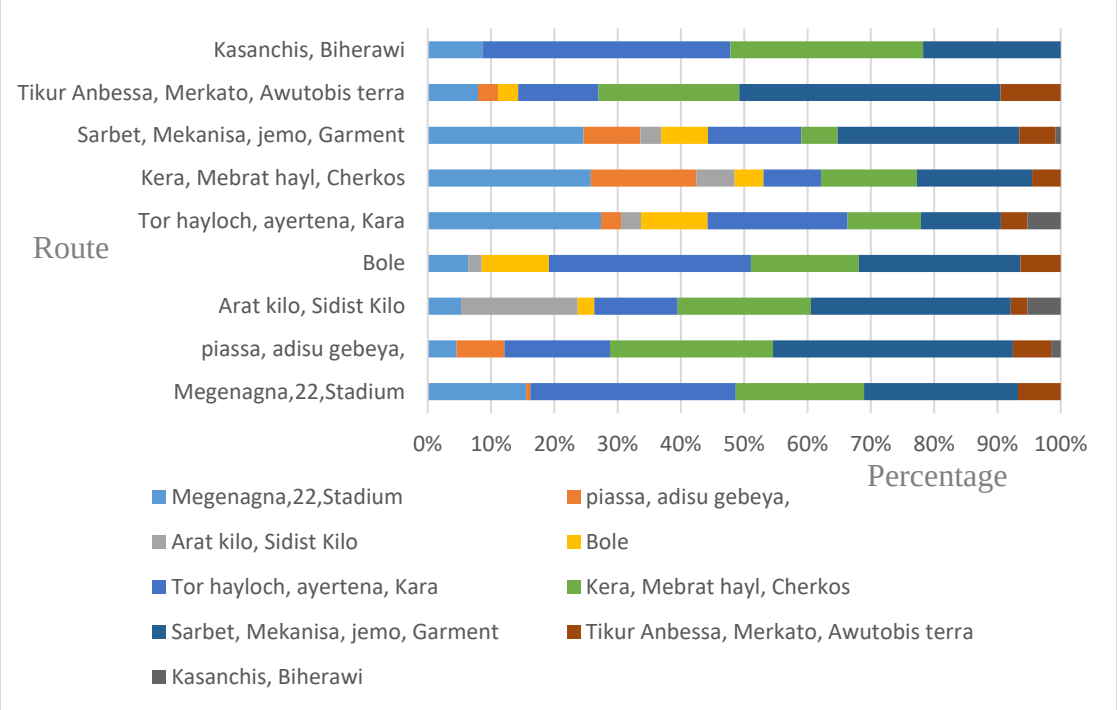

Figure 4. 12 Graph showing both the origin and destination routes of the respondents

(Source: organized by the author)

4.1.1.3.6 Distance traveled by respondents to make a transfer

The distance traveled by respondents was measured to understand how much distance the respondents had to travel to make the transfer. It was done by measuring the drop-off station of the respondent to the station the respondent traveled to catch the next transport mode. The figure 4.11 reveals that more than 30% of respondents had to walk 400-500 meters to make a transfer to another. It also shows that 6.9% had to walk 350-399 meters to make a transfer. Similarly 9.3% walked 300-

349 meters, 7.9% walked 250-299 meters,6% walked 200-249 meters, 10.9% walked 150-199 meters, 10.2% walked 50-99 meters and finally 18.7% walked 0-49 meters to make a transfer.

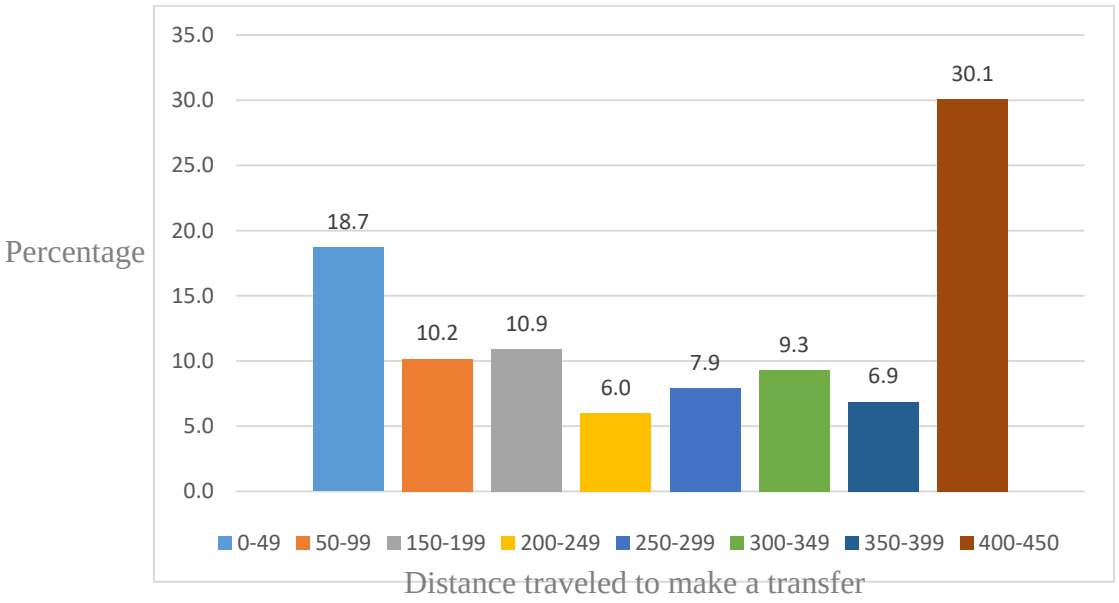

Figure 4. 13 Graph showing Distance traveled by respondents to make a transfer in meters (Source: organized by the author)

4.1.2 Effects of transfers on the public transport user by analyzing user satisfaction

A five point Likert scale measurement was introduced to measure the public transport users satisfaction in making the transfer required to make their next commute.

4.1.2.1 Distance traveled by respondents to make a transfer

Hence, of the indicators used distance traveled from the drop of public transport station to their next egress public transport station is one of them. The respondents were questioned how much they were satisfied by the distance they walked to make the transfer and 15% stated that they were very dissatisfied while 34.7 % claimed they were dissatisfied by the distance. In addition, 25.3% of the respondents answered neither while 15.9% claimed they were satisfied and 9.1 % of the sampled respondents were very satisfied with the distance they walked to make the transfer.

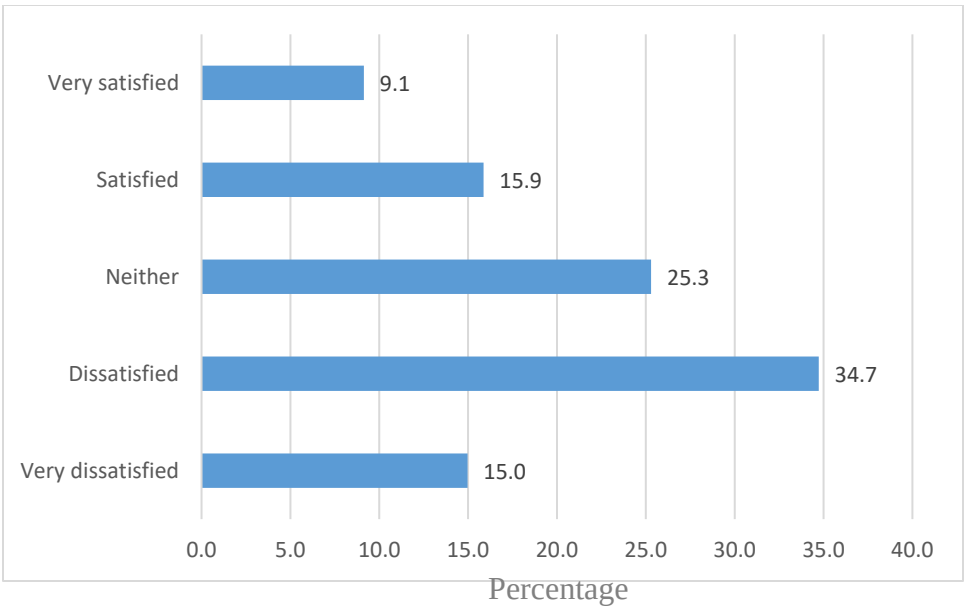

Figure 4. 14 Graph showing satisfaction of Distance traveled parameter of the respondents

(Source: organized by the author)

The satisfaction parameter for the distance traveled and the age group shows variation amongst different age groups, on average more than 35% of the age groups shows dissatisfaction towards the distance they had to travel to make the transfer. Age group above 70 show that they are very dissatisfied. For the age group 61-70 more than 14.3% are very dissatisfied while 57.1% are dissatisfied.

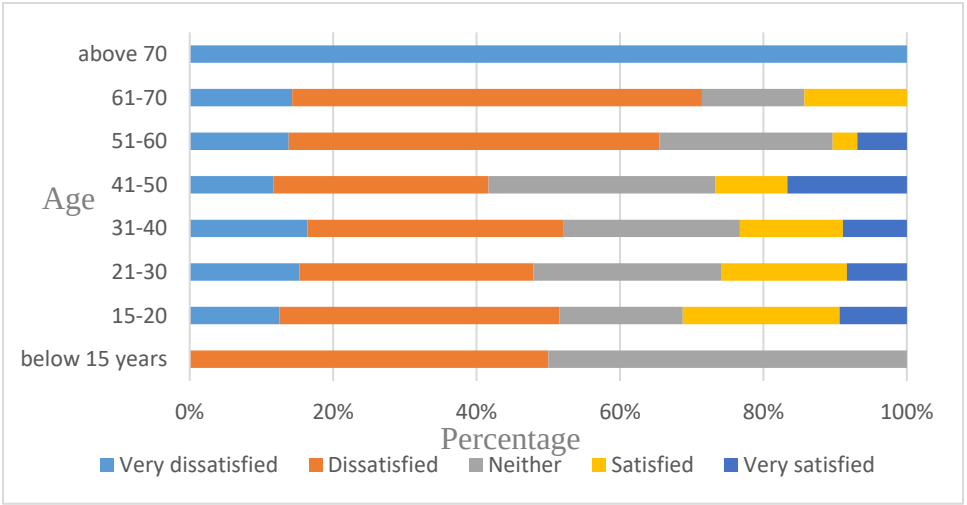

Figure 4. 15 Graph showing the satisfaction of distance traveled parameter with age group of the respondents

(Source: organized by the author)

However, the satisfaction level seems to show slight increment as the age group decreases, for the age group of 51-60 13.8% are very dissatisfied while 51.7% are very dissatisfied with the distance parameter of their transfer. In addition, people under the age group of 41-50 the data shows that 11.7% are very dissatisfied with the transfer while 30% are dissatisfied. Similarly ages 31-40 have similar characteristics with 16.4% being very dissatisfied with the distance they had to travel to make a transfer and 35.6% being dissatisfied. The age groups of 21-30 and 15-20 have parallel data's with more than 12% being very dissatisfied and more than 35% on average being dissatisfied with the distance they had to travel.

4.1.2.2 Satisfactions of the continuity of path by respondents in making the transfer

Continuity of path is one of the indicators that affect users perception or satisfaction of a path traveled during a transfer. The respondents were asked how satisfied they were with the continuity of the path they traveled. The majority of respondent answered neither (31%) while still 24% responding that they were dissatisfied and 8.5% very dissatisfied with the path's continuity. However, 26.2% of the sampled respondents are satisfied and 9.7% are very satisfied.

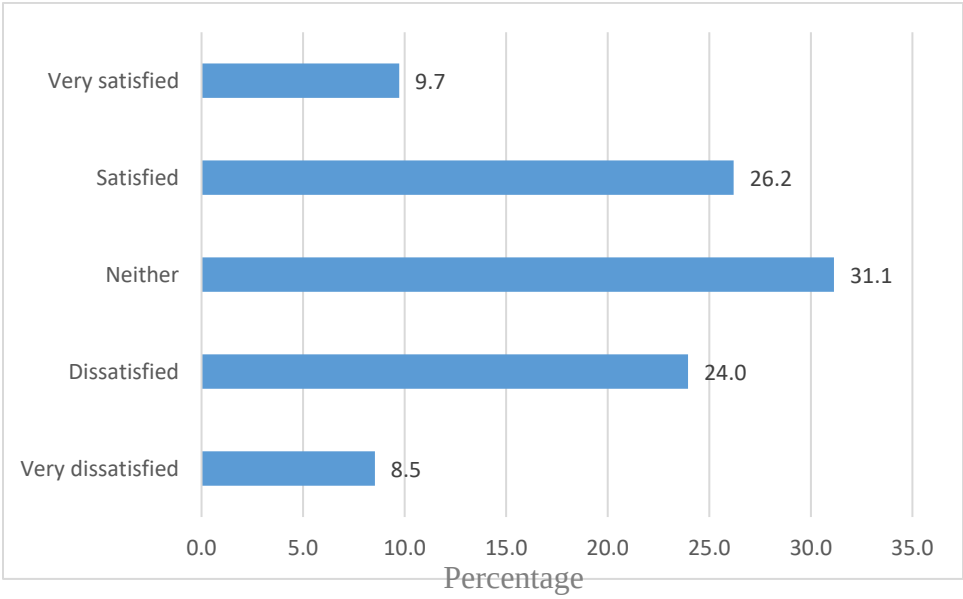

Figure 4. 16 Graph showing respondent's satisfactions of the continuity of path

(Source: organized by the author)

4.1.2.3 Convenience of path traveled by respondents to make the transfer

The respondents were asked to rate their satisfaction of the convenience of the path they traveled to make the transfer. 31.6% of the respondents answered neither while 27.4% of the respondent and

16.5% of the respondents answered dissatisfied and very dissatisfied respectively. In addition to the above respondents 18% claimed they were satisfied with convenience of the path and 6.4 % were very satisfied with the convenience of the path while making their transfers.

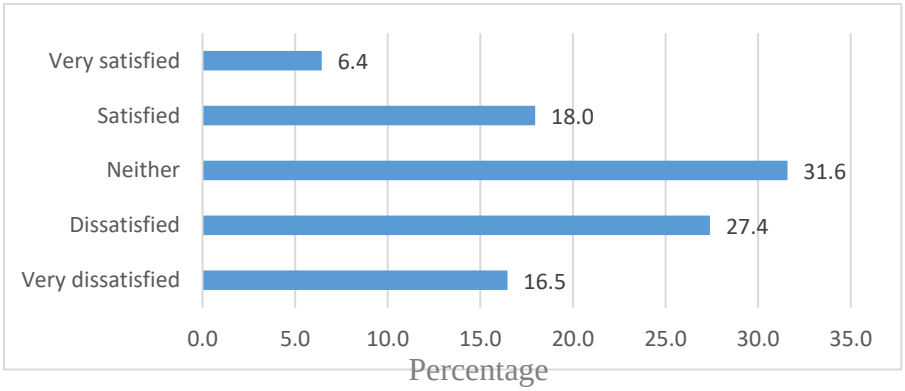

Figure 4.17 Graph showing convenience of path traveled by respondents to make a transfer

(Source: organized by the author)

4.1.2.4 Attractiveness of the path traveled to make the transfer

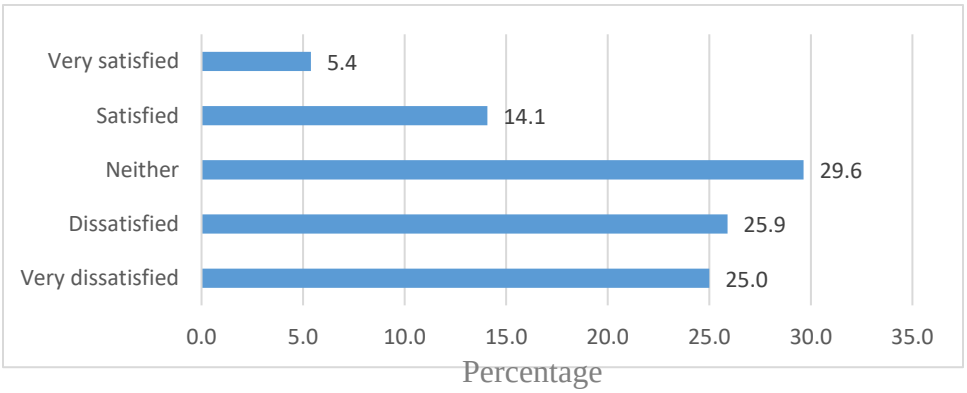

Figure 4. 18 Graph showing the respondent's satisfaction of attractiveness of path traveled to make a transfer

(Source: organized by the author)

From fig the data observed can show that 29.6% of the respondents have reacted "Neither" for their satisfaction level of the attractiveness of the path they traveled to make a transfer, while 25.9% answered "Dissatisfied" and 25% replied that they are "Very dissatisfied" with the attractiveness parameter of the path traveled to make a transfer.

4.1.2.5 Slope of the path traveled to make the transfer

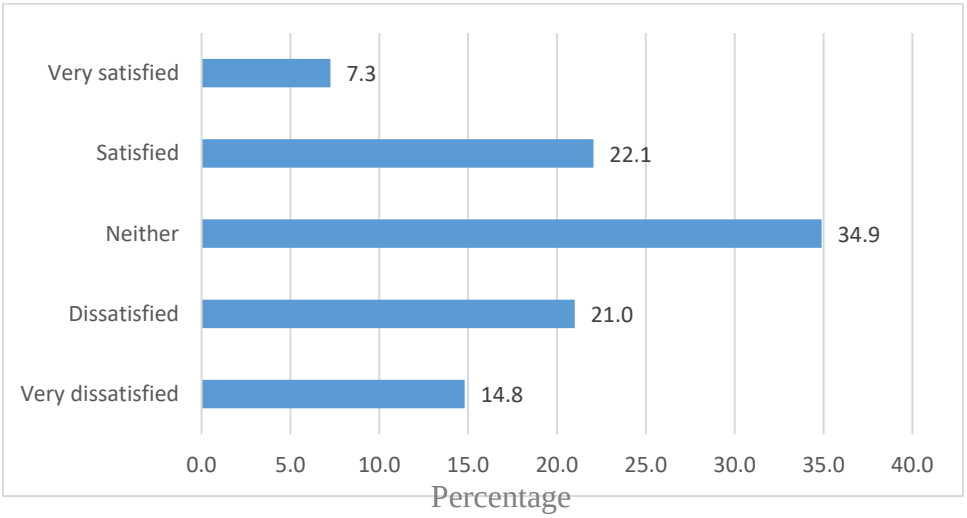

Figure 4. 19 Graph showing the respondent's satisfaction of slope of the path traveled to make the transfer

(Source: organized by the author)

The slope of the path traveled to make a transfer is one of the parameters that affect the perception of the public transport user while making a transfer. A five point Likert scale question was included in the survey. The data reveals that 14.8% of the respondents are "Very dissatisfied" with the slope they had to travel to make a transfer while 21% are dissatisfied. However, 34.9% of the respondents reacted "Neither", 22.1% are satisfied and finally 7.3% are very satisfied with the slope of the path they traveled to make a transfer.

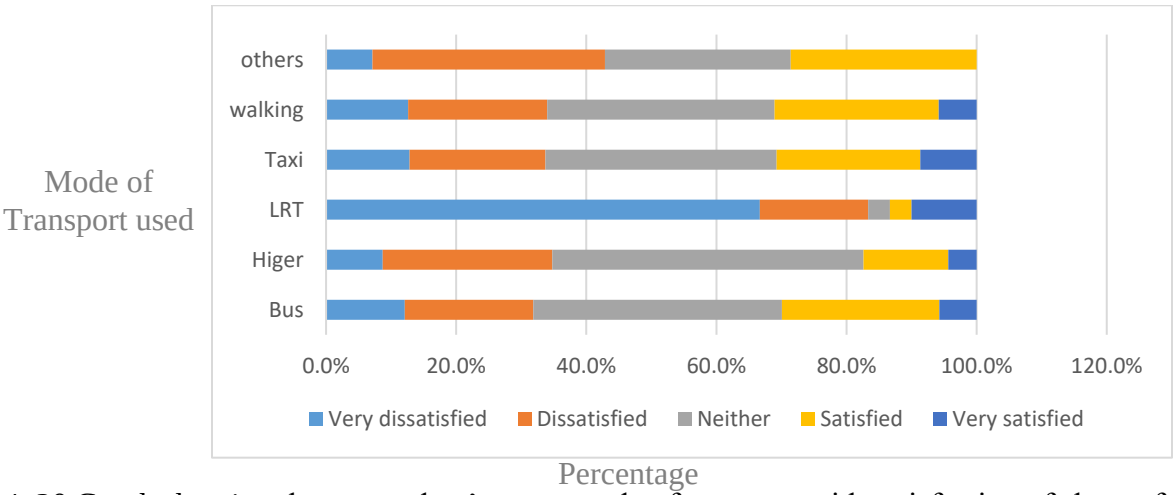

Figure 4. 20 Graph showing the respondent's entry mode of transport with satisfaction of slope of the path traveled

(Source: organized by the author)

On the other hand, observing the transport mode the respondents used to enter the study area and their response on the slope of the path they traveled the data shows that the LRT users increase in dissatisfaction almost 67% of the users are “Very dissatisfied” with the slope of the path they traveled and 16.7% are “Dissatisfied” with the slope. The other mode user responded with similar traits of an average of 10% being “Very dissatisfied” and more than 20% being “Dissatisfied”. However the users of Minibus taxis and Bus higher response in “Satisfied” with 22.1% and 24.2% respectively.

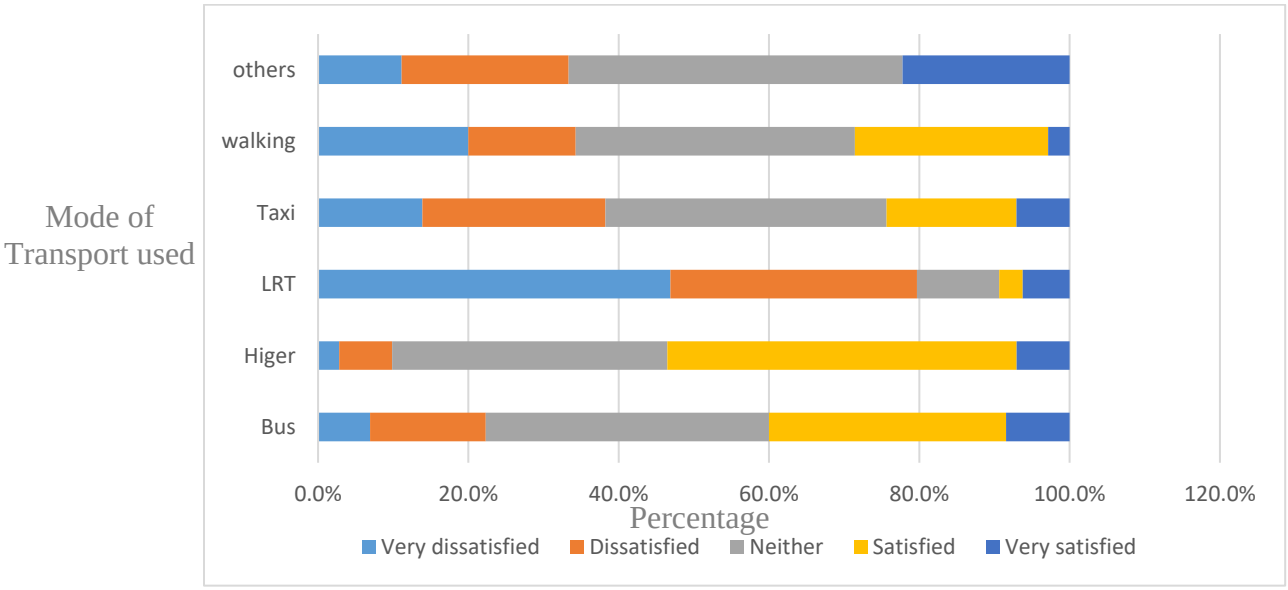

Figure 4. 21 Graph showing the respondent’s exit mode of transportation with satisfaction of the slope of the path traveled

(Source: organized by the author)

Resembling the entry mode of transport data the exit mode of transport data about the slope of the path reveals similar characters, with respondents Using LRT to exit the study area responding with 46.9% of “Very dissatisfied” and 32.8% of “Dissatisfied”. The data reveals that other modes have a higher satisfaction rate with Higer Bus users being 46.5% “Satisfied” and Bus users 31.5% Satisfied followed by Minibus taxi users 17.3% “Satisfied”.

4.1.2.6 Conditions of the sidewalk traveled to make the transfer

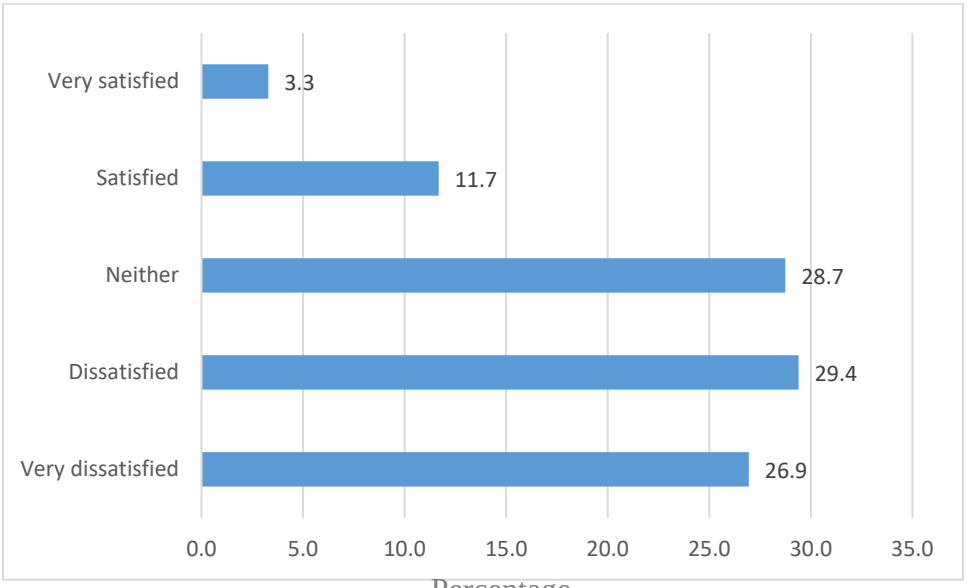

Figure 4. 22 Graph showing satisfaction of respondent's towards conditions of sidewalk

(Source: organized by the author)

The conditions of the sidewalk are one of the factors that affect the public transport user's perception while making the transfer, hence five point Likert scale was included in the survey. 26.9% of the respondents stated that they are "Very dissatisfied" while 29.4% responded "Dissatisfied" with the conditions of the sidewalk. Furthermore 28.7% replied "Neither" ,11.7% "Satisfied" and lastly 3.3% responded very satisfied with the conditions of the sidewalk.

4.1.2.7 Straightness of route path traveled to make the transfer

The path direction and simplicity is one of the factors that affect the public transport user's perception of making a transfer. Hence, the straightness of path was included as one of the parameters for the respondents to assess their transfer path. However only 5.7% of the respondents answered that they are "Very dissatisfied" and 25.4% rated the parameter "Dissatisfied". In addition 37% of the respondents assessed the parameter "Neither", 23.4% "Satisfied" and finally 8.5% "Very satisfied".

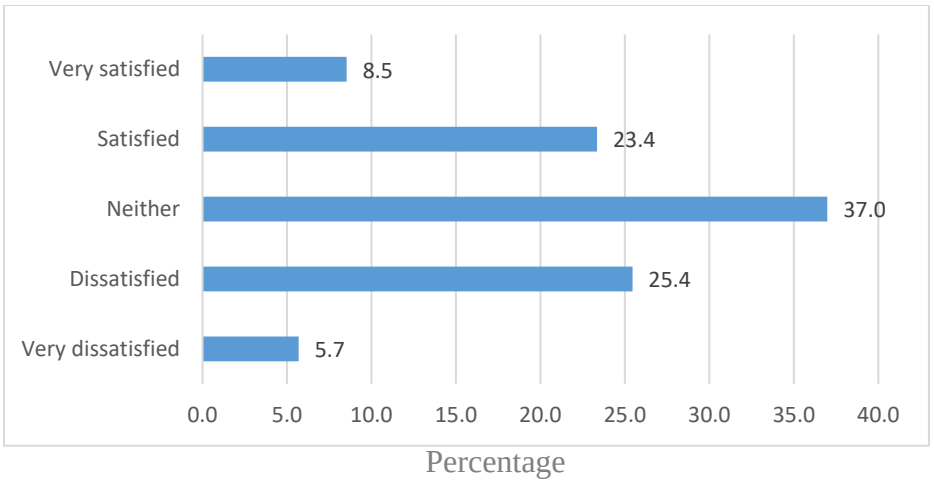

Figure 4. 23 Graph showing satisfaction of respondent's towards straightness of route traveled

(Source: organized by the author)

4.1.2.8 Time taken to travel from drop off station to egress station

The time taken parameter was included in the survey for the respondents to assess the time the path takes from drop off station to egress station. 12.3% of the respondents answered “Very dissatisfied” while 27.8% responded “Dissatisfied”. Nonetheless, 35% of the respondents are neither satisfied nor dissatisfied with the time taken to walk the path. In addition, 16% were “Satisfied” and 8.8% were “Very satisfied” about the time it took to make the transfer.

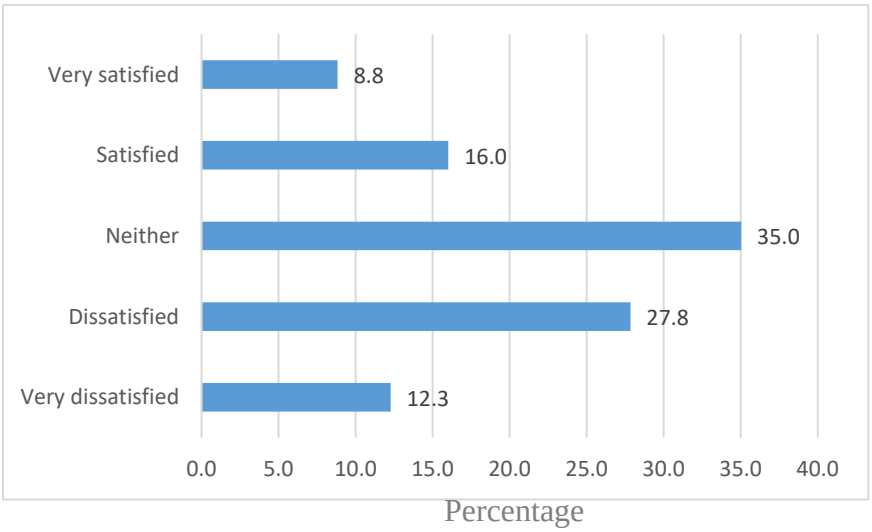

Figure 4. 24 Graph showing satisfaction of time taken to travel from drop off station to egress station

(Source: organized by the author)

Similarly, the transfer time of the day of the respondents and the time taken parameters measured by Likert scale can be observed. The data reveals that the respondents which make their transfer during the 09:00-12:00 am and 02:00-04:00 pm have minor increment (19.4% "Very dissatisfied" ,31.9% "Dissatisfied" and 24.6% "Very dissatisfied" and 29.% Dissatisfied respectively) in the dissatisfaction of the time parameter than the other respondents which make their transfers in other time window's. However, the 6:00-09:00 am transferring respondents responded 11.2% "Very dissatisfied", 27.2% "Dissatisfied". Furthermore, respondents transferring in period of 12:00-02:00 pm, 04:00-7:00pm and 07:00-09:00 pm have similar characteristics with an average of 10% of "Very dissatisfied" and 25% "Dissatisfied" respondents.

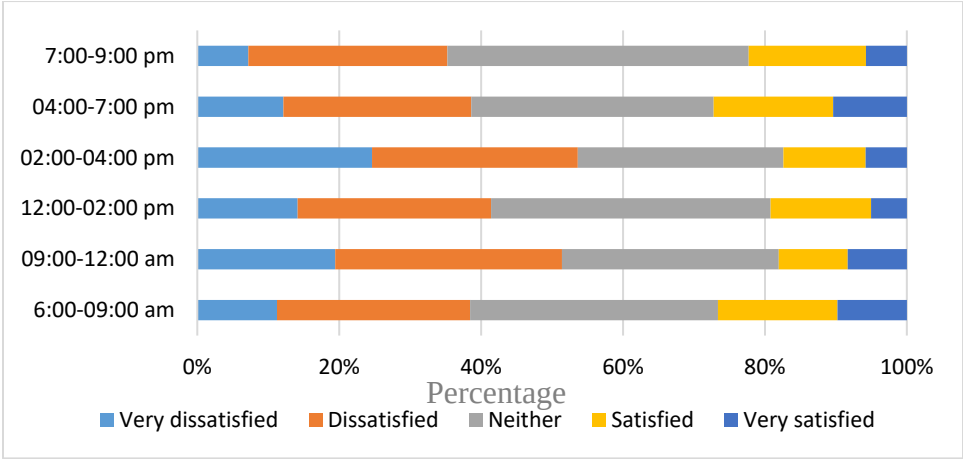

Figure 4. 25 Graph showing the transfer time of the respondents with satisfaction towards time taken to travel from access to egress stations

(Source: organized by the author)

4.1.2.9 The number of streets crossed to make the transfer

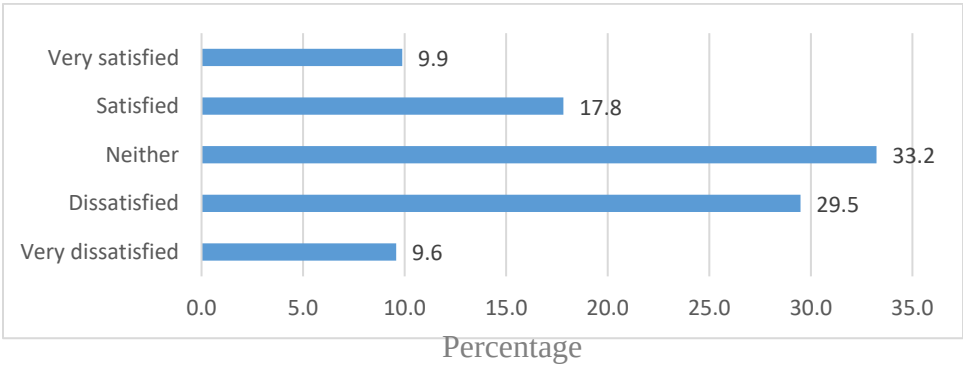

Figure 4. 26 Graph showing satisfaction towards number of streets crossed to make a transfer

(Source: organized by the author)

The number of streets a person has to cross to make a transfer is one of the parameters that affect the public transport user's perception of the path traveled to make the transfer. The data reveals that 9.6% of the respondents are "Very dissatisfied", 29.5% are "Dissatisfied", 33.2% are "Neither", 17.8% are "Satisfied" and 9.9% are "Very satisfied".

