THE MEDIATING EFFECT OF TRAFFIC CONGESTION SEVERITY ON ECONOMIC COST: CASE SUDY IN NIFAS SILKLAFTO SUB-CITY, ADDIS ABABA ETHIOPIA

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF JIMMAUNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF LOGISTICS AND TRANSPORT MANAGEMENT (MA) DEGREE

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JIMMA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

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Declaration

I hereby declare that, this thesis entitled "The mediating effect of traffic congestion severity on economic cost: case study in Nifas silk Lafto sub-city, Addis Ababa Ethiopia, has been carried out by the researcher of this study under the guidance and supervision of Dr. Mekonnen Bogale and Mr. Debebe Alemu.

The thesis is original and has not been submitted for the award of any degree or diploma to any university or institutions.

Researcher's Name	**Date**	**Signature**
Habtamu Kassa Tekettel	10/12/2020	_____

Statement of Certificate

This is to certify that the thesis entitled "The mediating effect of traffic congestion severity on economic cost: case study in Nifas silk Lafto sub-city, Addis Ababa Ethiopia "submitted to Jimma University, College of Business and Economics for the award of Degree of Master of Logistics and Transport Management (LTM) is a record of genuine research work carried out by Habtamu Kassa, under our guidance and supervision. Therefore, we hereby declare that no part of this thesis has been submitted to any other university or institution for the award of any degree or diploma.

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Lists of Acronyms and Abbreviations

AACRA	Addis Ababa City Road Authority
AATA	Addis Ababa transport authority
HCM	High way Capacity Manual
HPMS	Highway Performance Monitoring System
LOS	Level of Service
NCHRP	National Cooperative Highway Research Program
PCU	Passenger Car Unit
SIDRA	Signalized (Un-signalized) Intersection Design and Research Aid
TRB	Transportation Research Board
TTI	Texas Transportation Institute.
UMR	Urban Mobility Report
VOT	Value of Time
VOC	Vehicle Operating Cost
TRR	Transportation Research Record
VMT	Daily mile travel is the average daily Traffic
DVMT	Daily Vehicle-miles of travel
ADT	Average daily Travel
SEM	Structural equation model
FHWA	Federal Highway Administration
AMOS	Analysis of Moment of structure

Abstract

Transportation services are highly needed for human beings in day-to-day activities. It takes the lion share in the economy, social and political development activities. Now a day, transportation service is challenged by many factors that affect the transportation effectiveness. From those factors, traffic congestion is one of the major problems in the transportation system development due to different reasons in both developed and developing countries. This study focused on examining the mediating effect of traffic congestion severity on economic cost*: case study in Nifas silk Lafto sub-city, Addis Ababa Ethiopia. To achieve this objective, descriptive and explanatory research design with both qualitative and quantitative approach was used in the study. The study used Convenience sampling method to get a sample of 385respondents. Data was collected from primary and secondary sources. The primary data was collected from respondents by using Likert scale type questionnaire, interview, field measurement and traffic flow raw data was used as source of secondary data. Descriptive statistics such as means, frequency and standard deviation and inferential statistics (correlation, regression and structural equation model) by using Statistical Package for Social Sciences and Analysis of Moment of structure was used to analyze data. Based on the analysis of the result, the key cause of traffic congestion at Jemo Michael intersection are road condition, population numbers increase, vehicles numbers increase, insufficient traffic management and Parking problem. Level of traffic congestion at Jemo and Germen approach is very highly congested approach (F-level of service), on the other hand Ayer tena and Lideta approach are E level of service. When we look economic cost of traffic congestion, the total extra fuel consumption 217,640 lit and cost of extra fuel consumption per year at Jemo Michael intersection 4,352,814ETB.Additionally,total extra travel time loss 497,124.1minute(8285.4hours) and economic cost of congestion wasted travel time at Jemo Michael intersection is 25,891,656.25 ETB. The main mitigation way of traffic congestion is improving width of the existing road capacity, building new alternative road and developing parking management strategies. Encouraging mass transportation system and working on capacity building of traffic management with improve traffic management strategies are other mitigating strategies.*

Keywords*: Cause of congestion, Economic effect of congestion, Level of service, Traffic congestion*

CHAPTER ONE

INTRODUCTION

This chapter contains background of the study, statement of the problem, research questions, objective, significance, scope, operational definition and limitation of the study.

1.1. Background of the Study

Transportation movement is a basic human need during their lifetime. According to Coyle et al. (2011) movements of publics' goods and information have always important components of public societies. Transport is the vein of economic activities and the glue of demand with supply in any situation. Every person use transport service in lifetime for the aim of reduces extra cost and improves efficiency. But now a day inversely transport service is increase cost and reduces efficiency of in every activity. As well, transportation has many negative impacts on development of economy. Specifically, traffic congestion has impacts on development of global economy.

According to Goodwin(1997) congestions define as the obstruct vehicles impose on each other, when vehicles number increase and the capacity of road decrease vehicles is obstructing for each other due to this case congestion is occur. Congestion as the excess of road system capacity due to regular and irregular decreases in facility value represent by increase travel times (Banjo2004) similarly defined it. Traffic congestions are the inadequacy of road capacity and obstruct vehicles imposes on each other, through regular and irregular decreases in facility value (Goodwin, P. B., 1997; Banjo, G.A., 2004).

Traffic congestion is a condition when travel DD exceeds the existing road capacity and when the number of vehicles exceeds the ability of the roadway to carry the load at acceptable service levels (Rothenberg, 1985; Vuchic and Kikuchi, 1994). Traffic congestion is a condition in which traffic delay i.e. when the flow of traffic is slowed below reasonable speeds because of the number of vehicles (Weisbrod et al., 2011; Pisaraski, 1990). Traffic congestion is an excess of vehicles on a portion of roadway at a particular time resulting in speeds that are slower-sometimes much slower-than normal or "free flow" speeds (Kockelman, 2004; Cambridge Systematic and TTI, 2005; Turner, 1998).

Urban Mobility Report (2009) overall, it is difficult to overstate the negative effect that traffic congestion has on the nation economy. Congestion cost means external cost of road user on the rest of society, like travel delay, increase vehicle operating costs, pollution, fuel consumption. From the cost perspective traffic congestion refers to the incremental costs resulting from interference among road users (Litman, T, 2005; Haworth and Symons, 2001).Traffic congestion costs negatively affect countries economy; affect the quality of life by costing traveler's time, pollution environment and causing accident.

Negative impact of traffic congestion is wide and effect on all developed and developing countries so difficult to overcome all problems by quantitative measures. Road traffic congestion problem is the main challenges of urban peoples. European countries, expend more than 7% of their GDP on transportation and out of which only traffic congestion costs more than 1% of the GDP (ECMP, 2007). Additionally, the developed country like USA, India, China, many Europe country economy developments more challenging by congestion know a day. However, in developing country traffic congestion similarly highly affect economy through travel time delay and fuel consumption. Countries like South Africa, Egypt in Cairo, Tunisia and besides from Sub Sahara Africa like Ethiopia in Addis Ababa and Kenya Nairobi main challenges on day to day activities. In Ethiopia, different reports estimate the transportation expenditure to be about 10% of the country's GDP; however, the actual cost incurred due to traffic congestion is not yet know.

Therefore, traffic congestion is challenges for all world economy growth and highly affects developed and developing countries. Addis Ababa Ethiopia is one of fast-growing city and is affected by traffic overcrowding. According to Addis Ababa transport authority report shows, the vehicle fleet in 2016/17 is assess to be 524,444 with the average growth of the vehicle growth 30 percent in the year**.** This indicate in Addis Ababa highly increase demand of transport when comparatively to other country. The problem is not only increasing of vehicles but lack of infrastructure expanding parallel to demand increase. According to kefyalew T. (2017), based on the level of service analysis, most of Addis Ababa road intersections are performing above their capacities. Similarly, major reasons for traffic congestion: lack of good mass transport, imbalance of vehicle volume and road capacity, bottlenecks, poor traffic management, interference of pedestrians at junctions, on street parking and informal on street trade and traffic accidents.

The competence of urban centers activities is extremely dependent on the helpfulness of transport systems to more people and goods between multiple beginnings and destination. For improve this competition peoples use transportation service, but transportation service in Addis Ababa has effect economic cost through travel time delay and extra fuel use. As to Haregewoin (2010) congestion problem is a common characteristic in urban road transportation system of the cities of developing countries that results in high operation cost, loss of time, high delay, high travel time and increase in fuel consumption. In Addis Ababa, road traffic congestion is disorder, extravagant and unsafe. It is dangerously affecting the people mainly live in the town through loss of efficiency, obstructing social development, change in accident frequency, rise in air pollution, increase wastage of time, rise delay, lack of comfort. Mainly affect economically due to delay travel time, increase travel cost, fuel consumption and others.

Consequently, the above cases and problems motivated the researcher to select this research topic and it desires for investigation. The main objective of this study was to investigate the mediating effect of traffic congestion severity on economic cost: in the case of Nifas silk Lafto sub-city, Addis Ababa Ethiopia.

1.2. Statement of the Problem

Nowadays, traffic congestion is internationally a big issue and a challenge for country's economy. According to the Urban Mobility Report (2010), the cost of congestion in United States of America with high delay time and waste fuel cost of 2009. The result shows that the congestion cost for extra time and fuel for 439 urban areas were 24 billion (1982), 58 billion (2000) and 115 billion (2009) for the years respectively; this will increase to 186 billion US$ by 2030. Moreover, in USA 3.9 billion gallon of fuels wasted and 4.8 billion person-hours of extra time wasted. Similarly, in developing country the congestion cost estimate for Toronto and for major Australia's cities estimated to be 3.3 billion and 9.39 billion per year respectively. A study recently released by the World Bank reveals that Cairo's infamous traffic costs Egypt EGP 47 billion (USD 6.5 billion) annually and is expected to reach EGP 105 billion (USD 14.6 billion) by 2030.These results show how the traffic congestion costs affect individual travelers and a nation economy in general.

In Ethiopia, Addis Ababa, besides there is fast economic growth with high degree of urbanization and road traffic congestion. This urbanization and growth can cause many

challenges to the transportation service because of increasing urbanization and industrialization is a need for many transport services and enough capacity infrastructures. Road traffic congestion is currently severe problem in most sub-cities of Addis Ababa due to high degree of urbanization and increases population mobility (Institute of Transport Engineers, 2009). In This paper the probable causes mentioned for road traffic congestions are: insufficient road width; inadequate parking space and wrong parking; rapid urban population increase; increase vehicle number; poor traffic management; inefficient public transport services (Institute of Transport Engineers, 2009). These can directly affect the occurrence of traffic congestion and indirectly be a reason for economic impact due to that it consumes extra travel time cost and fuel cost consumption, besides these independent variables (insufficient road width; parking problem; rapid increase urban population; poor traffic management; vehicles number increase) directly affect economic cost of congestion

The economic cost of traffic congestion, according to Wondwossen T (2011) the total delay within the day for only the road length considered, the total veh-min delay at the six legs will be about 92,950 Veh-min (1550 Vehicle-hr or 193 Veh-day) or the total person-min at the six legs will be 845,230 person-min (14,087 person-hr or 1,760 person-day). Additionally, total congestion costs including delay costs and wasted fuel costs of passenger and truck vehicles at the road segments were calculated at ETB 42,940,309.52, 24,265,882.55, 56,517,437.03 and 89,244,561.02 respectively in respect of the Riche-Meshualekya, Global-Meskel Flower, Nifas Silk-Adey Abeba and Akaki-Kality Maseltegna road segments (Kefyalew (2017)).

According to Fasika M. (2015) on average the maximum delay of 1623 Veh-min and 891 Veh-min was lost during the evening and the morning peak period and economic cost of congestion due to ideal time or labor cost, fuel cost and rental cost of vehicles only, on average the cost of congestion at the selected approach varies from 29 to 51 million birr per year with the average of 39.6 million birr on one approach per year.

Transportation in A.A has extremely crowded, delay, consume extra travel time and fuel consumption especially on peak time morning and night. Furthermore, vehicle fleet in average increase by 30% in the year that invite for loss of people's efficiency, obstructing social development, change in accident frequency, rise in air pollution, increase wastage of time, delay travel time, lack of comfort, increase travel cost and fuel consumption.

The reports by the Addis Ababa City Roads and Transport Bureau (2016) indicated that the rate of vehicles in Ethiopia, as global standards show low motorization rates (i.e. only 1 people have vehicles from every 100 people) but, 60% of them live in Addis Ababa and in main city challenges by congestion. Transport in Addis Ababa city is besides inefficient. It is unsafely affecting the people mainly live in the town through loss of efficiency, hindering social development, change in accident frequency, rise in air pollution, rise noise, increase wastage of time, rise delay. All above mention problems are challenges that most of workers and the persons of the overall community do encounter under different steps and situations are say to be straightly subordinate with the current road traffic jamming. Particularly the above problem is more occur from Addis Ababa ten (10) sub cities severe at Nifas Silk Lafto.

Nifas Silk Lafto area is a largest quantity of voyages of peoples and means of transportation with among different road connections which are found, the one of German, Ayer tena, Lideta and Jemo Michael joint play a big role for the occurrence of traffic congestions. As information obtained from many people and traffic police shows that the traffic demand and the road capacity for using these intersections are not balanced. Mainly, for the period of morning and evening peak time, there are a high number of traffic volumes.

Addis Ababa City is dramatically expanding with population increase. Now a day as international urban corporation foundation report indicates that 50% of world peoples live in urban and this number also increases to 60% in (2025). As the researcher's formal observation and discussion with residents, Addis Ababa has subjected to traffic congestion problems that obstruct citizens' mobility and timely supply of commodities. Therefore, traffic congestion in Addis Ababa causes problems like waiting longer time for vehicles, delay to work places and school, long wait for transport service, long travel time, fuel consumption, air and noise pollution, freight delivery delays, environmental costs. These problems cause different negative effects on health of citizens, such as stress and headache.

According to Addis Ababa city report, in Addis Ababa, the number of people in the city highly increases in short time. Because of this traffic congestion problem in city is high impact on economy and social activities for futures. It is observed now a day that transportation in Addis Ababa is extremely crowded especially on peak time and increase yearly through volume of vehicles and capacity of road growth unbalanced. Unless some sort of mitigation strategy is

designed to the traffic congestion, it will become main challenge of the urban growth in the future.

Therefore, Addis Ababa traffic congestion problem needs all transport professions knowledge contribution. This problem similarly needs research work in order to find solution for the problem. In this regard, there is not enough research conducted on traffic congestion in Addis Ababa according to their congestion severity.

In conducting previous research took only one-day traffic counts few hours' video record, due to time limitation with budget constraints. Additionally, different types of variables that are in estimating traffic congestion cost, however the researcher took only three variables (economic impact on freight transport, on rental cost of vehicles, operation cost) which are believes to be important in the analysis of congestion costs. Therefore, researcher improve this gap of pervious research through touch that untouched variables like delay cost, fuel cost and level of service of road with factor of traffic congestion. Which was concealed (hidden) its indirect effect of traffic congestion severity or indirectly be a reason for the decline of the nation's economy due to that it consumes extra travel time and fuel consumption.

There are few studies conducted on traffic congestion in Ethiopia focusing on identifying what it looks like and the causes traffic congestion roughly through either scientific engineering formula or questioners (respondent idea). But it better to identify clearly the cause of congestion to reduce severity of traffic congestions on economic development. Further, understanding the residents feeling through questionnaires adds values for the data obtained through scientific engineering formula.

Furthermore, up to the knowledge of the researcher there is no previous studies conducted using traffic congestion severity as mediator between impacts of traffic congestion on economic development. Additionally, fulfill the demography coverage of most sever congestion area Nifas silk Lafto sub city. Hence, this research focus on this information gap and investigate the mediating effect of traffic congestion severity on economic cost at Jemo Michael intersection, based on extra travel time cost and extra fuel consumption cost with identify level of service of selected intersection for future plan.

1.3. Research Questions

The current study was guided by the following basic research questions:

1. What is the level of transportation service at Jemo Michael road intersections in Nifas Silk Lafto sub city of Addis Ababa?
2. What are the basic contributing factors for occurrence of traffic congestion at Jemo Michael road intersections in Nifas Silk Lafto sub city of Addis Ababa?
3. How much of travel time delay and extra fuel consumption are registered due to traffic congestion at Jemo Michael road intersection?
4. How much of economy cost is registered due to congestion in Jemo Michael road intersection by travel time delay and extra fuel consumption?

1.4. Objective of the Study

1.4.1. General Objective

General objective was to investigate the mediating effect of traffic congestion severity on economic cost with level of service of Jemo Michael road intersection at Nifas Silk Lafto sub-city.

1.4.2. Specific Objective

1. To identify the level of transport service (LOS) of selected road intersections in Nifas Silk Lafto Sub City.
2. To identify the main cause of traffic congestion in Nifas Silk Lafto sub city.
3. To identify travel time delay and extra fuel consumption registered due to traffic congestion at Jemo Michael road intersection.
4. To identify economy cost registered due to congestion at Jemo Michael road intersection by travel time delay and extra fuel consumption.

1.5. Significance of study

The significance of the study can be seen from different perspectives since it focused on the mediating effect of traffic congestion severity on economic cost. The following are some of them:

It may provide information and a better insight to the Addis Ababa City Transport Authority (AACTA) on the patterns of road traffic congestion cause in the city, which in turn, could help to develop countermeasures that could reduce the related traffic problems including the economic effect in the city.

Moreover, it can help the Addis Ababa city and Nifas Silk Lafto sub city Transport Management Agency as an input to develop a plan and strategy that minimizes the problem of traffic congestion and its economic effect based on each cause. Here, the agency can improve the quality of decision making in urban road transport management planning, can determine the need for road improvements, vehicle inspections and can initiate for educational programs.

The result of the study will help the Addis Ababa City Road Authority (AACRA) as source of information on the current road capacity, level of service at Jemo intersection and for future road project construction. Especially, it helps them to identify which road segments to be constructed first, by what facility and type of road size and quality at Jemo intersection.

The result of this study in addition help the Addis Ababa traffic police office to conduct better traffic management by developing problem solving strategy that fill the gap of traffic facility, equipment and skilled man power through short term and long-term plans.

It may serve as a source for further study on mediating effect of traffic congestion severity on economic cost. This study has its own limitation; hence, other researchers can capitalize on it as starting point so that to minimize the research gap on the subject area and adds more information on the existing knowledge. It also provides deeper knowledge about the complexity of traffic congestion.

The study further supports the Federal Road and Transport Authority to understand the main cause of congestion and the way to eradicate this effect through policy making and strategic plan development for better economic competitiveness and quality of life for the societies.