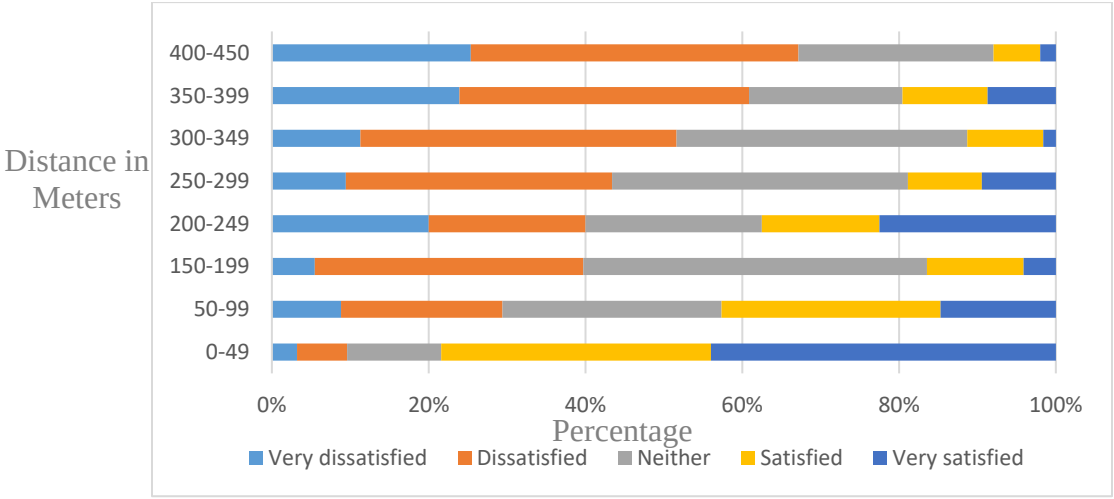

Figure 4. 27 Graph showing the distance traveled by respondent with satisfaction of number of streets crossed

(Source: organized by the author)

The distance traveled by the respondents and the number of streets the respondents cross to make their transfer has been cross tabulated and the it is clear to observe that the respondents who travel the longest have the higher dissatisfaction rate. Respondents that traveled 400-450 meters to make the transfer were 25.4% Very dissatisfied and 41.8% Dissatisfied with the number of streets they had to cross. Similarly, respondents that traveled 350-399 meters to make the transfer were 23.9% "Very dissatisfied" and 37% "Dissatisfied". The respondents who walked 300-349 meters and 250-299 meters have similar characteristics with an average of 10% Very dissatisfied and 37% dissatisfied. However, the respondents who walked 50-99 meters and 0-49 meters have a small dissatisfaction rate with 8.8% and 5.5% "Very dissatisfied" and 20.6% and 34.2% "Dissatisfied" respectively.

4.1.2.10 Safety and security while making the transfer

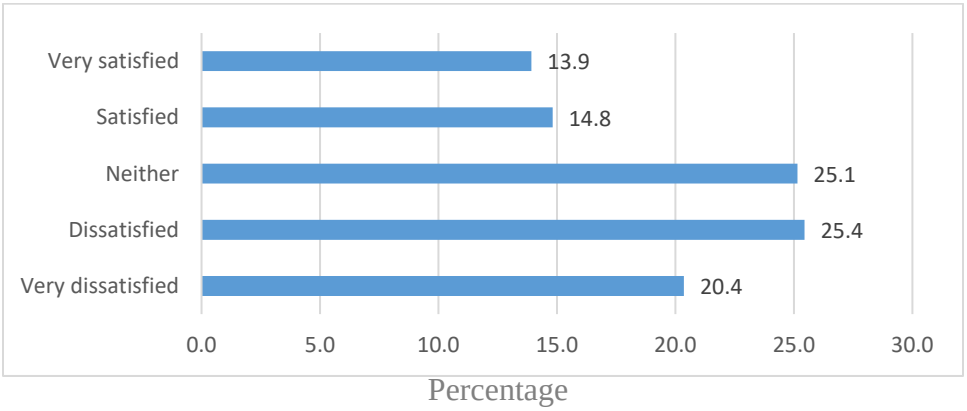

Figure 4. 28 Graph showing satisfaction of safety and security while making a transfer

(Source: organized by the owner)

The safety and security of the public transport user while making the transfer is a significant factor for assessing the transfer path. The data from the survey reveals that 20.4% of the respondents answered "Very dissatisfied" while 25.4% stated they were "Dissatisfied" with the safety and security parameter of the transfer path. Furthermore 25.1% of the respondents replied "Neither" while 14.8% stated that they were "Satisfied" and 13.9% stated they were "Very satisfied" with the safety and security aspects of the path traveled to make a transfer.

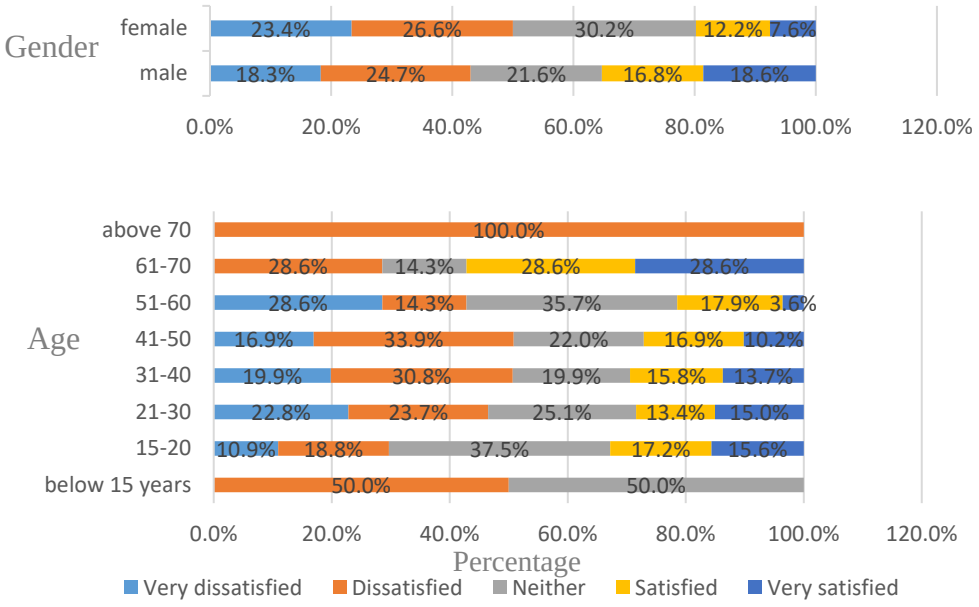

Figure 4. 29 Graph showing satisfaction of safety and security with Gender and Age

(Source: organized by the owner)

On the other hand observing the safety and security parameter of the transfer path from the point of view of gender, we can observe that 23.4% of females were “Very dissatisfied” and 26.6% were “Dissatisfied”. However, on the Male gender, 18.3% were “Very dissatisfied” and 24.7% were “Dissatisfied” with the safety and security parameter of the path traveled to make the transfer. Furthermore, when we see the safety and security parameter of the transfer path traveled from the perspective of Age group the data reveals that 28.6% of 51-60 age group were “Very dissatisfied” and 14.3% were “Dissatisfied” with the safety and security aspect of the transfer. Meanwhile in the 41-50 age group 16.9% were “Very dissatisfied” and 33.9% were “Dissatisfied” with safety and security of the path traveled to make a transfer.

4.1.2.11 Easy transfer parameter

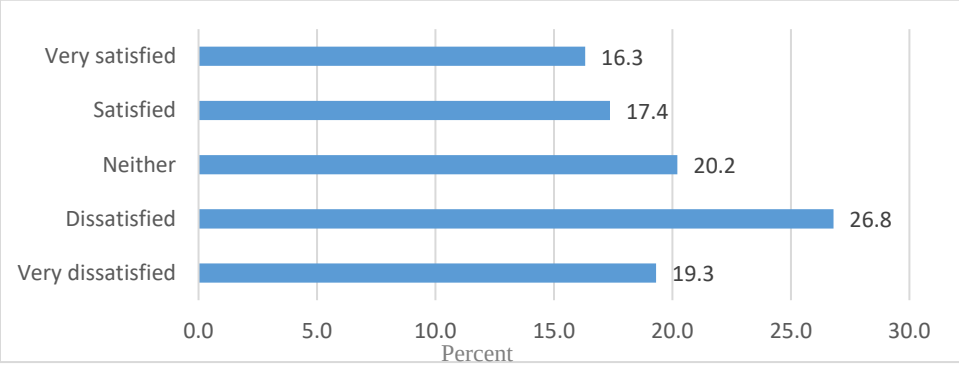

Figure 4. 30 Graph showing the satisfaction of respondents with easy transfer parameter

(Source: organized by the owner)

Easy transfer parameter was included in the survey for the respondents themselves to assess their whole transfer as easy or not a five point Likert scale. It can be observed that 19.3% of the respondents were “Very dissatisfied” and 26.8% were “Dissatisfied” with the easy transfer parameter. 20.2% of the respondents answered “Neither” for the question do they think their transfer path was easy to make. 17.4% were “Satisfied” and 16.3% were “Very satisfied” with the transfer they made.

On the other hand, the interaction of the Easy transfer parameter data with the data of the distance the respondents had to travel to make the transfer the relationship is easier to observe. More than 35% of the respondents that traveled 400-450 meters to make a transfer rated the easy transfer parameter “Very dissatisfied” and more than 40% rated it “Dissatisfied”.

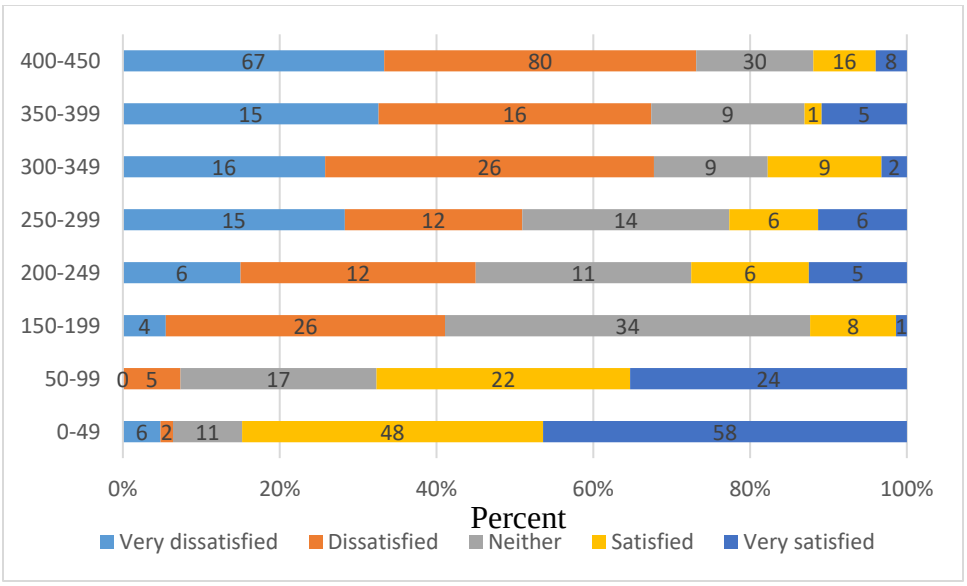

Figure 4. 31 Graph showing respondent's satisfaction of easy transfer with the distance traveled by respondents

(Source: organized by the author)

In addition to the above, similarly the respondents that traveled 350-399 meters to make the transfer had a 30% of “Very dissatisfaction” rate towards easy transfer parameter and a 35% “Dissatisfied” response. The number shows a slight decrease amongst the respondents who traveled 300-349 meters to make a transfer with a 25% “Very Dissatisfied” and more than 35% “Dissatisfied” response.

Moreover, observing the data of the respondents that traveled 250-299 meters to make a transfer, we can see that more than 27% of the respondents are “Very dissatisfied” with the easy transfer parameter and 20% are “Dissatisfied”. The data from the respondents with lesser distance traveled (200-249 meters) reveals that almost 15% of the respondents were “Very dissatisfied” 30% were “Dissatisfied”. The data form the other respondents, which traveled smaller distances than the above respondents did showed an increment in satisfaction level towards the easy transfer parameter with almost 35% “Very satisfied” and 40% satisfied towards easy parameter transfer for respondents who traveled less than 50 meters to make the transfer.

4.1.2.12 Necessary Requirements to make the transfer

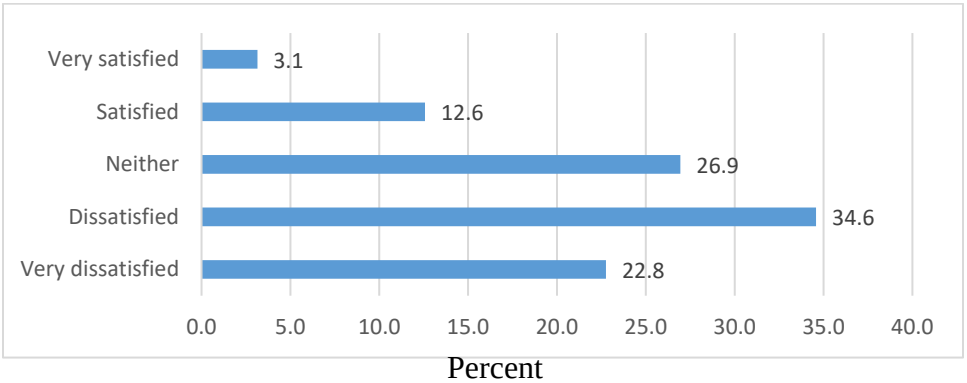

Figure 4. 32 Graph showing satisfaction towards necessary requirements to make a transfer

(Source: organized by the author)

The respondents were asked to rate their transfer experience in the parameters of the necessary requirement parameter of the transfer with a five point Likert scale. 22.8% of the respondents were "Very dissatisfied" with the parameter of necessary requirements to make the transfer while 34.6% were "Dissatisfied" with the parameter. However, 26.9% of the respondents rated the parameter "Neither" ,12.6 % were satisfied and 3.1% were "Very satisfied".

4.1.2.13 Weather transfer parameter

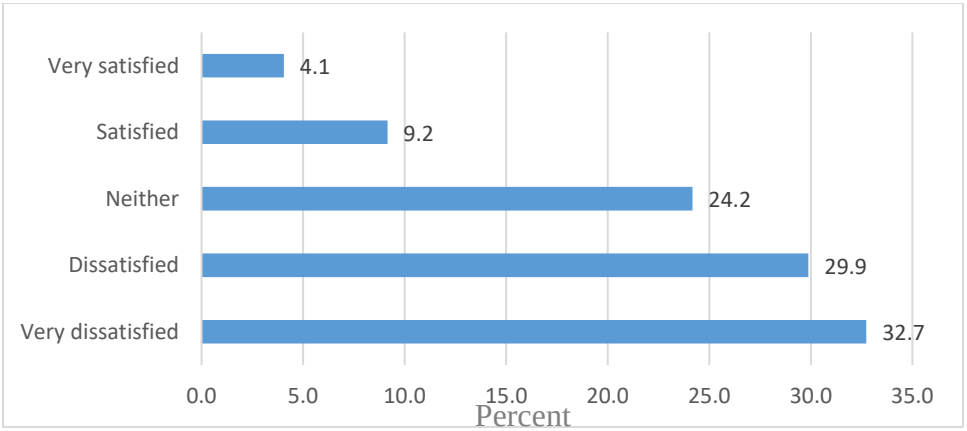

Figure 4. 33 Graph showing respondents' satisfaction of weather transfer

(Source: organized by the author)

The any weather transfer parameter was include in the survey to assess the respondents perception towards making the transfer during any weather time. It tried to assess the perception of users making the transfer during a harsh rain or sun time. The data shows that 32.7% of the respondents are "Very dissatisfied" with the parameter while 29.9% are "Dissatisfied". In addition, 24.2% of

the respondents answered “Neither” for the any weather time transfer while 9.2% responded “Satisfied” and 4.1% of the respondents countered “Very satisfied”.

4.1.2.14 The Anytime transfer parameter

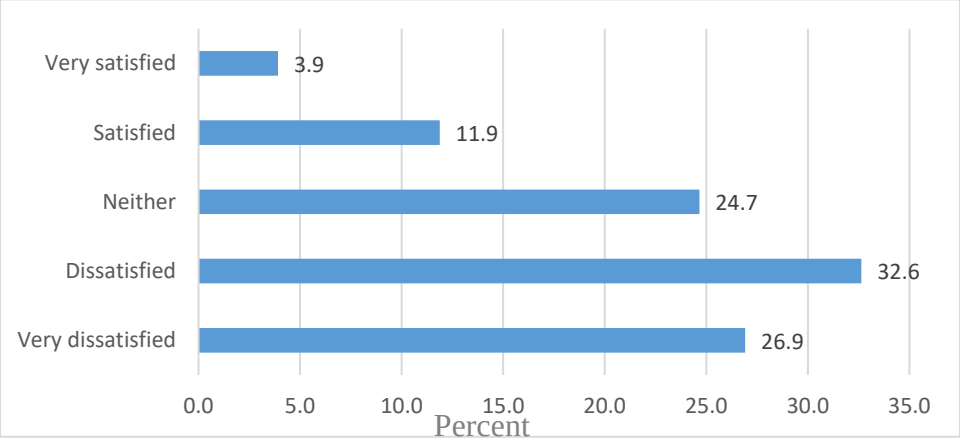

Figure 4. 34 Graph showing respondents’ satisfaction of anytime transfer parameter

(Source: organized by the author)

The anytime transfer parameter was included in the survey to understand the respondents perception for making the transfer during any given time of the day. This is corresponding to late hours or early morning. The respondents answered a five point Likert scale question, with 26.9% responding with “Very dissatisfied”, 32.6% responding “Dissatisfied”, 24.7% answering “Neither” ,11.9% “Satisfied” and lastly 3.9% “Very satisfied”.

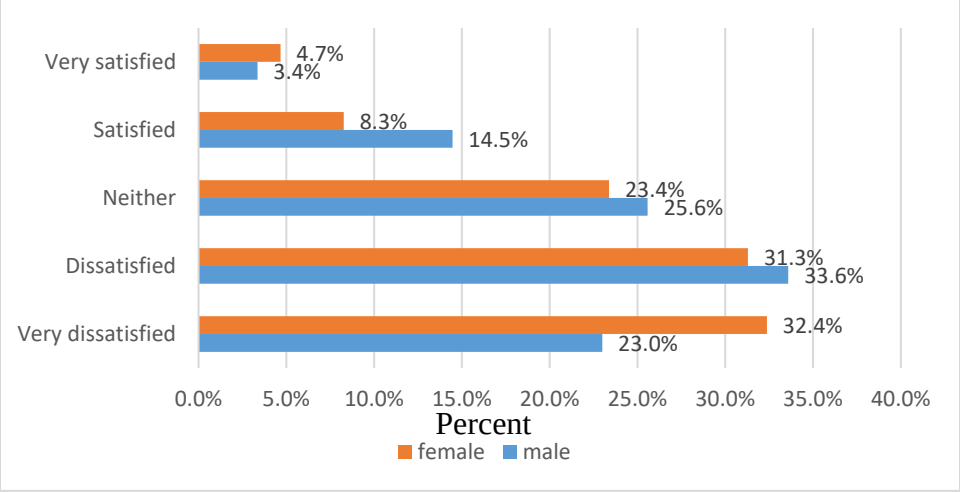

Figure 4. 35 Graph showing respondents satisfaction towards anytime transfer with Gender

(Source: organized by the author)

Similarly observing the data of the anytime transfer parameter with the Gender it is revealed that the women responded 32.4% “Very dissatisfied” while men 23.0% “Very dissatisfied”. Hence, both Female and male responded similarly with 31.3% and 33.6% “Dissatisfied” respectively. While the satisfaction level increases in the Male gender with 14.5% responding “Satisfied” and 3.4% “Very satisfied” it is 3% and 4.7% respectively for Females.

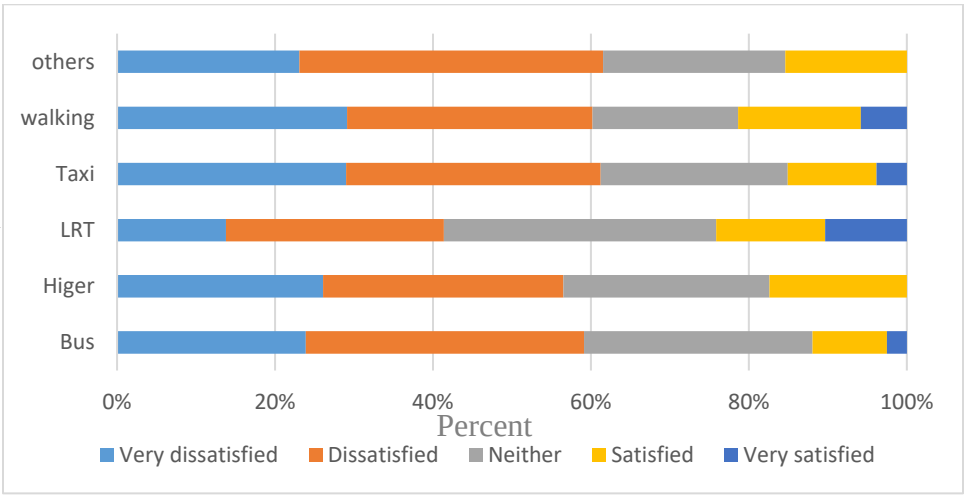

Figure 4. 36 Graph showing respondents satisfaction towards anytime transfer with the entry mode of transport

(Source: organized by the author)

4.1.2.15 Route and modal choice

In order to understand if the transfer experience affects the respondent’s route and transport mode choice a YES or NO question was included in the survey. The data reveals that 87.3% of them said YES the transfer experience affects their route and transport mode choice while 12.7 percent said No does not affect their choice.

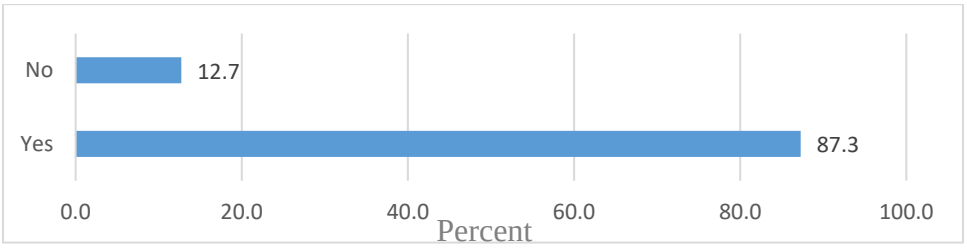

Figure 4. 37 Graph showing respondents’ response to influence of transfer on route and modal choice

(Source: organized by the author)

4.1.3 Major Variables that affect the perception of users in relation to physical integration

Ordinal regression is used to find and assess the major variables that affect the perception of users in relation to physical integration.

4.1.3.1 Descriptive Statistics of the perception of the respondents

Table 4.4 Descriptive Statistics of the perception of the respondents

Descriptive Statistics								
List of parameters to assess the transfer experience	N	Mean	Mode	Median	Std. Deviation	Variance	Skewness	
							Statistic	Std. Error
Distance traveled	668	1.69*	1	1.59	1.174	1.379	.393	.095
Continuity of transfer path	665	2.05**	2	2.06	1.112	1.237	-.039	.095
Convenience of transfer path	667	1.70*	2	1.67	1.134	1.287	.183	.095
Attractiveness of transfer path	668	1.49*	2	1.43	1.165	1.357	.331	.095
Slope of the transfer path	662	1.86*	2	1.88	1.138	1.295	-.031	.095
Conditions of sidewalk	661	1.36*	2	1.30	1.101	1.211	.397	.095
Straightness of route	668	2.04**	2	2.01	1.028	1.057	.086	.095
Time taken from drop off station to exit station	668	1.81*	2	1.76	1.118	1.250	.225	.095
Number of streets crossed	668	1.84*	1	1.74	1.246	1.553	.274	.095
safety and security of the transfer path	667	1.76*	1	1.66	1.313	1.725	.272	.095
Easy transfer	668	1.85*	1	1.74	1.359	1.846	.209	.095
Necessary requirements	668	1.39*	1	1.32	1.065	1.134	.433	.095
Weather transfer	666	1.22*	0	1.09	1.120	1.254	.649	.095
anytime transfer	665	1.33*	1	1.24	1.111	1.234	.526	.095

*average “Dissatisfied”, ** average “Neutral”, *** average satisfying parameters

(Source: organized by the author)

It can be observed that most of the values have perception value around “Dissatisfied”. However, there are some perception values, which tend to be near “Neutral There are no Satisfied and Very satisfied parameters found.

Some of the parameters tend to be more dissatisfying for the respondents like Conditions of sidewalk, Anytime transfer, any weather transfer and necessary requirements to make a transfer. while other parameters are standing at Neither satisfied nor dissatisfied like the Continuity of transfer path and the Straightness of transfer path .

In addition other parameters like the distance traveled to make a transfer, Convenience of path traveled to make a transfer, time taken to walk from drop off station to exit station, number of streets crossed to make the transfer, safety and security parameters of the transfer and easy transfer are the parameters with mean's closer to neither satisfied nor dissatisfied. The parameters that showed a high variance are the safety and security of the transfer path parameter and the perception of easy transfer assessed by the respondents.

Observing the skewness of the data, it can be revealed that the skewness of the responses are between -0.5 and 0.5, this suggests that the data are symmetrical. Except the parameters of weather transfer and anytime transfer which are between 0.5 and 1 inferring the data are moderately skewed. This generalized that the responses of the sampled users are skewed with minimal outliers present in the data. all the parameters and responses have a normal distribution or an acceptable distribution.

4.1.3.2 Ordered logit regression results towards the 14 parameters of the transfer

This model of regression was assimilated to further analyze ranked satisfaction and outcome variables and identify the major influence factors or predictors of the characters of the public transport users. In addition, the model can examine the significant factors to alter the perception of the public transport users making the transfer.
The interpretations of the results were based on degree of freedom and t-value to consider the result's statistical significance level. Hence, since t-value with a significance level of $p < 0.05$ at a confidence interval of 95% are considered for this model analysis.

In the Parameter Estimates table we see the coefficients, their standard errors, the Wald test and associated p-values (Sig.), and the 95% confidence interval of the coefficients. The dependent variables included in the above table are Distance traveled to make a transfer, Continuity of path traveled to make a transfer, convenience of routes traveled to make a transfer and attractiveness of Route traveled to make a transfer.

For each significant value the interpretation of the values are described below as follows.

Table 4.5 Ordered logit regression result for riders perception table 1 of 4

		Distance Traveled			Continuity of path traveled			Convenience of Routes			Attractiveness of routes		
		Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.
Threshold	Y = 0]	-6.995	88.047	.000	-3.847	31.787	.000	-2.953	19.243	.000	-2.539	14.407	.000
	Y = 1]	-4.468	38.198	.000	-2.128	10.097	.001	-1.515	5.185	.023	-1.356	4.176	.041
	Y= 2]	-2.319	10.997	.001	-.725	1.191	.275	-.076	.013	.908	.088	.018	.894
	Y = 3]	-.465	.447	.504	1.004	2.252	.133	1.512	5.038	.025	1.573	5.432	.020
Location	Distance	-.639	328.944	.000*	-.035	2.222	.136	-.010	.170	.680	-.017	.509	.476
	Sex	-.077	.264	.608	.193	1.793	.181	.175	1.475	.225	.053	.134	.714
	Age	-.113	2.172	.141	-.055	.560	.454	-.040	.309	.578	-.056	.600	.438
	Trip repetition	.021	.055	.814	-.114	1.698	.193	.030	.118	.732	.192	4.890	.027
	Transfer rate	-.087	.588	.443	-.249	5.188	.023*	-.454	17.065	.000*	-.313	8.163	.004*
	Occupation	.058	.440	.507	.155	3.481	.062	.027	.107	.744	.092	1.245	.264
	Trip purpose	-.013	.061	.806	-.026	.257	.612	-.124	6.053	.014	-.147	8.473	.004*
	Entry mode	-.086	2.376	.123	.075	2.009	.156	.089	2.804	.094	.030	.326	.568
	Exit mode	-.032	.266	.606	-.394	42.696	.000*	-.184	9.860	.002*	-.235	15.968	.000*
	Origin route	.029	.779	.377	-.005	.028	.866	-.050	2.583	.108	-.018	.340	.560
	Destination route	.032	1.174	.279	-.010	.118	.731	.076	7.268	.007*	.067	5.708	.017
	Transfer time	-.067	.579	.447	-.038	.206	.650	-.115	1.903	.168	-.103	1.519	.218
	Transfer_time_2	.005	.003	.953	.045	.337	.562	-.008	.010	.920	-.063	.682	.409

Significant* <0.05 statistically significant at 95% confidence interval
(Source: organized by the author)

4.1.3.2.1 Ordered logit model analysis result for Distance traveled to make a transfer parameter

It can be observed that observed that there are different independent variables, which can significantly affect the above listed parameters. In the distance traveled parameter measured with Likert scale the statistically significant independent variable which is <0.05 statistically significant

at 95% confidence interval which affects it is the measured distance the respondents traveled from entry station to exit station. For every 50-meter increase of Distance the respondent travels to make a transfer, we expect a 0.639 increase in the ordered log odds of being in a lower level of satisfaction for distance traveled, given all of the other variables in the model are held constant.

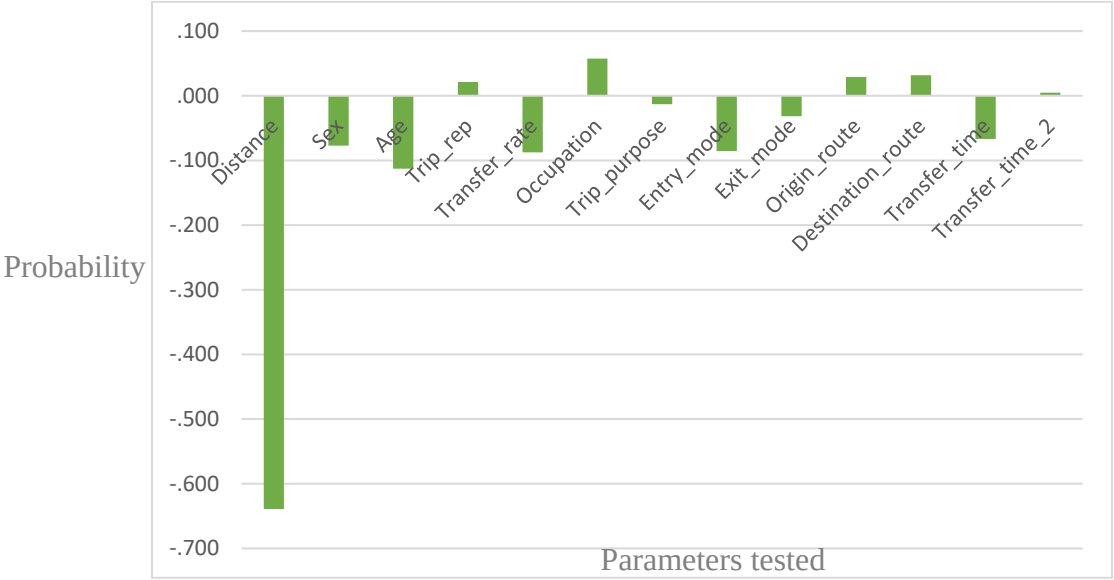

Figure 4. 38 Graph showing regression model result of distance traveled parameter

(Source: organized by the author)

4.1.3.2.2 Ordered logit model analysis result for Continuity of path traveled to make a transfer

On the other hand, observing the continuity of path traveled parameter, the significant variables that are <0.05 statistically significant at 95% confidence interval are the transfer rate and exit mode. It can be said that for every two transfers a, we would expect a 0.249 increase in the log odds of being in a lower level of satisfaction for Continuity of path traveled to make a transfer, given that all of the other variables in the model are held constant. This indicated that the more a respondent makes a transfer throughout the day the more is to be dissatisfied with the continuity of path traveled to make a transfer. The exit mode is also another significant variable that can affect the continuity of path traveled with a 0.40 ordered log odds. The negative beta attached to the result entails that some public transport modes used for exit have less satisfaction of continuity of path than other.

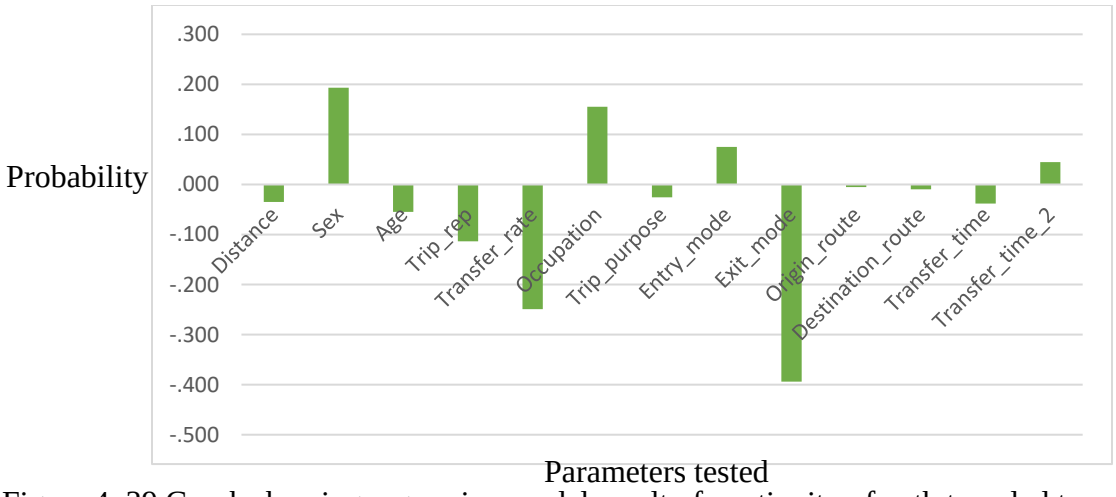

Figure 4. 39 Graph showing regression model result of continuity of path traveled to make a transfer

(Source: organized by the author)

4.1.3.2.3 Ordered logit model analysis result for Convenience of routes

The continuity of routes traveled parameter, the significant variables which is <0.05 statistically significant at 95% confidence interval are the transfer rate and exit mode. It can be said that for every two increment in transfers made throughout the day, we would expect a 0.454 increase in the log odds of being in a lower level of satisfaction for convenience of routes walked to make a transfer, given that all of the other variables in the model are held constant. This indicates that the more a user makes a transfer throughout the day the more he is to be dissatisfied by the convenience of routes. The exit mode is also another significant variable that can affect the convenience of route traveled with a 0.184 ordered log odds. This analysis implies that some public transport stations have an inconvenient route to make a transfer than other public transport stations.

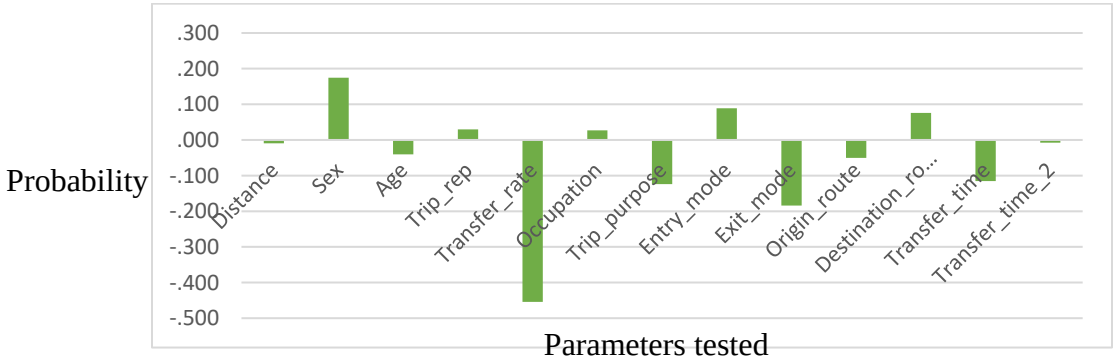

Figure 4. 40 Graph showing regression model result of convenience of routes traveled to make a transfer

(Source: organized by the author)

4.1.3.2.4 Ordered logit model analysis result for attractiveness of Transfer path

The ordered logit model analysis result for this explanatory variable shows statistically significant in affecting the over satisfaction. The significant variables which are <0.05 statistically significant at 95% confidence interval that affect the Attractiveness of Transfer routes parameter are the transfer rate of the respondents throughout the day, the exit transportation mode and the trip purpose. Accordingly, the result indicates that with a factor of 0.313 with a negative beta attached the transfer rate of the respondents affects the attractiveness of route satisfaction. Similarly like the above parameters more the people make a transfer throughout the out the day the more their satisfaction of transfer parameters decrease. Hence, the model analysis reveals the more people make transfers the more they are dissatisfied with the attractiveness of the transfer route given that all of the other variables in the model are held constant.

The additional variable with a significant value less < 0.05 is the exit transportation mode of the transfer. The ordinal logit model analysis indicates that the transport mode used to exit the site by the respondents affects their view of attractiveness of route in a 0.215 factor with a negative attached, revealing that there are some transfer routes used to travel to exit station that are less attractive than others.

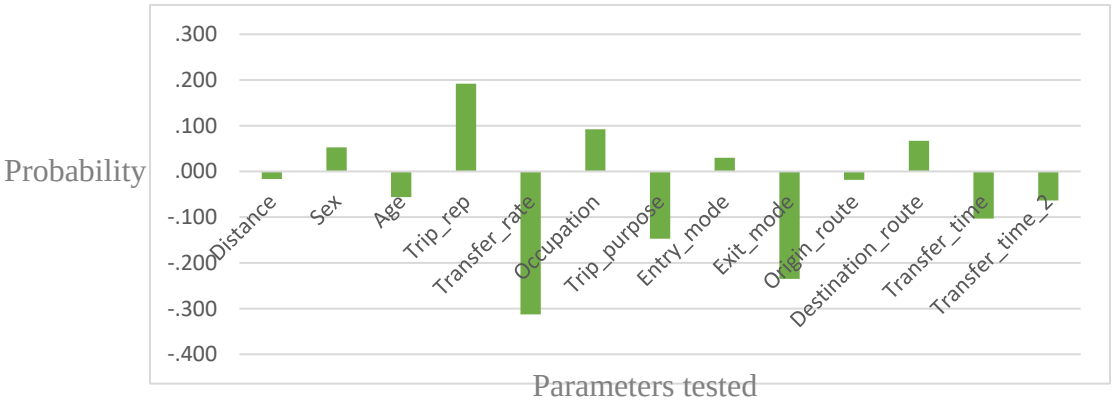

Figure 4. 41 Graph showing regression model result of Attractiveness of transfer path

(Source: organized by the author)

Table 4.6 Ordered logit regression result for riders perception Table 2 of 4

		Slope of track			Conditions of side walk			Straightness of route			Time taken		
		Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.
Threshold	Y = 0]	-2.748	16.506	.000	-2.821	17.029	.000	-4.097	35.120	.000	-2.986	19.506	.000
	Y = 1]	-1.545	5.315	.021	-1.521	5.045	.025	-2.045	9.247	.002	-1.347	4.079	.043
	Y= 2]	-.002	.000	.998	.086	.016	.899	-.419	.393	.531	.254	.145	.703
	Y = 3]	1.717	6.432	.011	1.793	6.547	.011	1.241	3.387	.066	1.529	5.177	.023
Location	Distance	-.006	.077	.782	-.017	.527	.468	-.018	.606	.436	-.018	.589	.443
	Sex	.121	.698	.404	-.220	2.260	.133	.267	3.395	.065	-.012	.007	.936
	Age	-.016	.046	.830	.051	.474	.491	-.026	.130	.718	-.015	.043	.836
	Trip repetition	-.137	2.445	.118	.029	.109	.742	-.035	.156	.692	-.256	8.555	.003*
	Transfer rate	-.110	1.019	.313	-.399	12.771	.000*	-.323	8.590	.003*	-.296	7.260	.007*
	Occupation	.042	.254	.614	.122	2.101	.147	.066	.619	.431	-.018	.046	.831
	Trip purpose	.039	.590	.442	-.124	5.803	.016*	-.045	.792	.374	.100	3.938	.047
	Entry mode of transportation	.088	2.759	.097	-.004	.007	.935	.045	.728	.393	.020	.148	.700
	Exit mode of transportation	-.281	22.343	.000*	-.254	18.206	.000*	-.253	18.081	.000*	-.302	25.735	.000*
	Origin route	-.008	.065	.799	.060	3.585	.058	-.028	.788	.375	.072	5.237	.022*
	Destination route	-.067	5.639	.018	.027	.937	.333	-.004	.020	.887	.014	.235	.628
	Transfer time	-.136	2.659	.103	-.362	16.588	.000*	-.026	.098	.755	-.030	.127	.722
	Transfer_time_2	.080	1.084	.298	.005	.004	.950	.000	.000	.998	.110	2.041	.153

Significant* <0.05 statistically significant at 95% confidence interval
(Source: organized by the author)

4.1.3.2.5 Ordered logit model analysis result for Slope of the track traveled to make a transfer

The table 4.12 above shows that the only <0.05 statistically significant at 95% confidence interval variable, to affect the perception of the slope of the track traveled to make a transfer is the exit mode of transportation used. The data reveals that at 0.281 factor the exit mode of transportation used affects the perception of the slope of the track with a negative beta attached. This implies that transportation mode used to exit the study area is a huge factor for the satisfaction of the slope of the track traveled to make a transfer. the model analysis entails that with a certain choice of transportation mode there is a decrease in satisfaction in slope of the track traveled to make a transfer.

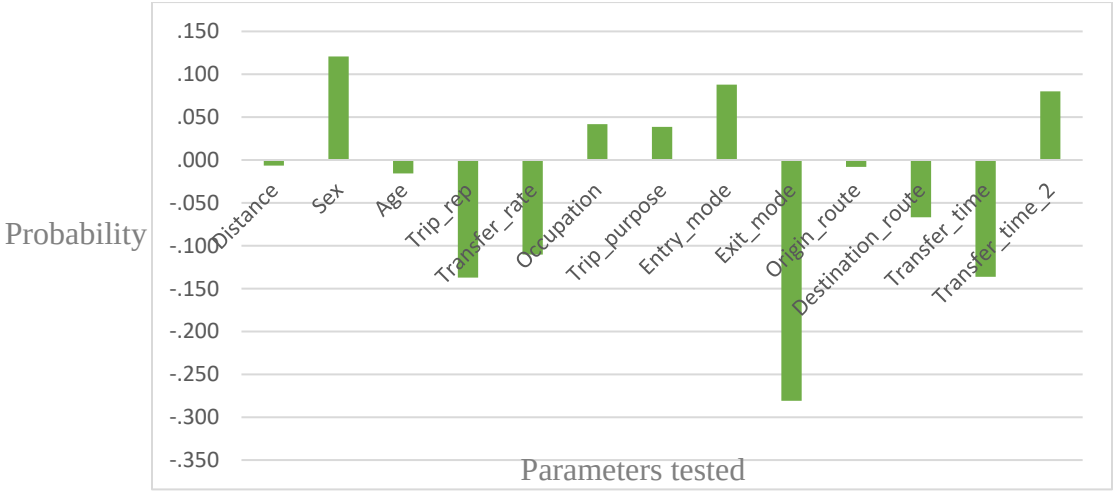

Figure 4. 42 Graph showing regression model result of slope of the path traveled to make a transfer

(Source: organized by the author)

4.1.3.2.6 Ordered logit model analysis result for Condition of the sidewalk

The data from the table indicates that there are four variables with a significant P value of <0.05 with a 95% confidence interval that are reliable factors to affect the perception of side walk conditions amongst respondents. The first variable is the transfer rate of the respondents for a one unit of transfer rate increase there is a .399 decrease in satisfaction of the sidewalk given that all the other variables are held constant. This implies the more transfers a respondent makes throughout the day the more they are dissatisfied with the conditions of the sidewalk they make the transfer on. The second variable that is significant in the ordered logit analysis is the trip purpose. This indicated that certain trip purposes are more dissatisfied with a factor of 0.12 with a negative beta attached entailing the increase in dissatisfaction towards the conditions of sidewalk with a choice of some

trip purposes. Similarly, the other significant variable with a p-value of less than 0.05 and a confidence interval of 95% is the transportation mode used to leave the area with a factor of 0.254 negative beta attached given that all the other variables are held constant. This implied that respondents who picked certain type of transportation mode to exit the area are more inclined to be dissatisfied with the conditions of sidewalk than others.

Lastly, the other significant variable that can affect the perception of conditions of the sidewalk is the transfer time of the respondents. This analysis indicates with a factor of 0.362 with a negative beta attached the transfer time of the respondents affects their perception towards the conditions of sidewalk. Hence implying certain transfer time's leave a negative impression on the user than others.

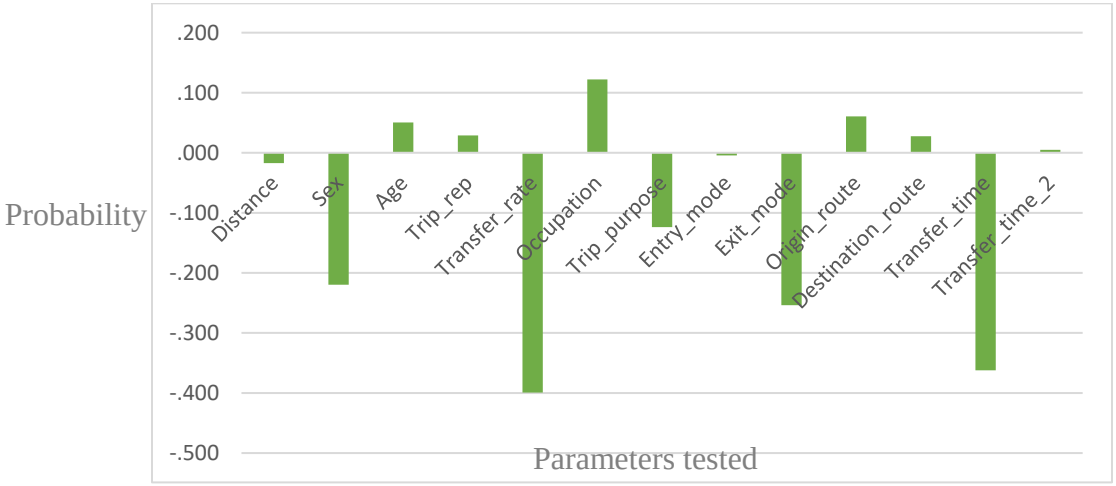

Figure 4. 43 Graph showing regression model result of conditions of sidewalk traveled to make a transfer

(Source: organized by the author)

4.1.3.2.7 Ordered logit model analysis result for Straightness of the route traveled to make a transfer

The variable that is significant in the ordered logit analysis with a p-value <0.05 at confidence interval of 95% to affect the perception of Straightness of the route traveled to make a transfer is the transfer rate of the respondents and the transport mode used to exit the site. Hence, when the transfer rate is observed it reveals that a factor of 0.333 with a negative attached affects the satisfaction of straightness of routes traveled to make a transfer given that all the other variables are held constant. This implicates that with one unit increase in transfers throughout the day 0.33 probability that their satisfaction towards straightness of route-traveled decreases.

The other significant variable is the transport mode used to exit the study area. it indicates that the choice of transport mode to exit the area affects the perception of straightness of route with a factor of 0.253 confirming a negative beta attached given that all the other variables are held constant. Hence, it denotes that certain transport mode options have a negative perception of straightness of route towards the user.

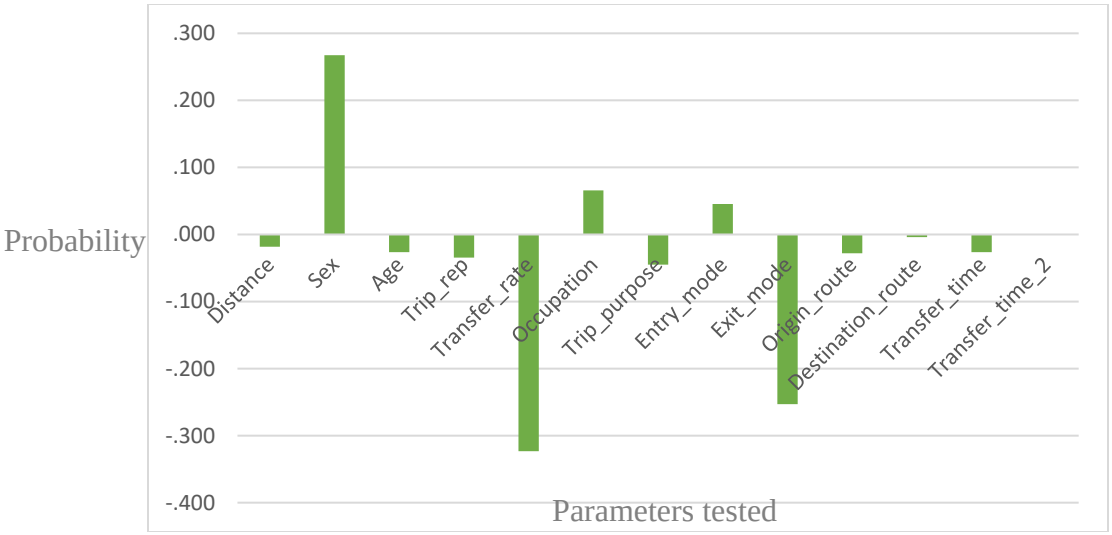

Figure 4. 44 Graph showing regression model result of Straightness of route traveled to make a transfer

(Source: organized by the author)

4.1.3.2.8 Ordered logit model analysis result for Time taken to walk from entry station to egress station

The significant variables with a p-value <0.05 at a confidence interval of 95% that affect the perception towards time taken are the trip repetition, the transfer rate, the exit mode and the origin route. Observing the implications of the trip repetition variable it affects the time taken perception with a factor of 0.256 given that all the other variables are held constant. It has also a negative attached meaning the more people make the trip the more they are likely to be dissatisfied with the time it takes to make the transfer.

In addition the data from the transfer rate variable indicates that the variable affects the perception of time taken with a factor of 0.293 given that all the other variables are held constant. It also has a negative attached meaning that the more people make transfers during their day the more they have a negative perception towards time taken to make the transfer.

Moreover, the variable that can also significantly affect the perception of time taken is the Exit mode of transportation with a factor of 0.302 given that all the other variables are held constant. This implicates that the choice of transportation mode to exit the study area affects the perception of time taken to make the transfer. Similarly the variable that has also a significant p-value <0.05 that affects the perception of time taken is the origin of route. It has a factor of 0.072 given that all the other variables are held constant. This indicates that some drop off stations of routes can create a negative perception of time taken.

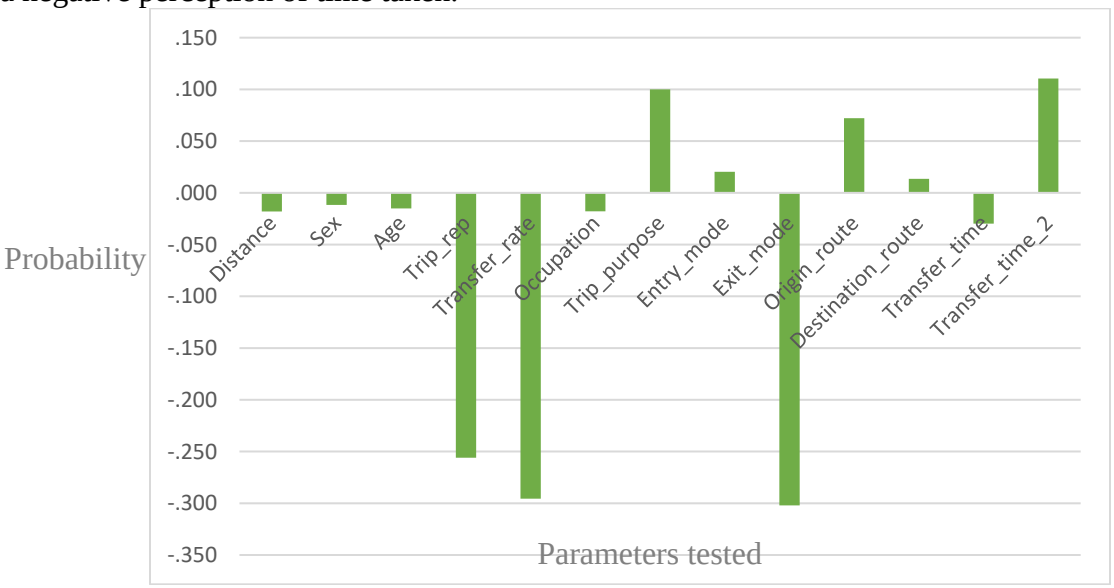

Figure 4. 45 Graph showing regression model result of time taken to walk from entry station to egress station

(Source: organized by the author)

Table 4.7 Ordered logit regression result for riders perception Table 3 of 4

		Number of streets crossed			Safety and Security			Easy transfer		
		Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.
Threshold	Y = 0]	-3.702	29.424	.000	-2.729	16.720	.000	-5.560	62.521	.000
	Y = 1]	-1.883	7.814	.005	-1.472	4.958	.026	-3.906	32.086	.000
	Y= 2]	-.426	.406	.524	-.335	.259	.611	-2.678	15.512	.000
	Y = 3]	.784	1.371	.242	.626	.897	.344	-1.380	4.194	.041
Location	Distance	-.356	175.694	.000*	.023	.998	.318	-.422	224.799	.000*
	Sex	.077	.285	.594	-.511	12.678	.000*	-.036	.061	.805
	Age	-.132	3.224	.073	-.168	5.376	.020*	-.056	.581	.446
	Trip repetition	-.121	1.925	.165	.077	.800	.371	-.049	.306	.580
	Transfer rate	.146	1.761	.184	-.032	.090	.764	-.276	6.205	.013*
	Occupation	.141	2.840	.092	.078	.908	.341	-.023	.077	.782
	Trip purpose	-.015	.084	.772	.017	.112	.737	-.056	1.207	.272
	Entry mode of transportation	-.029	.307	.580	.053	1.021	.312	-.055	1.066	.302
	Exit mode of transportation	.005	.008	.930	-.097	2.827	.093	.027	.203	.653
	Origin route	.045	1.975	.160	-.011	.119	.730	.045	1.990	.158
	Destination route	-.025	.764	.382	.057	4.165	.041	-.017	.357	.550
	Transfer time	-.082	.943	.331	-.430	25.430	.000*	-.138	2.643	.104
	Transfer_time_2	.124	2.573	.109	.038	.248	.619	-.040	.258	.611

Significant* <0.05 statistically significant at 95% confidence interval
(Source: organized by the author)

4.1.3.2.9 Ordered logit model analysis result for Number of streets crossed to make the transfer

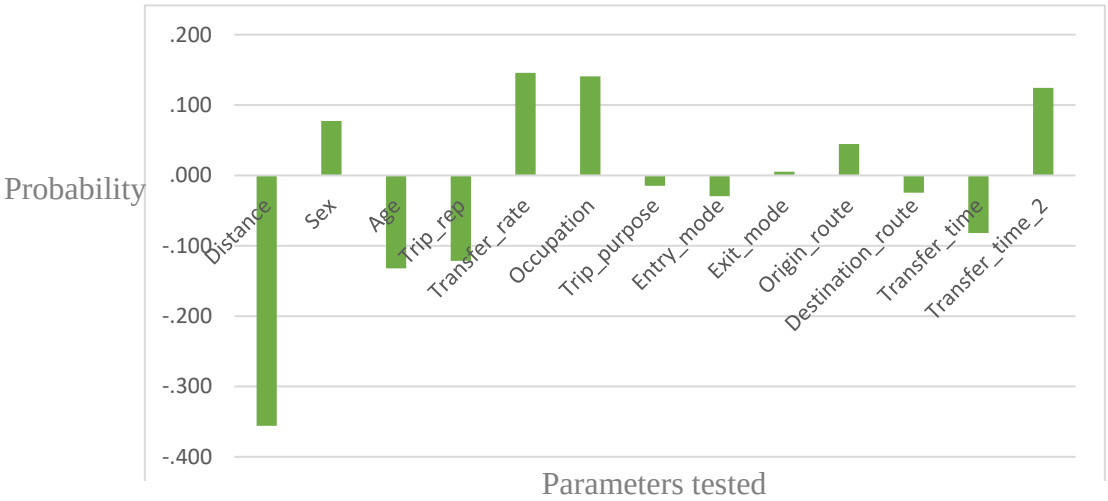

Figure 4. 46 Graph showing regression model result of number of streets crossed to make a transfer

(Source: organized by the author)

4.1.3.2.10 Ordered logit model analysis result for Safety and security parameter while making the transfer

Observing table 4.8 we can see that three variables are statistically significant with a p-value < 0.05 statistically significant at 95% confidence interval. The first variable is the Gender of the respondents. It indicates that gender affects the satisfaction of safety and security while making the transfer with a factor of 0.511 given that all the other variables are held constant. This infers that the female gender has a decreased satisfaction toward the parameter and it increases the chance of being dissatisfied with the safety and security parameter of the transfer.

The other variable that affects the perception of safety and security is the Age variable. The variable affects the parameter with a factor of 0.168 with a negative beta attached given that all the other variables are held constant. This indicates that with an increase in age the perception of safety and security decreases.

Lastly, the variable that affects the perception of safety and security is the transfer time. The model indicates with a factor of 0.430 with a negative attached that the transfer time can significantly affect the perception of safety and security given that all the other variables are held constant. This indicates that certain user that transfer during a specific time have a negative impression of safety and security than others.

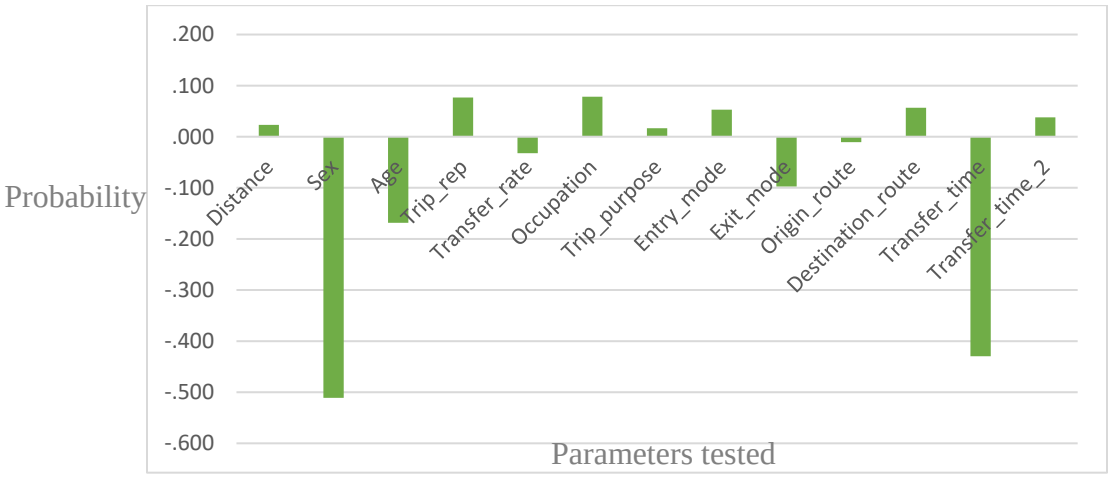

Figure 4. 47 Graph showing regression model result of safety and security of transfer path

(Source: organized by the author)

4.1.3.2.11 Ordered logit model analysis result for Satisfaction of Easy transfer parameter

The perception of easy transfer has two significant variables with a p-value <0.05 and a confidence interval of 95%. The variables that are significant are the Distance walked by respondents to make a transfer and the transfer rate of the respondents.

The distance walked variable affects the easy transfer parameter with a factor of 0.422 with a negative beta attached. For every increment in unit of distance, in this case 50 meters as a unit, the easy transfer dissatisfaction increases with a factor of 0.422 given that all the other variables are held constant. This implies that the distance walked by the respondents is a huge contributor to the easy transfer satisfaction of the respondents. The more people walk to make a transfer the less they will be satisfied with the easy transfer parameter.

The other variable that significantly affects the easy transfer parameter is the Transfer rate of the respondents. The variable affects the parameter with a factor of 0.276 with a negative betta attached given that all the other variables are held constant. This implies the more people make transfers throughout the day the more their dissatisfaction towards the easy transfer parameter increases.

Figure 4. 48 Graph showing regression model result of easy transfer parameter

(Source: organized by the author)

Table 4.8 Ordered logit regression result for riders perception Table 4 of 4

		Necessary requirements			Weather Transfer			Anytime Transfer		
		Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.
Threshold	Y = 0]	-2.864	17.986	.000	-2.063	9.361	.002	-1.396	4.357	.037
	Y = 1]	-1.290	3.732	.053	-.772	1.328	.249	.027	.002	.967
	Y= 2]	.154	.053	.817	.638	.901	.342	1.349	4.058	.044
	Y = 3]	1.934	7.781	.005	1.934	7.863	.005	2.895	17.583	.000
Location	Distance	-.035	2.207	.137	-.009	.154	.695	-.024	1.046	.306
	Sex	-.288	3.956	**.047***	-.467	10.206	**.001***	-.380	6.872	**.009***
	Age	-.137	3.520	.061	-.095	1.659	.198	-.060	.686	.407
	Trip repition	.097	1.231	.267	.111	1.616	.204	.025	.081	.775
	Transfer rate	-.312	8.044	**.005***	-.107	.955	.329	-.059	.295	.587
	Occupation	.141	2.858	.091	.092	1.205	.272	.049	.338	.561
	Trip purpose	-.116	5.240	**.022***	-.124	5.925	**.015***	-.063	1.552	.213
	Entry mode of transportation	.019	.132	.717	.029	.292	.589	.033	.398	.528
	Exit mode of transportation	-.166	7.974	**.005***	-.078	1.765	.184	-.108	3.388	.066
	Origin route	-.006	.037	.847	-.029	.841	.359	.027	.732	.392
	Destination route	.039	1.921	.166	.050	3.118	.077	.032	1.278	.258
	Transfer time	-.159	3.559	.059	-.235	7.461	**.006***	-.176	4.307	**.038***
	Transfer_time_2	.070	.815	.367	.040	.263	.608	.165	4.524	**.033***

Significant* <0.05 statistically significant at 95% confidence interval

(Source: organized by the author)

4.1.3.2.12 Ordered logit model analysis result for Necessary requirements to make a transfer

The satisfaction parameter of necessary requirements to make a transfer has four significant variables, which affect it with a p-value of <0.05 and a confidence interval of 95%. The variables are the Gender of respondents, the transfer rate of the respondents the trip purpose of the respondents and the exit mode transportation used by the respondents.

Gender variable affects the necessary requirement satisfaction parameter with a factor of 0.288 with a negative beta attached. This implies that Gender is a factor to affect the perception of necessary requirements to make a transfer parameter.

The second variable that affects the parameter is the trip purpose variable. The trip purpose affects the parameter with a factor of 0.116 with a negative beta attached given that all the other variables are held constant. This indicates that the trip purpose of respondents affects the perception of necessary requirements needed to make a transfer.

Thirdly, the variable that affects the parameter with a significant p-value is the transfer rate with an estimate of 0.312 given that all the other variables are held constant. It has a negative betta attached implying that the more the transfer made the less satisfied the respondents will be with the necessary requirements parameter.

In addition to the above, the exit mode of transportation of the respondents also affects the parameter with a factor of 0.166 given that all the other variables are held constant. This infers that the transportation mode used to exit the study area is a significant factor to alter the satisfaction of users in the necessary requirements to make a transfer parameter.

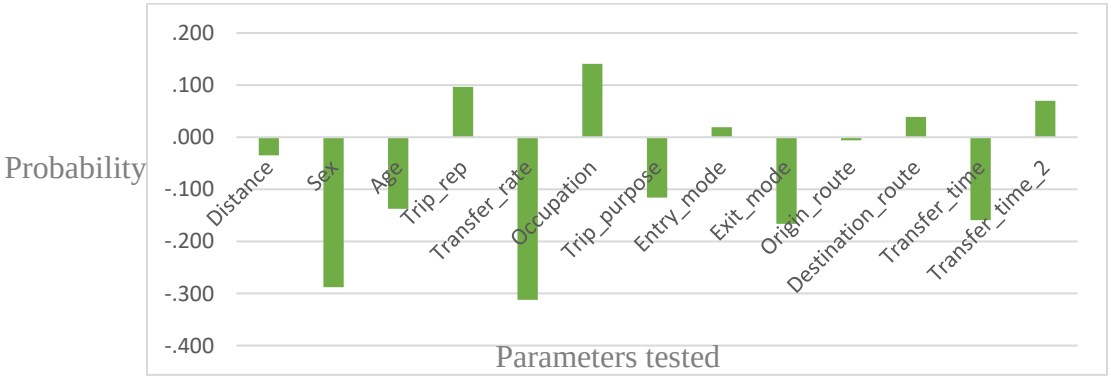

Figure 4. 49 Graph showing regression model result of necessary requirements to make a transfer (Source: organized by the author)

4.1.3.2.13 Ordered logit model analysis result for Weather transfer parameter

The protection against weather transfer parameter has three significant variables with a p-value < 0.05 at a confidence interval of 95%, which affects it. The first variable is the Gender variable with a factor of 0.467 it affects the Weather transfer perception of the respondents. This implies that the gender of the respondents is a huge factor that contributes to the dissatisfaction of the weather transfer parameter.