1.6. Scope of the study

The scope of the study is bounded by the mediating effect of traffic congestion severity on economic cost. Topic of road traffic congestion analysis touches lots of variables, areas and need long period for study. Therefore, it is necessary to define scope of study that touch and

untouched variables in this research in order to indicate which variable left for other researchers. Accordingly, this study is delimited to the traffic congestion of land transport mode and emphasis on road transport (vehicles). Particularly, the geographical scope of this study is at the South-West axis of Addis Ababa - Ethiopia, in Nifas Silk Lafto Sub-city, who connects the main road of Jemo, German, Lideta and Ayer-tena.

Based on the variable, scope of traffic congestion consequences many cause and effect like economic, social, and environmental, but in this paper as a title focus on the mediating effect of traffic congestion severity on economic cost. In terms of variables, effect of economic of congestion has many variables. However, this research mainly focuses on: economic cost of congestion due to travel time delay cost and fuel consumption cost. The reasons of traffic congestion are many cases (variables) but in this research we look at some predictors (road condition, population growth, vehicle number increase, poor traffic management and parking problem) due to inadequate budget, time and data. Without the above-mentioned variables the other are open for other researcher. The researcher employed descriptive and explanatory research design with more conveniently use field measurement, interview, questionnaire (from passenger, driver & traffic police) and some secondary data of raw traffic flow data and calculate economic cost effect due to extra fuel cost and extra travel time cost. Secondary data use two years from 2018 - 2019 vehicles volume counted by the traffic management agency. These data use for comparing with recently collected data by researcher using video capturing.

In terms of time, transportation is a continual movement of vehicles in a road. The basic study of video record happens for certain periods and point of time. That is for three day Thursday, Tuesday and Sunday start from 12: 00am -12:00pm hours record volume of traffic flow. Time scope of study from title selection period up to presentation of result of research is from August 1/2019 –July 30/2020 almost use from 10 months to one year. The objective of this paper is focus on investigating the mediating effect of traffic congestion severity on economic cost.

1.7. Limitation of the study

The most limitation of this study is traffic volume data collection by video recording methods has challenged to entering all four approach of intersection in to camera at the same time and high cost for latest camera. But researcher overcome this problem through identify conducive

video record site then gate permission letter from Nifas Silk Lafto police commission for any favorable building owner and gate consent from owner of building. In addition, time constraint and budget constraint faced researcher. This problem solved by efficiently used budget and time through all direction.

1.8. Operational Definition of Terms and Concepts

Traffic Congestion: -Traffic congestion is a situation where "there are more people trying to use a given transportation facility during a specific period of time than the facility can handle with what are considered to be acceptable levels of delay or inconvenience" (A Toolbox for Alleviating Traffic Congestion 1989). Traffic congestion is a condition on any network as vehicle use increases and road is deficient with characterizes by slower speeds, longer trip time, and increase line up. Traffic congestion occurs when the number of vehicles using the road is greater than the capacity of the available road space, impeding the efficient movement of traffic.

Level of service (LOS): -The concept of level of service is defines as a qualitative measure describing operational conditions and within a traffic stream and their perception by motorists and passengers. Traffic congestion impacts can be measure based on roadway volume to capacity ratios. LOS means the level of traffic congestion severity (stage of congestion).

Road condition: -Road condition characterized by width (limited road capacity), broken road, structures of road, standards of road, passenger's lane, traffic sign and etc. When road capacity is under volume of vehicles capacity, traffic congestion furthermore occurs.

Parking problem: - Parking problem means the shortage of vehicle parking area, suitable parking areas, a situation which accounts for haphazardly parking along the roads which consumes large amount of space and loading and discharging passenger on the middle road.

Population increase: - It characterized by numbers of peoples actively increase, activities of people's increase, and demand of transportation highly increase, illegal trade at road increase and etc. are happens at this area.

Poor traffic management: -The poor traffic management is a result of, absence of road signals, inadequate enforcement of laws, illegal trade, construction works, low penalties given to punish

violators of traffic congestions, illegal advertise board and employment of few law enforcers for instance traffic police.

Increase vehicle numbers: -Interims of transport management vehicles number increase occurs when the volume of vehicular traffic is greater than the available road capacity, a point commonly referred to as saturation. Increasing the number of car ownership is the main cause of traffic congestion.

Extra travel time consumption: -Travel time is the time necessary to traverse a route between origins to destination. The time loss of road users due to congestion is determined by comparing the average trip time on congested links with the trip time under free-flow conditions corresponding to the design speed of the road. There is associated inability to travel time accurately, leading to drivers allocating more time to travel just in case less time on productivities.

Extra fuel consumption: -Excess fuel usage means difference in fuel consumption of the vehicles operating under congested and uncongested conditions. Time spent idling in gridlock and the start-and-stop nature of travel in congestion conditions.

1.9. Organization of the Study

This paper is categorized in to five chapters as follows: Chapter one includes Introduction of thesis, problem statement, research objectives, significant of the study, scope of the study, limitation of the study, organization of the research. Chapter two include brief review of related literatures; theoretical review, empirical review and conceptual framework. Chapter three encompasses Methodology and description of study area, research approach, research design, sample size determination and method of data collection. Chapter four of this research work presents result analysis and discussion while the last chapter, Chapter five contains conclusion and recommendation based on the research objective.

CHAPTER TWO

REVIEW LITERATURE

2. Introduction

This section of study encompasses three important review of literature; these are theoretical review, empirical review and conceptual frame work of the study.

2.1. Theoretical Review

A theoretical framework is the conceptual model of how theories make logical sense of the relationship between the several variables that have been identified as important to the problem. It can be viewed as both a foundation and a pillar of a research project. Therefore, theories aid a researcher in understanding the problem and guiding the study.

Traffic congestion have many definitions by deferent perspective, from these definitions: According to Institute of Transporting Engineers, traffic congestion is a situation where there are more people trying to use a given transportation facility during a specific period of time than the facility can handle with what are considered to be acceptable levels of delay or inconvenience. Worsening 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.

Traffic congestion is an extremely irritating feature of road transport in any country in the worldwide. Many professionals in the field of transportation and road safety agree that road traffic congestion is an endlessly growing problem, challenges and global phenomenon of major cities of world. Traffic congestion is a negative output of a transportation system, which is many detrimental effects on the performance of the road network, the traffic flow, the society, the national economy and the environment. Summarizes some of the negative effects of traffic congestion as; loss of travel time cost, higher fuel consumption cost, more vehicle emission, health impact, increase accident risk, stress on commuters and greater transportation cost.

Similarly, in Addis Ababa city congestion is highly impact on economy and social activities. Addis Ababa reports indicate the challenges of the city transport are wide and complex. These are deficiency of smooth traffic flow, absence of infrastructures for non-motorized transport for walking and cycling, social problem, late arrive day to day activity place, it is high stress and fear when travel on the road, student late arrive on school and increasing air pollution. Congestion happens at times of high travel demand in morning and night-time, at illegal trade on road, when traffic accidents occur and other non-recurring incidents that temporarily reduce a road capacity.

Proper measuring the extent or level of congestion is an important step for understanding the performance of the existing road network, for assessment of plans congestion mitigation measures and for evaluation of cost of congestion (Weisbrodet.al, 2003) and (Taddesse W, 2011). According to many authors the main reason for occur this congestion own cause for occurring traffic congestion; like Inadequate road facility, population increase, own of vehicle rapid growth, parking problem, poor traffic management and etc.

2.1.1. Definition of Traffic Congestion

Traffic congestion have several and widespread definition, from that broad meaning of congestion late as look few definitions as next, Traffic congestion is a condition on any network as vehicle use increases and road is deficient with characterizes by slower speeds, longer trip time, and increase line up. Traffic congestion occurs when the number of vehicles using the road is greater than the capacity of the available road space, impeding the efficient movement of traffic (Weisbrod, et.al. 2003).

Wallis and Lupton (2013) three ways of define congestion are identifying by three ways: By economist's state congestion as the happening of time delay, fuel consumption, travel cost increase, by users perceive roads to be overcrowds when reduction speeds below an acceptable level. Additionally, by engineer, classify a road as congested when more vehicles are attempting to use the road than its capacity to carry. Rodriqueet.al, (2009) state that, congestion can be perceived as unavoidable consequences of scarce transport facilities such as; road space, parking area, road signals and effective traffic management.

Generally, traffic congestion means as above describes a way or condition of road user extremely increase with vehicle's in the similar time or same road line and the capacity of road insufficient below user capacity, in this case traffic congestion is happen and effect economy. Traffic congestion has many definitions by deferent perspective, from these definitions the following are indicator;

A. Demand Capacity related Definition

Traffic congestion occurs when travel demand exceeds the existing road system capacity and when the number of vehicles attempting to use a roadway at any time exceeds the ability of the roadway to carry the load at generally acceptable service levels (Rothenberg, 1985).Congestion is a condition that arises because more people wish to travel at a given time than the transportation system can accommodate: a simple case of demand exceeding supply (The Institute of Civil Engineers, 1989 cited in Miller and Li, 1994) and in addition when vehicular volume on a transportation facility (street or highway) exceeds the capacity of that facility, the result is a state of congestion (Vuchic and Kikuchi, 1994). Congestion is the impedance vehicles impose on each other, due to the speed-flow relationship, in conditions where the use of a transport system approaches its capacity (ECMT 1999).

B. Delay- travel time related Definition

According to Weisbrodet.al (2001) Traffic congestion is a condition of traffic delay (when the flow of traffic is slowed below reasonable speeds) because the number of vehicles trying to use the road exceeds the traffic network capacity to handle them. According to (Pisaraski, (1990) cited in Miller and Li, (1994)) congestion is an imbalance between traffic flow and capacity that causes increased travel time, cost and modification of behavior. Traffic congestion is travel time or delay in excess of that normally incurred under light or free-flow travel conditions

Similarly, Kockelman(2004)congestion is the presence of delays along a physical pathway due to presence of other users and congestion can defined as the situation when traffic is moving at speeds below the designed capacity of a roadway. In the transportation realm, congestion usually relates to an excess of vehicles on a portion of roadway at a particular time resulting in speeds that are slower-sometimes much slower-than normal or free flow speeds (Cambridge Systematic and TTI 2005).

C. Cost related definition

Traffic congestion refers to the incremental costs resulting from interference among road users. This means congestion is traverse or operators when to travel from one place to another place to consume extra travel cost than normal travel cost.

2.1.2. Types of congestion

There are two types of traffic congestion: recurrent congestion and non-recurrent congestion.

A. Recurrent congestion: is mostly the consequence of factors that act regularly or periodically on the transport structure, such as daily traveling or weekend trips. Recurrent congestion occurs mostly when there are too several vehicles wanting to use the road at the similar time and its known. Recurrent congestion normally occurs during weekday morning and afternoon peak periods, when most people go to work and return home at around the same time.
B. Non-recurrent congestion: is happening at non-regular times at a place. It is unexpected and irregular by the road users and is typically due to accidents, bad weather condition, vehicle breaks or other unexpected loss of carriageway capacity. Non-recurrent congestion is associated with special conditions and unique events, such as traffic incidents, truck spills, accidents, work zones, unusual, irregular facility of maintenance operations (e.g., periodic highway cleaners), adverse weather and special events. Non-recurrent congestion is harder to predict and address.

2.1.3. Congestion Indicator

According to Highway Capacity Management (2010) a multilane highway can be characterizing by three performance measures: - First density in terms of passenger cars per kilometer per lane, second speed in terms of mean passenger car speed, and third volumes to capacity ratio. All of these measures are signal (indicate) of how traffic flow is being offer accommodations by the highway. Traffic management most serious requirements for efficiently manage transportation situation to first to know clear considerate of how much a given facility can accommodate and under what working conditions carry out transport movement. Above all, travel time, level of service and speed is a common indicator of the happening of overcrowding.

2.1.4. Overview of congestion related word

a) Travel-time

Travel time is defining as time to consume from starting point to ending point on voyage. Travel time measures are used to for when starting travel simply to know when to address, for accurately time used in any appointment, for identify more crowded period and use to alternative travel time etc.

b) Volume of traffic

It is a representation of the level of demand, it is often compare with the available supply, and this relationship is typically express in terms of a volume to-capacity ratio (V/C). The most availability of traffic volume counts and vehicle miles travel data make volume measures attractive to use.

c) Travel time Delay

Delays means in increase travel time and reduce travel speeds. As such, measures of delay are closely ties to time related measures. Delay is the difference between free flow and actual travel time is considering a good measure of congestion intensity on a roadway link or in an overall system.

d) Level of service (LOS)

Highway Capacity Manual, (2010) the concept of level of service is defines as a qualitative measure describing operational conditions and within a traffic stream and their perception by motorists and passengers. Traffic congestion impacts can be measure based on roadway volume to capacity ratios (V/C)

Table 2.1: Typical Highway Level of Service (LOS) rating (Source: HCM 2010)

LOS	***Description***	***Average traffic volume/capacity ratio***	***Speed (mile/hrs.)***	***Flow (Vehicles/hr./ln)***	***Density (Vehicles/mile)***	***Delay at signalized intersection***	***Delay at un signalized intersection***
A	*No congestion, it is free flow*	*Less than 0.6*	*Over 60*	*Under 700*	*Under 12*	*≤ 10 sec*	*≤ 10 sec*
B	*Slightly congested with some reduced maneuverability and still know well flow*	*0.61-0.70*	*57-60*	*700-1100*	*12-20*	*10-20 sec*	*10-15 sec*
C	*The presence of other vehicles begins to restrict the maneuverability within the traffic stream.*	*0.71-0.80*	*54-57*	*1100-1550*	*20-30*	*20-35 sec*	*15-25 sec*
D	*Speed somewhat reduced, vehicle maneuverability limited and typical urban peak period highway conditions.*	*0.81-0.90*	*46-54*	*1550-1850*	*30-42*	*35-55 sec*	*25-35 sec*
E	*Intersection approach delays and low average speeds already congestion occur*	*0.91-1.0*	*30-46*	*1850-2000*	*42-67*	*55-80 sec*	*35-50 sec*
F	*Flow is forced; with frequent drops in speed to nearly zero mph. Travel, time is unpredictable. Extreme congestion*	*Greater than 1.0*	*Under 30*	*Unstable*	*67- max*	*≥80 sec*	*≥50 sec*

Source: Highway Capacity Manual 2010

e) Fuel consumption

Fuel consumption is simply the total quantity of fuel consume by a vehicle in a road network in a specified area and time. Fuel consumption per kilometer is besides known as specific fuel consumption liters consume per 100 kilometers travel as fuel consumption rate, in some studies that compare alternative fuel sources and fuel consumption rate is measure in mega joules per kilometer travel (Haworth and Symons 2001).

f) Total delay

Total delay is choosing as a performance measure because it relates to delay and the data need to calculate this measure is readily available. The travel times can be deriving by using speed and the length of a route. A comparison of delay among different segments of roadway is similarly possible when using total delay. Total delay shows the effect of congestion in terms of the amount of lost travel time.

2.1.5. Overview of Congestion Costing

Congestion cost means external cost of road user on the rest of society, like travel delay, increase vehicle operating costs, pollution, fuel consumption. From economic perspective congestions main impact is the lost productivity from more time consumed traveling to work rather than working, lost (delaying) meetings. Traffic congestion costs negatively affect countrieseconomy; affect the quality of life by costing traveler's time, pollution environment and causing accident.

Urban Mobility Report (2010) of TTI determines the cost of congestion in United States of America as a function of delay time and waste fuel cost of 2009. The result shows that congestion cost for extra time and fuel for 439 urban areas were 115 Billion for the years 2009 respectively, 3.9 Billion gallon of fuels wasted and 4.8 Billion person-hours of extra time wasted. The above results show how the traffic congestion costs affect individual travelers and a nation in general. Annual congestion cost in the United Kingdom (UK) will reach 33.4 billion US$ by 2030, rising by over 50% from the 2014 levels of 20.5 billion US$, Annual cost of congestion in the United States (US) as of 2014, has been pegged at 124 billion US$; this is project to increase to 186 billion US$ by 2030. In Australia, annual congestion cost levels are expected to rise from Australian Dollars (AUD) 3.5 billion (2005) to AUD 7.8 billion (2020) for Sydney, and AUD 3.0 billion (2005) to AUD 6.1 billion (2020) for Melbourne.

Taddesse W. (2011) similarly, in Addis Ababa on average about 38 Vehicles day and 352-person day are wastes at each major intersection entry and the city incurs annually about 5-8 Million Birr per intersection only for vehicle and fuel cost on the east west.

2.1.6. Economic theory

Today in worldwide traffic congestion is challenges to activities for every level of peoples. Therefore, when daily situation is challenge by congestion the first impact arises on economic development. Hardin et.al (2016) Traffic congestion costs consist of incremental delay, vehicle operating costs, pollution emissions and stress that result from interference among vehicles in the traffic stream, particularly as traffic volumes approach a road capacity. According to economist Anthony Downs and Stephen (2016) argues that rush hour (busy times) traffic congestion is predictable because of the benefits of having a relatively standard workday. At rush period traffic congestion increase and highly effect economy.

According to American urban areas research indicate congestion continues to grow in America's urban areas, in (2003) congestion caused increase of 79 million hours and 69 million gallons of wasted fuel from 2002 to a total cost of more than $63 billion (Schrank and Lomax, 2005). This result shows that how traffic congestion effect on once national economy by fuel cost and need to be measure before it causes irreversible problem. Transportation has been a factor in the location of industrial facilities since the industrial revolution. The cost of transporting raw materials to a production facility and the cost of transporting finished goods to the appropriate markets directly affects the profitability of the business. In addition, the quality of the transportation services, such as time required to traverse the spatial gap between sources of supply, the plants, the warehouses, and the markets, affects inventory cost, stock out costs.

Global Traffic Scorecard INRIX Research Trevor Reed (February 2019) report indicate, in the US Congestion cost drivers in the US more than $305 billion in direct and indirect costs in 2017 alone, up $10 billion from 2016 driven by an increase in the cost of motoring rather than an increase of congestion. Direct costs include the value of fuel and time wasted in congestion while indirect costs include the increase in prices to households from freight trucks. On a national level, Germans lost an average of 120 hours in one intersection due to congestion daily in 2018, costing the country €5.1 billion or €1052 per driver ($5.8 billion; $1,203 per driver). The massive delays cost London per drivers £1,680 annually ($2,199). While U.K. drivers lose more time in congestion, the difference in wages when compared to the U.S. results in lower gross costs of congestion. On average, drivers in the U.K. lost 178 hours due to congestion, costing the country £7.9 billion or £1,317 per driver ($10.3 billion; $1,725 per driver). Due to

London's much larger population compared to other cities in the U.K., it significantly influences the national average for time loss and cost per driver. When removing the capital, the average time loss drops to 131 hours, costing £969 annually ($1268).

2.1.7. Traffic Flow Theory

Road congestion solely on the interplay of shippers and people's needs and desires yet when one looks at the situation practically, lack of proper infrastructure and an efficient regulatory framework to control traffic has contributed more to the congestion. In Addis Ababa, the chaos on the road are a shock to anyone who visits the city for the first time, one is treated to an endless flow of people and mass transit buses that never seem to end and ward's research through its publication commented on the fact that to that due the limited nature of Addis Ababa infrastructure, efficient policies have to be formulated that will try to bring sanity in Ethiopia roads.

2.1.8. Queuing Theory

Queuing theory describes traffic flow especially during peak hours when the density is high. High density due to more vehicles on the roads causes congestion in the road bottlenecks slowing traffic and in many instances causing jams. This jam has been known to slow the rate of economic growth down due to lost time resources sitting in traffic. With increase in public transport services more people will use public transport which will reduce the amount of vehicles on the road thus decreasing jams which will translate to faster and cheaper transport which will have a positive impact on the economy.

2.2. Empirical Review

2.2.1. International Evidence

Traffic jam is mainly caused by increased number of cars, poor status of roads, bad parking and stopping by vehicles which reduce the number of trips in a day which leads to decreased revenues (Nyark 2014). Additionally, International social economic unit (2013) congestion, mainly cause by the following factors. These driver's attitude, driver's behavior, road users, increase in vehicle ownership or the total number of cars registered on annual basis, cost of transport, availability of parking as well as private car perception compared to public transport.

Raheem et al. (2015) growth of population in reality indicate that as the population of a country increases, the demand for road travel also growth. However, growth in population is not supplements (supports) by the construction of new roads, thus causing roads to be congested. Economically, transport is an essential element of city development that, in turn, is a major source of national economic growth and without transport facility service do not growth of economy. Simply poor transport service obstructs for growth. In many developing countries we see above reality, that means growth of population dramatically increase in opposite infrastructure of transportation and major city capacity highly crowd difficult for any day to day activities.

Many professionals in the field of transportation and road safety agree that road traffic congestion is an endlessly growing problem, challenges and global phenomenon of major cities of world. Traffic congestion is expanding toward the suburbs, as commercial activity is being pulls out of the central business districts and high challenges for growth of economy (Lomax, et.al 1999). Traffic congestion is a negative output of a transportation system, which is many detrimental effects on the performance of the road network, the traffic flow, the society, the national economy and the environment. According to Maitra (1999) summarizes some of the negative effects of traffic congestion as; loss of travel time, higher fuel consumption, more vehicle emission, health impact, increase accident risk, stress on commuters and greater transportation cost.

According to European and American literatures, estimate a range of congestion related costs per capital of between $200 and $800 per year. Annual congestion cost in the United Kingdom (UK) will reach 33.4 billion US$ by 2030, rising by over 50% from the 2014 levels of 20.5 billion US$(Tom & Neil Hurts, (2008)

2.2.2. National evidence

Haregewoin (2010) study in Addis Ababa, Congestion problem is a common characteristic in urban road transportation system of the cities of developing countries especially in Addis Ababa that results in high operation cost, loss of time, high delay, high travel time and increase in fuel consumption. The economic cost effects of congestion in capital city of Ethiopia that highly influence peoples leave in the city by delay travel time, increases travel time cost, consume extra

time for wait transportation and loss productive time. In addition, (Fasika 2015) in order to calculate cost of traffic congestion, there exist a number of parameters to be analysis. However, it is difficult to obtain all the parameters to determine the total cost of traffic congestion at the intersections. Therefore, in this to used parameters, which are extremely affects by the congestion namely, time loss and fuel cost with LOS. Cost of traffic congestion is highly affected society leave in the city by loss productive hours, accident cost and increase transport cost.

According to kefyalew T. (2017), based on the level of service analysis, most of Addis Ababa road intersections are performing above their capacities. Similarly, major reasons for traffic congestion: lack of good quality mass transport, imbalance of vehicle volume and road capacity, bottlenecks, poor traffic management, interference of pedestrians at junctions, on street parking and informal on street trade and traffic accidents.

Similarly, in Addis Ababa city congestion is highly effect economy cost and social activities. Ministry of Transport of Ethiopia (2014), reports indicate the challenges of the city transport are wide and complex. These are deficiency of smooth traffic flow, absence of infrastructures for non-motorized transport for walking and cycling, social problem, late arrive day to day activity place, it is high stress and fear when travel on the road, student late arrive on school and increasing air pollution. Congestion happens at times of high travel demand in morning and night-time, at illegal trade on road, when traffic accidents occur and other non-recurring incidents that temporarily reduce a road capacity.

Additionally, kefyalew T. (2017) traffic congestion has different costs, like travel time delay costs, vehicle fuel costs and cargo delay costs and environmental cost is including. As result indicate total congestion costs including delay costs and wasted fuel costs of passenger and truck vehicles at the road segments when calculated at ETB 42,940,309.52, 24,265,882.55, 56,517,437.03 and 89,244,561.02 respectively in respect of the Riche-Meshualekya, Global-Meskel Flower, Adey Ababa and Akaki-Kality, Maseltegna road segments. As this results indicate economic impact of road traffic congestion highly effects of city society.

According to (Mekonnen (2015), kefyalew T. (2017) and Natsanet (2014)) research resultin Addis Ababa city summarizes the major causes of traffic congestion as follows: traffic accident,

work zone environment, damage of existing traffic signals, reduction of road capacity, vehicle damage, and narrow road and on street parking. Above idea is major cause of congestion and traffic congestion cause are not only this. Additionally, like driver behavior, owner of car increase, public (mass) transport decrease, rapid increase of city population, poor traffic management and control and extra reason for occurrence of congestion.

According to Taddesse W. (2011), average traffic congestion in Addis Ababa expressed in Vehicles-min or person-min is very high. The result shows on average about 18,500 Vehicle-min 38 vehicle-days and 169,000 Per-min or 352-person-days are wastes at each intersection legs. Congestion cost per day on average the cost of wasted fuel & idle vehicle time at each entry leg of an intersection is above Birr 7.7 million/year and only the three legs at the Urael intersection costs more than Birr 28 million/year. Kefyalew T. (2017), average travel speed increases, fuel consumption decreases for both passenger and truck vehicles. However According to Littman (2013), when average travel speed increases above 65-80 km/hr. this relationship is not maintains because above 65-80 km/hr. vehicles consume extra fuel to maintain its speed.

2.2.3. Summery and gap analysis

Transportation is basic need for every human activity, especially for economic situation. However, know today transport services are hindering (challenges) through many problems in most cities around the world. From many transport services challenges traffic congestion is one of them and highly affect economic cost. Particularly in developing counties resulting in travel time delays, increase fuel wastage, travel cost increase, environmental pollution increases and etc. Therefore, all of above-mentioned negative effect and challenges are needs to investigation that indicates direction the way to reduce their impact.

Consequently, this paper tries to fulfill the gap around the challenges of transportation service specially, work on traffic congestion title area. The aim of this paper is to identify the mediating effect of traffic congestion severity on economic cost. Those means investigate the main cause for traffic congestion and the major economic impact of congestion with level of service of road. Additionally, predict what will come about in future with congestion impact severities on economic cost depend on past and present indicators. The research provides relevant

recommendations accordance to the nature of the findings as well as relating it to the current Ethiopian transportation policy.

In conducting previous research took only one-day traffic counts few hours' video record, due to time limitation with budget constraints. Additionally, different types of variables that are in estimating traffic congestion cost, however the researcher took only three variables (economic impact on freight transport, on rental cost of vehicles, operation cost) which are believes to be important in the analysis of congestion costs. Therefore, researcher improve this gap of pervious research through touch that untouched variables like delay cost, fuel cost and level of service of road with factor of traffic congestion. Which was concealed (hidden) its indirect effect of traffic congestion severity or indirectly be a reason for the decline of the nation's economy due to that it consumes extra travel time and fuel consumption.

There are few studies conducted on traffic congestion in Ethiopia focusing on identifying what it looks like and the causes traffic congestion roughly through either scientific engineering formula or questioners (respondent idea). But it better to identify clearly the cause of congestion to reduce severity of traffic congestions on economic development. Further, understanding the residents feeling through questionnaires adds values for the data obtained through scientific engineering formula.

Furthermore, up to the knowledge of the researcher there is no previous studies conducted using traffic congestion severity as mediator between impacts of traffic congestion on economic development. Additionally, fulfill the demography coverage of most sever congestion area Nifas silk Lafto sub city. Hence, this research focus on this information gap and investigate the mediating effect of traffic congestion severity on economic cost at Jemo Michael intersection, based on extra travel time cost and extra fuel consumption cost with identify level of service of selected intersection for future plan.

Additionally, modify the way to analysis data through using the integration of AMOS, SPSS and scientific measurement. Hence, this research focus on this information gap and investigate the mediating effect of traffic congestion severity on economic cost at Jemo Michael intersection, based on extra travel time cost and extra fuel consumption cost with identify level of service of selected intersection for future plan.

2.3. Conceptual framework and research hypothesis

A conceptual framework is a research tool plan to develop awareness and understanding of the situation under study and to communicate. In this portion look variables that cause for traffic congestion problem and outcome (result) of congestion. That means to investigate the mediating effect of traffic congestion severity on economic cost.

2.3.1. The causes of traffic congestion

Traffic congestion is occurring by different factors. According to report in UK 2017, Congestion in the UK is worse from other European countries and the key causes leading to these situations include rapid expansion of the city, poor state of majority of the buses, untrained bus drivers and conductors driven by the pursuit of daily income targets payable to the bus owners, non-adherence to traffic rules and regulations and lack of an organized communal transport system. Downier (2009) besides that traffic congestion happens when the capacity of vehicular traffic is greater than the existing road capacity, a point commonly refers to as overload. The causes of traffic congestion are: Numerous people moving at the same time, masses of freight moving at the same time, the slow growth in supply with demand rapidly increase that causes many trips to be late by events that are irregular (Schrank et al2013). Like crashes, vehicle breakdowns, incorrectly time traffic signals, special events and weather are factors that cause a variety of traffic congestion problems. Researcher above mention cause is the factors of congestion as refer others literature review and field observe in Nifas silk Lafto trend. Additionally, Mekonnen F (2015) reviews the major causes of traffic congestion as follows: traffic accident, work zone environment, damage of existing traffic signals, reduction of road capacity, vehicle damage and on street parking. This problem similarly nowadays the reasons for traffic congestion occur in Addis Ababa city.

In Addis Ababa traffic congestion is big challenges from other transportation service hinders, correspondingly many factors are reasons for traffic congestion occurs. In this paper researcher done on main factor of traffic congestion (road condition, parking problems, population increase, poor traffic management and vehicles numbers increase). These above predictors variables identify from many variables by first informal field observation around Nifas silk Lafto sub city Jemo Michael intersection. These variables test both through direct effect and indirect effect.

a. Road condition

Road condition characterized by: - width (limited road capacity), broken road, structures of road, standards of road, passenger's lane, traffic sign and etc. When road capacity is under volume of vehicles capacity, traffic congestion furthermore occurs. That mean most of roads are narrow compare to the volume of traffic in the road on this time congestion is occur at Jemo road. At Jemo intersection this sign directly observed and affect the movements of peoples.

b. Parking Condition

Another contributing factor to congestion as suggested by(Herman 2001) is parking problem. Road parking, which consumes large amount of space, has become a land issue that greatly inflates the demand for urban land, causing congestion in cities. In many cities particularly in developing countries, when develop plan and construct road do not consider sufficient and suitable parking areas, a situation which accounts for haphazardly parking along the roads. At Jemo road similarly, parking problem simply view as obstruct of traffic flow and this issue is described by vehicles park along the road, loading and unloading passengers along the road, not enough parking space, not comfortable parking area and etc. are the problems happen at this road.

c. Population Number

According to Rodniqueet al. (2009), note that congestion in urban areas is dominantly caused by commuting patterns (population growth). They further attributed the causes of congestion to rise in population densities which restrict capacity of roads and impair smooth traffic flows. The population increase is one of the reasons of traffic congestion at Jemo Michael intersection area. It characterized by numbers of peoples actively increase, activities of people's increase, demand of transportation highly increase, illegal trade at road increase and etc. are happens at this area. If Population increase demand of transport similarly increases, then crowd occur. The growth of population in urban globally averages 2 percent annually and the number of megacities-those with population in excess of 10 million people is increase in the past two decades.

D. Traffic management

The poor traffic management is a result of, absence of road signals, inadequate enforcement of laws, illegal trade, construction works, low penalties given to punish violators of traffic congestions, illegal advertise board and employment of few law enforcers for instance traffic

police. From above poor traffic characteristics point at Jemo Michael intersection happened problems like absence of road signals, illegal trade, construction works, illegal advertised board, inadequate enforcement of low are big problem happened. Similarly, at this segment many different modes of movement on the same roads as a cause of congestion in developing nations and also mix of old and new transport technologies, highlighted by the shared use of road space by fast moving motorized vehicles and slow-moving human-powered and animal-drawn vehicles (such as rickshaws, hand drawn carts and animal drawn vehicles), typifies many street scenes of the third world (Rietveld, et al., 1990).

d. Vehicle numbers

Downie (2008) that traffic congestion occurs when the volume of vehicular traffic is greater than the available road capacity, a point commonly referred to as saturation. Increasing the number of car ownership is the main cause of traffic congestion. This is occurring when mass transportation system reduces and many people buy their own vehicles (automobiles) and moreover the road capacity is insufficient with parking area. This traffic congestion cause is characterized by volume of vehicles greater than capacity of road, vehicles flow by queuing form, vehicles flow by slow and for long minute stop by congestion reasons at peak time etc. are big problem happen day to day transportation problem.

2.3.2. Impact of traffic congestion

Road traffic congestion is impacts on the economy cost. European conference of ministers of transport states (2014) that, congestion involves queuing, slower speeds and increased travel times, which enforce costs on the economy and generate multiple impacts on urban regions. According to Mahmud1 et al (2012) traffic congestion is great economic impact due the society losing money in four ways, that are; loosing person-hours, extra transportation cost, extra fuel consumptions, vehicle operating cost and various cost. Traffic congestion is various negative impacts ranging from economic loss to adverse environmental and social impacts. Generally, the economic cost of traffic congestion comes in many forms, such as increase fuel consumption, increase operating cost, time wastage, reduced income, health challenges, and shrinks market coverage; reduce work force productivity, among other. From more traffic congestion impact, in

this paper to identify economic cost effect of traffic congestion in terms of extra travel time delay and extra fuel consumption at selected intersection.

a) Increase travel time

The time loss of road users due to traffic congestion is determined by comparing the average trip time on congested links with the trip time under free-flow conditions corresponding to the design speed of the road. Travel time data handbook (1998), travel time is the time necessary to traverse a route between any two points of interest that origin to destination. At Jemo Michael intersection there is high travel time delay.

b) Excess fuel usage

Excess fuel usage means difference in fuel consumption of the vehicles operating under congested and uncongested conditions. According to HDR US Department of transportation, traffic congestion consumes to excess fuel usage due to two effects, Time spent idling in gridlock and the start-and-stop nature of travel in congestion conditions. Vehicles uses Jemo intersection road highly consume extra fuel.

2.3.3. Conceptual Framework Diagrams

Figure 2.1: Conceptual Framework of the mediating effect of traffic congestion severity on economic cost of congestion

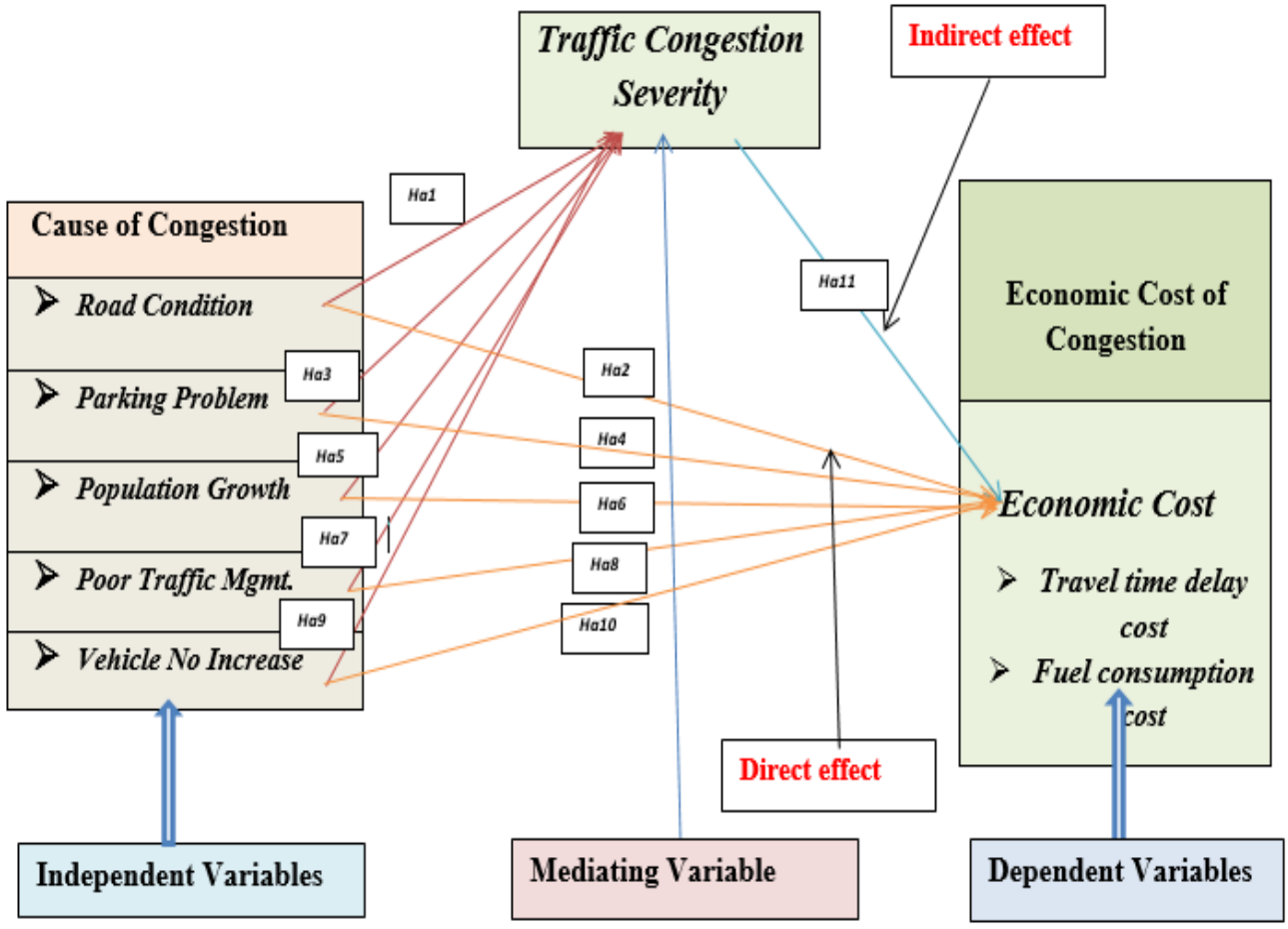


Figure 2.1 The mediating effect of traffic congestion severity on economic cost

Source: Own researcher develop from literature review

Conceptual framework is a hypothesized model identifying the concepts under the study and their relationships. In this model, the researchers will examine the direct effect and indirect

effect of independent variables on dependent variables. This means, when analyzing the mediator effect, there are two effects involved namely direct effect and indirect effect. The direct effect is the effect from independent variable directly to dependent variable, while the indirect effect is the effect from independent variable to dependent variable that goes indirectly through the mediating variable.