In addition, the trip purpose and the transfer time of the respondents are variables that can affect the weather transfer perception of the users with a factor of 0.124 and .235 respectively.

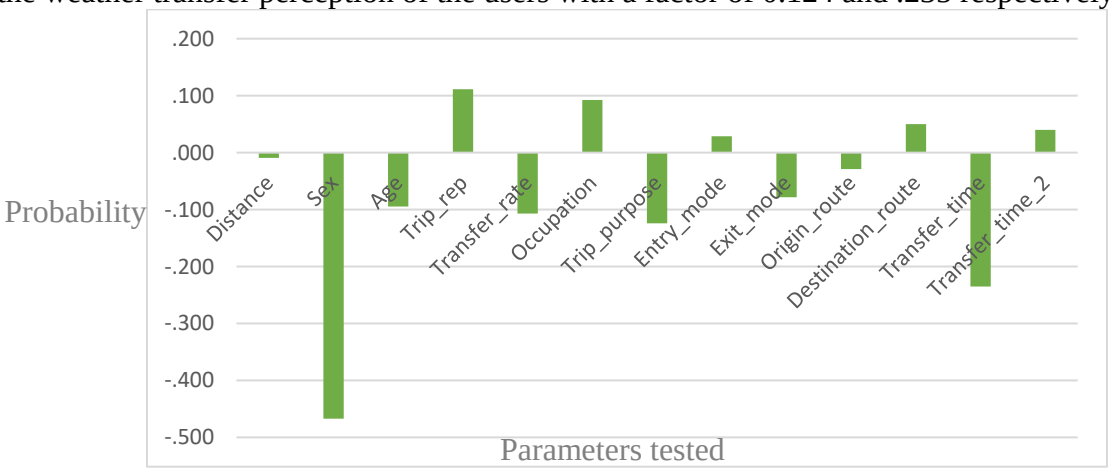

Figure 4. 50 Graph showing regression model result of weather transfer

(Source: organized by the author)

4.1.3.2.14 Ordered logit model analysis result for Anytime transfer parameter

The anytime transfer parameter has three variables that are significant with a p-value <0.05 at a confidence interval of 95%. The first variable is the Gender of the respondents, it affects the result of the anytime transfer parameter with a factor of 0.380 given that all the other factors are held constant. It infers that the gender of the respondents affects how the respondents perceive the anytime transfer parameter.

The second and third variables that affect the anytime transfer parameter are the transfer time windows of the respondents. The two transfer time windows affect the parameter with a factor of 0.176 and 0.165 respectively. It implies that the time window that the transfer is made by the respondents affects the satisfaction towards the anytime transfer parameter.

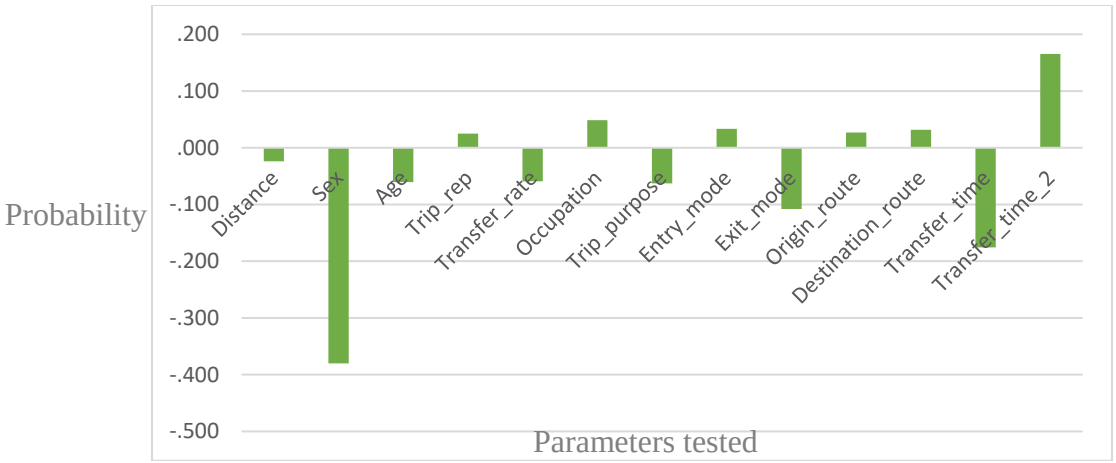

Figure 4. 51 Graph showing regression model result of anytime transfer

(Source: organized by the author)

4.1.4 Potential strengths and weaknesses of public transport stations

The results of this objective was investigated in relation to the physical integration of public transport stations in creating seamless urban transportation as presented below.

4.1.4.1 Public transport in Addis Ababa

Addis Ababa serves as the capital city of Ethiopia. It is also the major commercial and manufacturing city of the country (Aimero, 2016). Addis Ababa has an area of 527sqm. The city is divided in to 10 sub cities, which are further divided for convenience of administration in to 116 woredas. The city has total of 3,761km road length, out of which 706km are two lane or above which standard buses can comfortably maneuver. This means that more than 18 percent of the city's roads can support standard buses comfortably (AACRA, 2020).

The modal share of the city based on 2018 survey is dominated by walking at 54%, public transport at 31% and private cars at 15% with expected rise in the future (ITDP, 2020). There are many public transport service providers, which are funded by the government and others that are privately owned (TRANSIP, 2020). Public transport mainly consists of conventional bus services provided by the publicly owned Anbessa City Bus Enterprise and also and mini and midi-buses operated by the private sector (Transafrica, 2008). The city also has also a light rail transit system that was developed to assist the public transport sector (AACRA, 2020).

Even though there is presence of different transport operators there is lack of coordination amongst them (TRANSIP, 2020). Car ownership among residents is very low, so the majority depends on

buses and taxis for their day-to-day mobility in terms of motorized transport (Transafrica, 2008). Listed below on table 4.1 are the various public transport operators in the city excluding the LRT.

Table 4.9 Addis Ababa public transport in number and their share in percentage

No.	Type	In Number	Share in%
1	Code 3 Mini-bus	6,148	57.2
2	Code 1 Taxi	3,110	28.9
3	Anbessa City Bus	663	6.2
4	Sheger City Bus	209	1.9
5	Hyger/ Midi-bus	194	1.8
6	Isuzu Kitkit	242	2.3
7	Public Service	177	1.6
Total		10,743	100

(Source: Addis Ababa Transport Authority, December, 2019 data from the last five months of 2012 E.C, (i.e. July, August, September, October and November).

Based on table 4.2 it is clear to see that the private public transport operators such as the Mini-bus taxis are huge contributors to the public transport service of the city. They serve more than a million people per day while the conventional bus services serve 600,000 people per day.

Table 4.10 Public transport modes and estimated daily passenger transported in Addis Ababa in 2019

No.	Type	Served population in Last 5 months	Daily served population	Share in%
1	Code 3 Mini-bus	114,647,904	1,032,864	39.52
2	Code 1 Taxi	57,995,280	522,480	19.99
3	Anbessa City Bus	73,593,000	663,000	25.37
4	Sheger City Bus	16,239,300	146,300	5.60
5	Hyger/ Midi-bus	10,744,800	96,800	3.70
6	Isuzu Kitkit	8,613,600	77,600	2.97
7	Public Service	8,251,740	74,340	2.84
Total		**290,085,624**	**2,613,384**	**100**

(Source: Addis Ababa Transport Authority, December, 2019, data from the last five months of 2012 E.C, (i.e. July, August, September, October and November).

4.1.4.1.1 Public transport regulation of Addis Ababa

At the country level, the ministry of transport is responsible for the public transport sector. It is in charge of formulating policy and giving a clear vision for public transport development of the country (M.O.T, 2011). However, at the Addis Ababa regional level, the Addis Ababa city roads authority is responsible under the auspices of the City Government with the overall mandate to issue route licensing and permits to the operators. The public transport fares are also set and managed by the authority (Transafrica, 2008).

4.1.4.1.2. Analysis of the available public transport modes in Addis Ababa

4.1.4.1.2.1 Anbessa City Bus Service Enterprise and sheger bus

The Anbessa city bus service enterprise is a bus company that is known for operating large buses with in Addis Ababa (Transafrica, 2008). It has a rich history of transporting passengers in the city (TRANSIP, 2020).The company operates out of 3 central depots, four bus terminals 124 routes, 29 check points and 1640 bus stops (Weheyaga, 2019). Fares are controlled by the City government which compensates with a subsidy per ticket sold (Transafrica, 2008). The anbessa city bus service has 125 routes in and around the city of addis ababa.

The addis ababa transport authority through regulation no. 70/2015 has established sheger mass transport service enterprise in the year 2015. Sheger bus service has 48 routes in Addis Ababa (AACRA, 2020). It started its operation in 2016 .The average rough length of each routes is 11.59 km. It is an express service and has bus stations at every 1km compared to anbessas 500 meters (TRANSIP, 2020).

4.1.4.1.2.2 Minibus Taxi

The City of Addis Ababa has also another means of transportation service by minibuses also known as “taxis” (Transafrica, 2008). There were 8500 minibuses operating in the city (Weheyaga, 2019). They consist of code 1 and 3 minibuses and are one of the dominant privately owned transport service providers (AACRA, 2020).

The city’s transport authority is in charge of controlling the fares and routes of the service providers (TRANSIP, 2020). They contribute in bridging the gap created by anbessa and sheger city bus services. They typically cover 100 kms per day and work 6 to 8 round trips.The distance covered by minibus taxis range form 2.7kms to to 10.7 km with minimus length of 0.6km (AACRA, 2020).

4.1.4.1.2.3 Higer midibus

There are about 461 Higer midi buses operating in the city of Addis Ababa, which has a twenty-five seating capacity each, while, 411 Higer buses properly working on the routes .Most of these vehicles are out of market in a short period of time because of their quality is very low. These Higer midi buses operate on three zone and thirty-seven routes of the city (Eshetie, 2015).

4.1.4.1.2.4 Light rail transport of Addis Ababa

To address the gap in public transport the government developed a light rail transit (TRANSIP, 2020). It is the first light rail and rapid transit in eastern and sub-Saharan Africa. It consists of 34 km of running line. It is 17 km from east to west and 16.9 km from north to south. There are 39 stations with a minimum distance of 700 meters and a maximum of 1.1km. It has a daily ridership of 55,452 people (AACRA, 2020).

According to TRANSIP (2020), the LRT ridership numbers is not satisfactory for the government and the mode is struggling to be the most popular mode to commute. Hence, the expansion plans for the LRT route were canceled.

4.1.4.2 Physical integration of urban transportation in Addis Ababa

There is a clear physical integration problem in the city as public transport stations are seen scattered and unplanned (Aimero, 2016). There is lack of physical connection between the different public transport operators (Hussen, 2016). The public transport facilities do not create a vehicle interruption free walk for pedestrians. In addition, the high curbs and fences force users to make a longer walk for their transfers (Azemeraw, 2015).

Table 4.11 Number of scattered Anbessa city, midi and minibus stops at major public transport hubs

Public transport node	Number of city, midi and minibus stops at the node	Approximate longest walking distance for route change
Merkato	7	One kilometer
Megenagna	7	500 to 700 meters
Laghare-Stadium	6	300 to 500 meters
Menelik square to piazza	7	300 meters
Saris Abo	3	200 meters
Tor-hayloch	4	200 meters
Arat-kilo	6	400 meters
Sidist-kilo	4	300 meters
Kaliti	3	400 meters
Ayertena	4	400 meters

Source: (Hussen, 2016)

There have been attempts to improve the physical integration of public transport station in the city. The Megnagna terminal is one of the interventions made in the city. It was intended to collect and integrate the different public transport operators in one location. The terminal had an area of 16000m^2.

4.1.4.3 Physical integration of public transport station in Mexico roundabout

4.1.4.3.1 Connectivity of the Study area

There are six major roads leading to Mexico roundabout. Road from Megnagna from east direction, road from Torhayloch from west direction , road from Tikur Anbessa to the north , road from Mekanisa from the south west, roads from Kera from the south directions.

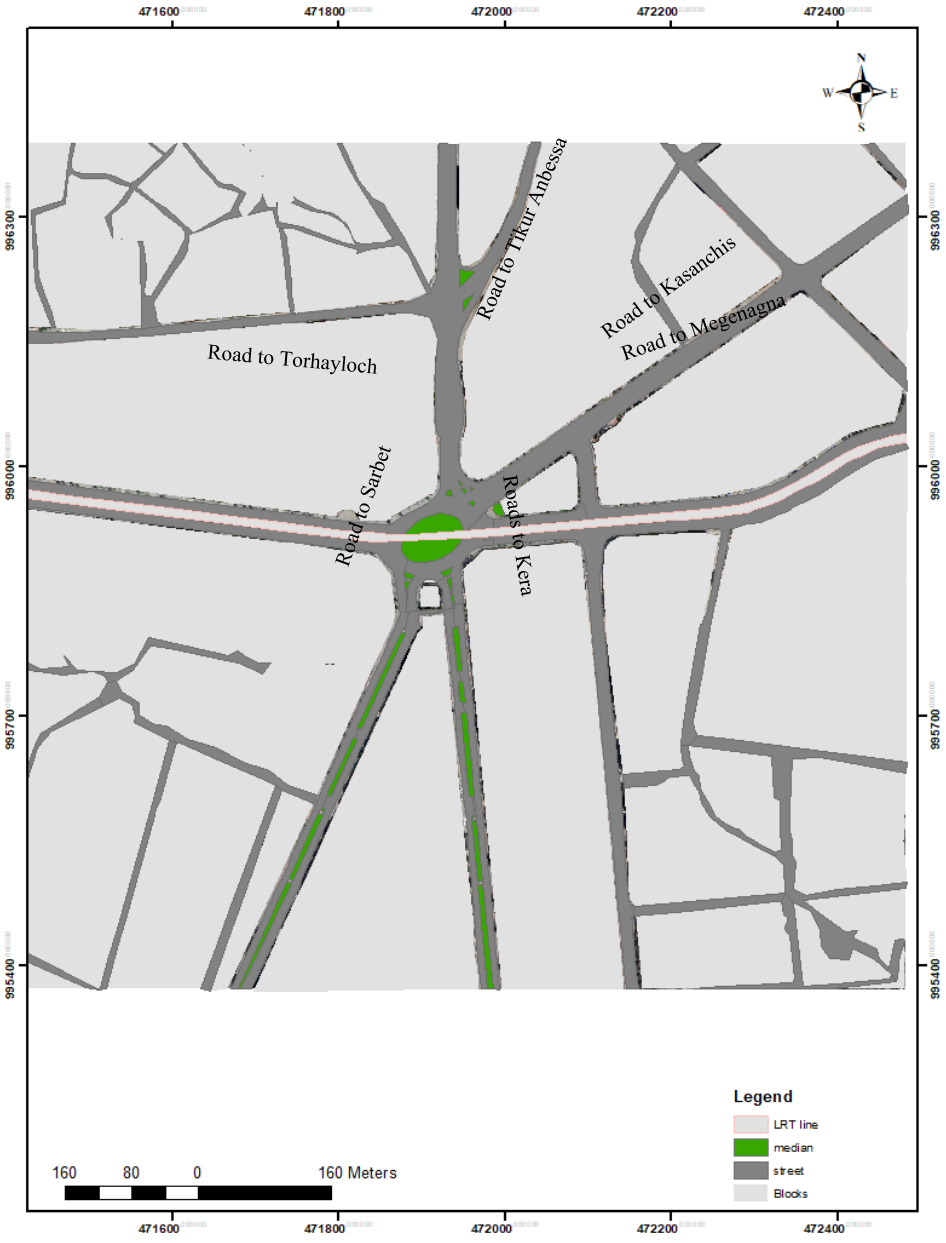

Figure 4. 52 Connectivity of Mexico roundabout

(Source: organized by the author)

The area is connected with major arterial streets that connect the study area to the different parts of the city. The site is linked highly to major and dominant parts of the city hence why the site is crucial in facilitating the public transport service of the city.

4.1.4.3.2 Public transport stations around the study area

There are 20 places serving as public transport stations in the study area, two of which located to serve the needs of the LRT route. The stations here mentioned are not all planned or designed for this purpose. Some are just spaces or places used as a public transport station.

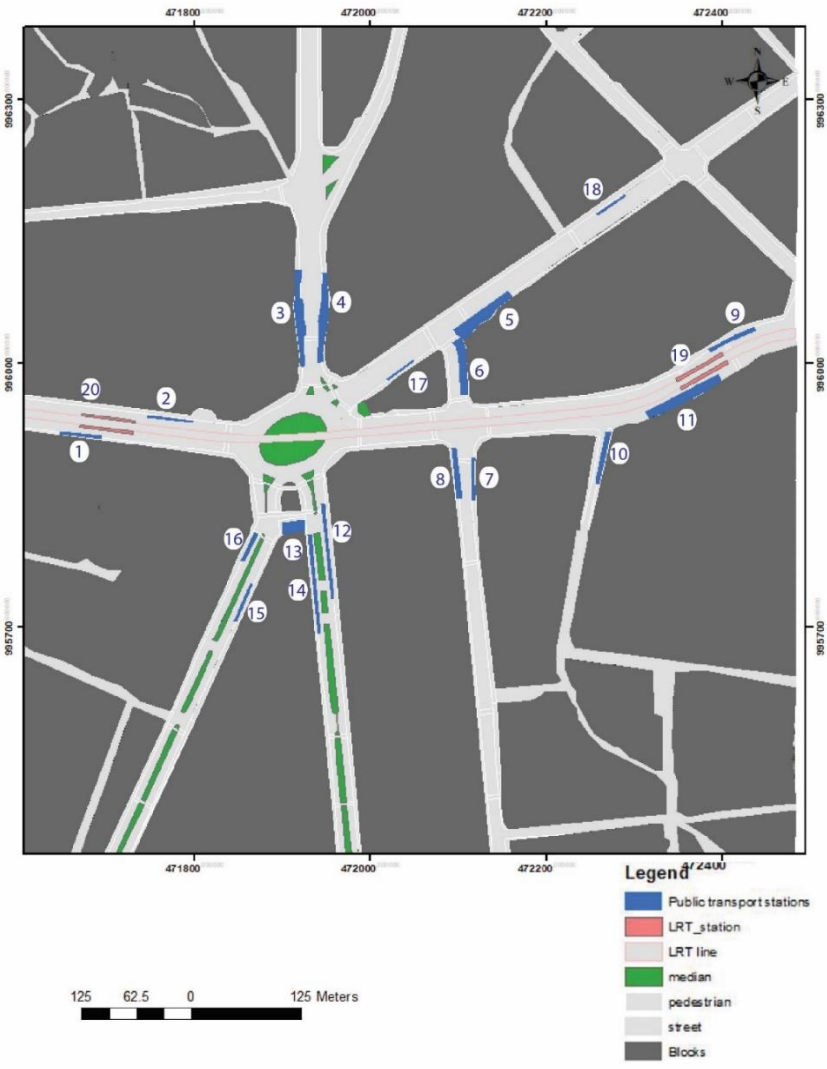

Figure 4. 53 Public Transport stations around Mexico roundabout

(Source: organized by the author)

Figure 4. 54 Public transport stations around Mexico roundabout and corresponding label numbers

(Source: organized by the author)

The public transport stations have different uses for different modes. Some are used only used for the purpose of dropping off public transport users while others are only used for loading passengers and some station serve both purposes. Listed below on table 4.4 we can see the purpose of each station and the transport modes that use them.

Table 4.12 Public transport stations of the study area and label numbers with their functions

Station label number	Transport Modes using the station	Use of station
1	Bus , Minibus taxis	Drop off station, Loading station
2	Bus , Minibus taxis	Loading station
3	Bus , Minibus taxis	Loading station, Drop off station
4	Bus , Minibus taxis	Loading station
5	Bus , Minibus taxis	Loading station
6	Minibus taxis, Higer	Loading station, Drop off station
7	Minibus taxis, Bus	Drop off station
8	Minibus taxis, Bus	Loading station
9	Bus , Minibus taxis	Loading station, Drop off station
10	Minibus taxis	Loading station
11	Higer bus, Bus, Minibus taxi	Loading station
12	Minibus taxis	Drop off station
13	Bus	Loading station
14	Minibus taxis	Loading station
15	Bus , Minibus taxis	Drop off station
16	Bus , Minibus taxis	Loading station
17	Minibus taxis	Drop off station
18	Bus	Loading station, Drop off station
19	LRT	Loading station, Drop off station
20	LRT	Loading station, Drop off station

(Source: organized by the author)

4.1.4.3.3 Transfer paths of the study area

The approach of the study has been to focus on the physical space where people transfer between two modes of transport. The path required to travel to make a transfer amongst the above mentioned stations vary in types and nature. Some stations in the study area are very close to each other and do not require crossing a street while other stations are very apart from each other and crossing multiple streets is required to make a transfer.

The transfer paths also differ in the straightness and their continuity of path. Hence, a few transfer paths are straightforward and easy to reach while some are very crooked and require change of direction. Similarly, the continuity of path of the transfer path differs amongst the different transfer paths. Hence, it can be observed that some transfer paths like the station 6 to station 9 are uninterrupted routes, while the transfer path from station 3 to station 10 is interrupted five times with two-way facing streets, making it a highly discontinued and interrupted path. A close

illustration of some of the paths traveled to make a transfer is in red and the crossing required in black is shown in the figures below.

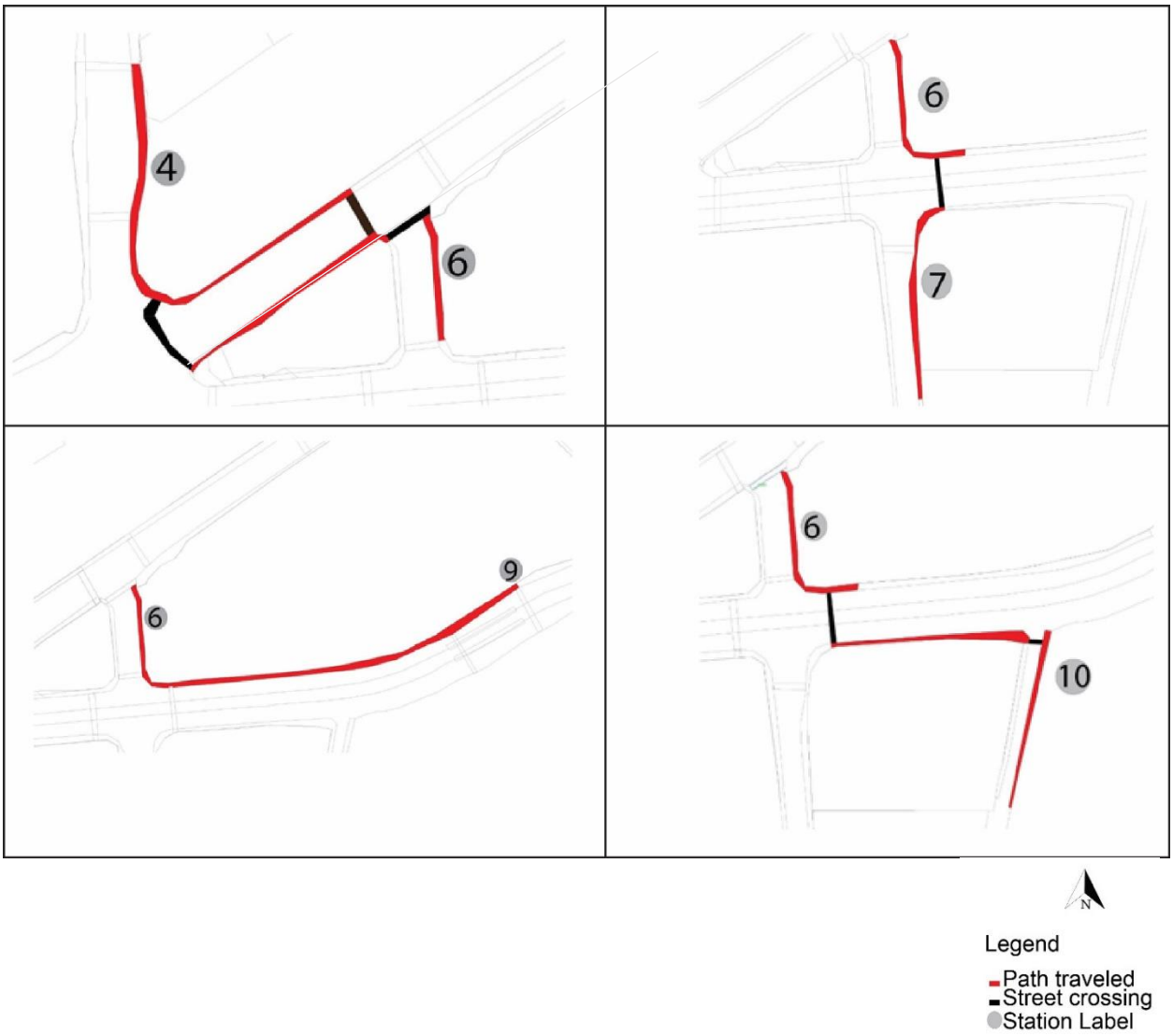

Figure 4. 55 Further illustrations of Transfer paths of Public transport stations around Mexico roundabout

(Source: organized by the author)

Some transfer path such as the path from station 3 to station 10 and station 10 to station 15 are more than 600 meters apart and require crossing more than 3 two-way streets which makes 6 crossing points. These are risky and tiresome transfer paths.

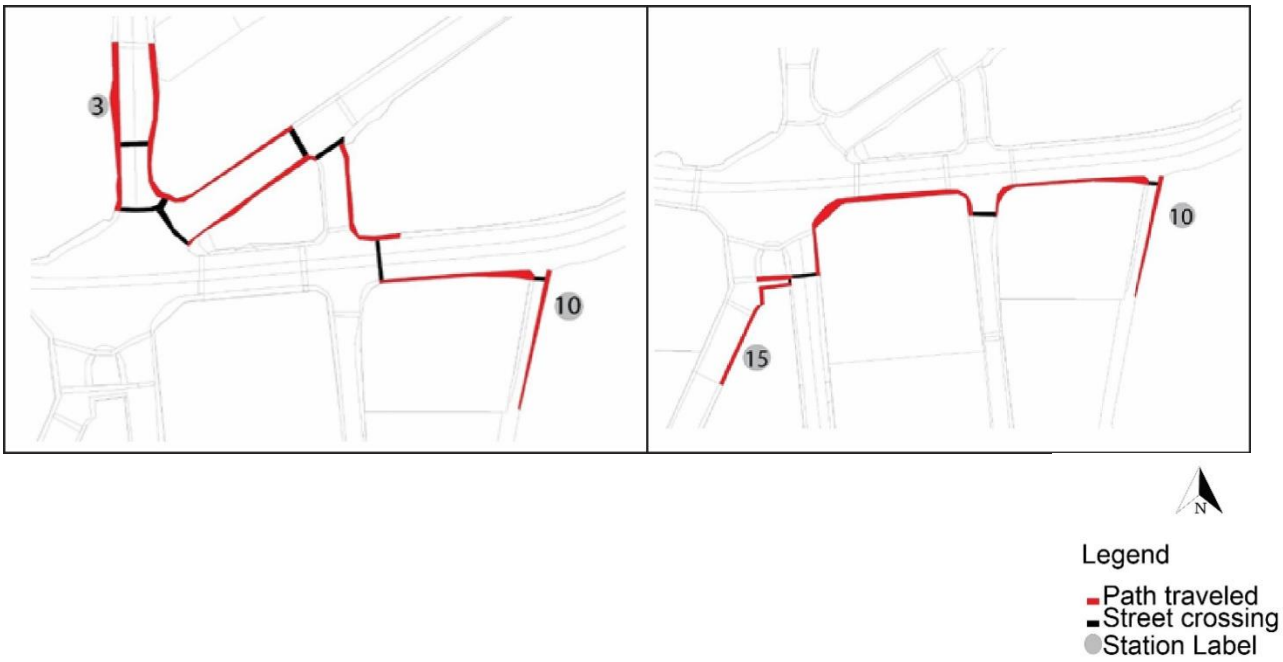

Figure 4. 56 Further illustrations of transfer paths of Public transport stations

(Source: organized by the author)

4.1.4.3.4 Origin destination matrix of public transport stations in the study area

Based on the path traveled to make a transfer the station-to-station distance can be analyzed using an origin-destination matrix. Table below shows the distance in meters needed to travel for a user to walk to different stations. The table 4.5 shows the distance of the stations amongst each other measured in meters taking in to account the formal crossing points and paths required to walk to the other stations.

Table 4.13 Origin destination matrix of the public transport station showing results of the distance measurement

Station's label	Station's label																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1		114	365	387	485	528	484	470	769	632	681	367	274	351	360	280	461	750	751	23
2	114		246	240	310	401	535	290	731	593	630	285	212	298	319	219	316	569	708	70
3	365	246		23	300	292	464	442	560	477	535	317	316	424	449	352	232	476	559	294
4	387	240	23		206	242	306	280	404	461	509	320	273	343	394	371	187	394	536	312
5	485	310	300	206		40	209	221	427	325	370	349	339	360	500	447	102	192	397	498
6	528	401	292	242	40		180	185	361	283	323	344	370	365	467	403	107	254	330	476
7	484	535	464	306	209	180		22	368	209	256	322	340	364	422	400	265	467	327	505
8	470	290	442	280	221	185	22		377	215	280	250	291	316	407	350	190	437	334	458
9	769	731	560	404	427	361	368	377		239	114	601	648	624	713	682	439	634	65	843
10	632	593	477	461	325	283	209	215	239		87	454	465	482	536	517	361	539	169	659
11	681	630	535	509	370	323	256	280	114	87		472	553	550	626	588	429	594	33	711
12	367	285	317	320	349	344	322	250	601	454	472		35	26	144	87	264	556	563	363
13	274	212	316	273	339	374	340	291	648	465	553	33		38	104	57	284	572	600	308
14	351	198	424	343	360	365	364	316	624	482	550	26	38		155	108	305	593	639	330
15	360	319	449	394	500	467	422	407	713	536	626	144	104	155		81	394	667	659	386
16	280	219	352	371	447	403	400	350	682	517	588	87	57	108	81		348	629	692	282
17	461	316	232	187	102	107	265	190	439	361	429	264	284	305	394	348		296	637	286
18	750	569	476	394	192	254	467	437	634	539	594	556	572	593	667	629	296		572	614
19	751	708	559	536	397	330	327	334	65	169	33	563	600	639	659	692	637	572		749
20	23	70	294	312	498	476	505	458	843	659	711	363	308	330	386	282	286	614	749	

(Source: organized by the author)

The figure 4.5 below shows the summed proximity distance a station is nearer or further from other stations. The data reveals that stations with the label of 9,18,19,20,11 and 1 are placed very far away from the other stations while stations 4,5,6,17,8 ,12 and 13 are placed with a much closer distance to other stations making them much more accessible and physically integrated to one another and to other stations.

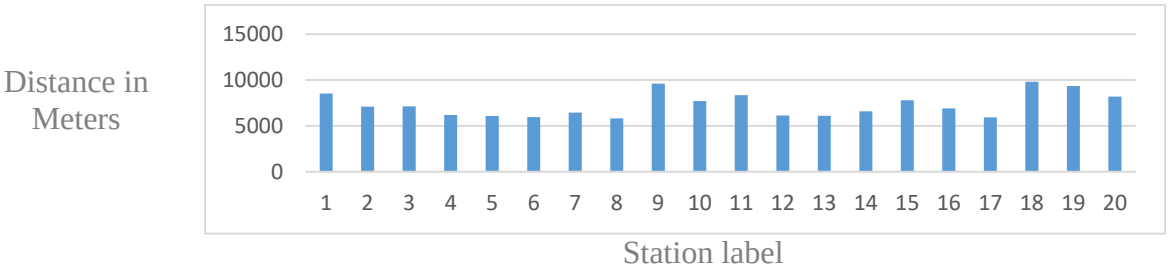

Figure 4. 57 Graph showing the summed distance proximity of the public transport station to each other

(Source: organized by the author)

4.1.4.3.5 Street crossing required for transfer

Figure 4. 58 Street crossing points for the public transport users of the area

(Source: organized by the author)

There are 59 crossing points provided for public transport users to make their transfers to the 20 station areas of which 2 are of the LRT located around Mexico roundabout. The public transport users, to make their daily transfer frequently uses these crossing points. These crossing points are the formal planned crossing points marked with zebra crossing, however there are informal crossing points regularly used by users to make their transfers. Although there are facilitators that guide pedestrians to cross during peak hours this crossing points are not accompanied by signalized pedestrian crossings.

4.1.4.3.6 Pedestrian Network

There is more than 40 thousand meter square of delineated pedestrian network in the delineated study area . The pedestrian network is interrupted with different street crossings, fencing structures, informal market vendors and parked cars, causing distress and inconvenience to the pedestrians making their transfers. In addition the path has, cracked walkways, and non-covered utility holes which creates more discomfort for the transferring users.