2.3.4. Research Hypothesis

This study was adopted quantitative research approach by testing hypotheses to estimate the effects of the traffic congestion. Based on the above conceptual framework, the study will hypothesize:

H_{a1}: Road condition has significant effect on traffic congestion at Jemo Michael intersection.

H_{a2}: Road condition has significant effect on economic cost of congestion at Jemo Michael intersection.

H_{a3}: Parking Condition has significant effect on traffic congestion at Jemo Michael intersection.

Ha_4: Parking condition has significant effect on economic cost of congestion at Jemo Michael intersection.

H_{a5}: Population Number has significant effect on traffic congestion at Jemo Michael intersection.

H_{a6}: Population Number has significant effect on economic cost of congestion at Jemo Michael intersection.

H_{a7}: Poor Traffic management has significant effect on traffic congestion at Jemo Michael intersection.

H_{a8}: Poor Traffic management has significant effect on economic cost of congestion at Jemo Michael intersection.

Ha_9: Vehicles number increase has significant effect on traffic congestion at Jemo Michael intersection.

Ha_{10}: Vehicles number increase has significant effect on economic cost of congestion at Jemo Michael intersection.

H_{a11}: Traffic congestion severity has significant effect on economic cost of congestion at Jemo Michael intersection.

Ha$_{12}$: Traffic congestion severity mediates the relationship between Road condition and economic cost of congestion at Jemo Michael intersection.

Ha$_{13}$: Traffic congestion severity mediates the relationship between parking problem and economic cost of congestion at Jemo Michael intersection

Ha$_{14}$: Traffic congestion severity mediates the relationship between Population growth and economic cost of congestion at Jemo Michael intersection

Ha$_{15}$: Traffic congestion severity mediates the relationship between poor traffic management and economic cost of congestion at Jemo Michael intersection

Ha$_{16}$: Traffic congestion severity mediates the relationship between vehicle number increases and economic cost of congestion at Jemo Michael intersection

2.4. Analyzing the mediating variable in a model

In this paper researcher focused on identify the mediating effect of traffic congestion severity on economic cost. Sometimes the research questions intend to address the effect of a mediating variable in the relationship between an independent variable and its corresponding dependent variable in a model. Diagram above simply illustrates the position of a mediator in the relationship between independent variable and its corresponding dependent variable.

For identify mediating effect, first of all identify direct and indirect effect of each variable. To analyzing the mediator, there are two effects involved namely direct effect and indirect effect. The direct effect is the effect from independent variable directly to dependent variable, while the indirect effect is the effect from independent variable to dependent variable that goes indirectly through the mediating variable.

In this paper to look the direct effect of independent variable (road congestion, population increase, parking problem, poor traffic management, vehicles number increase) effect on dependent variable (economic cost of congestion) or (effect of X on Y). Similarly, when to look indirect effect of independent variable on dependent variable (X on Y through mediating), this means the indirect effect is the effect from independent variable to dependent variable that goes indirectly through the mediating variable.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3. Introduction

Research methodology provides a means to systematically solve a research problem. This chapter explains the methodological approach used when conducting the research. This includes the research design; research approach, types and source of data, population and sampling technique, and method of data analysis are briefly explained.

3.1. Description of study area

The study area chosen for this research is Addis Ababa - the capital of the Ethiopia -established in 1886. It is the extremely populated and economic center of the country. It has a total population of 3,384,569 as per the 2007 population count with growth rate of 3.8%. Traffic congestion is one of challenges in the city owning to many factors.

The city is located at about 2,440m above sea level at 9.02°00'16.68" N 38044'49.39" E that covers over 540sq.kms with a10 sub-cities. From the highly crowded areas of 10 sub-cities, only Nifas-Silk Lafto sub-city was selected for this study due to time and budget constraint.

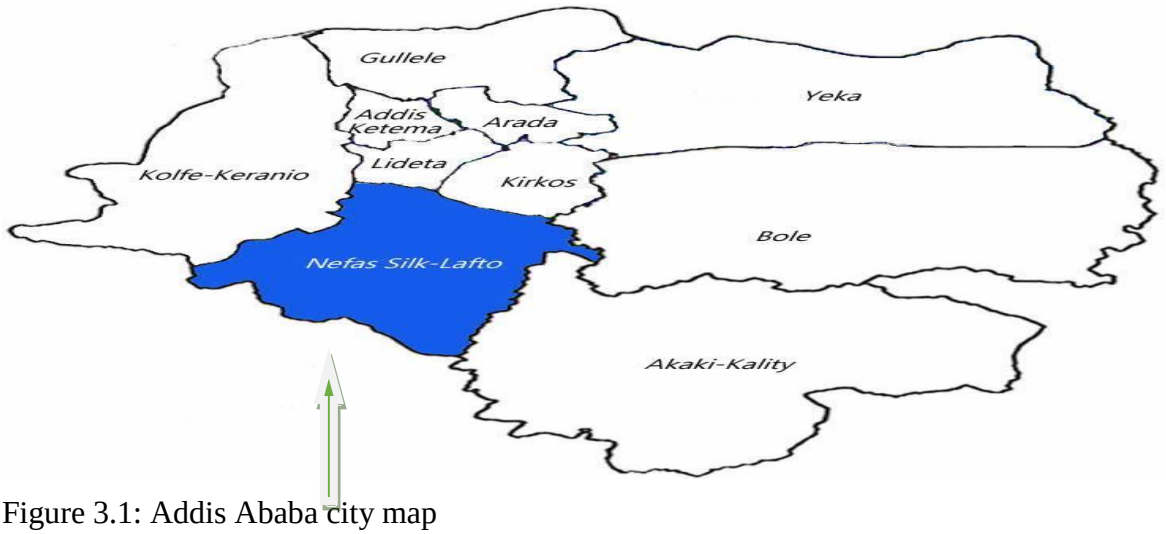


Figure 3.1: Addis Ababa city map

Source: Addis Ababa administration website

3.1.1. Description of Selected Intersection

Nifas-Silk Lafto sub-city has different types of intersections and roundabout. Currently, the Jemo-Michael Intersection is highly congested intersection of the surrounding road segment in the sub-city. It has four legs namely: Ayer-Tena approach, Lideta approach, Germen route approach and Jemo route approach. As a result, the study has chosen this intersection.

3.2. Research design

Research design addresses the research structure and strategy of investigation of issues. Designing a study helps the researcher to plan and implement the study in a way that help the researcher to obtain intended results, thus increasing the chances of obtaining information that could be associated with the real situation (Burns & Grove, 2001). This study used both a descriptive and explanatory research designs for the aforementioned objectives. Kothari (2004) explains descriptive research as a situation or condition at hand, it is one in which information is collected without changing operating environment. Descriptive research also directs at making careful observations and detailed documentation of a phenomenon of interest.

The researcher used explanatory design to analyze the mediating effect of traffic congestion severity on economic cost. It's also called explanatory research is the investigation of cause and effect relationships in order to determine causality; to observe variation in the variable that is assumed to cause the change in the other variable and then measure the changes in the other variable using statistical methods. The study aimed to examine the casual relations between the independent variable (road condition, parking problem, population increase, poor traffic management, and vehicle number increase), mediating variable (traffic congestion severity) and the dependent variable (economic cost of congestion) using correlation and regression analysis that makes the research explanatory.

3.3. Research Approach

Researcher used a mixed research approach to investigate the research problem in detail and to triangulate the findings. Quantitative research approach uses the existing traffic congestion, level of transport service, economic cost of congestion due to extra travel time cost& extra fuel consumption cost and cause of traffic congestion (road condition, parking problem, population growth, poor traffic management and vehicles number increase) that analyzes responses from

respondents with field measurement data. According Ajai S. Gauret.al (2009), it is a guide to data analysis using SPSS, quantitative research involves collecting quantitative data based on precise measurement using structured, reliable, and validated data collection instruments or through archival data sources. Qualitative research involves collecting qualitative data through way of interview. Qualitative data is particularly appropriate to define additional data to cause and mediating effect of traffic congestion severity on economic cost. Additionally, quantitative data like traffic volume, travel time, travel speeds, travel time delay, fuel consumption were triangulated by scientific measurement way.

3.4. Data and their sources

This study used both primary and secondary data. Primary data were collected through questionnaire, interview, field measurement (video record of traffic volume) and travel time data through manual way. The field measurement incorporates data on traffic volume, travel time, travel time speed, travel time delay, extra fuel consumption due to travel time delay, vehicles occupancy data, vehicles type and passenger's numbers. The Secondary data include books, journal articles, newspapers, reports and publications of various associations & organization. Although this study supported by both theoretical and empirical literatures. These data are used to support video record, each vehicles carrying capacity, each vehicles fuel use per kilometers, time value in terms of ETB and fuel cost per liters. Traffic volume raw data was collected from Addis Ababa traffic management agency main office and Nifas-Silk Lafto Sub city traffic management agency for supplementary information.

3.5. Sampling Design

3.5.1. Target population

According to Burns, and Grove,(1993), a population is defined as all elements that meet the sample criteria for addition in a study. The target population must be defined in terms of elements, geographical boundaries, and time. Based on these, target population of this study includes drivers, passenger and traffic police across Jemo Michael Intersection.

3.5.2. Sampling techniques

There are two major types of sampling design: probability and non-probability sampling. From these, researchers used non-probability sampling technique – convenience sampling technique (a man of the straight) –was used to select respondents. This is the method of collecting information from members of the population who are conveniently available to provide the required information. It is perhaps the best way of getting some basic information quickly and efficiently.

3.5.3. Sample size

Sample size is used for high level of confidence and small number of error. The universes are infinite data, which means number of items is uncertain. Therefore, researcher uses infinite sample size formula. For populations that are large, Cochran (1963:75) developed the following equation to yield a representative sample for proportions:

$$n = \left[\frac{Z}{e}\right]^2 pq$$

Where:

n - Sample size required for the study.

Z - Critical value (=1.96) for 95% confidence level.

p - Proportion of an attribute that is present (50%) in the population, and q is 1-p.

e - Margin of error that can be tolerated - 5% (0.05)

$n = [1.96/0.05]^2[0.5][0.5] \sim 385$

Therefore, **385** respondents were selected by employing convenience sampling technique.

3.6. Data procedures and instruments

Questioner was distributed by researcher and other supporter of researcher through direct a man of the straight (passenger, traffic police & driver who across Jemo intersection). This methods use for collecting information from members of the population who are conveniently available to provide the required information. In the data collection of the study, the following procedures were used: First, before distribute questioner briefing on the questioners was given to each respondents, and then questioner were distributed to the respondents. Second depending on the distribution time, the questions were collected from the respondents after a few times. Thirdly use through interview, carryout with 40 respondents at taxi station and bus fermata around Jemo

intersection. Fourth the questioners were coded and analyzed for usability of the questioners are made. Finally, the analysis of the data using different statistics on SPSS version 20 was made, thematic and structural equation model.

In addition of questionnaire and interview, primary data was gathered by using field measurement to measure an economic cost of congestion. For traffic count, video camera and manually take travel time was employed. This work was done in three continuous days (Thursday, Tuesday and Sunday). Traffic counts during Monday and Friday were very high volumes and are not normally used in the analysis. Data collection was started from morning to night (7:00AM – 7:00PM). The level of service at Jemo Michael intersection by using traffic volume, travel time, delay time, travel speed data was collected.

According to HCM (2000) handbook Manual, traffic volumes to be counted at 15-30 minute intervals for hours peak period and off-peak period to obtain the traffic volume data. For simply data manage, researcher use 15-minute interval video record. It was recommended and the vehicles are counted in the category of size classifications. Travel speed of vehicles measured by using specified mark of length for distance between two known places at origin point and destination point. This means by 200 meters' road length and by recording the vehicles starting time in order to pass that marked point and final destination time interval. The secondary data gate from Addis Ababa city traffic management agency recorded data of vehicles volume. Value of time data collect from target population, depend on respondent's daily income. After collecting daily income of respondents find average of them. Additionally, when gating to average daily income of respondents divide daily income to eight. Because of in Ethiopia working hours per day are eight hours. The following are the way to data collect:

3.6.1. Traffic volume data

Traffic volumes count data are very important to determine and understand the flow pattern in the facility, to determine the peak flow rates and peak periods, to assess the relationship between traffic volume and congestion. In this study, the traffic volume counted for 12 hours of three days through video recording of each peak period starting in the morning peak time 7:00AM - 7:00PM at 15 minutes' interval. After recording traffic volume, count traffic flow according to categories of each vehicle by replay that record data at interval of fifteen minute taken.

3.6.2. Travel Time

Travel time can be directly measured by crossing the route that connects any two or more points of interest and time in which the mode of transport is stop or moving sufficiently slow as to stop. From different travel time data collections technique, video camera with manual transcription is selected. Travel time data collect through manual and video record. Manual travel time collect through, record watch how much time wait vehicles for across the intersection at 200m length. This data takes frequently and find average travel time of all intersection segments.

3.6.3. Vehicle Occupancy Data

Vehicle occupancy, the number of peoples per vehicles, is an extremely important parameter in transportation planning. Usually, it is use to convert person trip to vehicle trip. To obtain vehicle occupancy data, first it is necessary to find carrying capacity of each categories of vehicle. Then multiply vehicles volume across by their carrying capacity. First gate total passenger number across this intersection. After accesses total number of passengers divided that total passengers to traffic volume.

3.6.4. Fuel consumption data

Fuel consumption is simply the total quantity of fuel consumed by a vehicle in a road network in a specified area and time. It was calculated as quantity of fuel consumption at congested time minus total fuel consumption at free flow time. This volume of fuel is generally defining in liters. Fuel consumption per kilometer is also known as specific fuel consumption refers to liters consume per 100 kilometers travel as fuel consumption rate, in some studies that compare alternative fuel sources, fuel consumption rate is measure in mega joules per kilometer travel (Haworth and Symons, 2001). Fuel consumption identify through all type of vehicles fuel consumption standard per km under free flow and congestion period. After this data gate, volume of vehicles multiply by their fuel usage under congested and free flow. Finally, under congested fuel usage minus free flow fuel usage and gate extra fuel consumption due to traffic congestion.

3.6.5. Travel speed data

Travel speed data was collected through video recording system; this means record time from origin to destination between 200 meters' research area and the difference between free flow travel time speed and peak period travel time speed was identified.

3.6.6. Delay data

Travel time delay means extra consumption of transportable time. Delay data was collected through video recording system; this means record time from origin to destination between taken length research area and the difference between free flow travel time consumption and peak period travel time consumption was determined. Additionally, delay data gather through manual travel time collect through at four approaches of intersection take data through record watch of how much time delay vehicles for across the intersection at 200m length. This data takes frequently and find average delay time of all intersection segments.

3.6.7. Timetable for Data Recording

For the proper analysis of the required data, the following points were taken in to consideration. Monday and Friday have high traffic variation from the normal weekdays; Tuesday, Thursday and Sunday represents the free flow value of traffic. Due to time and budget limitation, data were collected for the average value of the whole week Tuesday, Thursday and Sunday. Time of record is from 7:00am-7:00pm ranges.

3.7. Measurement Instruments

The study designs 46 questions in six parts including traffic congestion, road condition, population increase, parking problem, poor traffic mgmt., extra travel time delay to collect data. A Likert type questionnaire and structured interview were used to obtain data from the respondents. The measuring scale adopts a five point Likert scale. The Likert scale – a widely used rating scale – was used to indicate a degree of agreement or disagreement of respondents with each of a series of statements from (1) strongly disagree to (5) strongly agree, and (1) Very Low to (5) Very high for traffic congestion statements. The respondents' gender, age, educational back ground, and Jobs were included in the questionnaire.

3.8. Pilot Study

Likert scale is a widely used rating scale which requires the respondents to indicate a degree of agreement or disagreement with each of a series of statements or questions i.e. from (1) strongly disagree to (5) strongly agree. In order to cross-check its completeness the researcher has used traffic congestion literature and empirical review of the previous researches on the area of the

study and additional content on the framework are included based on it. However, according to the research texts, in survey based research, before the questioners are administrated, it is important to validate the scales used for reliability and validity. Though, the questionnaire used for this survey is adopted form previous research with minor customization and its validity and reliability were tested. The researcher has made a pilot survey to test the questioner validity and reliability on current survey situations.

3.9. Methods of Administration/ Quality Criteria

Reliability and validity are two important characteristics of any measurement procedure.

3.9.1. Reliability test of the Instruments

Reliability refers to the confidence we can place on the measuring instrument to give us the same numeric value when the measurement is repeat on the same object. It uses to gate accurate information and minimize the errors and biases in a study. According to Bryman and Bell (2007), reliability analysis is concern with the internal consistency of the research instrument. As multiple items in all constructs were used, the internal consistency/reliability was assessed with Cronbach's Alpha. The reliability test is indicated by the reliability coefficient. It is denoted by the letter "r," and is expressed as a number ranging between 0 and 1.00, with r = 0 indicating no reliability, and r = 1.00 indicating perfect reliability. Do not expect to find a test with perfect reliability. Generally, the larger the reliability coefficient and more repeatable is reliable the test scores.