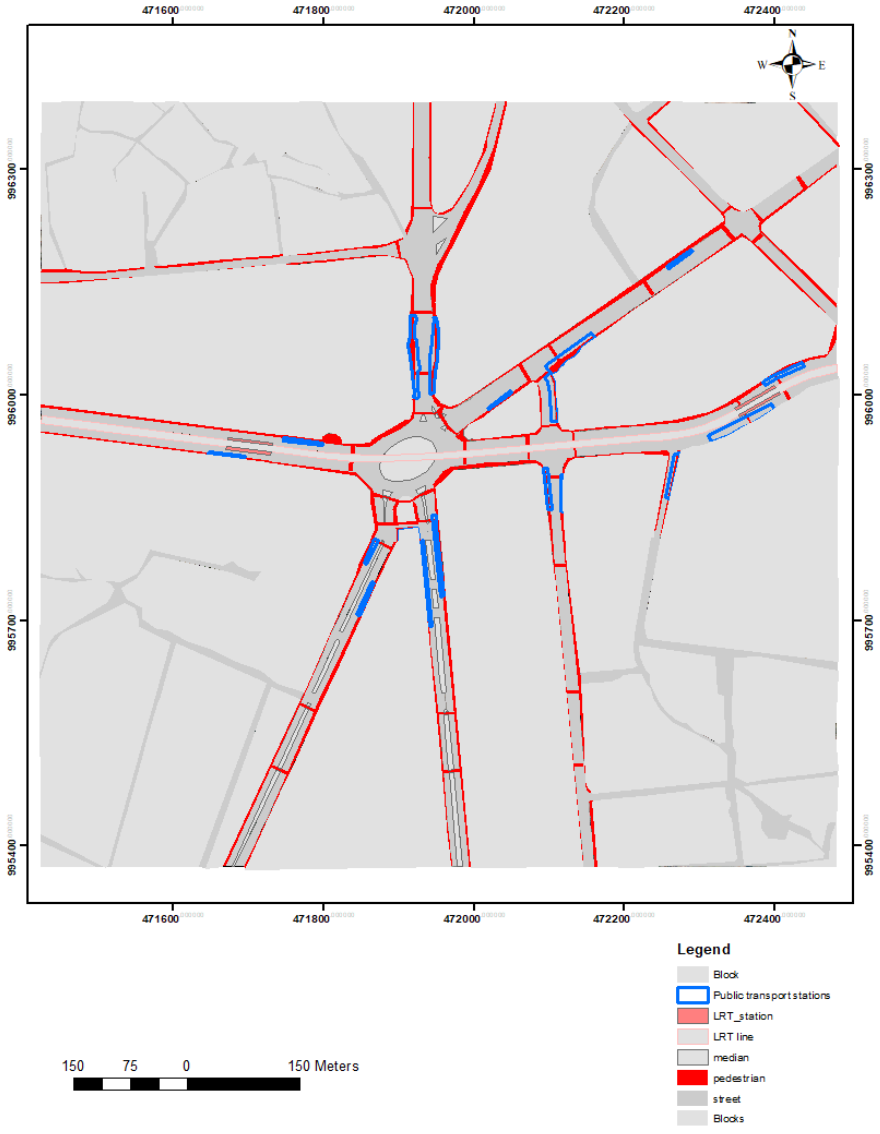

Figure 4. 59 The pedestrian network around the Mexico roundabout

(Source: organized by the author)

4.1.4.3.7 Pedestrian Activity map of the study area

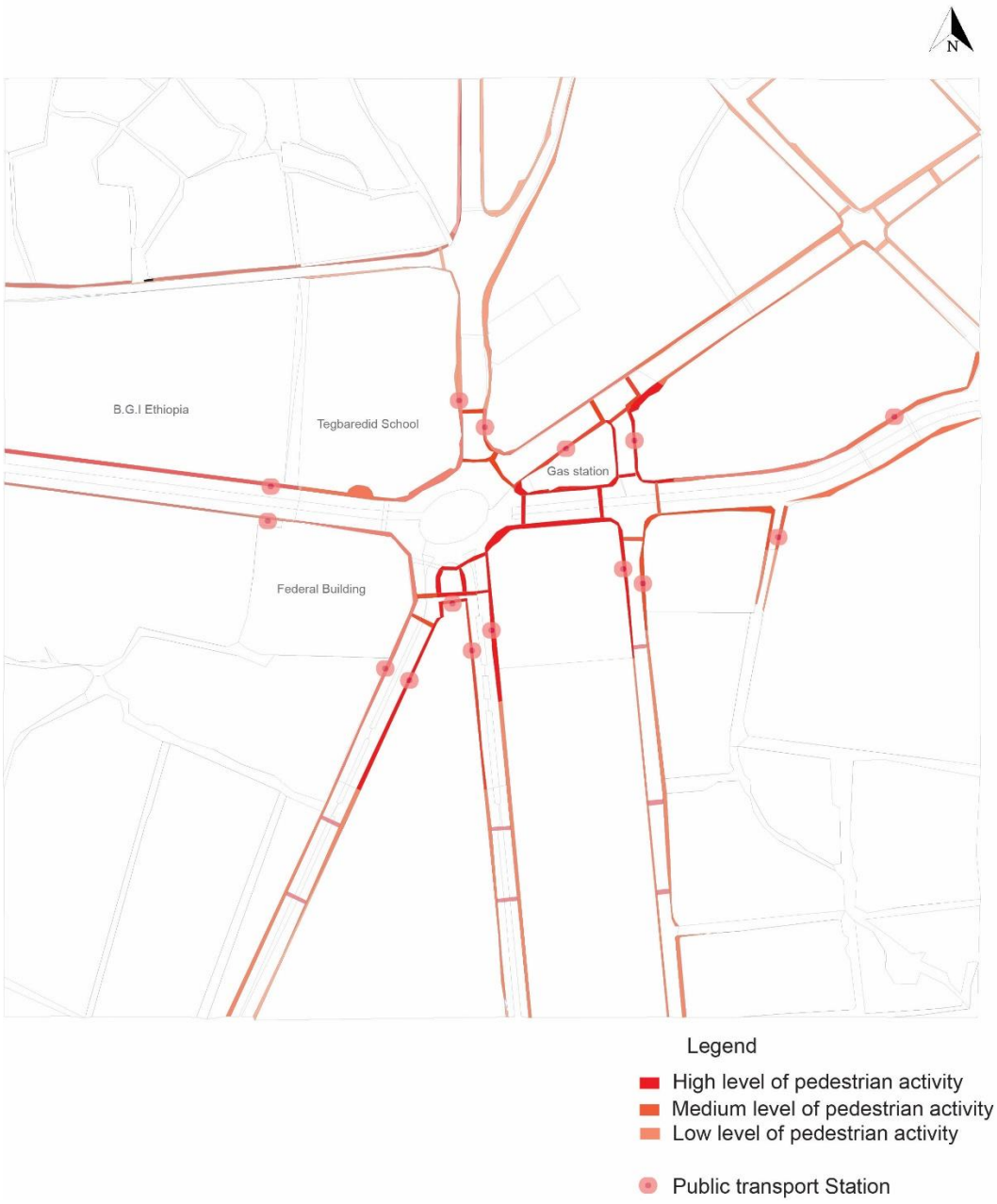

Figure 4. 60 Pedestrian Activity map of the area around Mexico roundabout

(Source: organized by the author)

Analysis of pedestrian flow characteristics constitute one of the foundations of urban traffic planning. This map shows the pedestrian movement and activity that are of fundamental importance in making the transfer. The flow map of the pedestrain was constructed using observational data and the activity can show that there is a huge number of pedestrian flow around

the gas station and walkways adjacent to it and across south from it. The pedestrian network's level of activity is higly influenced by the placement of the transport station. The majority of the pedestrian activity is the users trying to transfer to another mode of transport on another station.hence the data shows a large increase of activity in between stations than exterior of them. These areas are crowded and can cause stress, as it can be difficult to navigate around to the specific stations.

4.1.4.3.8 Analysis of transfers in accordance to Weather conditions in the study area

Exposure to weather elements during transfer is one of the factors that make a specific transfer undesirable and affect the perception of transfer experience. The weather conditions that make transfers undesirable are exposure to harsh suns or rain. The study area is located in Addis Ababa and according to analysis of climate and temperature's it is estimated that Addis Ababa is provided with on balance 1089 mm (42.9 in) of rainfall per year, or 90.8 mm (3.6 in) per month. On average there are 148 days per year with more than 0.1 mm (0.004 in) of rainfall (precipitation) or 12.3 days with a quantity of rain, sleet, snow etc. per month. It is important to assess the transfer path in perspective of protection against harsh sun or rain. The public transport user should be sheltered from the unsuitable weather conditions of the city.

According to the findings of the study it can stated there is lack of any planned or designed sheltering objects or area that is placed to protect the public transport users during harsh weather time. The paths connecting all station currently do not have sufficient shelter amenities to protect the public transport users making transfers during harsh weather times.

The buildings that are located around the public transport stations do not support this function they are not designed to have exterior arcades to create a covered walk way for pedestrians.

Figure 4. 61 Image showing the station (A) areas and paths (B) do not have any shelter (Source: organized by the author)

4.1.4.3.9 Landuse of the study area

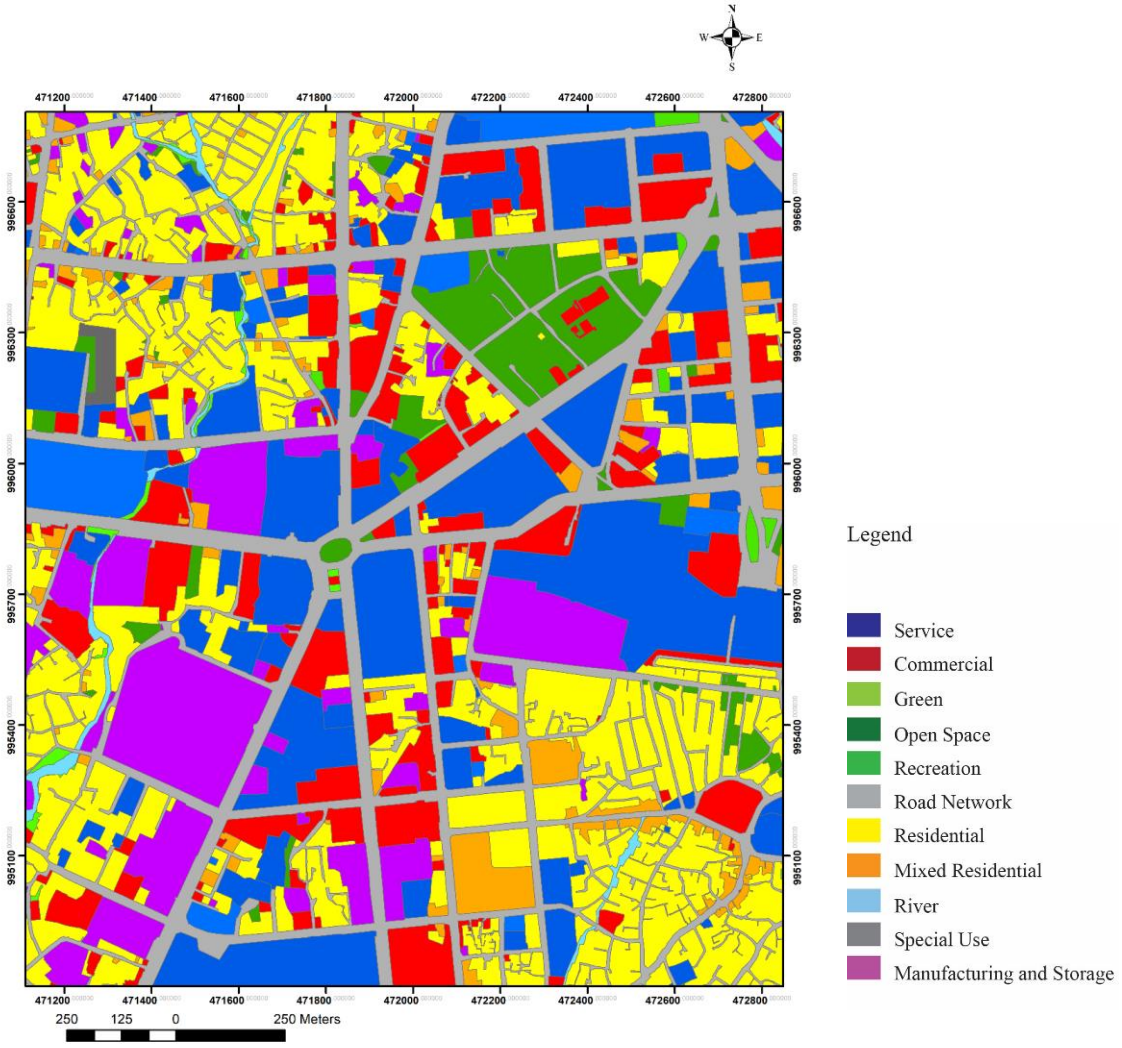

Figure 4. 62 Land use of the Mexico roundabout

(Source: organized by the author)

It can be observed that the majority of the land use around the Mexico roundabout is occupied by the road network (36%) followed by residential (28.44%) and different administrative and municipal services. In addition, the majority of the functions around the Mexico roundabout are dominated by government institutions followed by manufacturing and storage services, which are known to be huge contributors for increment in people and traffic flow.

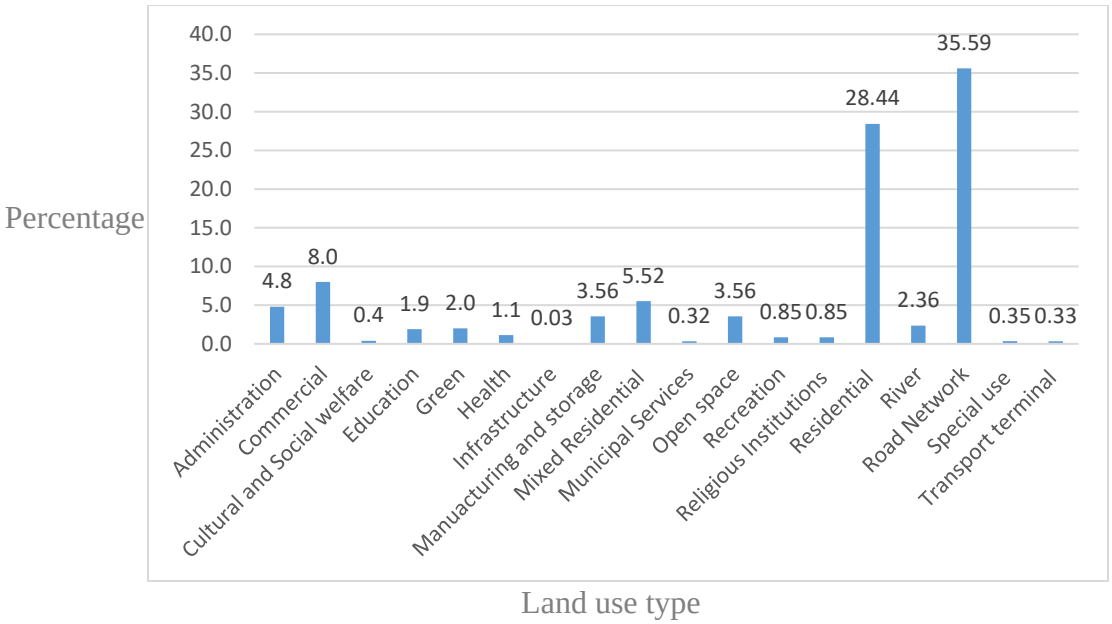

Figure 4. 63 Graph showing the percentage share of the land uses around Mexico roundabout (Source: organized by the author)

Space in urban areas is a scarce resource however, it is essential to include and integrate public transport spaces and future public transport interchange and terminal spaces for such a crucial public transport hub of a city. In addition, here so it can is observed that there is absence of space dedicated for urban public transport terminal or interchange terminal for this study area.

The study has found numerous sites around the study area, which meet the specifications of serving as a public transport interchange facility being leased out by the municipality for other purposes. This is a huge loss for the city as a whole, which loses critical opportunities, and spaces, which have the ability and role to play in increasing the physical integration of public transport stations.

4.1.4.3.10 Structural plan of the study area

The future structure plan of the city of Addis Ababa has included the construction of a city wide bus rapid transit(BRT) and a Mass rapid transit(MRT) the map shows that both of this future projects are passing through and nearby the Mexico roundabout bringing more traffic and influence to the area. This increases the site's importance and influence on the public transport network's integration of the city.

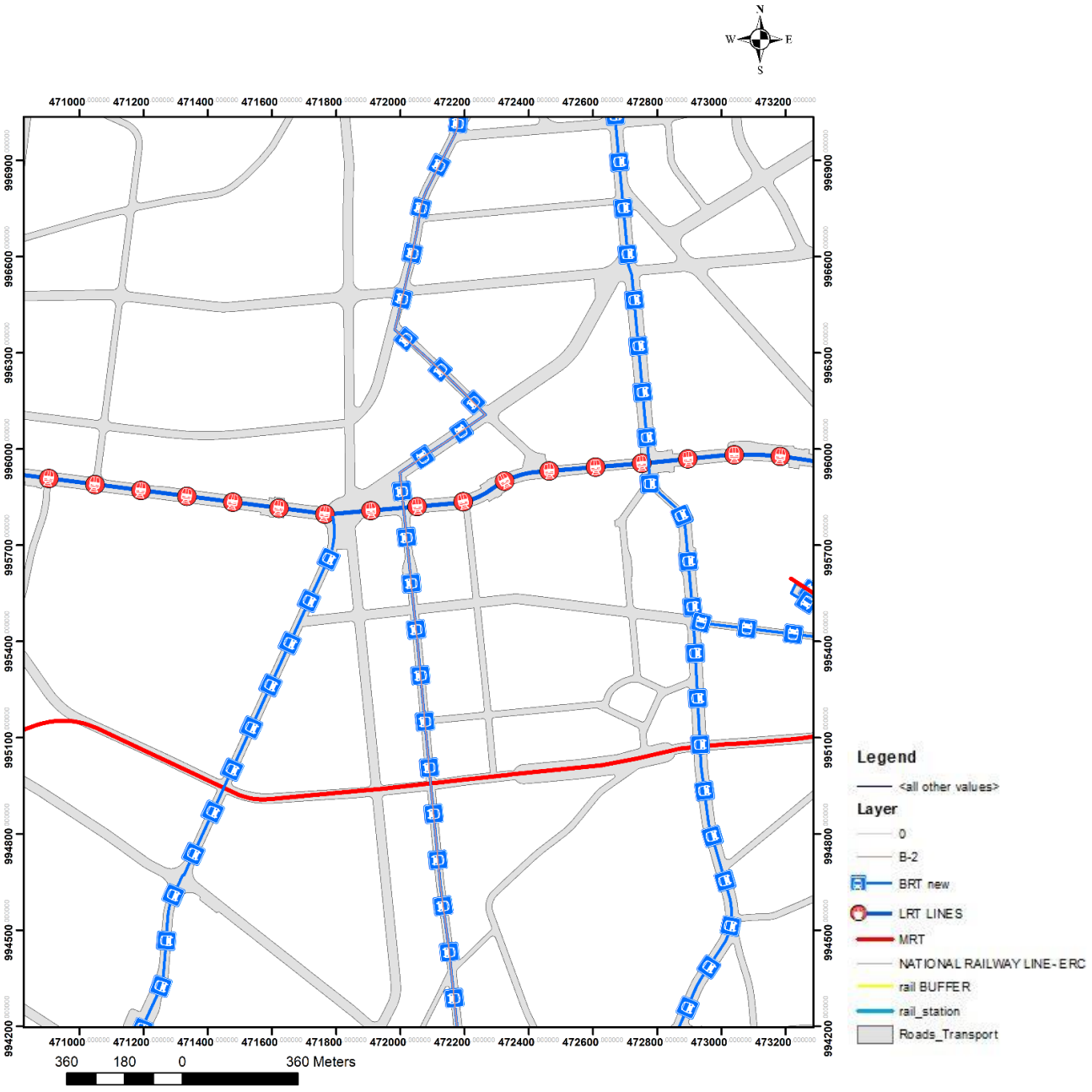

Figure 4. 64 Structural plan of the Mexico roundabout area

(Source: Addis Ababa transport Authority, organized by the author)

4.1.4.3.10 Interviews with stakeholders

As stakeholders appear to be the key players in the planning and operation of public transport services, supporting their engagement and enhancing their cooperation in the planning, design and operation of public transport is crucial to address the problem.

There are three groups of stakeholders that affect public transport integration: decision makers, service providers and end users. In particular to the study the decision makers are the Addis Ababa transport authority the service providers are the Anbessa city bus operation managers and the individual vehicle owners of the Higer bus and minibus taxis and lastly the end users are the public transport users of the area.

Existing transport policy and the involvement of governments are the two principal factors in development of multimodal integration of public transport.

4.1.4.3.10.1 Decision makers

The previous master plan of Addis Ababa mentioned amongst its recommendation to improve the urban transport challenges the city faces was "to improve the efficiency of the city's public transport service and traffic management system, to provide the required bus stops, to build the capacity of concerned institutions in planning and management so as to upgrade them in performing urban transport planning and management". It has been understood from the statement that there is a desire to increase the efficiency of public transport services of the city however; it falls short in mentioning or including the need to integrate and design for multimodal integration of public transport service.

The transport policy of Addis Ababa city was also published on August 2011. It detailed the problems the transport problems the city faces and the recommendations and the future prospects the city should aspire to achieve in regards to urban transport. One of which was giving attention to inter and multimodal public transport and the different suppliers involved to enable an "integrated and convenient service to users". In addition, the strategies also stated are "organize and strengthen prevailing scattered private sector operators and deploy them in the provision of mass transport service". Furthermore, the policy mentioned, "developing standards, integrated and coordinated system for the mass transport service provided in the city and organize public and private operators forum and share best practices of other cities convenient to its users". It also illustrated the need for interchanges describing the strategy as "deliver convenient inter modal mass transport service for transfer in terminals". The transport policy of Addis Ababa has better awareness and notions to improve the multimodal integration of the city. The policy also included the interest in decreasing the private car ownership by stating "Take measures that initiate private car owners to use mass transport". It can revealed from the transport policy of the city that there is a huge desire to increase

the quality of public transport service of the city and decrease private car ownership in the process. There is a strong mention of efficient public transportation system and an integrated multimodal public transportation service.

However, in reality it cannot be overlooked that there is very few being done to improve the multimodal integration of public transport services. There is also hardly anything done to improve the transfer experience of the public transport user. The city does not have any facilitated public transport interchanges in majority of the public transport centers, which can protect users from harsh weather conditions of the area by providing shelter.

4.1.4.3.10.2 Service providers

The service providers are the key stakeholders to accomplish a multimodal integration of public transport. The challenge of multimodal public transport integration was assessed from the perspective of the service providers using informal interviews. One of the interviewed stakeholders was the authorities in charge of planning of the city bus routes and stations. The planning authority personnel stated when asked about the consideration of integrating service with other public transport options. That it is not something that the public transport service provider considers. They focus on their "own routes and designated stations". "We have a lot of customer base and lots of old buses to maintain and need to get operational , our priorities are set on that issue". In addition, the personnel replied that recently the city's transport authority has overtaken the task of assgning routes and designing station and integrations with other public transport providers.

The city bus planning personnel also replied that they have given priority to route optimization and efficiency. Solving redundant routes by sharing and dividing routes amongst the anbessa city bus provider and sheger city bus provider. This was intended to increase service coverage and profit by maximixing efficiency.

Similarly, from the privately owned minibus taxi owners and drivers it was the same response. They stated in their interviews that "we have our dropping and loading stations and also have assigned routes there is little we can do to change that". The minibus owners further specified the transport authority is the one in charge that assigns routes and manages them. Further more the minibus taxi drivers requested more freedom to be given to them in picking their work routes as it benefits them and their customers.

4.1.4.3.10.3 End users

The study has conducted a close-ended intercept survey to assess the transfer experience of the public transport users of the study area. However, it was important to further analyze the experience of the users by using other methodologies like interviews to further enrich the analysis of the transfer experience. Hence, interviews were held with different public transport users of the area.

The public transport users making their transfers in the area explained their tiresome transfer experience. “It is very difficult to make a transfer during the rainy season and the harsh sun is very tiring” explained a young interviewee. “I always carry an umbrella in my purse to avoid the harsh sun and sometimes rain that I have to deal with while making a transfer,” said a women heading to work in the midday. She further explained that she had lost her cell phone while making a transfer in this area. “The rush and concentration of people making transfers has made it easy for the robbers to steal from the users” explained another interviewee.

The final portion of the survey included an open-ended question for respondents to express their recommendations on how to improve the public transport transfer experience in their own words. It was also believed to be an eye opener for new parameters and issues that affect the transfer experience.

Accordingly from the 668 usable questionnaires most of the open question have a low response rate. Hence, only 30% of the open-ended question have been tempted. The responses were categorized, and collected in themes except the recommendations that are out of context or out of scope for the study. The summary is listed below on table 4.9.

Table 4.14 List of recommendations by respondents to improve their transfer experience

List of recommendations by respondents to improve their transfer experience	Number of people who recommended it
The tight control of informal street side vendors	53
A wider pedestrian walkway to increase people’s flow	45
Long and uninterrupted transport route options	32
Better and comfortable walkways for disabled and older people	15
Increase in ticketing stations for LRT users to increase access	18
Safety and security improvements	21
Decreasing distance between public transport stations	4
Provisions of shades and sitting area for hard weather transfers	12

(Source: organized by the author)

4.2 Discussion of the results

4.2.1 Demographic, modal choice and trip characteristics of the respondents

For this study, from 700 respondents 668 were considered as usable and complete. The demographic character of respondents reveals that 58% are men and 42% are female in their genders. Observing the age classification of the respondents it is clear to see that the majority of them are of a young age with 21-30 years being 53.7%. Moreover, the occupation of respondents was included in the survey and 15.9% are students and 68.9% are full time employed. The majority of the public transport user are full time employees, which correlates to a strict time schedule and in turn implies there is a need and requirement of efficient public transport service.

The findings of the study about the trip behavior of the respondents, the purpose of the trip and the rate of the trip reveal that the majority of the trips made by the respondents consist of the work trip, which accounts for 60%. Following the work trip the education trip is 10%, visiting family consists of 6.6% and lastly leisure 3%. In addition to the purpose of the trip the repetition of the trip data can reveal that more than 50% of the respondents make their trip on a daily basis and 15% make their trip very often. The data can show that most of the respondents make

The data from transfer rate of the respondents throughout the day shows that 42% of respondents make 1-2 transfers per day while 51% make 3-5 transfers per day and only 2% make 9-10 transfers per day. The data shows that, for the respondents, transfer is a crucial and redundant part of their journey. In addition, the improvement of the transfer experience or the reduction of number of transfers required to finish their journey can have huge impact in increasing their satisfaction towards the public transport service.

Considering the transfer time of the respondents trip 72% picked 6:00-9:00 am as the first transfer time for them. Furthermore, 4:00-7:00 pm was the transfer window for 60.5% of the respondents. There is concentration of people transferring during the above periods and this can create inconvenience for the users as the pedestrian walkways can be congested and suffocated.

The origin and destination routes of the respondents was compiled, and it reveals that, respondents from Sarbet Mekanisa and Jemo area consist of 26.2% of the respondents origin followed by Kera area and Megenagna route with both consisting of above 16%. All others routes are less than 6% of origin of trip. The destination routes of the respondents gives increment to the Megnagna 22

route consisting of 22.2% of destinations of the respondents. In addition, the Sarbet Mekanisa Jemo route consist of 18.3% of destination and the Torhayloch Kara area consisting of 14.2% of destinations. The findings of the origin route and destination routes of the respondents reveal that there are four major routes from the nine routes connected to the study area. The Megenagna route, the Torhayloch route, the Sarbet Mekanisa route and the Kera saris route are the major routes that the respondents access and egress.

In addition to the demographic and trip character of the respondents, their transportation modal choice was included in the study. The data reveals that 51% of the respondents use Minibus taxis the second ranking mode of transport is Bus transport with 24% of the respondents followed by Walking with only 5% of the respondents using the LRT and 3% Higer bus. The data reveals that there exists a multimodal transport integration and respondents are multimodal in their trip character using different modes of transport to complete their journey. However, the data explains that users of the minibus taxi service are more reliant to use the same mode of transport for access and egress from the study area they are also more favored than any other mode of transport. The data from the transportation modes used to access and egress the site it can inferred that for longer routes respondents tend to favor Bus service and Higer and for shorter trips respondents favor minibus taxis.

The distance traveled by respondents was measured to understand how much distance the respondents had to travel to make the transfer. The data reveals that more than 30% of respondents had to walk 400-500 meters to make a transfer to another mode of transport. It also shows that 6.9% had to walk 350-399 meters to make a transfer. Similarly, 9.3% walked 300-349 meters, 7.9% walked 250-299 meters, 6% walked 200-249 meters, 10.9% walked 150-199 meters, 10.2% walked 50-99 meters and finally 18.7% walked 0-49 meters to make a transfer.

4.2.2 Effects of transfers on the public transport user by analyzing user satisfaction

A Likert scale was used for the respondents to assess the physical integration of public transport stations; this would entail a satisfaction survey by the respondents about the transfer experience in respect to the different parameters of the transfer. There were 14 parameters set to assess the transfer experience in detail. The distance traveled from the drop off public transport station to their next egress public transport station is one of them. The respondents were questioned how much they were satisfied by the distance walked to make the transfer and 15% stated that they were very

dissatisfied while 34.7 % claimed they were dissatisfied by the distance. In addition, 25.3% of the respondents answered neither while 15.9% claimed they were satisfied and 9.1 % of the sampled respondents were very satisfied with the distance they walked to make the transfer. On average, more than 35% of the all age groups shows dissatisfaction towards the distance they had to travel to make the transfer. The satisfaction level seems to show slight increment as the age group decreases. The findings also show a direct connection with the distance the respondents traveled to make a transfer and their satisfaction towards the parameter. The more they travel to make a transfer the less satisfied they were with the parameter.

On the other hand the Continuity of path is one of the parameters that affect users perception or satisfaction of a path traveled during a transfer. The majority of respondent answered neither (31%) while still 24% responding that they were dissatisfied and 8.5% very dissatisfied with the path's continuity. However, 26.2% of the sampled respondents are satisfied and 9.7% are very satisfied.

Additionally the respondent's satisfaction towards the Convenience of path traveled to make a transfer parameter 31.6% of the respondents answered neither ,while 27.4% of the respondent replied dissatisfied and 16.5% of the respondents answered very dissatisfied. In addition to the above respondents 18% claimed they were satisfied with convenience of the path and 6.4 % were very satisfied with the parameter while making their transfers.

The attractiveness of path traveled to make a transfer parameter and the slope of the path traveled to make a transfer are the parameters that have better satisfaction rate with majority falling under neither satisfied nor dissatisfied. The first parameter as reported consisted of 29.6% of the respondents having reacted "Neither" for their satisfaction level of the attractiveness of the path they traveled to make a transfer. While 25.9% answered "Dissatisfied" and 25% replied that they are "Very dissatisfied" with the attractiveness parameter of the path traveled to make a transfer. Likewise the slope of the path parameter has a 34.9% neither response, 14.8 very dissatisfied and 7.3% very satisfied rate. On the other hand, observing the transport mode the respondents used to enter the study area and their response on the slope of the path they traveled the data shows that the LRT users increase in dissatisfaction almost 67% of the users are "Very dissatisfied" with the slope of the path they traveled and 16.7% are "Dissatisfied" with the slope. However, the users of Minibus taxis and Bus higher response in "Satisfied" with 22.1% and 24.2% respectively.

The conditions of sidewalk parameter is one of the parameters with a high dissatisfaction rate of almost 50% of the respondents showing they are dissatisfied and very dissatisfied. The straightness of route parameter and the time taken to walk from drop off station to exit station parameters has done much better with most of the respondents being neither satisfied nor dissatisfied. However, in the time taken parameter the time schedule of the respondents transfer has shown to be a factor. Hence, peak hour transferring and harsh sun time transferring respondents has shown more dissatisfaction towards the time it takes to make the transfer.

There is better understanding of the satisfaction parameter of the number of streets crossed when cross-tabulated with the actual distance the respondents had to walk to make the transfer. The data reveals that the respondents who travel the longest have the higher dissatisfaction rate. Respondents that traveled 400-450 meters to make the transfer were 25.4% “Very dissatisfied” and 41.8% “Dissatisfied” with the number of streets they had to cross. Similarly, respondents that traveled 350-399 meters to make the transfer were 23.9% “Very dissatisfied” and 37% “Dissatisfied”. The respondents who walked 300-349 meters and 250-299 meters have similar characteristics to the above. However, the respondents who walked 50-99 meters and 0-49 meters have a small dissatisfaction rate with 8.8% and 5.5% “Very dissatisfied” rate respectively.

The other crucial parameter of a transfer is the perception of safety and security of the user while making the transfer. The data of this parameter revealed that more than 20% of the respondents are very dissatisfied and 25.4% are dissatisfied with the parameter. There seems to be also a connection with the gender of the respondents, as more females are very dissatisfied and with the parameter than male respondents. The age group also has a role to play in this parameter the older age groups have an increased dissatisfaction rate towards the parameter than the younger ones.

The easy transfer parameter assesses the perception of efficient condition of transfer amongst the respondents. More than 25% of the respondents voted dissatisfied and almost 20% voted very dissatisfied while 20% voted neither with the easy transfer parameter. In addition the easy transfer parameter looked at from the perspective of the distance the respondents traveled to make a transfer the longest traveling respondents had a very dissatisfied rate of 35% and a 40% of dissatisfied while the respondents who traveled the shortest distance had a very satisfied rate of 35% and a 40% satisfied rate. The result are related to transfer path analysis of the site as users with longer transfers

paths are required to cross different streets jostle through uncomfortable spaces to make their transfer.

The perception towards necessary requirements to make a transfer 22.8% of the respondents revealed they are very dissatisfied while 34.6% responded dissatisfied and very small portion of the respondents 3.1% claimed they are very satisfied with this parameter of the transfer. the result is consistent with realities of the site as there is lack of interchange terminal on the site placed to serve the public transport user.

The satisfaction towards making the transfer during any weather time shows that 32.7% of the respondents are very dissatisfied with the parameter while 29.9% are dissatisfied this correlates with observations made during the site as there are no sheltering objects placed on transfer paths to protect users from harsh weather times. In addition to this the anytime transfer data also shows a high dissatisfied rate with 26.9% Very dissatisfied and a 32.6% dissatisfied rate towards the parameter. The anytime transfer data of the gender subgroup reveals that the female are more dissatisfied with the parameter than male respondents are.

The route and modal choice of the respondents in accordance with the transfer experience was surveyed and it implies that more than 85% of the respondents claimed that the transfer experience affects their route and mode of transport choice for their required trip.

4.2.3 Major Variables that affect the perception of users in relation to physical integration

The finding of this study indicated that the majority of the transfer parameters have a satisfaction around “Dissatisfied” only a few have a closer response to “Neither satisfied nor dissatisfied”. There are no parameters with a mean falling on “Satisfied” or “Very satisfied”. Although some parameters of the transfer are doing much worse like ‘condition of side walk parameter’, ‘anytime transfer’ and ‘any weather transfer parameter’. The parameters that have better perception of satisfaction to the respondents are ‘the continuity of transfer path’ and ‘the straightness of transfer path’. The parameters that showed a high variance are the safety and security of the transfer path parameter and the perception of easy transfer assessed by the respondents. The skewness of the responses are between -0.5 and 0.5, this suggests that the data are symmetrical. Except the parameters of weather transfer and anytime transfer which are between 0.5 and 1 concluding the data are moderately skewed. All the parameters and responses have a normal distribution or an acceptable distribution.

The finding of the study based on the regression model analysis excludes the variables that are significant for the satisfaction parameters. The model concludes that for every 50 meters increase in distance traveled to make a transfer there is 0.63 factor increase in the dissatisfaction of the user towards the distance parameter of the transfer. The other parameter affected by distance is the perception of number of streets crossed to make a transfer. The findings shows that for every one unit meaning in this case fifty meters walked by the respondents their satisfaction towards number of streets crossed to make a transfer decreases with a 0.356 factor given that all the other variables are held constant. Finally, the distance walked variable affects the easy transfer parameter with a factor of 0.422 the more people walk to make a transfer the less they will be satisfied with the parameter.

The other significant factors in affecting the perception of transfer parameters is the users transfer rate throughout the day the more a person makes a transfer there is an increased dissatisfaction towards different parameters of the transfer. These parameters are the 'continuity of path traveled to make a transfer', 'the convenience of routes walked to make a transfer', 'the attractiveness of the transfer path'; the conditions of side walk on the transfer path and so on. This concludes that the more transfers a person makes the increase in dislikes of the different transfer parameters.

The results of the regression model also shows that the slope of the track traveled to make a transfer is influenced by the transport mode used by the respondents to travel to their next destination. This determines that transport modes like the LRT have altered the satisfaction rate of this parameter because users of the LRT have increased dissatisfaction towards this parameter than others.

The findings of the study also indicate that the female gender has a decreased satisfaction toward the safety and security parameter and it increases the chance of being dissatisfied with the safety and security parameter of the transfer with a factor of 0.511. The other variable that affects the perception of safety and security is the Age variable. The variable affects the parameter with a factor of 0.168. Finally, the variable that affects the perception of safety and security is the transfer time of the respondents. The model indicates with a factor of 0.430 that the transfer time of the respondents can significantly affect the perception of safety and security given that all the other variables are held constant.

The regression result also concludes that ‘any weather transfer parameter’ is affected by the respondents gender, trip purpose and transfer time. While ‘anytime transfer parameter’ is also affected by the gender and the transfer time of the respondents.

In summary, the variables that are highly influential in affecting the holistic transfer experience of the public transport user are the transfer rate per day of the user, the distance traveled by the user to make a transfer. The mode of transportation used also affects parameters like the slope of the transfer path while the gender of the public transport user affects the perception of safety and security.

The parameters that have left a negative perception on the users are mainly the conditions of sidewalk, any weather transfer parameter and safety and security of the transfer path. However, the majority of the parameter are still falling in dissatisfied range. Observing the results of the study it can be seen that Although there is a dedicated pedestrian sidewalk to facilitate the transfer experience, this loss of physical integration has created a huge number of public transport users, which are required to walk from their drop off stations to their exit stations. This also means by crossing a number of streets and passing through uncomfortable pedestrian walkways that are overcrowded with people and informal vendors. The physical problems are mostly related to boarding and alighting public transport modes at the study area, as well as crowding, which restricts smooth movement of the users. This transfer experience was one of the focus of the study by using different parameters users were asked to rank their experience. The findings show that the majority of the parameters are not satisfying to the public transport user, from the customer’s perspective; the quality of services provided by public transport is not at a satisfactory level. There is a need to mobilize and create and integrated approach to increase the efficiency of the public transport service and improve mobility of the users.

The above findings are similar to the results obtained by (Terzis & Last, 2000) in which the users physical reaction and psychological perception of the transfer experience is highly dependent on the design and operation of the public transport transfers. It is important to improve and enhance the transfer experience of the users.

4.2.4 The strengths and weaknesses of the public transport stations of the study area in relation to physical integration and creation of seamless transportation

The idea of integrating different modes of transport services to provide an efficient and improved seamless journey is a core issue for urban transport. Journeys are rarely made because of an innate desire to travel but are typically due to the need to travel to the places where numerous kinds of activities are carried on, such as work, shopping, studies, recreation, leisure, etc., all of which need travelling to various locations. The achievement of seamless one sit journey for everyone from origin to destination is an ultimate standard that seems to be futuristic and a hard idea to design and plan for with the limited resource and technology that exists in the world presently. However, what is the standard for a day to day journey that needs to be accomplished, How many interruptions and transfers are too much transfers, what is the standard for distance to walk to make a transfer, what is the standard transfer experience that should be expected, this are questions that needs to assessed and answered. A seamless journey is a one-chair transport service where a person travels from origin to destination by only sitting on one chair and thus this is achieved by private automobiles only and that is why an increment in number of private automobile is seen throughout the world. The public transport sector as seen in the findings of the study is far from seamless journey with a lot of walking to get the service and lots of transport transfers required to accomplish the journey.

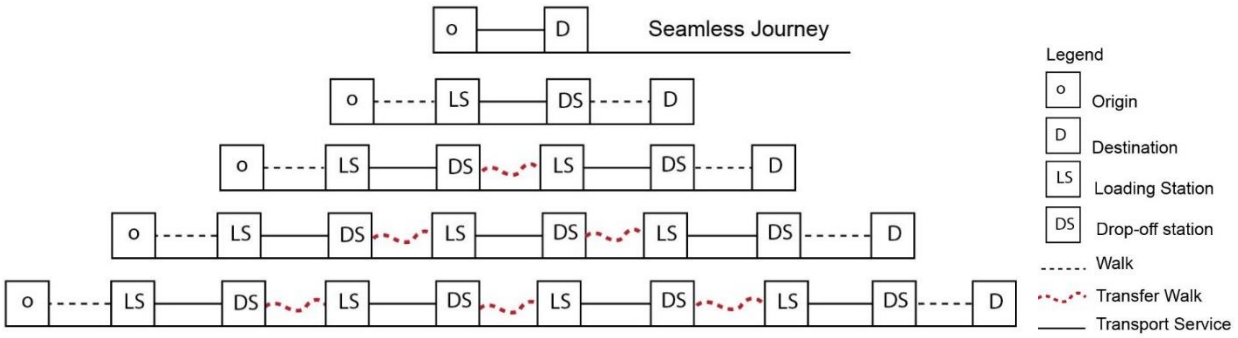

Figure 4. 65 illustration of day-to-day trips of public transport users

(Source: organized by the author)

The major points that needs to be addressed in the matter is how to deal with transfers. Because transfers are the key to address the physical integration of public transport. A physically integrated public transport service is a service where minimum transfers are required and those transfers are achieved with a minor walking distance with minimum jostles and high level of comfort and security. In addition, this foresaid transfer can be done with the same level of comfort and security

at any weather time and any time of the day. This is the level of public transport service that the future of urban transport should aspire to achieve. This case is crucial especially in a low-income capital city where the majority of the motorized transport modal share is dominated by public transport users like the city of Addis Ababa.

The study area named Mexico roundabout is one of the major public transport transit areas of the city where an agglomeration of public transport station 20 in number two of which are of the light rail transit are found this a huge potential of the area. The roads leading to the area are six in number but functionally they connect the area to all major parts of the city in all the directions , hence one of the reasons the site is significant and plays a huge role in facilitating the public transport network of the city. This is one of the major positive characters of the site the high connectivity and the multiple placement of public transport stations.

The future structural plan of the site has also cemented the site's significance as a public transport hub of the city. The structural plan shows the introduction of a new BRT (Bus rapid transit) line passing north south and east west of the site. There is also plan for constructing an MRT (Mass rapid transit) that passes with a near proximity to the roundabout. This further strengthens the multimodal integration of the different public transport options around the site. Moreover Most of the stations around the site are connected with delineated pedestrian network.

However, in the other hand it can be exposed that the public transport stations in the study area are not physically integrated to each other some stations are more than 700 meters apart. This in turn created a situation where there is a need for transfer walk for a huge number of public transport user with unintegrated distant public transport stations. The public transport sector should enable seamless mobility, travel efficiency, increase user satisfaction and improve performance of the sector. The focus is to ensure that all users be given equal opportunities for reaching their destination, to optimize interconnections between alternative modes in the trip and, at the same time, ameliorate public transport space utilization and integration.

The other weakness the findings reveal about the study area is the lack of any planned or designed sheltering objects or areas that are placed to protect the public transport users during harsh weather times. It is clear to observe why the any weather transfer parameter has a high dissatisfaction rate amongst the public transport users.

The huge number of people, which are required to cross the arterial streets to make their transfers, have also created another problem to the area, which is Traffic congestion. Frequent operational bottlenecks were created by transport services dropping off passengers and loading passengers, traffic-influencing event such as pedestrian crossing were among the main causes of traffic congestion on the study area. These are the associated problems caused by a huge number of people's making public transport transfers by crossing a number of streets.

The respondents had a numerous number of recommendation on how to improve their transfer experience. It was categorized and compiled in to eight issues. The most recommended was to put a tight grip or find solution to the informal street vendors that use the sidewalk. The second increasing the width of the pedestrian lane. The third most recommended option was to provide long and uninterrupted transport mode options where the respondents can make their trip with minimum transfers or no transfers. There are also recommendations on safety and security improvements and provisions of shades and sitting areas around transfer areas.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The research is conducted to assess the physical integration of public transport stations and its effect on the public transport user. The study was conducted on Mexico roundabout and included the study of 20 public transport stations including the LRT stations and it covered all the public transport modes present in the area. The study has assessed the physical integration of the public transport stations of the area by assessing the transfer experience of the public transport users.

The findings reveal that the Public transport is still a dominant and equitable service for the urban dwellers of the area. The minibus taxi is the dominant mode of transport for the area followed by city bus and Higer midibus the LRT shares small percentage of the modal usage in the study area. The result are similar with (TRANSIP, 2020) data with public transport being the most dominant mode of transportation next to walking.

Public transport is still the way forward for any rapidly urbanizing city like Addis Ababa. It is rather important to make the service as efficient as possible. Different methods were used to assess the trip characters and the transfer experience of the public transport users of the study area. The transfer experience of the public transport users was compared with the seamless one-seat journey private automobiles provide. 14 parameters of the transfer were provided for the respondents to rate their satisfaction towards the transfer experience. Accordingly, the efficiency of the public transport transfer was found to be lacking in different aspects.

There is a strong policy and institutional interest in increasing the multimodal integration of the public transport service of the city. However, concrete measures to take and revolutionize the integration of public transport has been dormant.

According to the study the positive aspect of the site is the agglomerated public transport modes and their station around the area. In addition to this, the site is highly connected to the major parts of the city. The site is also future host to different mass public transport services. It is also near to the central business district of the city. Most of the stations around the site are connected with delineated pedestrian network.

The physical integration of public transport stations has a significant role to play in increasing public transport user's satisfaction especially during rainy or sunny days. The findings reveal that

more than 32% of respondents are very dissatisfied and 29.9% are very dissatisfied with the transfer they make during bad weather times. The result observed correspond to the result obtained by (Miaoa, Welchb, & Sriraj, 2019) in their study about relations of bad weather and public transportations, which suggest that public transport amenities and area with "weather proof attributes" has the ability to increase satisfaction towards the service and attract more ridership. This is not the case when it comes to Mexico roundabout; there are hardly any facilities or objects placed to protect public transport users from bad weather times. The buildings constructed around the area also do not respond or recognize any of the above roles. They do not have any arcades or shading designs to protect the transferring users from the above-mentioned weather.

Observing the data form origin-destination surveys, it was found that, the public transport stations of the area do not serve the same number of people. Some stations to station transfers are high while others station to station transfers are low in number. Hence, the path traveled to make those transfers are highly active while others are moderately and mildly active. Based on the data obtained from the study area the Megenagna and Sarbet Mekanisa routes are the routes which most of the respondents were transferring to and from, hence, it is important to provide better options for the transferring users.

The paths traveled to make a transfer are interrupted with street crossings furthermore, the pedestrian paths are crowded with informal vendors, which use portions of the pedestrian paths for selling their commodities. In addition the transfer path is characterized by being non-continuous, having cracks, and non-covered utility holes. This in turn has created dissatisfaction towards the transferring users as the results from the survey are similar with 8.5% being very dissatisfied and 24% being dissatisfied with continuity of path. Similarly 16.5% are very dissatisfied with the convenience of path while 27.4% being dissatisfied. The respondents seem to increase their dissatisfaction towards conditions of sidewalk with 26% being very dissatisfied and 29.4% being dissatisfied. The result obtained by the study are similar with (Alemgena, Quezon, & Kumela, 2018) study done on pedestrian safety in Nekemte town with also 60% of the respondents being dissatisfied with side walk discontinuity and quality of sidewalk. Hence, it is clear to conclude that the quality of pedestrian walkways, the continuity and convenience of the path has a huge factor to play in increasing the satisfaction towards the walk traveled to make a transfer. The conditions of the sidewalk need to improve to increase the physical integration of public transport stations.

In addition to the above scenarios, more than 30% of respondents had to walk 400-500 meters to make a transfer to another mode of transport. The result obtained from the study are similar to (Hussen, 2016) study in which most of the city's public transport hubs users have to travel similar amount of distance to make their transfers. This is not a comfortable and convenient way of making a public transport transfer. The public transport stations are not physically integrated.

According to the survey of the respondents, almost all the parameters of transfer have been rated as dissatisfied in the perception of the public transport user. This is an additional proof to support the evidence that the public transport stations are not physically integrated and the parameters leave a negative impression of the public transport service on the user.

The perception of the transfer experience is highly affected by the distance a person walks to make a transfer. However, the perception of the distance might get worse following the conditions of the sidewalk, slope of the path traveled or the weather conditions while making the transfer. The number of times a person makes a transfer throughout the day is also one of the significant factors that affect the perceptions of the transfer experience. The consequences of an inefficient public transport service and a physically disintegrated public transport stations have increased the dissatisfaction towards the public transport service of the city.

The decrease in number of people making transfers will also benefit the flow of traffic, as people crossing streets to make a transfer are one of the externalities that forces traffic flow to slow down the decrease in people crossing the streets will increase the speed and flow of traffic in the area. This are the added benefits of decreasing people which make transfers on a daily bases.

5.2 Recommendations

In a developing world, which is urbanizing in rapid manner it is important for a city to give priority and focus to urban services. One of the vital vessels of a city is urban transport. For a developing city with limited resources when it comes to urban transport, public transport service and development are the significant tools that the city can efficiently use with the urban infrastructure at hand. The primary focus should be to increase the public transport users' satisfaction. One of the undesirable parts of a public transport journey is a transfer. It is important to find solution to decrease or improve the physical integration of their multimodal transport systems.

5.2.1 Recommendations for enhancing physical integration of multimodal public transport in the Study area

The routes from Sarbet Mekanisa area to Megenagna area have a high rate of transferring users and hence needs to be provided with longer route options which can provide a one seat seamless journey.

There should be use of signalized intersections for transferring users to protect them from pass through vehicles and increase their safety.

The sidewalks in the study area should be well maintained and cleared from any open ditches, inconvenient materials or unlawful parked vehicles.

The study recommends placement of shading objects aligning the transfer paths of the users to protect them from rain and harsh sun.

The study also recommends integration of arcades in existing buildings of the study area such that they will assist in protecting transferring users from rainy and harsh sun days.

Open spaces in the study area should be transformed to public transport interchange facilities to enhance the physical integration for users.

Measures should be taken to free pedestrian walkways in the study area from street vendors as they create inconvenience for transferring users.

The minibus taxi is the dominant mode of transport in the study area and responsible for most of the transferring users. Hence, longer routes should be assigned for minibus taxis to decrease the inconvenience of transfers.

5.2.2 Recommendations for enhancing physical integration of multimodal public transport in the city

From the management perspective a progressive authority which constitutes of the city's transport authority, transport operators, owners and end users should be formed and focus on increasing the efficiency and service of the city's public transport network. This authority should also focus on improving and decreasing transfers of the public transport. This might help in creating a feeding and interconnected hierarchical public transport network. In addition, the design and the progressive construction of a hierarchized public transport network can be a long-term target, which organizes all actions of a public transport authority along a common road map.

Important locations around public transport hubs of the city should be allocated and designed to enhance the physical integration of public transport stations. Priority should be given to public transport interchange facilities around transport hubs of the city.

Modern and sustainable public transport interchange facilities should be the way forward for the city's public transport service. These interchange facilities should protect users from harsh weather condition, provide comfortable spaces for transfers and increase users safety and security while making the transfers.

Future Buildings built around or in public transport; hubs of the city should integrate and protect the public transport users from harsh sun or rain. They should include arcades or shading objects in their designs.

Origin destination Data should be collected about the transferring public transport users. it is important to find out which station to station transfers are highly required and provide a longer transport option for users to avoid transferring.

Measures can also be taken to place the drop off station and exit station at a convenient location for public transport users to have an easier transfer. it is important to reduce the distance a public transport user has to walk to make a transfer.

Public transport is an equitable service for every urban dweller the service should be continuously analyzed and improved to efficiently serve the public. Modal Use and trip characters of the users should be traced and assessed to advance the service. User surveys should be an integrated process in managing and designing public transport services as they could provide a strong input to the progression of the service.

6. References

A.F.D. (2014). *FINDING URBAN TRANSPORT SOLUTIONS:THE CHALLENGES OF FINANCING AND INTEGRATION OF NETWORKS.* Bandung: Agence Francaise Development.

AACRA. (2020). *Ethiopian Transport System Improvement Project (TRANSIP).* Addis Ababa.

Abreha, D. A. (2007). Analysing Public Transport Performance Using Efficiency measures and spatial analysis.

Agarana, M., Anake, C., & Okagube. (2016). Optimization of Urban Rail Transportation in Emerging Countries Using Operational Research Techniques. *Applied Mathematics*, 1116-1123.

Aimero, B. (2016). Integration of Light Rail Transit with other Public transport modes: The case of East West Transit Corridor in Addis Ababa.

Alan, B. (1995). *Urban Mass Transport Planning* . New York: Mc Graw hill.

Alemgena, H., Quezon, P. E., & Kumela, T. (2018). Investigation of Pedestrian Safety Problems and Its Countermeasures: A Case Study in Nekemte City, Ethiopia. *International Journal of Engineering and Technical Research (IJETR), ISSN: 2321-0869 (O) Volume-8,*(Issue-2,), 2454-4698 (P).

Alsger, A., Assemi, B., Mesbah, M., & Ferreira, L. (2015). Validating and improving public transport origin–destination estimation algorithm using smart card fare data. *Transportation Research Part C*, 490-506.

Anastasia, A., Lantseva, V, S., & Ivanov. (2016). Modeling transport accessibility with open data: Case study of St petersburg. St-Petersburg Russia: International Young Scientist Conference on Computational Science.

APTA. (2009). *Defining Transit Areas of Influence. , .* American Public Transportation Association,Document Number: APTA SUDS-UD-RP-001-09.

Armstrong-Wright, & Sebastian. (1987). Bus services: reducing cost, raising standards. *Urban Transport Series*.

Azemeraw, E. (2015). Effects of Light Rail Transit System on Pedestrians and Public Transport Users' Mobility.

Berlepsch, H.-J. v. (2018). Public transport integration and transit alliances. *Transformative urban mobility initiative*.

BLUMAN., A. G. (2009). *Elementary Statistics a Step by Step Approach, seventh edition.*

Bogale, y. a. (2012). E*valuating transport network structure : case study in Addis Ababa, Ethiopia.*

Bok, J., & Kwon, Y. (2016). Comparable Measures of Accessibility to Public Transport Using the General Transit Feed Specification. *Sustainability* .

Cascetta, E., & Cartenì, A. (2014). The hedonic value of railways terminals A quantitative analysis of the impact of stations quality on travellers behaviour. *Transportation Research Part*, 41-52.

Cervero, Robert, & Michael. (2003). Walking, Bicycling, and Urban Landscapes: Evidence From the San Francisco Bay Area. *American Journal of Public Health*, 1478–83.

Cherry, T., & Townsend, C. (2012). Assessment of Potential Improvements to Metro–Bus Transfers in Bangkok, Thailand. *Transportation Research Record: Journal of the Transportation Research Board*, 116–122.

Chowdhury, S., Chowdhury, A., & Sachdeva, R. (2013). The effects of planned and unplanned transfers on public-transport users' perception of transfer routes. *Transporation Planning and Technology*, 37.

Clever, R. (1997). Integrated timed transfer. Transportation Research Record 1571. 109-115.

Creswell, J. W. (2009). *Research Design qualitative quantitative and mixed method approaches* (Third Edition ed.). singapore: sage.

CTPS. (1997). *Central Transportation Planning Staff, Transfer Penalties in Urban Mode Choice Modeling, Report prepared for the Travel Model Improvement.* Department of transportation.

Dagnachew, A. G. (2007). Integrating Transport and Land use policies for sustainable development.

Davison, & Knowles. (2006). Bus quality partnerships, modal shift and traffic decongestion. *Journal of Transport Geography* , 177-194.

Eboli, L., Forciniti, C., & Mazzulla, G. (2018). Spatial variation of the perceived transit service quality at rail stations. *Transportation Research Part A*, 67-83.

ESHETE, M. (2015). *PUBLIC TRANSPORTATION SYSTEM: THE CASE OF ADDIS ABABA.* Addis Ababa University;school of graduates studies, college of social sciences .

Eshetie, M. (2015). PUBLIC TRANSPORTATION SYSTEM: THE CASE OF ADDIS ABABA. Addis Ababa.

EU . (2016). *The Economic Benefits of Sustainable Urban Mobility Measures.* european commision .

EU. (2013). lessons from descriptive case stdies - recommendations for city hub , innovative design and operation of new or upgraded efficient urban transport interchanges . european commission seventh framework programme.

EU. (2018). *Policy Learning Platform on Low-carbon economy.* European unioun development fund .

F.T.A. (1996). *Passenger Transfer System Review: A synthesis of Tranit Practice.* Washington D.C: US Federal Transit Administration.

Fernanda B. Monteiro, V. B. (2012). A Proposal of Indicators for Evaluation of the Urban Space for Pedestrians and pedestrians and cyclists in access to mass transit station. *15th meeting of the EURO Working Group on Transportation*, pp. 637 – 645 .

Freeman, P., & Jamet, C. (1998). *Urban Transport Policy; A Sustainable Development tool.* Addis Ababa: rotterdam International scientific committee.

Fruin, J. (1971). Designing for pedestrians: a level-of-service concept. . *Highway Research Record*.

GEORGE, M. M. (2017). *INTERCITY BUS TERMINALS study of passenger facilities* . Nairobi: University of Nairobi.

GTZ. (2016). Public Transport integration and Transit alliances. *Sustainable Transport: A Sourcebook for Policy-makers in Developing Cities*.

Guerra, E. C. (2011.). *The Half-Mile Circle: Does It Best Represent Transit Station Catchments?* Berkeley: University of California, .

Guo, Z., & Wilson, N. (2011). Assessing the cost of Transfer inconvenince in Public transport systems; a case study for london underground. *Transport Research part A*, 91-104.

Haider, F., Rehman, Z. u., Sheikh, M. U., & Malik, B. Z. (2018). Alleviating Transportation System Problems by Providing Public Transit Integration in High-Density Metropolitan Cities. *Pak. J. Engg. Appl. Sci. , Vol. 22* , (p. 43–55).

Hernandez, S., Monzon, A., & Oña, R. d. (2016). Urban transport interchanges: methodology for evaluating perceived quality. *Transportation Research* , (pp. 31-43). Madrid, spain.

Hernandez, S., Monzon, A., & Oña, R. d. (2016). Urban transport interchanges: methodology for evaluating perceived quality.

Hine, J., & Scott, J. (2000). Seamless, accessible travel: users' views of the public transport journey and interchange. *Transport Policy, 7,*, 217–226.

Hussen, B. W. (2016). *Sustaining Sustainable Mobility : the Integration of Multimodal Public Transportation in Addis Ababa.* lyon.

Ibrahim, F. (2003). Improvements and integration of a public transport system:The case of Singapore. Cities. 205-216.

Iseki, H., & Taylor, B. (2010). Style versus Service? An Analysis of User Perceptions of Transit Stops and Stations . *Journal of Public Transportation*, 23-48.

ITDP. (2020). *ETHIOPIA NON-MOTORISED STRATEGY 2020-2029.* Addis Ababa: Instittute for transport development policy, Ministry of Transport .

ITDP. (2021). *Bus Rapid Transit Planning Guide*. Retrieved 9 3, 2020, from https://brtguide.itdp.org/branch/master/guide/multi-modal-integration/physical-integration

James, D. (2010). *Light Rail Transit Design Concept and Feasibilty report.* Ottawa.

Kieu, L., Bhaskar, A., & Chung, E. (2004). Transit passenger segmentation using travel regularity. *Transportation Research Board 93rd Annual Meeting*.

Knutton, M. (2005). *LRT Is Changing The Face Of French Cities.* International Railway Journal.

Krygsman, S., & Dijst, M. (2004, july). Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio. *transport policy* .

Krygsmana, S., Dijsta, M., & Arentze, T. (2004). Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio. *Transport Policy, 11*, 265–275.

Lam, s., & Xie, F. (2002). Transit path-choice models that use revealed preference and stated preference data. *Transportation Research Record, 1799*, 58–65.

Lambas, L., E, M., & Monzon. (2010). Private funding and management for public interchanges in Madrid. *Research in Transportation Economics*, 323-328.

Lared Statistics. (2020, April 5). *Lared Statistics*. Retrieved from Lared Statistics: https://statistics.laerd.com/spss-tutorials/ordinal-regression-using-spss-statistics.php

Lee, S. (2013). one nation, one seamless public transport. Paris , france: The korea transport institute.

Lhomelet, E., & Cornelis, L. (2014). Finding urban transport solutions: the challenges of financing and integration of networks. Bandung: Agence France Development .

Liu, R., R, P., & S, P. (1997). Assessment of Intermodal Transfer Penalties Using Stated Preference Data. Transportation Research. *Journal of the Transportation Research Board, 1607*, 74-80.

Luk, J., & Olszewski, P. (2003). Integrated public transport in Singapore and Hong Kong. . *Road and Transport Research*, 41-51.

M.O.T. (2011). *Tranport Policy of Addis Ababa.* Addis Ababa: Federal Democratic Republic of Ethiopia, Ministry of Transport.

Mackie, P Jara-Díaz, S., & Fowkes, A. S. (2001). The value of travel time savings. *Transportation Research Part E: Logistics and Transportation review, 2-3*(37), 91–106.

Mahardhika, H., AndreasRau, & MengMeng. (2018). Public transport travel time perception: Effects of socioeconomic characteristics, trip characteristics and facility usage. *Transportation Research Part A: Policy and Practice, Volume 114, Part A*, 24-37.

Maxwell, R. R. (2003). Converting a large region to a multimodal pulsed-hub public transport network. . *Transportation Research Record 1835*, 128-136.

Mbatta, G., Sando, T., & Moses, R. (2008). Developing Transit Station Design Criteria with a Focus on Intermodal Connectivity. *Journal of the Transportation Research Forum,Vol.47,No. 3 (Public Transit Special Issue),*, pp.77-91.

Meeder, M., Aebi, T., & Weidmann, U. (2017). The influence of slope on walking activity and the pedestrian. *20th EURO Working Group on Transportation Meeting, EWGT 2017, 4-6 September 2017,*.

Milller, A. (2004). *Assessment of Service Integration Practices for Public Transportation:*. Review of the Literature California Partners for advaned transit and highways.

Monzón, A., & Ciommo, F. D. (2016). *City Hubs- sustainable and efficient urban transport interchanges* . London and newyork: CRC press .

Monzón, A., Hernández, S., & Ciommo, F. D. (2016). Efficient urban interchanges: the City-HUB model. *Transport Research Arena*.

Nag, D., Goswami, A. K., & Bharule, S. (2019). FRAMEWORK FOR PUBLIC TRANSPORT INTEGRATION AT RAILWAY STATIONS AND ITS IMPLICATIONS FOR QUALITY OF LIFE.

Nallet, C. (2018). The Challenge of Urban Mobility: a case study of Addis Ababa light rail, ethiopia. *Notes de I'fri*.

Olszewski, P., & Sony, W. (2005). Using Equivalent Walking Distance to Assess Pedestrian Accessibility to Transit Stations in Singapore. *Transportation Research Record: Journal of the Transportation Research Board*, 38-45.

ORAAMP. (2010). *Addis Ababa City Development plans 2001-2010.*

Pratelli, & Brebbia. (2010). *urban transport XVI urban tranport and the environment of 21st century.* WIT press.

R. Jayakrishnan, C. E. (2005). *High Coverage Point to Point Transit (HCPPT): A New Design Concept and Simulation –Evaluation of Operational Schemes California PATH Research Report.* CALIFORNIA, irvine: CALIFORNIA PARTNERS FOR ADVANCED TRANSIT AND HIGHWAYS.

RHIHUB . (2020, April 16). *Rural Health Information Hub* . Retrieved from Rural transportation tool kit : https://www.ruralhealthinfo.org/toolkits/transportation/1/types-of-transit-systems

Rivaspalta, C. (2008). Three perspectives on the role of competitive tendering in integration of public transport. *Proceedings of the 22nd Southern African Transport Conference* . Pretoria, South Africa: Document Transformation Technologies .

Sabyasachee Mishra, T. F. (2012). Performance indicators for public transit connectivity in multi-modal transportation networks. *elsevier,Transportation Research Part A, 46*, 1066-85.

Saliara, K. (2014). Public Transport Integration: the Case Study of Thessaloniki,Greece. *Mobil. TUM 2014 "Sustainable Mobility in Metropolitan Regions", May 19-20*(Transportation Research Procedia), 535 – 552.

Silva, J. A., & Bazrafshan, H. (2013). sing Structural Equations Modeling to analyze User Satisfaction in Intermodal Transfer Facilities in Lisbon, Portugal. *Transportation Research Record: Journal of the Transportation Research Board*, 102-110.

Stradling, S. (2002). Transport user needs and marketing public transport. *Municipal Engineer*, 23-28.

Terzis, G., & Last, A. (2000). *Group for Urban Interchanges Development and Evaluation.* European 4th RTD Framework Programme.

Transafrica. (2008). overview of Public transport in sub saharan africa.

TRANSIP. (2020). *Final route optimization report* . Addis Ababa: Addis Ababa city roads authority.

Transit Laboratory. (2020, April 20). *Origin Destination Flows*. Retrieved from Transit Laboratory: https://transitlab.osu.edu/origin-destination-flows

TRB. (1985). Highway Capacity Manual. *Transportation Research Board, National Research Council, Washington, D.C., EUA.*

Tsami, M., Adamos, G., & Nathanail, E. (2013). INVESTIGATING THE ACCESSIBILITY LEVEL FOR DISABLED USERS AT URBAN TRANSPORT INTERCHANGES. Riga, Latvia: Transport and Telecommunication Institute, Lomonosova.

Tufa, D., & Girma, T. (2001). Mass Transport in Addis Ababa , Ethiopia.

U. Javaid, S. R. (2015). ASSESSMENT OF TRANSIT STOPS SERVICE AREA USING GEOGRAPHICAL INFORMATION SYSTEM – A CASE STUDY OF PUNJAB UNIVERSITY. *Pakistan Journal of Science , 67* (No.4).

UN. (2000). *An Introduction to Indicators.* UNAIDS.

UN. (2015). *SUSTAINABLE URBAN MOBILITY AND PUBLIC TRANSPORT IN UNECE CAPITALS.* New York and Geneva: United Nations.

UN. (2016). *Mobilizing Sustainable Transport for development.* Ashgabat, Turkmenistan: United nations.

UN Habitat. (2009). *planning sustainable cities : Global report on human settlements.* united nations human settlements programme.