Table 3.1: Reliability Statistics

Construct	Number of item	Cronbach's alpha
Existence of traffic congestion	7	.912
Road condition	7	.761
Population increase	5	.934
Parking problem	6	.871
Poor traffic management	6	.811
Vehicle number increase	5	.870
Economic cost of congestion	10	.835
Total	46	.951

When Cronbach's alpha values greater than 0.7, it is acceptable. Similarly, as it can be seen from the table 3.1, all values of the Cronbach's alpha for the mediating effect of traffic congestion severity on economic cost show greater than 0.7. Therefore, we can conclude that the data collection instruments were acceptable as reliable.

3.9.2. Analysis of Validity

Validity indicates the degree to which the instrument measures what it is supposed to measure (Kothari, 2004). Similarly, Validity of an instrument is how accurate the instrument is in obtaining the data it intends to collect (Mugenda 2003). Depend on this definition, Malhotra (2010) mention about three types of validity in his study: content validity, predictive validity, and construct validity. This study addressed content validity through the review of literature and adapting instruments use in previous research, discussed with peers and professional experts of transport management.

3.10. Methods of data analysis

Data from the questionnaire was summarized, edited, coded, tabulated and analyzed. After all data was organized, both descriptive and inferential statistical techniques were employed to analyze the data. The data was analyzed using Statistical Package for Social Sciences (SPSS) version 20 and analysis of moment structure (AMOS) version 22.0. The statistical tools were aligned with the objectives of the study. Descriptive analysis was presented by using statistical tools mainly frequencies, percentages, mean and standard deviation to summarize the respondents' responses.

Inferential analyses were conducted by using correlation and multiple regression techniques to show the relationship and the significance between independent variables, mediating variable and dependent variables. The correlation analysis has been computed by using Pearson correlation method and the regression analysis has been estimated by using the hierarchical regression analysis methods. Thus, after testing its significance statistically, the researcher identified direct effect of IV on DV and indirect effect of IV on DV through mediating variable.

Structural equation modeling (SEM)is a multivariate technique that seeks to explain the relationship among multiple variables of underlying constructs, and to test if these variables could form a structural model (Hair et al. 2006). In the SEM measurement construct, the full

construct consists of observed measurements and their latent constructs. SEM can test not only the measurement and structural models simultaneously, similarly, examines the compatibility of the models with the data and the significance of the individual casual paths (Hair et al. 2006).

A thematic analysis with narrative presentation was employed to present the qualitative data. Economic cost effect of traffic congestion due to extra fuel cost and travel time consumption cost are analysis through scientific methods. Field measurement, interview and information obtained from documents were systematically checked, and compared to establish their validity. Analyses of data were presented with tables, graphs, and charts. Additionally, quantitative data like traffic volume, travel time, travel speeds, travel time delay, fuel consumption were triangulated by scientific measurement way.

3.11. Model and Estimation Techniques

In order to find the mediating effect of traffic congestion severity on economic cost we need to identify the relationship of each variable. Based on this the study has used multiple regression models to measure the level of significant relationship between the dependent and independent variables as whereas mediating variable.

The model applied to show this influence is presented as follows;

$Y = B0 + B1X1 + B2X2 + B3X3 + B4X4 + B5X5 + \varepsilon$ (direct effect)

$Y = B0 + B1RC + B2PG + B3PP + B4PTM + B5VNI + B6TC + \varepsilon i$ (indirect effect)

Where: Y= economic cost of congestion, Xn= Represents the Independent Variables in the estimation model, B0 = Constant (value of Y when X1, X2, X3, X4 and X5= 0).

Independent variable is: B1 =Regression coefficient for Road condition with X1= Road condition, B2=Regression coefficient for Population growth with X2= Population growth, B3=Regression coefficient for Parking problem with X3= Parking problem B4=Coefficient of regression for Poor traffic management with X4= Poor traffic management, B5=Coefficient of regression for Vehicles number increase with X5= Vehicles number increase. Mediating variable B6=Coefficient of regression for Traffic congestion severity with X6= Traffic congestion severity, ε = the error. Road condition, population growth, parking problem, poor traffic management, vehicles numbers increase are Independent variables, Traffic congestion severity is mediating variable whereas, Economic cost of congestion is the dependent variable.

3.11. Ethical Consideration

According to Leedy & Ormarod (2010), there are four ethical issues that need to be addressed in the process of undertaking a research: That are protection from harm, informed consent, right to privacy, and honesty with professional colleagues. Accordingly, Ethical clearance and permission latter is obtained from Jima University. Before the data collection, permission of Addis Ababa transport authority and police office volunteer was requested. During the distribution of the questionnaire, respondents were informed about the purpose. Similarly, Interviews get started after obtaining respondent's willingness. The respondents` were told their response would be kept confidential and their identity shall not be exposed. According to Saunders, et.al (2001, p.130), Ethics refers to the appropriateness of your behavior in relation to the rights of those who become the subject of your work, or are affected by it. The response that the participants give are analyze without any change by the researcher. Every person involved in the study was entitled to the right of confidentiality of treatment, with no personal harm were caused to subjects in the research. Information obtained is thought in severe confidentiality by the researcher. All assistance, collaboration of others and sources from which information was drawn were acknowledged. It was assured by briefing the purpose of the research was exclusively for academic purpose. The works of other researchers and authors was cited appropriately.

CHAPTER FOUR

ANALYSIS OF RESULT AND DISCUSSION

4. Introduction

This chapter presents the analysis and describes the result of the mediating effect of traffic congestion severity on economic cost. The presentation is organized according to the research specific objectives and research questions. A total of 385 questionnaires were distributed to collect data on the mediating effect of traffic congestion severity on economic cost but 356 questionnaires were returned that are completely filled with a response rate of 92.4%. Both descriptive and explanatory (inferential) analyses are presented in this paper. Additionally, presented data was analysis through AMOS version 22. The analysis was made on the gathered quantitative and qualitative data to look in to the trend of the traffic flow with in the day and identify the peak period and peak hour volumes. The level of service (LOS) for the identified intersections was analyzed using a high way traffic manual criteria of LOS and the intersections were checked if they fall as congested or not based on HCM 2000criteria.The mediating effect of traffic congestion severity on economic cost due to extra travel time and fuel consumption is analysis through SPSS, AMOS and scientific measurement way.

4.1. Descriptive statistics analysis

Descriptive statistics is a summary statistic for quantitative data that describes a collection of information using different mechanisms like using mean, standard deviation, variance, range, minimum and maximum value, sum, graph, diagram, table and percent etc.

4.1.1. Demographic Analysis

A questionnaire was distributed to assess the perception of different road users towards traffic crowding in the city and it was prepared in order to gather additional information for the congestion analysis. It was essential to collect evidence and data on how the road users in Addis Ababa city observe the existing traffic flow overcrowding and know how much delay, extra travel cost is acceptable by travelers and extra fuel consume by extra travel time. According to

the definition by Lomax (1997), congestion is a travel delay in excess of the acceptable travel time. Therefore, according to this meaning the road users are identifying congested and uncongested intersections. Hence, the questionnaires were distributed based on convenience sampling technique (a man of the straight) – was used to select respondents (Drivers, passengers and Traffic polices).

Table4.1: Questionnaire respondents' profile

SN	Items	Alternatives	Number	Percentage
1	Questioner	Distributed	385	100%
		Returned	356	92.4%
2	Gender	Male	228	64.0%
		Female	128	36.0%
		Total	356	100%
3	Age	Below 20	38	10.7%
		20-29	88	24.7%
		30-39	114	32.0%
		40-49	67	18.8%
		Above 50	49	13.8%
4	Qualification	Below grade 12	41	11.5%
		Grade 12 complete	46	12.9%
		Diploma/ LEVEL	111	31.2%
		BSC	130	36.5%
		MSC	25	7.0%
		PHD	3	0.8%
5	Jobs	Government employment	116	32.6%
		Self – employment	88	24.7%
		Private employment	115	32.3%
		Student	37	10.4%

Source: Own Survey result 2020

The above table 4.1 presents demographic analysis of the respondents. This analysis includes gender of respondents, their age, department they work, their experience in the company, and their educational level. As it is shown in the table 4.1 above, out of the total respondents about 228 (64.0%) were male and 128 (36.0% percent) were females. The assumption was that males and females (Passengers, Drivers and traffic police) have different experiences of traffic congestion.

In this paper the age of the respondents could be classified in five categories. As shown in the above table, 10.7% were below 20 years, 24.7% were 20-29 years, 32.0% were 30-39 years, 18.8% were 40-49years and 13.8 % were above 50 years.

The educational qualification of the research participant of this paper in the percentage of educational level is shown in below and grouped in to six categories. As we can see most of the respondents, 36.5 percent were degree level, 7.0 percent were MSC level, 0.8 percent PHD level, 31.2 percent diploma/level, 11.5 percent were below grade 12 whereas the remaining 12.9 percent of the respondents were grade 12 complete. This is very important to concentrate the issue and give the reality of information need about cause and effect of traffic congestion.

According to above data indicate the respondents' occupation is: Government employed, private employed, self-employed and student. Jobs types of the respondents were most of employed in government and private sectors. Here is 32.6 percent government employed, 32.3 percent private sectors employed, 24.7percent were self-employed, and 10.4 percent were students.

4.1.2. Descriptive Analysis of users' Traffic Congestion perception

The below result is Jemo road users (respondents) perception that offers research questions. The mediating effect of traffic congestion severity on economic cost at Jemo Michael intersection was presented and discussed for each parameter of traffic congestion with respective tables through mean and standard deviation. Let as look variables of research one by one;

4.1.2.1. Existence of Traffic Congestion severity

Table 4.2: Table Respondents responses on traffic congestion existence

SN	Respondents responses to items on the Traffic congestion existence	Mean	Std. D
1	There is traffic congestion problem at Jemo Michael road intersection	3.64	.776
2	Volume of traffic flow is greater than to maximum capacity of road	3.69	.759
3	There is low speed of traffic flow at Jemo Michael road intersection	3.74	.725
4	Vehicles continuously flow by forming a queuing at Jemo Michael road intersection	3.71	.742
5	Vehicles flow are fully stopped for periods of time at Jemo Michael road intersection	3.69	.878
6	Vehicles are use highly Jemo Michael intersection segment at the same time	3.63	.821
7	There is no free movement of vehicles at Jemo Michael road intersection	3.48	.899
	Mean of Traffic congestion existence: 3.65		

Source: Own Survey, 2020

Existence of traffic congestion was presented in the table 4.2 above. It was presented by using mean and standard deviation. Based on previous literatures the researcher developed seven questions to identify existence of traffic congestion partnership. To identify the criteria for selection of existence of traffic congestion, the researcher asked the respondents whether there is traffic congestion problem at Jemo Michael road intersection or not. The responses with mean value of 3.64 indicated that there are traffic congestion problems at Jemo Michael intersection with Standard deviation of 0.776. It is a slight variation from the mean that the respondents have common agreement on existence of traffic congestion.

Mean of responses for statement ‘volume of traffic flow is greater than maximum capacity of road’ with mean value respondent of 3.69 indicate the existence vehicle flow greater than road capacity. The standard deviation of 0.759 indicates that the respondents have similar outlook about volume of traffic flow is greater than to maximum capacity of road.

In addition, mean of responses for statement ‘there is low speed of traffic flow at Jemo Michael road intersection’ the mean value for this response is 3.74 indicating that, the flow of vehicle is low speed. The standard deviation of 0.725 indicates that there is low variation from mean. The

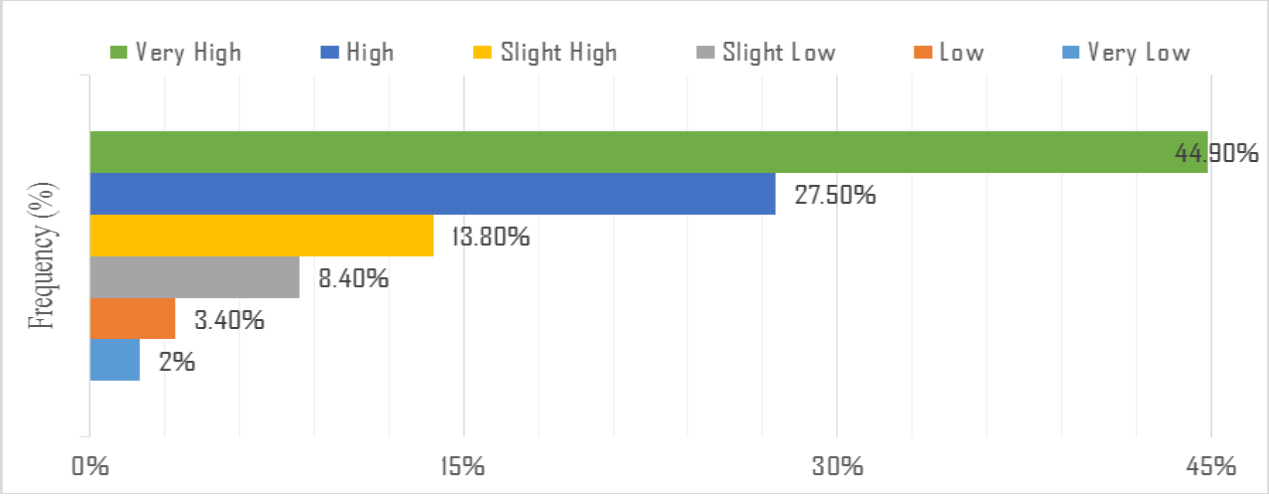
mean value of 3.71 ‘indicates that the vehicles continuously flow by forming a queuing at this intersection’ and the standard deviation of responses for these questions0.742suggesting that there is low variation in agreement of respondents.

The mean value of responses for ‘vehicles flow is fully stopped for periods of time because of crowded movement at Jemo Michael intersection’ is 3.69 suggesting that the respondents are agreed vehicle flow same times fully stopped for period of time and the standard deviation of this response is 0.878 suggesting that there is little variation from mean response. Additionally, value of statement ‘the vehicles are use highly Jemo Michael intersection segment at the same time’ mean value of 3.63 indicates that many vehicles use Jemo road at the same time and standard deviation of response is 0.821. Similarly, ‘shortage of free movement at Jemo road ’mean value of has not free movement of vehicles 3.48. This indicates at Jemo road intersection there is shortage of free movement and it is crowed. Similarly standard deviation of response is 0.899.

Generally, according to more road users (respondents) say on existence of traffic congestion with mean value of 3.65 suggests the respondents agree that there is traffic congestion at Jemo Michael intersection. Standard deviation of suggests that there is low variation in agreement from common mean. Hence, this implies that there is traffic congestion at this area.

4.1.2.2. Level of Traffic Congestion at the Intersection

Figure 4.1: Level of Traffic congestion at Jemo Michael intersection



Source: Own Survey, 2020

Base on above respondent's results and highway capacity manuals criteria the level of service traffic congestion severity (LOS) at Jemo Michael intersection is categorized under six level that means from "A" (free flow) – "F" (highly congestion). As the result of respondents49.9% says very high (extremely) traffic congestion at this intersection, this result as well indicate the severity of congestion when to explain as highway traffic manual (2000) this congestion type categorized under F level of service, 27.5% respondents say high traffic congestion occur at Jemo intersection this categorized under E level of service, 13.8% respondent's slight high(D level of service), 8.4% slight low (C level of service), 3.4% low (B level of service) and 2% of respondents say very low (A level of service or free flow without any obstacles). Generally, above data indicate at Jemo Michael intersection traffic congestion is very high and effect economic cost at this road.

4.1.3. Descriptive Analysis of cause of traffic congestion perception

Traffic congestion is one of the major problems facing Addis Ababa City. According to Institute of Transport Engineers, (1989), Urban traffic congestion can be contributed by a number of factors including rapid increase in urban population, economic growth, increase in employment opportunities, increase in number of cars, and number of peoples using cars, low capacity of transport infrastructure, road lay out, under investment in road infrastructure, poor management, shortage of off-street parking, signal and equipment failure, non-adherence to traffic regulation, poor urban planning transport etc.

According to the results of this paper indicates, at Jemo Michael intersection causes of traffic congestion are: imbalance of vehicle volume and road capacity, population and activities of peoples day to day extremely increase, shortage of mass transport, parking of passenger cars for loading and unloading of passengers near intersection entry and exit, on street parking on walkways and road ways which forces passengers to use roadways and poor traffic management are main reason for occurrence of traffic congestion. When to look road condition it is unbalance volume and capacity of road, for example, at the Jemo Michael intersection, pedestrian movements have great impact on traffic flow, because, the area is business center and many people come to the area for either buying or selling and to cross the intersection.

At this intersection, during the morning peaks period, a number of vehicles come into from the boarders of Addis Ababa (Sebeta, kality, Furi, Jemo-two, Hayile-germent, germen intersection) into centers area is significantly delay at Jemo and Germen approach creates long queues up to the Jemo Michael intersection. In the afternoon, due to a large number of vehicles returning to their home traffic congestion occurs. Similarly, parking at the exit and entry of intersection creates big problem. In this paper researcher focus on five cause of traffic congestion (Road condition, population growth, parking problems, poor traffic management and vehicles numbers increase), let as look the results one by one as below:

4.1.3.1. Road Condition

According to Rosenbloom, 1978, Traffic congestion occurs when travel demand exceeds the existing road system capacity. At Jemo Michael intersection the road capacity and volume of traffic flow does not balance, this means at the same time the volume of vehicles flow on Jemo intersection are greater than maximum road capacity. Therefore, road condition is one of the reasons for traffic congestion occurs at this intersection.

Table 4.3: Respondents responses to items on the road condition as cause of traffic congestion

Respondents responses to items on the road condition as cause of traffic congestion severity	**Mean**	**Std. D**
There is insufficient road width at Jemo Michael intersection	3.70	.642
There is uncomfortable road for travel Jemo Michael road intersection	3.81	.676
There is imbalance between demand and supply of road space at Jemo Michael intersection	3.83	.754
There is broken road at Jemo Michael road intersection	3.78	.879
There is illegal goods exchange on Jemo Michael road intersection	3.67	.720
There is no alternative road near to Jemo Michael road intersection	3.51	.673
There is insufficient pedestrian road at Jemo Michael intersection	3.34	.650
Mean of Road condition: 3.67		

Source: Own Survey result, 2020

Table 4.3 above presents the road condition problem at Jemo Michael road traffic congestion. The researcher used seven sub-variables to identify road condition problem effect on traffic

congestion. The respondents were asked to give their responses ‘there is insufficient road width at this intersection’ the responses with mean value of 3.70 suggest that there is insufficient road width at this intersection and standard deviation 0.642. This indicates Jemo road intersection is narrow and volume of flow is greater than their capacity.