UNDP. (2010). *City wide integrated transport plan.* Ministry of urban transport india.

Vikash. (2003). Variegated System of Mass Rapid Transit: An Innovation that Changes the "Familiar World" of Urban Transport" . *Map India*.

Weheyaga, S. (2019). Improving Addis Ababa Transport System by Using Transport Demand Management Strategy.

World Bank. (2001). *Cities on the Move: A Worlds Bank Urban Transport Strategy Review,draft document.* world bank.

World Bank. (2017). *Mobile Metropolises: Urban transport Matters.* Washington: International Bank for Reconstruction and Development / The World Bank.

Zhao, F. C. (2003). Forecasting transit walk accessibility: regression model alternative to buffer method. *Journal of the Transportation Research Board* (1835 (-1),), 34–41.

Zimmerman, S., & Fang, K. (2015). *public transport service optimization and system integration* . washington , U.S.A: the world bank .

Annexes

Annex Í: Publishable Manuscript

Enhancing multimodal Public Transport service by increasing physical integration: The case of Mexico roundabout, Addis Ababa, Ethiopia.

Nathnael Kefyalew[1*], Berhanu woldetensae[2]**

[1] Lecturer at Hawassa University department of Urban and regional planning, Ethiopia

[2] Assistant Professor at Ethiopian Institute of Architecture, Building Construction and City Development, Addis Ababa University, Ethiopia

[*]Corresponding author: nathnaelkefyalew@gmail.com , +251-912-474-880

** Corresponding author: berhanu.woldetensae@eiabc.edu.et, +251-911-404-883

ABSTRACT

Physical integrations of public transport aims to make the intermodal transit system accessible for all users by reducing discontinuities within the system. Enhancing the physical integration of public transport stations allows users to make travel decisions that enables them to save their time and money. The research is conducted to assess the physical integration of public transport stations and its effect on the public transport user. The study area was on Mexico roundabout Addis Ababa and included the study of 20 public transport stations including the LRT stations and covered all the public transport modes present in the area. The study has assessed the physical integration of the public transport stations of the area by assessing the transfer experience of the public transport users.it used survey method to capture the perception of the public transport users. The study also assessed the trip characters and modal usage of the public transport users. The findings reveal that more than 30% of respondents had to walk 400-500 meters to make a transfer to another mode of transport. Ordinal regression was used to analyze which parameters of the transfer experience had significant effect on the public transport users. The distance traveled to make a transfer , protection against weather while making a transfer, the increase in number of transfers a public transport user makes , safety security and conditions of sidewalk are amongst the significant parameters that affect the satisfaction towards the transfer experience. There is a strong institutional interest to enhance physical integration however, concrete measure are not undertaken. The study recommends changing open spaces in the study area to interchange facilities and provision of longer routes to decrease discontinuities of trips. The study further recommends the city place public transport interchange facilities around transport hubs of the city to enhance physical integration of transport modes.

Key words: Physical integration, Public transport

1. INTRODUCTION

According to World Bank (2017) the share of people living in cities has surpassed fifty percent and expected to reach 60 percent by the year 2030. In addition, European Union (2016) reports that despite urbanization, allegedly contributing to economic growth, it is out stripping the capacity of most urban centers to provide adequate services for their citizens and that it is essential to ensure a high quality of life in urban areas. Furthermore, Anastasia, Lantseva, V, & Ivanov (2016) observes, it is certain that the economic prosperity of nations and urban areas is highly dependent on the efficiency of their transportations system.

As specified by Monzón, Hernández, & Ciommo (2016) the significant tasks in trying to attain accessible urban transport is the integration of mobility and enhancing collective transport modes. Based on Haider,

Rehman, Sheikh, & Malik (2018) a properly integrated public transport system is timely and expected to enhance the mobility of the public by giving a "state of the art" public transport service. However, Nallet (2018) identifies that, in the global south, the urban transport sector has been an issue that was neglected.

As attested by Luk & Olszewski (2003) there is significant determination in improving public transport connectivity across all transport modes and services. According to Liu, R, & S (1997) the accessibility of opportunities for direct trips when using public transport is becoming a scarce reality, and for this reason, the majority of trips require transfers between transport modes. In addition, Lee (2013) elaborated that there is a need for public transport integration, the various transport modes are planned and operated independently. The lack of intermodal linkage has created in convenience for public transport users.

Furthermore Nag, Goswami, & Bharule (2019) claims, enhancing the physical integration of public transport stations allows users to make travel decisions that enables them to save their time and money. Furthermore, (Nag, et al., 2019) claims, that true physical integration is possible when there are coordinated and seamless modal transfers. According to (UNDP, 2010) seamless mobility is the uninterrupted journey of users while still being able to roam across various transport modes. The presence of an efficient and seamless public transportation system is important for the city dwellers to achieve their day to day activities (A.F.D, 2014).

2. LITERATURE REVIEW

2.1 Urban Transport

As reported by World Bank (2017) for a rapidly urbanizing world, a well functioning and well planned urban transport sector acts as an artery with the ability to facilitate the urban economy and link disadvantaged and poor people to services and opportunities. Cities worldwide can be compared based on the efficiency of their transport system (GEORGE, 2017). The prosperity of cities depend on the accessibility to markets and services (UN, 2015).

As claimed by A.F.D (2014) deteriorating transport conditions affect all city residents; they impact particularly the poor through a decline in public transport service levels, increased length of the journey to work and other essential services and the negative impacts on environment, safety and security that the poor are least able to mitigate. GEORGE (2017) argues that urban authorities should give priority to transport problems for them to achieve their development goals.

2.2 Public transport

Public transport has long since received attention as a sustainable and environmentally sensitive transport form (Krygsmana, et al., 2004). As also, emphasized by EU (2013), public transport symbolizes an alternate to car transport and is as such a significant element in of the sustainable transport policy. UN Habitat (2009) Observed Cities that are able to create a sustainable system of public transport decreased their ecological footprints by reducing fossil fuel consumptions and decreased urban sprawl and automobile dependence of their residents.

Public transport is an essential tool to "attract users to public and non-motorized transport by providing a safe and efficient public transport system" (Saliara, 2014). However, there is an increase seen in private car ownership and it is obvious that the availability of public transport the increase in city size (i.e. distance from home or destinations) and the disutility (or inconvenience) associated with the non-seamless stages and connections that characterize public transport are very much to blame (Krygsmana, et al., 2004).

In developing nations it is also important to combine informal public transport operators as they provide a vital service in areas where official public transport is either not provided or too costly for residents (UN Habitat, 2009). In addition, Conventional public transport services should be reorganized to feed, rather than to compete with, Light Rail and BRT systems (Ibrahim, 2003).

2.3 Intermodal Integration

Intermodal integration entails in providing a coordinated, smooth, convenient high quality public transport service with minimum interruption on interchanges (Saliara, 2014). Integration of public transportation can be described as holistic planning of services, which results in a rationally structured public transport service (Hussein, 2016). Integration of transport networks aims at making public transports more attractive than individual modes. An integrated public transport network undeniably has the ability to attract larger number of users (Berlepsch, 2018).

In addition Monzón & Ciommo, City Hubs- sustainable and efficient urban transport interchanges (2016) argues, integration of the different modes is required in order to provide a seamless door to door transport service. Integration of the different aspects is beneficial for all parties involved as it decreases competition and increases cooperation (A.F.D, 2014). Integration is important where there is presence of multiple modes of public transportation operators and they lack coordination, cooperation and interaction amongst each other (Saliara, 2014).

2.4 Physical integration of public transport

Physical integration can be defined as the planning of stations, stops and facilities in order to create a safe environment for transferring users (Milller, 2004). It also embraces the coordination of vehicle movements for transfers to be safe without any conflicts between pedestrians and vehicles movement (Saliara, 2014).

Physical integration can also be described as an effort to “co-locate” various parts of the public transport system with the intent of facilitating transfers (ITDP, 2021) . According to Krygsman & Dijst (2004), the weakest part of a public transport service is the access and egress stages (together with wait and transfer times) or simply put transfers. In addition, CTPS (1997) shows that transfers are considered the “necessary evils” of public transport even though they make it possible to access a hierarchical and multimodal service with an enlarged network.

3. MATERIALS AND METHODS

3.1 Location of the study area

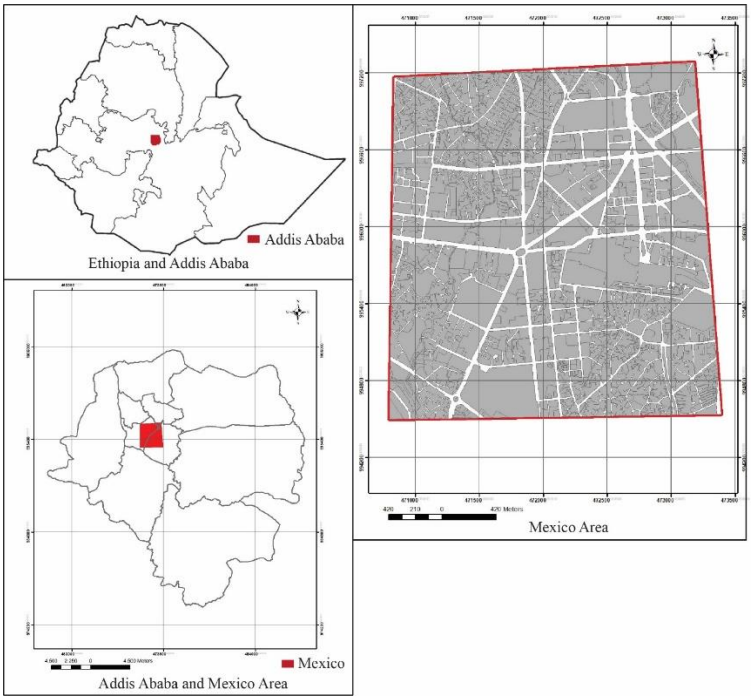

Figure 1 Map of the study area

Mexico Square is a traffic circle in Addis Ababa, Ethiopia named after the country of Mexico. After the Second Italo-Ethiopian War, Mexico was one of only five countries that refused to recognize Italy's annexation of Ethiopia. Mexican support for an independent Ethiopia was a key event in Ethiopia–Mexico relations. The Addis Ababa Light Rail system has an overpass over Mexico Square. In 2013, much of the square was demolished to make way and integrate the LRT line that passed through the square and transformed it to a roundabout.

Figure 2 Images showing past (A) and present (B) pictures of the study area

There are different public transport stations present in the area. they serve the anbessa city bus, sheger city bus or the midi bus and minibus taxi transport modes of the area.

3.2 The study design and setting

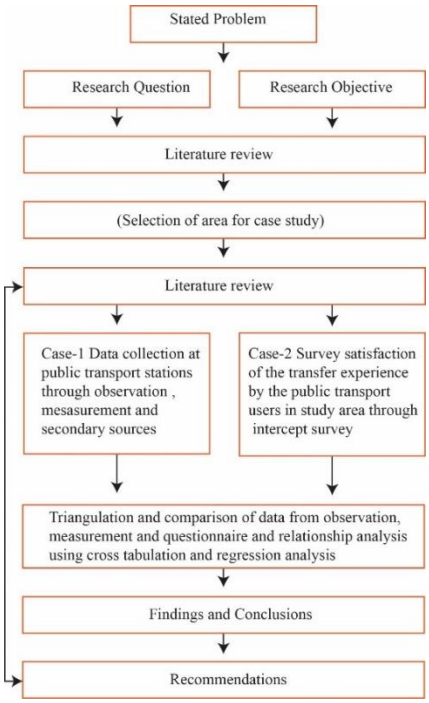

Figure 3 Study design

The method used for the study was the survey method. It is one of the methods that can help analyze the perception or satisfaction of users on a certain product or service. The method helped analyze the satisfaction of user towards the public transport transfers they make. The survey method can help gather information from a sampled sub group of population and acquire a holistic picture of a larger population.

In addition, the survey was based on 15 survey questionnaires, which consist of 27 variables. The variables consisted of the demographic character of the respondents (gender, age), the occupation of the respondents, the trip purpose, the trip rate, transfer time of the respondents. The variables also include the origin and destination route of the respondents. Furthermore the transport mode used to enter the site and egress the site is also included in the variables. The number of transfers throughout the day a respondents makes is also included in the transfer. Finally, the 14 parameters of a transfer are included in the variables with a five-scale Likert measurement of the satisfaction of respondents towards the parameters. The measurements ranged from very satisfied to very dissatisfied. This form of measurement was introduced to analyze the perception of the public transport users towards the transfer experience.

The questionnaires are self-administered close-ended questions with only one open-ended question. The open-ended question was included for the respondents to recommend different viewpoints on how to improve their transfer experience.

3.3 Type source and aquisiton of data

The study has used both primary and secondary data. The primary data was collected through questionnaires, interviews, observations and downloading satellite imageries. The collection of the secondary data was done by collecting soft and hard documents on the subject matter.

An intercept survey approach was used to capture pedestrians, question, and ask them about their travel patterns, their mode of choice and perception of their transfers to other modes. The questionnaire included several questions about intermodal and unimodal travel behavior and assessment criteria for the transfer path. The respondents will be asked whether they combined different means of transport on one trip. The users were also asked to rate their satisfaction of the different aspects of their transfer.

The study will use a mixed method approach, hence both qualitative and quantitative approaches will be used. From mixed method approach ,Concurrent mixed methods will be used. Concurrent mixed methods procedures are those in which the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. In this design, the investigator collected both forms of data at the same time and then integrated the information in the interpretation of the overall results (Creswell, 2009).

The independent variables of the study are composed of the demographic, trip and modal character of the respondents. The dependents variables are the physical integration of the public transport stations and the satisfaction of public transport users towards their transfer experience.

14 Parameters of the public transport transfer

Table 1 Parameters of the transfer

No	Physical integration Parameters used to measure the satisfaction of users on the transfer	Analysis of the variables	Analysis method
1	Satisfaction of Distance traveled to make a transfer	Ranked data by Likert scale of five points which is from very satisfied to very dissatisfied	Cross tabulation and ordinal regression
2	Satisfaction of the continuity of path traveled to make the transfer		
3	Satisfaction of the convenience of path traveled to make the transfer		
4	Satisfaction of the attractiveness of path traveled to make a transfer		
5	Satisfaction of the slope of the track traveled to make a transfer		
6	Satisfaction of the straightness of route traveled to make the transfer		
7	Satisfaction of the time taken to walk from drop off station to exit station		
8	Satisfaction of the number of streets crossed to make a transfer.		
9	Satisfaction of the conditions of sidewalk while making the transfer		
10	Satisfaction of safety and security while waking the transfer path		
11	The perception of easy transfer		
12	The satisfaction of provision of necessary requirements to make the transfer		
13	The satisfaction of making the transfer during any weather conditions		
14	The satisfaction of making the transfer during any time of the day		

Sampling

The research will use different type of sampling methods to conduct the study. Stratified sampling was used to make sure equal number of sample is taken from all the public transport stations present in the study area. Random sampling was used in the intercept survey to choose people to be engaged in the survey from each public transport station.

Population of the study

Based on data from four months (September – December 2018) the center and operation control of ticketing division of AALRTs office the average passengers per day is greater than 105,760. This coupled with the transport users of minibus taxis which serve more than 1,000,000 per day and the Anbessa bus which serves more than 600 thousand people per day it is for sure that the study area will serve more than 100,000 people per day.

Sample size determination

In the process of the sample size selection, simple random and stratified sampling (for the station) was used. The first step was to calculate sample size out of the total public transport users in the area including the LRT users. Because the population size is unknown, the Cochran formula was used to determine the minimum sample size. Accordingly the minimum sample sized for a larger population greater than 100,000 at 95% confidence interval, with 0.5(50%) degree of variability and +\- 5% precision is 384.

Depending on this figure the researcher has collected a survey of 700 passengers to get a more sound and representative size for the study. Even though the Cochran formula is 384 enough sample size. The next will be to proportionally divide the sample size to the number of public transport stations present in the study area.

Data analysis and presentation techniques

Quantitative data is numerical and will be collected in a number of forms. Statistical analysis is used to summarize and describe quantitative data and graphs or tables are used to visualize present raw data.

Intercept survey analysis

The intercept survey is used to interact and ask the public transport users on route to make a transfer about their transport mode of choice, perception of their transfer path and the whole transfer experience.

Pedestrian trip analysis

Walk distances and Walk times is analyzed by conducting analysis on the path of transfer from drop off station to egress station. This helps to know which stations posed the longest and shortest travel distance and time to the public transport users.

Presentation techniques

The data analysis and results is presented using graphs, charts, tables, figures and map. This assisted in simplifying and clearly showing the results of the data collection and analysis.

4. RESULT AND DISCUSSIONS

4.1 Demographic character of the respondents

it is observed that out of the 668 usable respondents which filled out the survey questionnaires 58.2% of the respondents are male and 41.8 % of the respondents are female. The age category of respondents shows that more than 80% of the respondents are under the age of forty and above the age of 20 which shows that majority of the respondents that favor the area are young, with 53.7% falling in the age range of 21-30 and 21.9% in the age range of 31-40. Even though it is lower in number people in the age range of 41-50 consist of 4.3 of the population followed by people above sixty years of age with only 1% of the respondents being categorized in this age range.

4.2 Trip purpose

60 percent of the respondents were making the work trip followed by the education trip purpose, which is consisting of 9.4 percent of the respondents. The other form of trip purposes included in the survey are trips made for the purpose of leisure and for the purpose of visiting family. Which are 3% and 6.6% respectively of the respondents answer on the reason they are making the trip.

4.3 Modal share of transport used by respondents

Observing the mode of transport used to enter the site. it can be observed that 51% of the public transport users that come to the area use minibus taxis. The second preferred transport mode amongst the respondents is the city bus which consist of 24% of public transport used. Walking is also another major mode of choice,

which consist of 15% of modal share. This suggests that people living nearby the roundabout prefer walking to the area than using any public transport service. From the respondents response it has been understood that only 5% of the public transport users used the LRT to enter the area. The Higer bus has a small role to play as only 3% of the respondents use this public transport service.

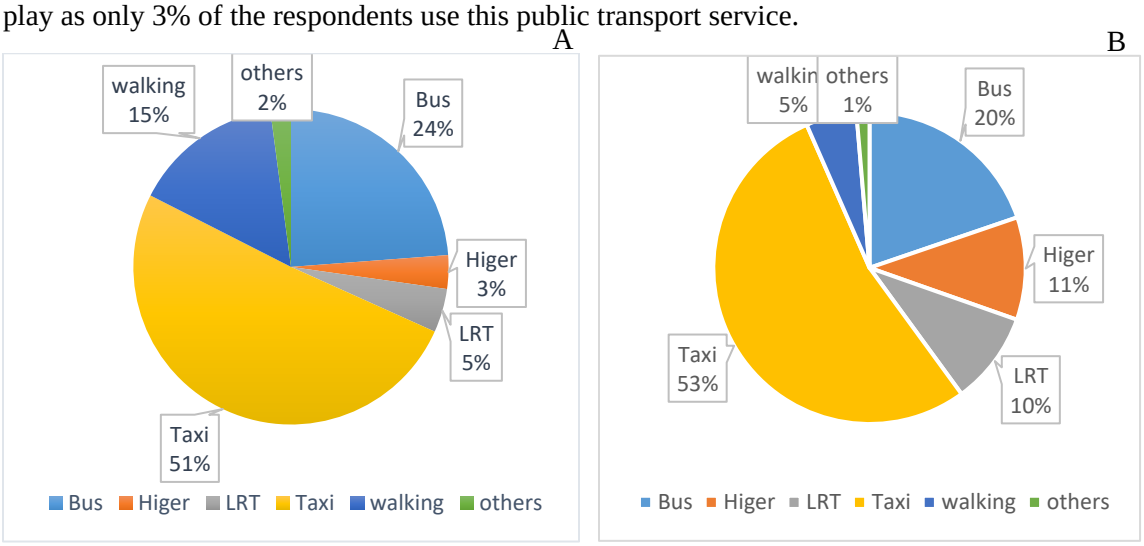

Figure 4 Chart showing the entry (A) and exit modes of transport (B) in the area in percent

The exit mode of transport has also similar characteristics with 53% of the public transport used to exit the site dominated by local minibus taxis. With slight increase in LRT and walking.

The data reveals that 72.6% of respondents who entered the site with Minibus taxi have used the same mode of transportation to exit the site, While 6.8% used LRT, 7.4% used Higer bus, 9.1% used Bus and 2.9 % used walking to exit the site. 47.2% of the Respondents, which used Bus to enter the site, used the same mode of transportation to exit the site, while 28.9% used Mini bus taxis, 12.6 % used Higer bus, 10.1% used LRT and 1.3% used walking to exit the site.

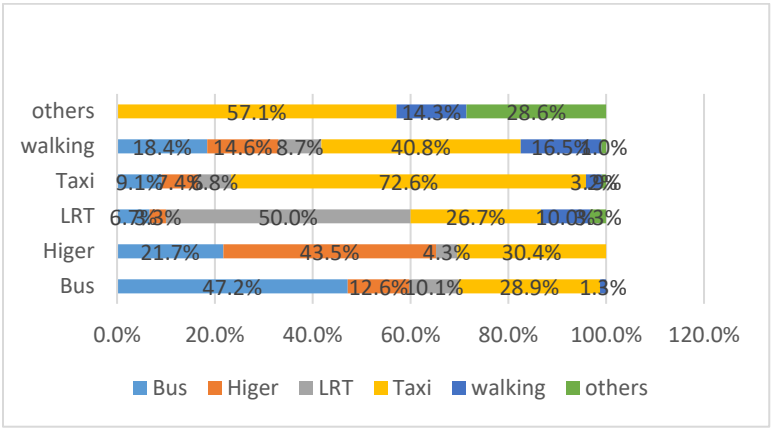

Figure 5 Graph showing entry and exit mode of transport cross tabulation of respondents

Looking at the data of the respondents, which used Higer bus, to enter the site, 43.5% of them used the same mode of transportation to leave the site while 30.4% used Minibus taxi, 21.7% used Bus and 4.3% used LRT to exit the site. In addition observing the data of respondents which use LRT to enter the site 50% used the same mode of transportation to exit the site, in addition 26.7% used taxi, 10% used walking, 6.7% used the Bus transport, 3.3 % used the other forms and 3% used Higer bus. Similarly, 16.5 % of the respondents who walked in the site used the same mode to leave the site, in addition, 40.8% used minibus taxi, 14.6% used

Higer Bus 18.4% used Bus and 8.7% used LRT to exit the site. Lastly, respondents who used other form of transportation, 57.1% used taxi, 14.3% used walking and 28.6% used other forms of transportation.

4.4 Origin and destination route of respondents

The data reveals that most of the respondents come from Sarbet, Mekanisa , Jemo Garment area (26.2 %) followed by respondents from the torhayloch ayer tena and kara area (21.1 %). In addition to the above similar number of respondents (16.8 and 16.6% respectively) coming from the Kera , Mebrat hayl Cherkos and Megenagna 22 stadium area route. Other routes are not consisting of more than six percent.

The destination route response from the sampled public transport user shows that the megenagna 22 stadium route is the major route for destinations of the respondents consisting of 22.2%. The following most favored route is the sarbet mekanisa jemo garment route with 18.3% of sampled respondents making their trip to that area. Similarly Tor hayloch, Ayer Tena , Kara consists of 14.2% of the respondents destinations. In addition the other routes also have a role to play as they significant shares as 9.9 % each for the Kera Mebrat hayl and Piassa Addisu Gebeya route. With other routes having minor shares like the kasanchis route and aratkilo route with 3.4% and 5.7 % respectively.

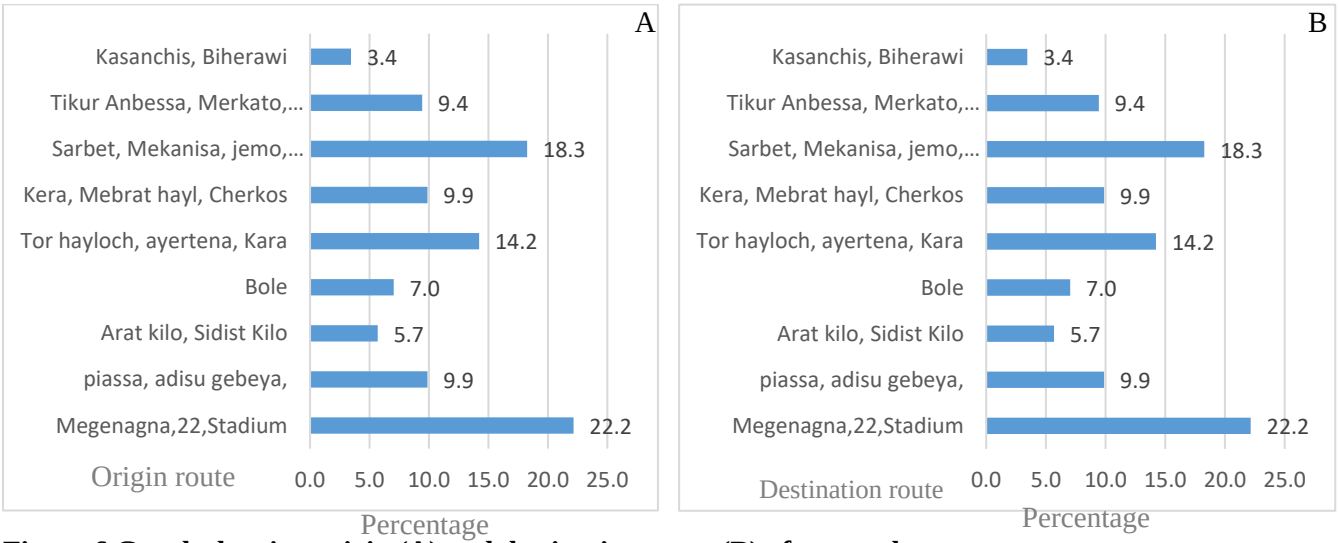

Figure 6 Graph showing origin (A) and destination route (B) of respondents

The assessment of Origin and destination routes of the respondents helps analyze which paths are mostly walked for transfer and which routes lack connection. Hence, the figure below shows from which routes the respondent access the study area and to which routes the respondents egress.

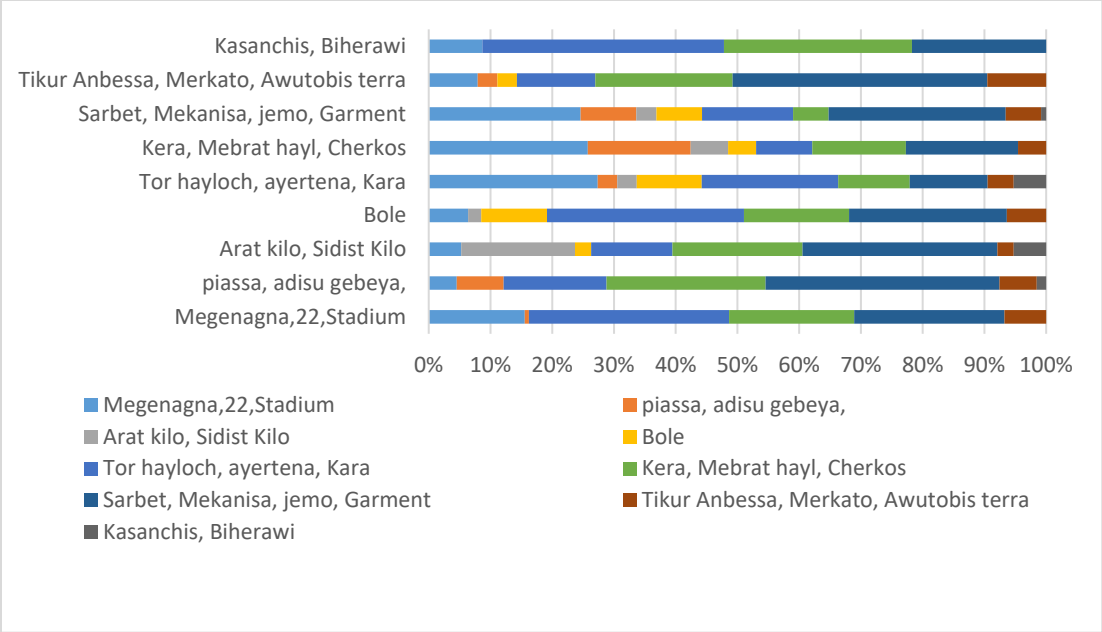

Figure 7 Origin and destination cross tabulation of respondents

The data reveals that the majority of the respondents that came from Megenagna area egress to Sarbet Mekanisa area and Torhayloch. While similarly the respondents from Sarbet Mekanisa area majorly egress to Megenagna (30%) and Torhayloch area (21%) . This interpretation does not include the people that work in the Mexico area and head back the same route. The respondents coming from the Torhayloch area also egress majorly to Megenagna area (26%) and Sarbet Mekanisa area (12%) followed by Bole route (10%) and Kera route (11%).

4.5 Distance traveled by respondents to make a transfer

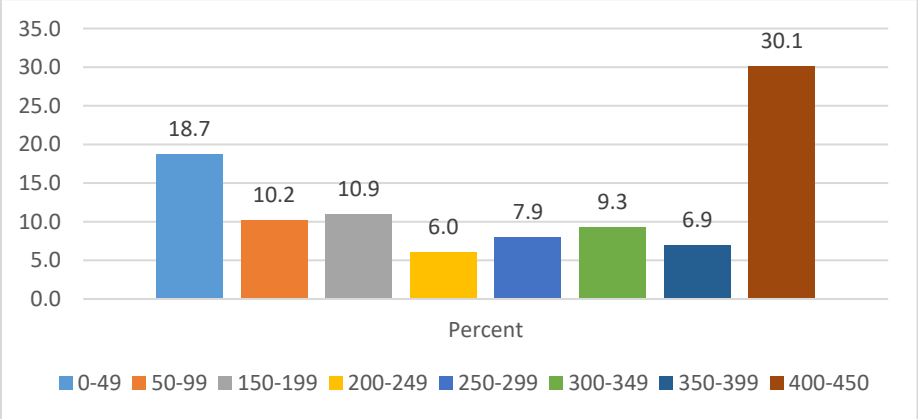

Figure 8 Graph showing distance traveled by respondents

The distance traveled by respondents was measured to understand how much distance the respondents had to travel to make the transfer. It was done by measuring the drop-off station of the respondent to the station the respondent traveled to catch the next transport mode. The figure 4.11 reveals that more than 30% of respondents had to walk 400-500 meters to make a transfer to another. It also shows that 6.9% had to walk 350-399 meters to make a transfer. Similarly 9.3% walked 300-349 meters, 7.9% walked 250-299 meters,6%

walked 200-249 meters, 10.9% walked 150-199 meters, 10.2% walked 50-99 meters and finally 18.7% walked 0-49 meters to make a transfer.

4.6 Trip repetition

In order to understand how often the passengers make the trip a question was included to the survey. it has been observed that from the sampled respondents 50% of the respondents make the trip on a daily basis and 15% of the respondents make the trip very often. In addition to the above respondents 34% of the respondents claim they make the ascertained trip sometimes while only 1% responded that they rarely make the trip.

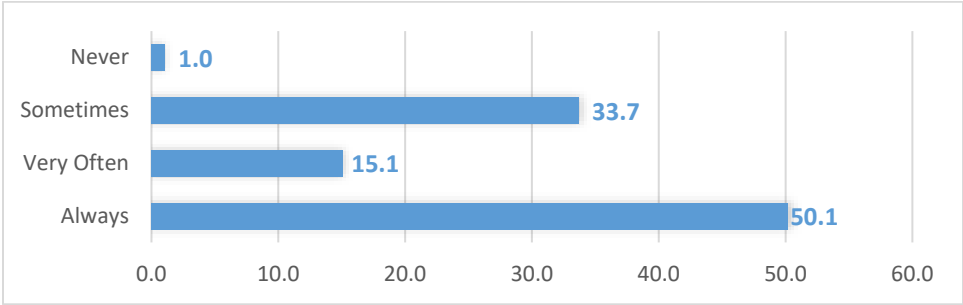

Figure 9 Graph showing trip repetition of respondents

4.7 Transfer Rate per day of the respondents

As the study focuses on public transport transfers it was important to identify how many times a day a transfer was required to complete their trip. A question was incorporated to find out with 1-2, 3-5 , 6-8 or 8-10 transfers a day. The data reveals that from the sampled respondents 51% of them make 3-5 transfers per day. While 42% of respondents answered that, they make 1-2 transfers a day. In addition to the above respondents 4.3 % of the sampled respondents make 6-8 transfers and 1.9 % make 9-10 per day.

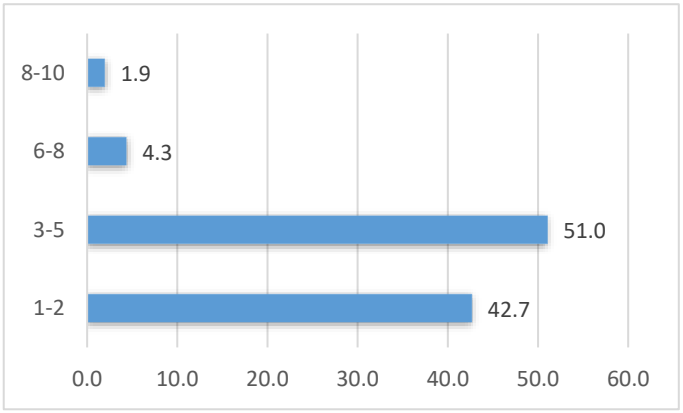

Figure 10 Graph showing Transfer rate of respondents

4.8 Transfer time of the respondents

The respondents were asked two time windows where they pass through or make a transfer through the study area 72% of the respondents picked 6:00-9:00 am as first time they make their transfer 10.8% make their transfers during 09:00-12:00, 14.8% make their transfers during 12:00-02:00 pm. The second transfer time the respondents gave 10.3% is during 02:00-04:00 pm, 60.5% is during 04:00-7:00 pm and 20.8% is during 7:00-9:00 pm.