Mean value for responses of statement ‘uncomfortable road for traverse at Jemo Michael intersection’ is 3.81 suggesting that the respondents agreed that there is uncomfortable road condition at Jemo intersection. The standard deviation for this statement is 0.676 suggesting that there is little variation of agreement on the statement. There is imbalance between demand and supply of road space. Mean response for imbalance between demand and supply of road space is 3.83 and the standard deviation of 0.754 suggests the there is little variation in from common mean.

The mean value for statement ‘There is broken road at Jemo Michael road intersection’ mean is 3.78 suggesting that the respondents agree on the broken road at this intersection exit and entrance. This is similarly reason for traffic congestion severity and economic effect due to travel time delay and extra fuel consumption occurs. The standard deviation for this statement is 0.879suggesting that there is low variation in responses.

Mean value for ‘illegal goods exchange around this intersection on the road’ is 3.78, that respondents agree that illegal goods exchange on Jemo intersection, this furthermore when activities of goods exchange on road its obstacle to traffic flow. The standard deviation for illegal goods exchange on road is 0.720.

Mean value for ‘has no enough alternative road near to Jemo Michael road intersection’ is 3.51, that respondents agree that shortage of alternative road around Jemo Michael intersection, this besides when visit all direction shortage of other alternative route occur many vehicles use at the same route at the same time, this is similarly cause for congestion and economic cost. The standard deviation for shortage of alternative road segment is 0.673.

Mean value for statement ‘insufficient pedestrian road at Jemo Michael intersection’ is 3.34, that respondents agree that there is insufficient pedestrian road at Jemo Michael road intersection, this likewise when shortage of pedestrian road occur, pedestrian use vehicle road

the traffic flow obstruct, congestion and delay occur. The standard deviation for shortage of pedestrian's road is 0.650

Generally, there is the road condition (problem) by comfort ability, width, facility, efficiency, capacity etc. at Jemo Michael road intersection. This is indicated by overall mean of 3.67.From cause of congestion road condition is one of them, as above respondents answers average mean of road condition question 3.67, this means in average respondents answer on road condition problems are exist agree, as a result it is cause of traffic congestion at Jemo Michael intersection.

4.1.3.2. Population growth

Institute of Civil Engineers (1989), congestion is a condition that arises because more people wish to travel at same time than the transportation system can accommodate, a simple case of demand exceeding supply. Respondent say, at Jemo area there are highly increase population year to year. This population more migrate from different all directions of rural area to city.

Table 4.4: Respondents responses to items on the population growth as cause of congestion

Respondents responses to items on the population growth as cause of traffic congestion severity	**Mean**	**Std. D**
The numbers of population are increased around Jemo Michael	4.12	.890
The demand for transport has increased at Jemo Michael road intersection	3.90	.796
Activities of peoples increased around Jemo Michael road intersection	3.83	.805
More peoples live and work around Jemo Michael road intersection	3.84	.882
There are high numbers of pedestrian use Jemo Michael road intersection	3.96	.957
Mean of Population growth: 3.93		

Source: Own Survey, 2020

The population growth as cause of traffic congestion is presented in the table 4.4 above. To identify the population growth, five sub-variables were used. First when to look 'the numbers of population around Jemo Michael increase' responses with mean value of 4.12 and standard deviation of 0.890 indicate that there is population increase. When population number increase its similarly affect traffic congestion. 'The demand for transport has increased at Jemo road segment' that indicated by mean of 3.90 and standard deviation of 0.796. That means at Jemo

Michael intersection segment demand for transport is increase. Other sub variable 'activities of peoples increased around Jemo intersection'. This is indicated by mean value of 3.83 and standard deviation of 0.805. Similarly, 'more peoples live and work around Jemo Michael road intersection' with mean value of 3.84 and standard deviation of 0.882. Additionally, 'there are high numbers of pedestrian use Jemo Michael road intersection'. This is indicated by mean value of 3.96 and standard deviation of 0.957.

Generally, mean value of responses for population increase about issues that affect mean value is 3.93suggesting that population growth highly causes for traffic congestion severity and economic cost of congestion. According above to respondents answers to population increases question mean are 3.93, this indicate at Jemo area there are population increase and activities of those peoples moreover highly increase at this area. Then it is similarly cause for occurs of traffic congestion severity at this intersection.

4.1.3.3. Parking problem

According to respondents say, at Jemo Michael area there are big problem of parking place, this means shortage of parking, uncomfortable and risk exposed parking place, even if same time drivers load and unload passengers on at road place. Hence, uneven road network features lack of lane discipline, and unsuitable bus-stop location prompt road congestion (Tilak& Reddy, 2016).

Table 4.5: Respondents responses to items on the Parking problem as cause of traffic congestion

Parking problem as cause of traffic congestion severity	**Mean**	**Std. D**
There are parking problem at Jemo Michael road intersection	3.41	.651
There are inadequate parking space at Jemo Michael road intersection	3.67	.777
Drivers use road sections to park vehicles at Jemo road	3.85	.713
There is uncomfortable parking space at Jemo road	3.72	.747
Parking area is exposed to risk along the road	3.63	.685
Operator load and unload passenger at any road place	3.47	.774
Mean of Parking problem: 3.65		

Source: Own Survey, 2020

Table 4.5 above presents the parking problem, researcher offers through six sub-question. The responses result that 'There are parking problem at Jemo Michael intersection' mean value 3.41 and 0.651. This result indicates there are parking problem, this moreover implies shortage of parking cause for traffic congestion severity and economic cost of traffic congestion. The responses result that 'inadequate parking space at Jemo Michael intersection' mean value 3.67 and 0.777. This result indicates at this intersection there is inadequate parking space this is similarly impact on traffic congestion and economic cost. By the same way 'at this intersection driver use road section to park vehicles' (mean value 3.85 and 0.713), un comfortable parking space(mean value 3.72 and 0.747), risk exposed parking area (mean value 3.63 with 0.685) and operator load and unload passengers at any road place (3.47 and 0.774).In table 4.5 parking problem indication sub-variables are existing at Jemo Michael intersection. This implies parking problem cause for traffic congestion. Overall mean for parking problem is 3.65 at this intersection.

Above respondent results show at Jemo intersection there are highly parking problem. The indication is, there is shortage of parking, unsafe, risky and uncomfortable parking place. Consequently, from cause of congestion parking problem additionally exist at this intersection according to respondents say.

4.1.3.4. Poor Traffic Management

As respondents say at Jemo intersection area there are problem of traffic management, like insufficient awareness of pedestrians on traffic law, does not have enough road traffic sign, does not use enough high technology traffic equipment's and well corporate team work. Poor traffic management besides reason for traffic congestion occur, but at Jemo area as respondent's result indicate traffic management is somehow moderate and exercised by traffic police. Road congestion can occur due to the narrow and poorly constructed roads and streets that are ineffective in handling various vehicle types. This results in the inability to effectively manage traffic, creating bottlenecks that last for extended periods (Jain et al. 2012).

Table 4.6: Respondents responses to items on the poor traffic mgmt. as cause of congestion

Poor Traffic management as cause of traffic congestion severity	**Mean**	**Std. D**
There is no enough traffic lights at Jemo Michael intersection	3.49	.933
There is no enough road signals on Jemo Michael road intersection	3.52	.908
Traffic police enforce (penalty) not sufficient on Jemo road	3.86	.727
Drivers violet traffic regulation at Jemo Michael intersection	3.85	.819
Pedestrians uses Jemo intersection are insufficient awareness on traffic rule	3.54	.802
There is old traffic sign at Jemo Michael intersection	3.50	.793
Mean of Poor Traffic Management: 3.72		

Source: Own Survey, 2020

Table 4.6above presents poor traffic management identified through6questionnaires. The responses with mean value of 3.49 and standard deviation of 0.933 indicated that 'there are no enough traffic lights at Jemo Michael intersection'. The mean value there is no enough road signals on Jemo Michael road intersection time is 3.52 suggesting that at these road insufficient road sign. The standard deviation is 0.908 suggesting that there is slight variation in agreement of the respondents. The mean value for 'traffic police enforce (penalty) not sufficient on Jemo road' is 3.86 and standard deviation is 0.727. The mean value for 'driver's violet traffic regulation at Jemo Michael intersection' is 3.85 and the standard deviation of 0.819suggests that the agreement of the respondents is similar with little variation.

The value of overall mean value for 'pedestrians used Jemo road are insufficient awareness on traffic rule' 3.54 and the standard deviation of 0.802 that the agreement of the respondents is similar with little variation. The value of overall mean value for 'old traffic sign at Jemo Michael intersection' 3.50 and the standard deviation of 0.793 suggests that the agreement of the respondents is similar with little variation.

Generally, overall mean value for poor traffic management 3.72.According to respondent's answer indicate from the cause of traffic congestion poor traffic management correspondingly one of the reasons to traffic congestion occurs.

4.1.3.5. Vehicles Number increase

Vehicles numbers increase respondent say that at Jemo Michael area vehicles number highly increase, this means the volume of traffic flow are greater than maximum capacity, many vehicles at the same time use this segment, furthermore individual(automobiles) vehicles highly increase than mass transportation. Vehicles number increases at the same way big reasons for occurrence of traffic congestion. According to Vuchic and Kikuchi (1994) when vehicular volume on a transportation facility (street or highway) exceeds the capacity of that facility, the result is a state of congestion. Traffic congestion is a condition of traffic delay (when the flow of traffic is slowed below reasonable speeds) because the number of vehicles trying to use the road exceeds the traffic network capacity to handle them (Weisbrod et.al 2001).

Table 4.7: Vehicles numbers Increase as cause of traffic congestion

Vehicles numbers Increase as cause of traffic congestion severity	Mean	Std. D
There is an increase vehicles numbers at Jemo Michael intersection	3.58	.643
Volume of vehicles flow at Jemo Michael intersection are greater than available capacity	3.72	.707
Vehicles flow continuously by overcrowding queue form at Jemo Michael intersection	3.77	.754
There are heterogeneous vehicles use Jemo Michael intersection	3.55	.758
Many vehicles at the same time use Jemo Michael intersection	3.55	.672
Mean of Vehicles Number increase: 3.64		

Source: Own Survey, 2020

Table 4.7 above presents the vehicles number increase at Jemo Michael road traffic congestion. The researcher used 6 sub-variables to identify vehicles number increase effect on traffic congestion. The respondents were asked to give their responses there is ‘vehicles number increase at intersection’. Responses with mean value of 3.58 suggest that there is vehicles number increase at these intersection and standard deviation 0.643. This indicates low variation at degree of agreement.

Mean value for responses of statement ‘volume of vehicles flow is greater than available capacity’ is 3.72 suggesting that the respondents agreed that there is volume of vehicles flow at

Jemo intersection are greater than available capacity. The standard deviation for this statement is 0.707 suggesting that there is little variation of agreement on the statement. Similarly, 'vehicle flow continuously through overcrowding queue form at Jemo Michael intersection'. Mean response for vehicles flow overcrowding queue form at these intersection is 3.77and the standard deviation of 0.758 suggests the there is little variation in from common mean.

The mean value for statement 'There are heterogeneous vehicles uses Jemo Michael intersection' mean is 3.55suggesting that the respondents agree that heterogeneous vehicles use at the same time at this intersection, besides its cause for traffic congestion. The standard deviation for this statement is 0.758suggesting that there is low variation in responses.

Mean value for responses of statement 'many vehicles at the same time use Jemo intersection' is 3.55, that respondents agree that many vehicles use this intersection at the same time, this similarly when many vehicles use this intersection at the same time, this condition besides obstacle to traffic flow. The standard deviation for many vehicles at the same time use Jemo intersection is 0.672. Vehicles number increase at Jemo road mean value of 3.64.

Generally, when to look the causes of traffic congestion through mean scores, the vehicles number increase has mean score (3.64), population increase (3.93), road condition (3.67), poor traffic management practices (3.72) and parking area problem (3.65) as causes of traffic congestion.

4.1.4. Analysis economic Cost of traffic congestion based on respondents' perception

4.1.4.1. Economic cost of congestion due to extra travel time and fuel consumption

Traffic congestion is a condition of traffic delay (when the flow of traffic is slowed below reasonable speeds) because the number of vehicles trying to use the road exceeds the traffic, network capacity to handle them (Weisbrod, et.al 2001). Traffic congestion is travel time delay in excess of that normally incurred under light or free-flow travel conditions (Lomax et al, 1997). Congestion is the presence of delays along a physical pathway due to presence of other users.

Traffic congestion has a number of economic cost effects, but in this paper researcher look economic effect based on travel time delay and extra fuel used. Extra fuel consumption result

offers through using scientific formula, but extra travel time consumption is offers through both scientific and respondent's response. The result of economic cost effect due to road traffic congestion based on respondent feedback, describes as below; Delay which is result in late arrival work place for employment, late arrival school for student, late arrive appointment place, inability to forecast travel time and drivers need more time to cover a given distance.

Table 4.8: Economic effect of traffic congestion severity

Economic effect of traffic congestion due to TTD and FC	Mean	Std. D
There is travel time delay at Jemo Michael intersection	3.62	.679
Passenger use Jemo Michael intersection late arrival to work place	3.88	.709
Drivers use Jemo intersection need more time to cover given distance	3.75	.819
Passenger pass through Jemo Michael intersection not enables to forecast travel time accurately	3.67	.747
Traveler use Jemo Michael intersection late arrive at appointment place	3.51	.694
Student use Jemo Michael intersection late arrival to school	3.37	.674
There is extra fuel consumption at this Intersection	3.12	.562
Operator loss income via extra fuel cost at Jemo intersection	3.34	.652
Commuters to pay more money by means of reason of extra fuel consumption at Jemo intersection	2.81	.521
Vehicles consume high energy at Jemo intersection	3.24	.6.32
Mean of economic effect of traffic congestion: 3.67		

Source: Own Survey, 2020

Researcher used ten sub-questions for identify economic cost effect of traffic congestion due to travel time delay and fuel consumption. The respondents were asked to give their responses there is travel time delay at Jemo Michael intersection. Responses with mean value of 3.62 suggest that there is travel time delay at this intersection and standard deviation 0.679. This indicates low variation at degree of agreement.

Mean value for responses of statement 'passengers use Jemo intersection are late arrival to work place' is 3.88 suggesting that the respondents agreed that there is late arrival to work place at Jemo intersection. The standard deviation for this statement is 0.709suggesting that

there is little variation of agreement on the statement. By another way ‘driver use Jemo intersection need more time to cover given distance’ mean response for operator use Jemo road need time to cover given distance3.75and the standard deviation of 0.819suggests the there is little variation in from common mean.

The mean value for statement ‘Passenger pass through Jemo Michael intersection not enables to forecast travel time accurately’ mean is 3.67suggesting that the respondents agree that passenger use this road segment not enables to forecast travel time accurately. The standard deviation for this statement is 0.747suggesting that there is low variation in responses.

Mean value for ‘traveler use Jemo Michael intersection late arrive at appointment place’ is 3.51, that respondents agree that passenger use this road segment late arrive at appointment place with standard deviation of 0.694. Mean value for ‘student use Jemo Michael intersection late arrival to school’ is 3.37that respondents agree that student use this road segment late arrive to school with standard deviation of0.694. According to respondent say, at this intersection high losing to travel time, by consequences of travel time delay highly economic lose due to traffic congestion with mean value of travel time delay: 3.67.

Additionally, there are extra fuel consumption, Operator loss income by extra fuel cost, Commuters to pay more money by reason of extra fuel consumption and Vehicles out (consume) more energy at this Intersection.

4.2. Inferential Analysis

4.2.1. Correlation Analyses

Correlation analysis is one of an explanatory design that is intended to identify the relationship between variables. Based on assumption of linear relationship between the variables, Pearson correlation method is used to identify the correlation. It deals with relationships among variables and helps to gain insight into the direction and strength of relation between the variables. Pearson’s Correlation coefficient takes values between -1 and 1 ranging from being perfect negatively correlated (-1), to uncorrelated (0), to perfect positively correlated (+1). The sign of the correlation coefficient defines the direction of the relationship. Correlation analysis was conducted to assess the association among the predictor variables, mediating variable and the dependent variables. According to rule of thumb, the correlation coefficient between 0.1 and 0.3

indicates a weak correlation, between 0.4 and 0.6 a moderate correlation, and between 0.7 and 0.9 a strong correlation among variables. The below tables show the variables have relation between them but, the strength of association varies.

Table 4.9: The Pearson's correlation coefficient between variables

Composite variables		**RC**	**PG**	**PP**	**PTM**	**VNI**	**TCS**	**EC**
Road condition (**RC**)	Pears cor.	1						
	Sig.							
Population Growth (**PG**)	Pears. cor.	.247**	1					
	Sig.	.000						
Parking Problem (**PP**)	Pears cor.	.348**	.172**	1				
	Sig.	.000	.001					
Poor Traffic Management(**PTM**)	Pears cor.	.266**	.139**	.315**	1			
	Sig.	.000	.009	.000				
Vehicles Number Increase(**VNI**)	Pears cor.	.582**	.208**	.386**	.258**	1		
	Sig.	.000	.000	.000	.000			
Traffic Congestion severity (**TCS**)	Pears cor.	.521**	.219**	.413**	.327**	.356**	1	
	Sig.	.000	.000	.000	.000	.000		
Economic Cost (**EC**)	Pears cor.	.568**	.248**	.502**	.401**	.491**	.667**	1
	Sig.	.000	.000	.000	.000	.000	.000	
** Correlation is significant at the 0.01 level and * = significant at the 0.05 level (2-tailed).								

Source: Own Survey, 2020

Table 4.9 above presents the correlation coefficients and respective significance of the correlation. It indicates that there is a significant positive relationship between independent variables with mediating variable. The result indicated road condition (r = .521, p <.001), population growth (r = .219, p<.001), parking problem (r=.413, p<.001), poor traffic management ((r =.327, p<.001), vehicles number increase (r = .356, p<.001) have positive and significant relationship with the mediating variable (traffic congestion severity). A significant positive correlation was obtained for all independent variables with dependent variable economic cost of congestion. The result indicated road condition (r = .568, p <.001), population increase (r = .248, p<.001), parking problem (r=.502, p<.001), poor traffic management ((r =.401, p<.001), vehicles number increase (r = .491, p<.001) has positive and significant relationship with the dependent variable. The mediating variable (traffic congestion severity (r = .667, p<.001),) has a significant positive correlation with dependent variable (economic cost of congestion).

As a result of correlation indicate all independent variables (road condition, population growth, parking problem, poor traffic management, vehicles number increase) and mediating variables (traffic congestion severity) has positively and significant correlation with significance level 0.05 and 0.01 affect economic cost. Let as indicates one by one**:**

The road condition problem and traffic congestion severity has positive significant correlation with significance level of 0.05 and 0.01 suggesting that increase road condition problem increases traffic congestion severity significantly. This implies that road condition problem of Jemo Michael intersection has positively and significantly affect the traffic congestion severity. Result of this study is supported by another author's idea; according to (Weisbrodet.al. 2003) traffic congestion severity occurs when the number of vehicles using the road is greater than the capacity of the available road space, obstructing the efficient movement of traffic. Similarly, according to Downie (2008) similarly opines that traffic congestion occurs when the volume of vehicular traffic is greater than the available road capacity, a point commonly referred to as saturation.

Additionally, Response gate from respondents through interview indicates that, Jemo Michael intersection roads approach are narrow, has no enough parking, illegal trader's different goods exchange on road, lack of bridge to cross road for passenger and accumulation of construction materials on the road. This situation which forces the vehicles slowly flow and sometime to stop anywhere on the road which in turn leads the presence of traffic congestion and high economy losses such as extra travel time cost consume, extra fuel cost consumption, losses appointment place, loss extra fuel cost and loss productive hours through traffic congestion severity. This finding indicated as it was the same finding with the result of data analysis.

The correlation between population growth and economic cost of congestion is positive and significant at significance level of 0.05 and 0.01. The correlation between the parking problem and economic cost of congestion is positive and significant at significance level of 0.05 and 0.01. As interview result indicates population increase around Jemo intersection is increase. The number of megacities and population numbers are excess from rural area and small town. As population continues to increase and as the city continues to sprawl, more people live and work in the city and make more trips within the urban areas, often over long distances. Furthermore, at these area people's activities on the road highly increase by on road trading, demand of

transportation increase. Consequently, the limited capacity of the existing transport infrastructure is busy to the limit. Thus, it has become a constraint to cope with the public demand for travel. This result is miss much with the finding analysis through questioner.

The correlation between the parking problem and traffic congestion severity is positive and significant at significance level of 0.05 and 0.01. This indicates parking problem has positively and significantly affects traffic congestion. Contributing factor to traffic congestion as suggested by Herman (2001) are parking problem. He is view that road parking, which consumes large amount of space has become a land issue that greatly inflates the demand for urban land, causing congestion in cities. Furthermore, traffic congestion in urban road is attributable to limited road capacity, parking space, dysfunctional road signals, drivers' behavior, vehicle breakdown on roads and too many cars within the city (Takyi et.al 2013).

At this intersection segment there are not have adequate parking areas. It has haphazardly parking along the roads. At all approach of this intersection road segment, the most serious problem related to parking is, vehicles load and discharge passengers at road section. It is aggravated by the nature of the area activity where the major roads converge from the city road, hence forcing all vehicles in the city streets. This occurs because whenever one tries to park somewhere they slow their vehicles causing those following him/ her to slow down too and increase traffic congestion. This behavior or situation is common at area of Jemo intersection. Similarly, when traffic over crowding occurs, it is impact on economic situation. This result supports the finding of data analysis through questioner.

The correlation between the poor traffic management and traffic congestion severity is positive and significant at significance level of 0.05 and 0.01. These indicate poor traffic management has positively and significantly affect traffic congestion severity of passengers. According to Rodriqueet.al, (2009) state that, congestion can be perceived as unavoidable consequences of scarce transport facilities such as road space, parking area, road signals and effective traffic management.

According to interviewed person say, at Jemo intersection area there are problem of traffic management. The indicator of these problem is poor traffic lights, absence of road signs, inadequate enforcement of laws like illegal trade on the road, low penalties given to punish violators of traffic congestions, employment of few law enforcers for instance traffic police.

Additionally, at this intersection shows reckless driving due to violation of traffic rules. Drivers have a tendency to disregard or violate the traffic regulations such as to overtake where it is forbidden, driving while drunk, neglecting road signs and markings, discharging passengers on the road instead of the bus to stop. Thus, misbehavior of some drivers on failure to adhere to traffic regulations is among the main contributing factors to the increase of traffic jam at Jemo intersection. This problem is furthermore cause and contributes to occur for traffic congestion at this intersection area. The result of traffic congestion is moreover effect on economy through time losses, fuel consumption and other.

The correlation between the vehicles number increase and traffic congestion severity is positive and significant at significance level of 0.05 and 0.01. This indicates vehicles number increase has positively and significantly impact on traffic congestion. According to (Rothenberg, 1985) traffic congestion is a condition in which the number of vehicles attempting to use a roadway at any time exceeds the ability of the roadway to carry the load at generally acceptable service levels, by another way when vehicular volume on a transportation facility (street or highway) exceeds the capacity of that facility, the result is a state of congestion, (Vuchic and Kikuchi, 1994). Congestion is the impedance vehicles impose on each other, due to the speed-flow relationship, in conditions where the use of a transport system approaches its capacity, (ECMT, 1999). As well the remarkable increase in the number of vehicles on the roads as a result of rapid urbanization has led to a rise in traffic volume, thus causing roads to be congested in every city in India (Tilak& Reddy, 2016).

According to interview of respondents at Jemo road intersection there are high traffic flow and vehicles number increase. At this intersection traffic volume are greater than maximum road capacity especially at morning and afternoon peak time. Furthermore, many people in cities own vehicles and mass transport are less number. Number of vehicles increase disproportionally with the road capacity and this leads to traffic congestion. The output of congestion similarly effects economic cost. This result supports the find of data collect through questioner.

The relationship between mediating variable (traffic congestion severity) and dependent variable (economic cost of congestion) has positive and significant correlation with significance level of 0.05 and 0.01suggesting that increase traffic congestion increases economic cost of congestion significantly. This indicates that traffic congestion severity of Jemo Michael intersection has

positively and significantly affects the economic cost of congestion travel time delay and fuel consumption. Result of this study is similar to findings of authors,((Kockelman, (2004)) congestion is the presence of delays along a physical pathway due to presence of other users. Similarly, Cambridge Systematic and TTI, (2005) in the transportation realm, congestion usually relates to an excess of vehicles on a portion of roadway at a particular time resulting in speeds that are slower than normal speeds.

According to the interview with respondents, economic cost of congestion is occurring by the reason of traffic congestion problem. At Jemo intersection there are high traffic congestion problem, this problem similarly, reason to happen travel time delay and fuel consumption. Travel time and extra fuel consume are the largest categories of transport costs and time savings are often the greatest expected benefit of transport improvement projects. At this intersection cost of travel time happen are various that caused by traffic congestion, such as passenger miss finding better jobs, loss of productive hours, losses of appointment time and delay to product deliver. This cost of traffic congestion is the delay associated with lower travel speeds, start-and-stop traffic flow, and in extreme cases gridlock. The result is the same to data gate from questioner.

The relationship of each independent variable with direct dependent variable result indicates: road condition problem and economic cost of congestion has positive and significant correlation with significance level of 0.05 and 0.01suggesting that increase road condition problem increases economic cost of congestion significantly. This implies road condition problem has positively and significantly affect the economic cost of congestion. Result of this study is similar to findings of authors (Pisaraski, 1990cited in Miller), congestion is an imbalance between traffic flow and road capacity that causes increased travel time, cost and modification of behavior.

The correlation between population growth and economic cost of congestion is positive and significant at significance level of 0.05 and 0.01. The correlation between the parking problem and economic cost of congestion is positive and significant at significance level of 0.05 and 0.01. The correlation between the poor traffic management and economic cost of congestion is positive and significant at significance level of 0.05 and 0.01. This indicates poor traffic management has positively and significantly affect economic cost of congestion of passengers. Congestion is the presence of delays along a physical pathway due to presence of other users and poor traffic management (Kockelman, 2004).

The correlation between the vehicles number increase and economic cost of congestion has positive & significant at significance level of 0.05 and 0.01. This indicates vehicles number increase has positively and significantly affect economic cost of congestion of passengers. According to Cambridge Systematic and TTI, 2005 in the transportation realm, congestion usually relates to an excess of vehicles on a portion of roadway at a particular time resulting in speeds that are slower than normal speeds, the its arise travel time delay.

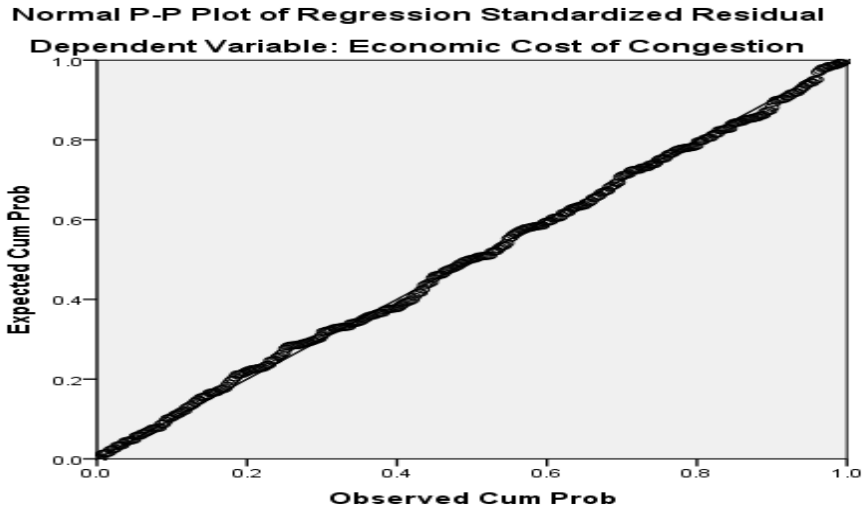
4.2.2. Diagnostic Tests

Before carrying out multiple regression analysis, the researcher has checked the required assumptions that the data must meet to make the analysis reliable and valid. The following assumptions of multiple linear regressions were tested using SPSS.

4.2.2.1. Linearity assumption:

Linearity defines the dependent variable as a linear function of the predictor (independent) variable. Linearity assumption was tested by producing scatter plots of the relationship between each of independent variable and the dependent variable. By visually looking at the scatter plot produced by SPSS, the relationship between each independent variable and the dependent variable found to be linear as shown in figure 4.2 below.

Figure 4.2: Linearity assumption



4.2.2.2. Multicollinearity assumption:

Multicollinearity is a statistical phenomenon in which there exists a perfect or exact relationship between the predictor variables. Field (2009) cited that Variance Inflation Factor (VIF) value above 10 and a tolerance (1/VIF) value below 0.1 pose a multicollinearity problem. The result in table 4.10 below shows that the collinearity between independent variables has no problem since the value of tolerance for all independent variable is greater than (0.1)and all VIF is less than ten.

Table 4.10: Multicollinearity Test

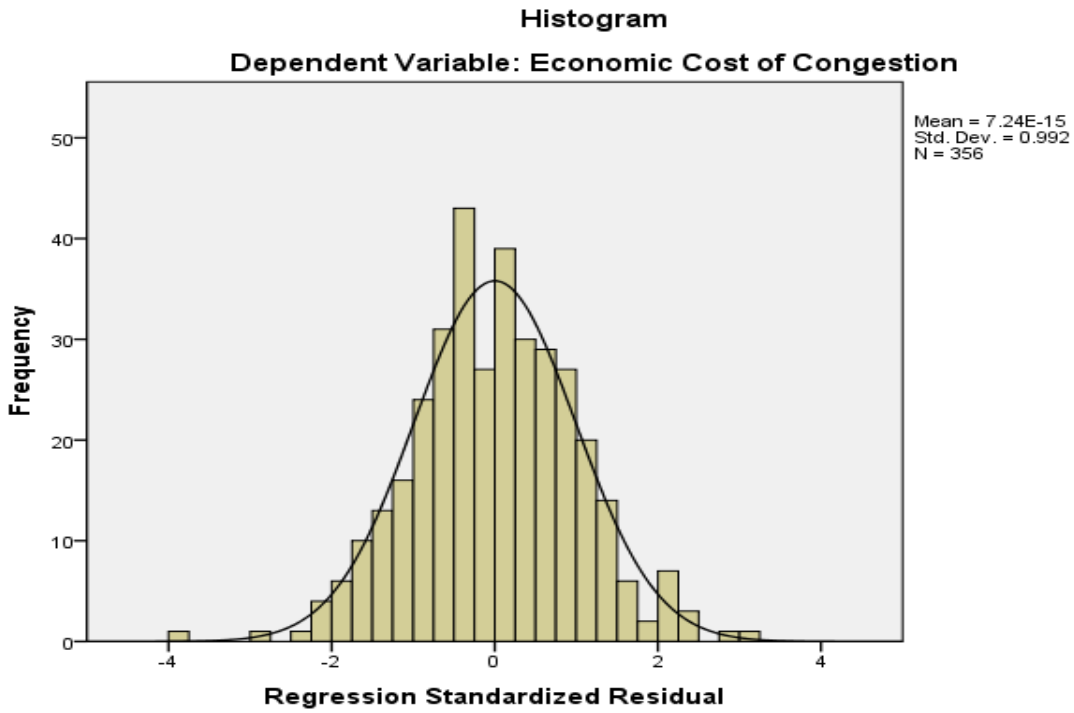
	Collinearity Statistics	
	Tolerance	**VIF**
Road condition	.542	1.846
Population growth	.919	1.088
Parking problem	.739	1.353
Poor traffic management	.842	1.188
Vehicles number increase	.617	1.621
Traffic Congestion	.645	1.551

Source: Own survey, 2020

4.2.2.3. Normality assumption

Multiple regressions assume that variables have normal distributions. This means that errors are normally distributed and that a plot of the values of the residuals will approximate a normal curve. Normality assumption was checked by using a histogram. It can be concluded that normality is guaranteed as the histogram generated is normally distributed as shown in figure below.

Figure 4.3.: Normality assumption

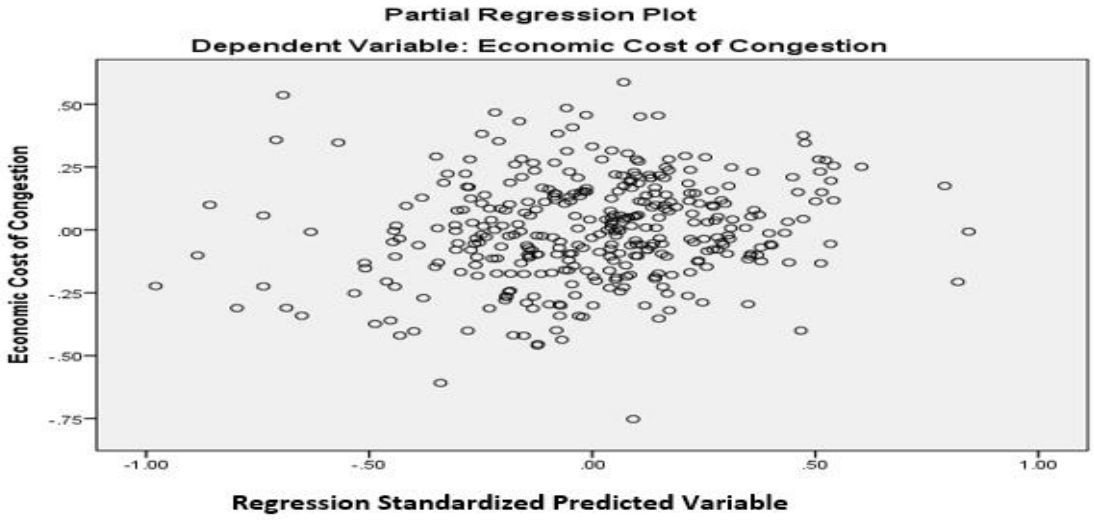


Source: Own survey, 2020

4.2.2.4. Homoscedasticity assumption

Homoscedasticity describes a situation in which the error term – noise or random distribution in the relation between the independent variable and dependent variable will be the same across all values of the independent variables. In Homoscedasticity assumption, the variances of error terms are similar across the independent variables. At each level of the predictor variable(s), the variance of the residual terms should be constant. The assumption of homoscedasticity refers to equal variance of errors across all levels of the independent variables. This means that errors are spread out consistently between the variables. This is evident when the variance around the regression line is the same for all values of the predictor variable. Homoscedasticity can be checked by visual examination of a plot of the standardized residuals by the regression standardized predicted value. Ideally, residuals are randomly scattered around zero (the horizontal line) providing even distribution.

Figure 4.4: Homoscedasticity



Source: Researcher (2020)

As can be seen in the scattered plot on figure 4.4 above, the residuals at each level of explanatory Variables look like they are evenly dispersed and that the graphs do not assume any type of shaped. Therefore, it is safe to say that this study has no heteroscedasticity problem.

4.2.3. Results of Hierarchical Regression Analysis

Another explanatory method used was regression analysis. Regression coefficient is a measure of how strongly each IV (predictor variable) predicts the DV. A hierarchical regression analysis was conducted to predict how much the independent variable explains the dependent variable and a mediating variable. Hypotheses were tested by using this method. The hierarchical regression analysis was conducted to assess the mediating role of traffic congestion severity on the relationship between causes of traffic congestion with economic cost of congestion. The first step of the regression model was to conduct the analysis without mediating (traffic congestion severity), and in the next step, analysis was conducted with the inclusion of mediating variable in the model. All decisions were made at significance level of 5% (0.05). The significance of independent variables in explaining the dependent variable was decided by using both p-value and t-statistics at significance level of 0.05 and 1 respectively. The model is summarized by using R-squared.

4.2.3.1. Model Summary

Table 4.11: Model Summary:

Model Summary [ab]										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
a	.794[a]	.597	.590	.22518	.597	74.145	5	350	.000	1.880
b	.862[b]	.687	.680	.20117	.687	91.896	6	349	.000	1.989

a. Predictors: (Constant), Vehicles number increase, Road condition, Traffic Management, Population Growth, Parking Problem

b. Predictors: (Constant), Vehicles number increase, Road condition, Traffic Management, Population Growth, Parking Problem, Traffic congestion severity

c. Dependent Variable: Economic cost of congestion

The output of the summary under 'a' letter is used to identify how independent variable explaining economic cost of congestion without mediating variable. As it is shown in the table, R squared is 0.594 and adjusted R squared is 0.589 that 59% variation in dependent variable is explained by independent variables used in the model. This implies that 59% variation in economic cost is affected by this independent variable. The model is significant ($F(5, 350) = 74.145$, $p < 0.001$) with Durbin-Watson value of 1.880 indicating the absence of autocorrelation problem.