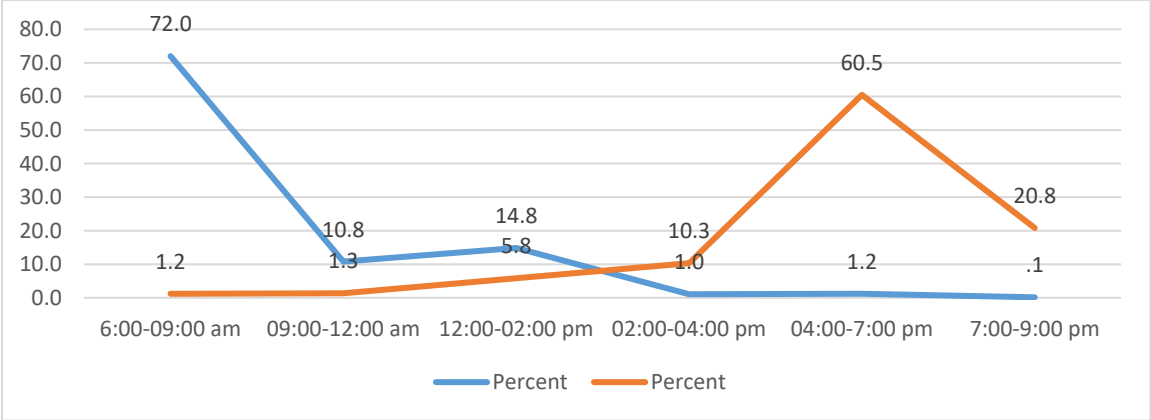

Figure 11 Graph showing transfer time of the respondents

4.9 Respondents satisfaction towards 14 parameters of the transfer

4.9.1 Distance traveled to make a transfer

The respondents were questioned how much they were satisfied by the distance they walked to make the transfer and 15% stated that they were very dissatisfied while 34.7 % claimed they were dissatisfied by the distance. In addition, 25.3% of the respondents answered neither while 15.9% claimed they were satisfied and 9.1% of the sampled respondents were very satisfied with the distance they walked to make the transfer.

4.9.2 Satisfactions of the continuity of path by respondents in making the transfer

The majority of respondent answered neither (31%) while still 24% responding that they were dissatisfied and 8.5% very dissatisfied with the path's continuity. However, 26.2% of the sampled respondents are satisfied and 9.7% are very satisfied.

4.9.3 Convenience of path traveled by respondents to make the transfer

The respondents were asked to rate their satisfaction of the convenience of the path they traveled to make the transfer. 31.6% of the respondents answered neither while 27.4% of the respondent and 16.5% of the respondents answered dissatisfied and very dissatisfied respectively. In addition to the above respondents 18% claimed they were satisfied with convenience of the path and 6.4 % were very satisfied with the convenience of the path while making their transfers.

4.9.4 Attractiveness of path traveled to make a transfer

29.6% of the respondents have reacted "Neither" for their satisfaction level of the attractiveness of the path they traveled to make a transfer, while 25.9% answered "Dissatisfied" and 25% replied that they are "Very dissatisfied" with the attractiveness parameter of the path traveled to make a transfer.

4.9.5 Slope of the path traveled to make a transfer

The data reveals that 14.8% of the respondents are "Very dissatisfied" with the slope they had to travel to make a transfer while 21% are dissatisfied. However, 34.9% of the respondents reacted "Neither", 22.1% are satisfied and finally 7.3% are very satisfied with the slope of the path they traveled to make a transfer.

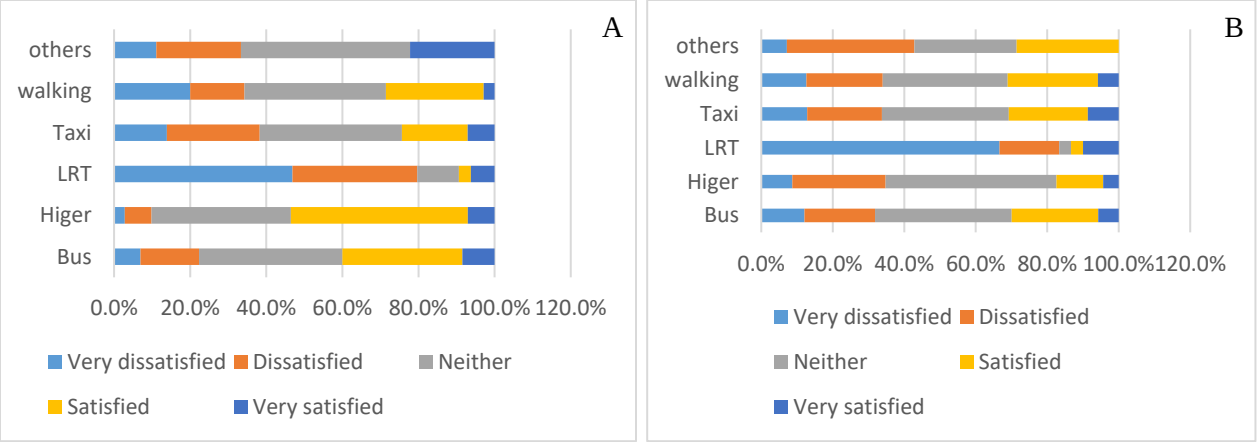

Figure 12 Graph showing Entry (A) and Exit modes of transport (B) cross tabulated with slope of the path

On the other hand, observing the transport mode the respondents used to enter the study area and their response on the slope of the path they traveled the data shows that the LRT users increase in dissatisfaction almost 67% of the users are "Very dissatisfied" with the slope of the path they traveled and 16.7% are "Dissatisfied" with the slope. The other mode user responded with similar traits. Slope of the path reveals similar characters, with respondents Using LRT to exit the study area responding with 46.9% of "Very dissatisfied" and 32.8% of "Dissatisfied". The data reveals that other modes have a higher satisfaction rate with Higer Bus users being 46.5% "Satisfied" and Bus users 31.5% Satisfied followed by Minibus taxi users 17.3% "Satisfied".

4.9.6 The conditions of the sidewalk traveled to make a transfer

26.9% of the respondents stated that they are "Very dissatisfied" while 29.4% responded "Dissatisfied" with the conditions of the sidewalk. Furthermore 28.7% replied "Neither" ,11.7% "Satisfied" and lastly 3.3% responded very satisfied with the conditions of the sidewalk.

4.9.7 Straightness of route path traveled to make the transfer

The path direction and simplicity is one of the factors that affect the public transport user's perception of making a transfer. Hence, the straightness of path was included as one of the parameters for the respondents to assess their transfer path. However only 5.7% of the respondents answered that they are "Very dissatisfied" and 25.4% rated the parameter "Dissatisfied". In addition 37% of the respondents assessed the parameter "Neither", 23.4% "Satisfied" and finally 8.5% "Very satisfied".

4.9.8 Time taken to travel from drop off station to egress station

The time taken parameter was included in the survey for the respondents to assess the time the path takes from drop off station to egress station. 12.3% of the respondents answered "Very dissatisfied" while 27.8% responded "Dissatisfied". Nonetheless, 35% of the respondents are neither satisfied nor dissatisfied with the time taken to walk the path. In addition, 16% were "Satisfied" and 8.8% were "Very satisfied" about the time it took to make the transfer.

4.9.9 The number of streets crossed to make the transfer

The number of streets a person has to cross to make a transfer is one of the parameters that affect the public transport user's perception of the path traveled to make the transfer. The data reveals that 9.6% of the respondents are "Very dissatisfied", 29.5% are "Dissatisfied", 33.2% are "Neither", 17.8% are "Satisfied" and 9.9% are "Very satisfied".

4.9.10 Safety and security while making a transfer

The data from the survey reveals that 20.4% of the respondents answered “Very dissatisfied” while 25.4% stated they were “Dissatisfied” with the safety and security parameter of the transfer path. Furthermore 25.1% of the respondents replied “Neither” while 14.8% stated that they were “Satisfied” and 13.9% stated they were “Very satisfied” with the safety and security aspects of the path traveled to make a transfer.

4.9.11 Easy transfer parameter

It can be observed that 19.3% of the respondents were “Very dissatisfied” and 26.8% were “Dissatisfied” with the easy transfer parameter. 20.2% of the respondents answered “Neither” for the question do they think their transfer path was easy to make. 17.4% were “Satisfied” and 16.3% were “Very satisfied” with the transfer they made.

4.9.12 Necessary Requirements to make the transfer

The respondents were asked to rate their transfer experience in the parameters of the necessary requirement parameter of the transfer with a five point Likert scale. 22.8% of the respondents were “Very dissatisfied” with the parameter of necessary requirements to make the transfer while 34.6% were “Dissatisfied” with the parameter. However, 26.9% of the respondents rated the parameter “Neither” ,12.6 % were satisfied and 3.1% were “Very satisfied”.

4.9.13 Protection from bad weather while transfer

The any weather transfer parameter was include in the survey to assess the respondents perception towards making the transfer during any weather time. The data shows that 32.7% of the respondents are “Very dissatisfied” with the parameter while 29.9% are “Dissatisfied”. In addition, 24.2% of the respondents answered “Neither” for the any weather time transfer while 9.2% responded “Satisfied” and 4.1% of the respondents countered “Very satisfied”.

the anytime transfer parameter with the Gender it is revealed that the women responded 32.4% “Very dissatisfied” while men 23.0% “Very dissatisfied”. Hence, both Female and male responded similarly with 31.3% and 33.6% “Dissatisfied” respectively. While the satisfaction level increases in the Male gender with 14.5% responding “Satisfied” and 3.4% “Very satisfied” while it is 3% and 4.7% respectively for Female’s.

4.9.14 The physical integration of public transport stations and its effect on the users

The finding of this study indicated that the majority of the transfer parameters have a satisfaction around “Dissatisfied” only a few have a closer response to “Neither satisfied not dissatisfied”. There are no parameters with a mean falling on “Satisfied” or “Very satisfied”. Although some parameters of the transfer are doing much worse like ‘condition of side walk parameter’, ‘anytime transfer’ and ‘any weather transfer parameter’. The parameters that have better perception of satisfaction to the respondents are ‘the continuity of transfer path’ and ‘the straightness of transfer path’. The parameters that showed a high variance are the safety and security of the transfer path parameter and the perception of easy transfer assessed by the respondents. The skewness of the responses are between -0.5 and 0.5, this suggests that the data are symmetrical. Except the parameters of weather transfer and anytime transfer which are between 0.5 and 1 concluding the data are moderately skewed. All the parameters and responses have a normal distribution or an acceptable distribution.

The finding of the study based on the regression model analysis excludes the variables that are significant for the satisfaction parameters. The model concludes that for every 50 meters increase in distance traveled to make a transfer there is 0.63 factor increase in the dissatisfaction of the user towards the distance parameter of the transfer. The other parameter affected by distance is the perception of number of streets crossed to make a transfer. The findings shows that for every one unit meaning in this case fifty meters walked by the respondents their satisfaction towards number of streets crossed to make a transfer decreases with a 0.356

factor given that all the other variables are held constant. Finally, the distance walked variable affects the easy transfer parameter with a factor of 0.422 the more people walk to make a transfer the less they will be satisfied with the parameter.

The other significant factors in affecting the perception of transfer parameters is the users transfer rate throughout the day the more a person makes a transfer there is an increased dissatisfaction towards different parameters of the transfer. These parameters are the 'continuity of path traveled to make a transfer', 'the convenience of routes walked to make a transfer', 'the attractiveness of the transfer path'; the conditions of side walk on the transfer path and so on. This concludes that the more transfers a person makes the increase in dislikes of the different transfer parameters.

The results of the regression model also shows that the slope of the track traveled to make a transfer is influenced by the transport mode used by the respondents to travel to their next destination. This determines that transport modes like the LRT have altered the satisfaction rate of this parameter because users of the LRT have increased dissatisfaction towards this parameter than others.

The findings of the study also indicate that the female gender has a decreased satisfaction toward the safety and security parameter and it increases the chance of being dissatisfied with the safety and security parameter of the transfer with a factor of 0.511. The other variable that affects the perception of safety and security is the Age variable. The variable affects the parameter with a factor of 0.168. Finally, the variable that affects the perception of safety and security is the transfer time of the respondents. The model indicates with a factor of 0.430 that the transfer time of the respondents can significantly affect the perception of safety and security given that all the other variables are held constant.

The regression model also concludes that 'any weather transfer parameter' is affected by the respondents gender, trip purpose and transfer time. While 'anytime transfer parameter' is also affected by the gender and the transfer time of the respondents.

In summary, the variables that are highly influential in affecting the holistic transfer experience of the public transport user are the transfer rate per day of the user, the distance traveled by the user to make a transfer. The mode of transportation used also affects parameters like the slope of the transfer path while the gender of the public transport user affects the perception of safety and security.

The parameters that have left a negative perception on the users are mainly the conditions of sidewalk, any weather transfer parameter and safety and security of the transfer path. However, the majority of the parameter are still falling in dissatisfied range. Observing the results of the study it can be seen that Although there is a dedicated pedestrian sidewalk to facilitate the transfer experience, this loss of physical integration has created a huge number of public transport users, which are required to walk from their drop off stations to their exit stations. This also means by crossing a number of streets and passing through uncomfortable pedestrian walkways that are overcrowded with people and informal vendors. The physical problems are mostly related to boarding and alighting public transport modes at the study area, as well as crowding, which restricts smooth movement of the users. This transfer experience was one of the focus of the study by using different parameters users were asked to rank their experience. The findings show that the majority of the parameters are not satisfying to the public transport user, from the customer's perspective; the quality of services provided by public transport is not at a satisfactory level. There is a need to mobilize and create and integrated approach to increase the efficiency of the public transport service and improve mobility of the users.

4. Conclusions

The research is conducted to assess the physical integration of public transport stations and its effect on the public transport user. The study was conducted on Mexico roundabout and included the study of 20 public transport stations including the LRT stations and it covered all the public transport modes present in the area.

The study has assessed the physical integration of the public transport stations of the area by assessing the transfer experience of the public transport users.

Public transport is the way forward for any rapidly urbanizing city like Addis Ababa. It is rather important to make the service as efficient as possible. Different methods were used to assess the trip characters and the transfer experience of the public transport users of the study area. The transfer experience of the public transport users was compared with the seamless one-seat journey private automobiles provide. 14 parameters of the transfer were provided for the respondents to rate their satisfaction towards the transfer experience. Accordingly, the efficiency of the public transport transfer was found to be lacking in different aspects.

According to the survey of the respondents, almost all the parameters of transfer have been rated as dissatisfied in the perception of the public transport user. This is an additional proof to support the evidence that the public transport stations are not physically integrated and the parameters leave a negative impression of the public transport service on the user.

The perception of the transfer experience is highly affected by the distance a person walks to make a transfer. However, the perception of the distance might get worse following the conditions of the sidewalk, slope of the path traveled or the weather conditions while making the transfer. The number of times a person makes a transfer throughout the day is also one of the significant factors that affect the perceptions of the transfer experience.

The findings reveal that the Public transport is still a dominant and equitable service for the urban dwellers of the area. The minibus taxi is the dominant mode of transport for the area followed by city bus and Higer midibus the LRT shares small percentage of the modal usage one of the reasons is the physical disintegration of the service with other public transport modes.

The consequences of an inefficient public transport service and a physically disintegrated public transport stations in the end will lead to most of the users choosing to own private vehicles. This will put a strain on the developing infrastructure of the city. It will increase the number of the vehicles on the road, which, in turn will lead to more congestion on the streets.

The decrease in number of people making transfers will also benefit the flow of traffic, as people crossing streets to make a transfer are one of the externalities that forces traffic flow to slow down the decrease in people crossing the streets will increase the speed and flow of traffic in the area. This are the added benefits of decreasing people which make transfers on a daily bases.

5. Recommendations

In a world, which is, urbanizing in unplanned and rapid manner it is important for a city to give priority and focus to urban services. One of the vital vessels of a city is urban transport. For a developing city with limited resources when it comes to urban transport, public transport service and development are the significant tools that the city can efficiently use the urban infrastructure at hand.

One of the undesirable parts of a public transport journey is a transfer. It is important to find solution to decrease or improve the transfers of public transport journeys.

There should be use of signalized intersections for transferring users to protect them from pass through vehicles and increase their safety.

The sidewalks in the study area should be well maintained and cleared from any open ditches, inconvenient materials or unlawful parked vehicles.

The study recommended placement of shading objects aligning the transfer paths of the users to protect them from rain and harsh sun.

Important locations around public transport hubs of the city should be assigned and designed to manage the physical integration of public transport stations. Priority should be given to public transport interchange facilities around transport hubs of the city.

Modern and sustainable public transport interchange facilities should be the way forward for the city's public transport service. These interchange facilities should protect users from harsh weather condition, provide comfortable spaces for transfers and increase users safety and security while making the transfers.

Future Buildings built around or in public transport; hubs of the city should integrate and protect the public transport users from harsh weather times. They should include arcades or shading objects.

Origin destination Data should be collected about the transferring public transport users. it will assist in identifying which station to station transfers are highly required and provide a longer transport option for users to avoid transferring.

Measures can also be taken to place the drop off station and exit station at a convenient location for public transport users to have an easier transfer. it is important to reduce the distance a public transport user has to walk to make a transfer.

Public transport is an equitable service for every urban dweller the service should be continuously analyzed and improved to efficiently serve the public. Modal Use and trip characters of the users should be traced and assessed to advance the service. User surveys should be an integrated process in managing and designing public transport services as they could provide a strong input to the progression of the service.

1. References

A.F.D, 2014. *FINDING URBAN TRANSPORT SOLUTIONS:THE CHALLENGES OF FINANCING AND INTEGRATION OF NETWORKS,* Bandung: Agence Francaise Development.

Berlepsch, 2018. Public transport integration and transit alliances. *Transformative urban mobility initiative.*

Creswell, J. W., 2009. *Research Design qualitative quantitative and mixed method approaches.* Third Edition ed. singapore: sage.

CTPS, 1997. *Central Transportation Planning Staff, Transfer Penalties in Urban Mode Choice Modeling, Report prepared for the Travel Model Improvement,* s.l.: Department of transportation.

EU , 2016. *The Economic Benefits of Sustainable Urban Mobility Measures,* s.l.: european commision .

EU, 2013. *lessons from descriptive case stdies - recommendations for city hub , innovative design and operation of new or upgraded efficient urban transport interchanges.* s.l., european commission seventh framework programme.

GEORGE, M. M., 2017. *INTERCITY BUS TERMINALS study of passenger facilities ,* Nairobi: University of Nairobi.

Hine, J. & Scott, J., 2000.. Seamless, accessible travel: users' views of the public transport journey and interchange.. *Transport Policy,* Volume 7,, p. 217–226..

Hussen, B. W., 2016. *Sustaining Sustainable Mobility : the Integration of Multimodal Public Transportation in Addis Ababa,* lyon: s.n.

Ibrahim, F., 2003. Improvements and integration of a public transport system:The case of Singapore. Cities. pp. 205-216.

ITDP, 2021. *Bus Rapid Transit Planning Guide.* [Online]
Available at: https://brtguide.itdp.org/branch/master/guide/multi-modal-integration/physical-integration
[Accessed 3 9 2020].

Krygsmana, S., Dijsta, M. & Arentze, T., 2004. Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio. *Transport Policy,* Volume 11, p. 265–275.

Krygsman, S. & Dijst, M., 2004. Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio. *transport policy* , july.

Lam, s. & Xie, F., 2002. Transit path-choice models that use revealed preference and stated preference data. *Transportation Research Record,* Volume 1799, p. 58–65.

Luk, J. & Olszewski, P., 2003. Integrated public transport in Singapore and Hong Kong.. *Road and Transport Research,* pp. 41-51.

M.O.T, 2011. *Tranport Policy of Addis Ababa,* Addis Ababa: Federal Democratic Republic of Ethiopia, Ministry of Transport.

Milller, A., 2004. *Assessment of Service Integration Practices for Public Transportation:,* s.l.: Review of the Literature California Partners for advaned transit and highways.

Monzón, A., Hernández, S. & Ciommo, F. D., 2016. Efficient urban interchanges: the City-HUB model. *Transport Research Arena.*

Nag, D., Goswami, A. K. & Bharule, S., 2019. FRAMEWORK FOR PUBLIC TRANSPORT INTEGRATION AT RAILWAY STATIONS AND ITS IMPLICATIONS FOR QUALITY OF LIFE.

Pratelli & Brebbia, 2010. *urban transport XVI urban tranport and the environment of 21st century.* s.l.:WIT press.

R. Jayakrishnan, C. E. C. L. P. L. A. C. R., 2005. *High Coverage Point to Point Transit (HCPPT): A New Design Concept and Simulation –Evaluation of Operational Schemes California PATH Research Report,* CALIFORNIA, irvine: CALIFORNIA PARTNERS FOR ADVANCED TRANSIT AND HIGHWAYS.

Sabyasachee Mishra, T. F. W. a. M. K. J., 2012. Performance indicators for public transit connectivity in multi-modal transportation networks. *elsevier,Transportation Research Part A,* Volume 46, pp. 1066-85.

Saliara, K., 2014. Public Transport Integration: the Case Study of Thessaloniki,Greece. *Mobil. TUM 2014 "Sustainable Mobility in Metropolitan Regions", May 19-20,* Issue Transportation Research Procedia, p. 535 – 552.

UN Habitat, 2009. *planning sustainable cities : Global report on human settlements,* s.l.: united nations human settlements programme.

UN, 2015. *SUSTAINABLE URBAN MOBILITY AND PUBLIC TRANSPORT IN UNECE CAPITALS,* New York and Geneva: United Nations.

UNDP, 2010. *City wide integrated transport plan,* s.l.: Ministry of urban transport india.

Zimmerman, S. & Fang, K., 2015 . *public transport service optimization and system integration.* washington , U.S.A: the world bank .

Annex ÍÍ. Questionnaire for surveying transfer experience of public transport users

We appreciate you for providing your perspective on your public transportation transfer experience

Survey date_____Survey place/station_____who collected the survey_____

1. **Gender** Male (1) Female (2)
2. **Age** Below 15 years old (1) 15-20 (2) 21-30 (3) 31-40 (4) 41-50 (5) 51-60 (6) 61-70 (7) above 70 (8)
3. **Occupation** Student (1) Full time (2) Part time (3) Unemployed (4) Home maker (5)

4. **What is the purpose of your trip?**
   Work (1) Education (2) visiting family (3) leisure (4) other (5)

5. **Which Mode of transportation did you use to get to the area?**
   Bus (1) Higer (2) LRT (3) Minibus taxi (4) Walking (5) Other (6)

6. **Which Mode of transportation did you use to leave the area?**
   Bus (1) Higer (2) LRT (3) Minibus taxi(4) Walking (5) Other (6)

7. **From which area did you come?**
   Megenagna, 22, stadium (1) Bole (4) Sarbet, Mekanisa, jemo, Garment (7)
   Piassa, Addisu gebeya (2) Torhayloch, Kara(5) Tikur Anbessa, Merkato awotibistera (8)
   Aratkilo, Sidist kilo (3) Kera mebrat, Cherkos (6) Kasanchis, Biherawi (9)

8. **To which area are you going?**
   Megenagna, 22, stadium (1) Bole (4) Sarbet, Mekanisa, jemo, Garment (7)
   Piassa, Addisu gebeya (2) Torhayloch, Kara(5) Tikur Anbessa, Merkato Awotibistera(8)
   Aratkilo, Sidist kilo (3) Kera mebrat, Cherkos (6) Kasanchis, Biherawi (9)

9. **How often do you transfer using this roundabout?**
   Always (1) Very often (2) Sometimes (3) Rarely (4) Never (5)

10. **How many times a day do you make a transfer to finish your journey?**
    1-2 (1) 3-5 (2) 6-8 (3) 8-10 (4)
11. **What time of the day do you usually pass through this roundabout?**
    12:00-3:00(1) 3:00- 6:00AM (2) 6:00 -8:00 PM (3) 8:00 -10:00 PM (4)
    10:00-1:00 PM (5) 1:00 -3:00 PM (6)

12. How satisfied are you with the following components of your transfer?

	Very satisfied (4)	**Satisfied (3)**	**Neither (2)**	**Dissatisfied (1)**	**Very dissatisfied (0)**
Length of walk traveled to make a transfer					
Continuity of path traveled to make a transfer					
Convenience of routes traveled to make a transfer					
Attractiveness of path traveled to make a transfer					
Slope of the track traveled to make a transfer					
Conditions of sidewalk traveled to make a transfer					
Straightness of the route					
Time taken to make the walk from drop off station to egress station					
No of streets crossed					
Safety and security while making a transfer					

13. Do you agree with the following statements about the Mexico roundabout?

	Very satisfied (4)	**Satisfied (3)**	**Neither (2)**	**Dissatisfied (1)**	**Very dissatisfied (0)**
It has made it easy for me to make a transfer to another mode					
All the necessary requirements to make my transfer are there					
it is easy to make the transfer during all weather times					
It is easy to make the transfer during any time of the day					

14. Do you think the transfer experience affects your route and modal choice?

 Yes (1) No (2)

15. Do you have any recommendation on how to improve the transfer experience?

_____

_____

Thank You for your cooperation!!

Annex ΙΙΙ. Sample filled out questionnaire

EiABC

ስለሚገለገሉበት የህዝብ ትራንስፖርት አገልግሎት ያሎትን አስተያየት ይሰጡን ዘንድ በታላቅ ትህትና እንጠይቃለን።

ስለትብብሮ እናመሰግናለን።

መጠየቁ የተሰበሰበት ቀን 24/02/2013 መጠየቁ የተወሰደበት ቦታ 10 መጠየቁን የሰበሰበው ሰው ANAዓG

1. ጾታ ☒ ወንድ (1) ☐ ሴት (2)

2. ዕድሜ ☐ ከ15 አመት በታች (1) ☒ 15-20 (2) ☐ 21-30 (3) ☐ 31-40 (4) ☐ 41-50 (5) ☐ 51-60 (6)
☐ 61-70 (7) ☐ ከ 70 አመት በላይ (8)

3. ስራ ☐ ተማሪ (1) ☐ ሙሉ ጊዜ ሰራተኛ (2) ☒ የትርፍ ጊዜ ሰራተኛ (3) ☐ ስራ አጥ (4)
የቤት እመቤት (5) ☐ ጡረተኛ (6) ☐ ሌላ የተለየ (7)

4. የጉዞዎ ምክንያት ምንድን ነው?

☒ ለስራ (1) ☐ ለትምህርት (2) ☐ ለመዝናናት (3) ☐ ቤተሰብ ለመጠየቅ(4) ☐ ለሌላ ጉዳይ(5)

5. ወደ አካባቢው የመጡት የትኛውን የህዝብ ትራንስፖርት አገልግሎት ተጠቅመው ነው ?

☒ አውቶቢስ (1) ☐ ሃይገር (2) ☐ ቀላል ባቡር (3) ☐ ታክሲ (4) ☐ በእግር (5) ☐ ሌላ (6)

6. የሚቀጥለውን ጉዞዎትን የትኛውን የህዝብ ትራንስፖርት አገልግሎት ይጠቀማሉ?

☐ አውቶቢስ (1) ☒ ሃይገር (2) ☐ ቀላል ባቡር (3) ☐ ታክሲ (4) ☐ በእግር (5) ☐ ሌላ (6)

7. ከየትኛው አካባቢ ነው የመጡት?

☐ መገናኛ፤ 22፤ ስታዲየም (1) ☐ ቦሌ(4) ☐ ሳርቤት፤ መካኒሳ፤ ጀሞ፤ ጋርመንት(7)
☐ ፒያሳ፤ አዲሱ ገበያ(2) ☐ ጦር ሃይሎች፤ አየር ጤና፤ ካራ(5) ☐ ጥቁር አንበሳ፤ መርካቶ፤ አውቶቢስ ተራ(8)
☐ አራት ኪሎ፤ ሰዲስት ኪሎ(3) ☒ ቄራ፤ መብራት ሃይል፤ ጨርቆስ(6) ☐ ካሳንችስ፤ ብሄራዊ (9)

8. ወደየትኛው አካባቢ ነው የሚጓዙት?

☒ መገናኛ፤ 22፤ ስታዲየም(1) ☐ ቦሌ(4) ☐ ሳርቤት፤ መካኒሳ፤ ጀሞ፤ ጋርመንት(7)
☐ ፒያሳ፤ አዲሱ ገበያ(2) ☐ ጦር ሃይሎች፤ አየር ጤና፤ ካራ(5) ☐ ጥቁር አንበሳ፤ መርካቶ፤ አውቶቢስ ተራ(8)
☐ አራት ኪሎ፤ ሰዲስት ኪሎ(3) ☐ ቄራ፤ መብራት ሃይል፤ ጨርቆስ(6) ☐ ካሳንችስ፤ ብሄራዊ (9)

9. ምን ያህል ጊዜ ነው ይህን ጉዞ የሚያረጉት?

☐ ሁል ጊዜ (1) ☒ ብዙ ጊዜ (2) ☐ አንዳንድ ጊዜ (3) ☐ አላረግም (4)

10. የትራንስፖርት አገልግሎት በቀን ውስጥ ምን ያህል ጊዜ ይቀይራሉ?

☐ 1-2 (1) ☒ 3-5 (2) ☐ 6-8 (3) ☐ 8-10 (4)

11. በየትኛው ሰአት ነው በእዚህ አካባቢ ትራንስፖርት አገልግሎት ለማግኘት የሚያልፉት? ሁለት መምረጥ ይቻላል

☒ 12:00-3:00(1) ☐ 3:00- 6:00 (2) ☐ 6:00 -8:00 (3) ☐ 8:00 -10:00 (4)
☒ 10:00-1:00 (5) ☐ 1:00 -3:00 (6)

12. በሚከተሉት የትራንስፖርት አገልግሎት ለመቀየር በሚያደርጉት ጉዞ ምን ያህል ረክተዋል ?

	እጅግ በጣም አረክቻለሁ (4)	በጣም አረክቻለሁ (3)	በጥቂቱ አረክቻለሁ (2)	ያን ያህል አልረካሁበትም (1)	ፈጽሞ አልረካሁበትም (0)
የትራንስፖርት አገልግሎት ለመቀየር የተጓዙት ርቀት			✓		
የተጓዙት መንገድ ወጥነት		✓			
የተጓዙት መንገድ ምቹነት				✓	
የተጓዙት መንገድ ማራኪነት				✓	
የተጓዙት መንገድ ተዳፋት			✓		
የእግረኛው መንገድ ሁኔታዎች				✓	
የተጓዙት መንገድ ቁጥ ማለትን		✓			
ከወረዱበት ስፍራ እስከሚሳፈሩበት ቦታ የፈጀው ሰአት			✓		
ከወረዱበት ስፍራ እስከሚሳፈሩበት የእቋረጡት አስፋልት ብዛት			✓		
ከወረዱበት ስፍራ እስከሚሳፈሩበት ድረስ የደህንነቶ ሁኔታ					✓

13. የትራንስፖርት አገልግሎት ለመቀየር በተጠቀሙት አካባቢ ላይ ከታች የተሰነዘሩት አስተያየቶችን እንዴት ያዩታል ?

	እጅግ በጣም አረክቻለሁ (4)	በጣም አረክቻለሁ (3)	በጥቂቱ አረክቻለሁ (2)	ያን ያህል አልረካሁበትም (1)	ፈጽሞ አልረካሁበትም (0)
በቀላሉ ወደ ሌላ የትራንስፖርት አገልግሎት ለመቀየር ችያለው			✓		
የትራንስፖርት አገልግሎት ለመቀየር የሚያስፈልጉ ነገሮች ተሟልተዋል				✓	
በየትኛውም አየር ንብረት ሁኔታ በቀላሉ የትራንስፖርት አገልግሎት ለመቀየር ችያለው					✓
በየትኛውም የቀኑ ሰአት በቀላሉ የትራንስፖርት አገልግሎት ለመቀየር ችያለው				✓	

14. የትራንስፖርት አገልግሎት ለመቀየር የሚያሳልፉት ሁኔታ የሚመርጡትን መንገድና የትራንስፖርት አገልግሎት ይወስናል ወይ ?

☑ አዎ ይወስናል (1) ☐ አይወስንም (2)

15. አርስዎ ይህን አሰራር ለማሻሻል መፍትሄ ይሆናል ብለው የሚያስቡት ነገር አለ ?

የትራንስፖርት አገልግሎት መጨመር

ለትብብሮ እናመሰግናለን

Annex ⅠV. Interview questions for service providers

This interview is for a thesis done on physical integration of public transport stations and it is for academic purposes only

1. How are routes assigned and designed does it consider the integration of other public transport services?
2. What are the problems associated with assigning longer routes?
3. Does your route planning consider protection against harsh weather environment?
4. Do you have any associations with other public transport providers?
5. Are there any future considerations to avoid or decrease transfers for your users?
6. Do you follow any guidelines or standards you have to follow from the transport authority in the planning of public transport service?