By another side summery under b letter used to identify independent variable plus mediating variable (traffic congestion severity) in explaining economic cost of congestion. As it is shown in the table, R squared is 0.685 and adjusted R squared is 0.68 that 68% variation in dependent variable is explained by independent variables and mediating variable used in the model. This implies that 68% variation in economic cost of congestion is affected by these independent variable and mediating variable. The model is besides significant ($F(6, 349) = 91.896$, $p < 0.001$) with Durbin-Watson value of 1.989 indicating the absence of autocorrelation problem.

4.2.3.2. ANOVA

Table 4.12: Anova [bc]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.263	5	3.253	74.145	.000[b]
	Residual	17.748	350	.051		
	Total	34.011	355			
2	Regression	19.886	6	3.314	91.896	.000[c]
	Residual	14.124	349	.040		
	Total	34.011	355			

a. Dependent Variable: Economic cost of congestion

b. Predictors: (Constant), Vehicles number increase, Road condition , Traffic Management, Population Growth, Parking Problem

c. Predictors: (Constant), Vehicles number increase, Road condition , Traffic Management, Population Growth, Parking Problem, Traffic congestion severity

Source: Own Survey, 2020

This analysis is used to identify the mediating effect of traffic congestion severity effect on economic cost. Above result indicate independent variable(road condition, parking problem, poor traffic management, population increase and vehicles number increase) and mediating variable (traffic congestion severity) are economic effect due to travel time delay cost and fuel consumption, which is general objective of the study. In addition, this analysis is used to identify appropriateness of the model in estimating the mediating effect of traffic congestion effect on economic cost.

As result indicate, F-statistic value of the model one(without mediator) is 74.145 with degrees of freedom five and 350 it is significant at 0.01 and 0.05 indicating that the model used is appropriate to explain the mediating effect of traffic congestion severity on economic cost. Similarly, the result of F-statistic value of the model two(with mediator) is 91.896 with degrees of freedom six and 349, it is significant at 0.01 and 0.05 indicating that the model used is appropriate to explain cause and effect of traffic congestion. This implies that all independent variable and mediating variable significantly effect on economic cost.

4.2.3.3. Coefficients

Regression coefficient is a measure of how strongly each IV (also known as predictor variable) predicts the DV. There are two types of regression coefficient unstandardized coefficients and standardized coefficients, besides known as beta value. The unstandardized coefficients can be used in the equation as coefficients of different IVs along with the constant term to predict the value of DV.

Table 4.13: Coefficients

Coefficient [bc]

Model		Unstandardized Coefficients		Standardized Coefficients	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta		Lower Bound	Upper Bound
b	(Constant)	.367	.189		.005	-.004	.739
	Road condition	.317	.047	.390	.000	.225	.409
	Population growth	.045	.027	.570	.008	-.008	.098
	Parking condition	.257	.042	.950	.000	.174	.341
	Traffic mgmt.	.159	.036	.520	.000	.089	.229
	Vehicles number	.116	.043	.040	.007	.032	.200
c	(Constant)	.221	.169		.019	-.112	.555
	Road condition	.324	.045	.302	.000	.076	.252
	Population growth	.047	.024	.054	.007	-.021	.075
	Parking condition	.270	.039	.194	.000	.093	.246
	Traffic mgmt.	.108	.032	.0284	.001	.045	.171
	Vehicles number	.119	.038	.095	.002	.045	.194
	Traffic congestion severity	.347	.037	.450	.000	.275	.419

a. Dependent Variable: Economic cost of congestion
b. Predictors: (Constant), Vehicles number increase, Road condition, Poor traffic Management, Population Growth, Parking Problem
c. Predictors: (Constant), Vehicles number increase, Road condition, Poor traffic Management, Population Growth, Parking Problem, Traffic congestion severity

The Mathematical Model of multiple regressions below can be used determine the quantitative association between the variables: The model applied to show this influence is presented as follows;

$Y = .367 + .317X1 + .045X2 + .257X3 + .159X4 + .116X5 + \varepsilon$ (direct effect)

$Y = .221 + .324X1 + .047X2 + .270X3 + .108X4 + .119X5 + .347X6 + \varepsilon$ (indirect effect)

For direct effect the model illustrates that when all variables are held at zero (constant), the value of economic cost of congestion would be 0.367. However, holding other factors constant, a unit increase in road condition would lead to a 0.317 increase in economic cost of congestion, a unit increase in population increase would lead to a 0.045 increase in economic cost of congestion but it is insignificant, a unit increase in parking problem would lead to a 0.257 increase in economic cost of congestion, a unit increase in poor traffic management would lead to a 0.159 increase in economic cost of congestion and a unit increase in vehicles number increase would lead to a 0.116 increase in economic cost of congestion.

The coefficient of indirect effect, the model illustrates that when all variables are held at zero (constant), the value of economic cost of congestion would be 0.221. However, holding other factors constant, a unit increase in road condition would lead to a 0.324 increase in economic cost of congestion, a unit increase in population increase would lead to a 0.047 increase in economic cost of congestion but insignificant value, a unit increase in parking problem would lead to a 0.270 increase in economic cost of congestion, a unit increase in poor traffic management would lead to a 0.108 increase in economic cost of congestion, a unit increase in vehicles number increase would lead to a 0.119 increase in economic cost of congestion and a unit increase in traffic congestion would lead to a 0.347 increase in economic cost of congestion. The researcher used unstandardized coefficients and their sign to analyze the effect on economic cost of congestion. The specific objectives are addressed based on this analysis.

Coefficient of road condition is positive and significant at 0.01and 0.05. The positive coefficient indicates improving road width improves of economic cost of congestion. This implies that road condition problem of Jemo intersection has significant positive effect on economic cost of congestion. Coefficient of population increase is positive significant p- values at 0.01 and 0.05 indicating that population number increase has significant effect on economic cost of congestion.

Coefficient of parking problem is positive and significant at 0.01and 0.05. The positive coefficient indicates improving parking problem improves of traffic congestion severity and economic cost of congestion. This implies that parking problem of Jemo intersection has significant positive effect on economic cost of congestion. Coefficient of poor traffic

management is positive and significant at 0.01and 0.05. The positive coefficient indicates improving traffic management improves of traffic congestion and economic cost of congestion. This implies that traffic management of Jemo intersection has significant positive effect on economic cost of congestion. Coefficient of vehicles number increase is positive and significant at 0.01and 0.05. This implies that vehicles number increase of Jemo intersection has significant positive effect on economic cost of congestion.

This study has identified the mediating effect of traffic congestion severity on economic cost based on t-statistics. Road condition has high positive effect with t-value of 6.778. Next to road condition, parking problem has the next highest effect with t-value of 6.084. Poor traffic management has the third level of positive effect with t-value of 4.465. Among the three significant factors of variables vehicles number increase and population increase the lowest effect on traffic congestion and economic cost of congestion positive effect with t-value of 2.725 and population increase are the least positive effect with t-value of 2.657.

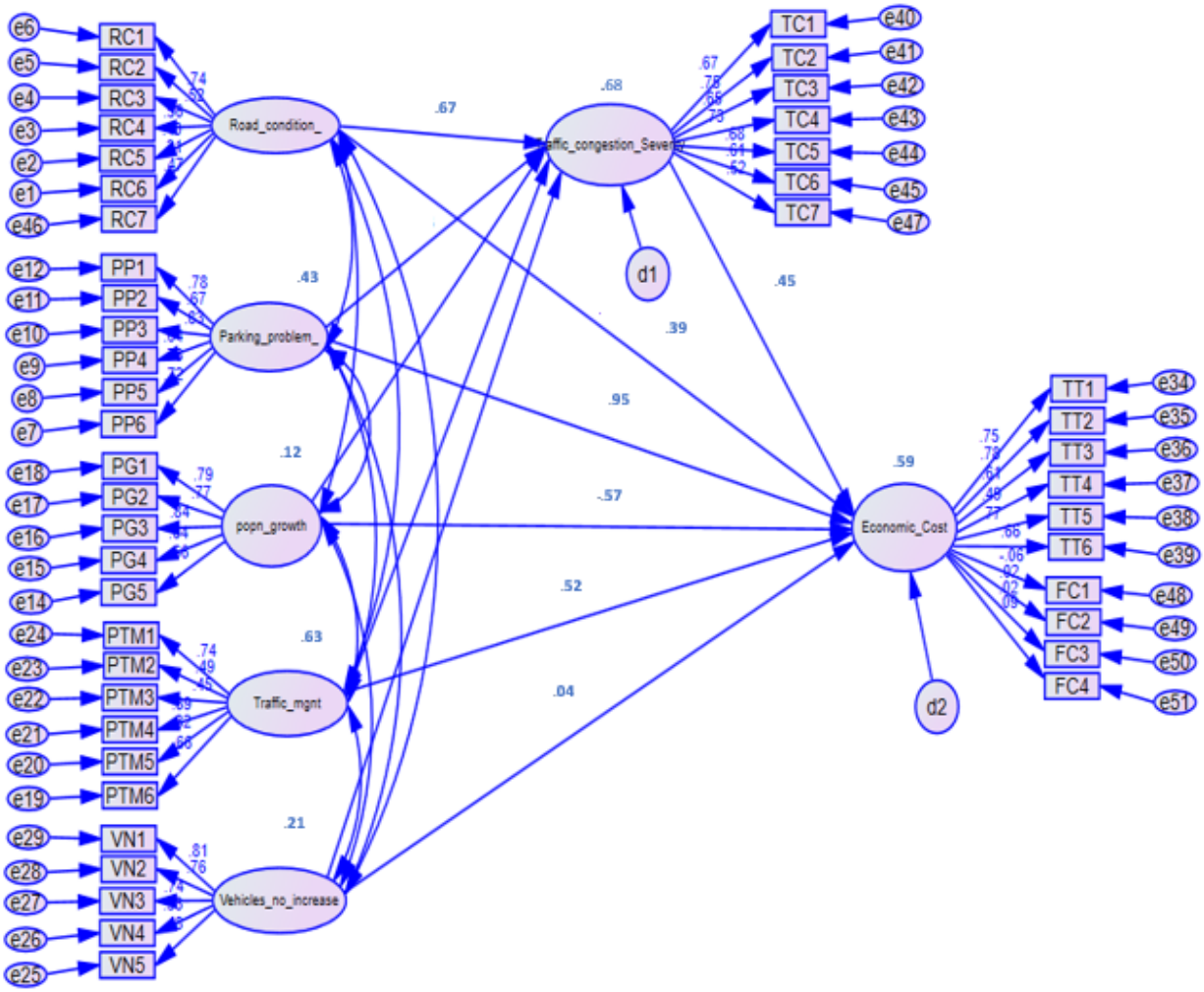
4.3. Structural equation model analysis

Structural Equation Modeling (SEM) is a multivariate technique, which estimates a series of inter-related dependence relationships simultaneously. The term Structural Equation Modeling conveys that the causal processes under study are represented by a series of structural (i.e. regression) equations, and that can be modeled pictorially to enable a clearer conceptualization of the study. The hypothesized model can be tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. If the goodness-of-fit is adequate, the model argues for the plausibility of postulated relations among the variables. When analyzing the mediator, there are two effects involved namely direct effect and indirect effect. The direct effect is the effect from independent variable directly to dependent variable, while the indirect effect is the effect from independent variable to dependent variable through the mediating variable.

In this paper we look observed and latent variables only by using path diagram. Observed variables are variables that are included in our dataset. They are represented by rectangles in below diagram. Latent variables are unobserved variables that we wish we had observed. They can be thought of as a composite score of other variables. They are represented by ovals in this

path diagram. Paths are direct relationships between variables. Estimated path coefficients are analogous to regression.

Figure 4.5 Structural model analyses



In Figure 4.5 the PA-OV analysis presented, as the Adjusted R squared is (0.59) which means independent variable (Vehicles number increase, Road condition, Traffic Management, Population Growth, Parking Problem) predict resultant variable(economic cost of congestion) by 59% and the left 41% predict by other variable. However, Figure 4.5 presented, to identify independent variable plus mediating variable (traffic congestion severity) in explaining economic cost of congestion. Hence, the Adjusted R squared is (0.68) which depicts 68% variation in dependent variable is explained by independent variables and mediating variable used in the model.

4.4. Hypotheses Test Summary

The researcher tested hypotheses by using p-value. As a result, Road condition (problem) has positive significant effect on traffic congestion severity significance value 0.000. Instead, the researcher fails to reject alternative hypothesis. Which stated that, road condition has positive significant effect on traffic congestion. Similarly, the effect of road condition is positive significant effect economic cost of congestion at 0.01, the researcher similarly fails to rejects alternative hypothesis; road condition has positive significant effect on economic cost of congestion. Since their effects are significant value is 0.000.

Parking problem is positive significant effect on traffic congestion severity with p value 0.000. Besides parking problem significant positive effect on economic cost of congestion. Consequently, researcher fails to rejects alternative hypothesis, which is parking problem positive significant effect on traffic congestion severity and similarly parking problem positive significant effect on economic cost of congestion with sig. value 0.000. As a result, researcher fails to rejects alternative hypothesis.

Population increase (growth) has positive significant effect on traffic congestion severity with p value 0.008. As a result, fails to reject alternative hypothesis. Therefore, population increase has positive significant effect on traffic congestion severity. Similarly, population growth has positive significant effect on economic cost of congestion with p value 0.007 at 0.01. Consequently, researcher fails to reject alternative hypotheses.

Based on result poor traffic management has positive significant effect on traffic congestion with p value 0.000, significant at 0.01 sig. value. As a result, fails to rejects alternative hypothesis. Consequently, poor traffic management has positive significant effect on traffic congestion severity. Similarly, poor traffic management is positive significant effect on economic cost of congestion at significant p value 0.001. As a result, fails to rejects alternative hypothesis.

In the same way, vehicles number increase has significant effect on traffic congestion severity at p value 0.001. Therefore, fails to rejects alternative hypothesis that is vehicles numbers increase positive significance effect on traffic congestion. Another result indicates vehicles number increase is positive significant effect on economic cost of congestion at p value 0.001. Therefore,

fails to rejects alternative hypothesis. That vehicle number increase is positive significant effect on economic cost of congestion.

Finally, traffic congestion severity has significant positive effect on economic cost of congestion with 0.000 p value. As a result, indicate, fails to rejects alternative hypothesis. That means traffic congestion severity has positive significant effect on economic cost of congestion.

4.4.1. Analysis Direct Effect and Indirect Effect

The study follows Baron & Kenny (1986) suggestions to examine the mediating effects in three steps: (1) the independent variable must be shown to affect the dependent variable in the first equation, (2) second, the independent variable must affect the mediator in the second equation; and (3) the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in third equation than in the second. Perfect mediation holds if the Independent variable has no effect when the mediator is controlled. To test the mediation hypothesis, HLM hierarchal linear modeling bootstrapping steps guided by Rucker et al. (2011).

i. Result of standardized Beta value without mediating variable (Direct effect)

Above figure 4.5 indicate direct effect from independent variable to dependent variable are, the Beta value of road condition is.390 which means that as road condition problem increase by 1 percent economic cost of congestion will increase by .390 times keeping the other factors constant. Population increase Beta value .570, which means that population increase by 1 percent economic cost of congestion, will decrease by .570. Based on the Beta value parking problem is .950 which means that as parking problem increase by 1 percent economic cost of congestion will increase by .950 times keeping the other factors constant. Besides on the Beta value traffic management is .520 which means that as traffic management increase by 1 percent, economic cost of congestion will increase by .520 times keeping the other factors constant. Finally, the Beta value vehicle number increase is .040 which means that as vehicles number increase by 1 percent, economic cost of congestion will increase by .040 times keeping the other factors constant.

Table 4.14:Hypotheses summery of direct effect

Hypothesis	Path coefficients (β value)	T	P-value	Hypothesis
RC→ TCS	.670	6.778	0.000	Failed to Reject Ha1
RC→ECC	.390	1.657	0.000	Failed to Reject Ha2
PP→ TCS	.430	1.657	0.000	Failed to Reject Ha3
PP→ ECC	.950	4.465	0.009	Failed to Reject Ha4
PG→ TCS	.120	2.727	0.008	Failed to Reject Ha5
PG→ ECC	-.570	3.53	0.007	Failed to Reject Ha6
PTM→ TCS	.630	3.61	0.000	Failed to Reject Ha7
PTM→ ECC	.520	2.61	0.000	Failed to Reject Ha8
VNI→ TCS	.210	2.29	0.000	Failed to Reject Ha9
VIN →ECC	.040	3.24	0.000	Failed to Reject Ha10
TCS →ECC	.450	1.82	0.000	Failed to Reject Ha11

The direct effects of RC, PP, PG, PTM and VNI on TCS were (β=.670, $\rho < 0.01$), (β=.430, $\rho < 0.01$), (β= .120, ρ>, 0.01), (β= .630, $\rho < 0.01$), and (β=.210, $\rho < 0.05$) respectively. As the result Hypothesis 1, 3, 5, 7 and 9 direct effect on traffic congestion severity. The results show that acts as the independent variable that further leads to traffic congestion severity.

Similarly, the direct effects of RC, PP, PG, PTM and VNI on ECC were (β=.390, $\rho < 0.01$),), (β= .095, $\rho < 0.05$), (β= .570, $\rho > 0.01$), (β= .520, $\rho < 0.01$), (β=.040, $\rho < 0.01$and (β=.450, $\rho < 0.05$) respectively. In this regard, the variables act respectively as direct effect on economic cost of congestion (ECC). As the result Hypothesis 2, 4, 6, 8, 10 and 11 posited that direct effect on ECC. As the traffic congestion severity mediates the relationship of the RC, PP, PG, PTM and VNI with ECC were also supported as an indirect effect. The results depict that all independent variable and mediating variable acts as the variable that further leads to economic cost of congestion.

ii. Result of standardized Beta value with mediating variable (Indirect effect)

Based on the above figure 4.5 results, the Beta value of road condition is.302 which means that as road condition problem increase by 1 percent, economic cost of congestion will increase by 0.302 times keeping the other factors constant. Beta value of population number 0.054, which means, When to population number increase by one percent, similarly economic cost of congestion increase by 0.054 times keeping other factors constant. Based on the Beta value parking condition is 0.194 which means that as parking problem increase by 1 percent, economic cost of congestion will increase by 0.194 times keeping the other factors constant. In the same way, the Beta value of poor traffic management is .284 which means that as poor traffic management increase by 1 percent, economic cost of congestion will increase by 0.284 times keeping the other factors constant. Finally, the Beta value vehicle number increase is .095 which means that as vehicles number increase by 1 percent, economic cost of congestion will increase by 0.095 times keeping the other factors constant. When to look the Beta value of mediating variables (traffic congestion severity) is 0.450. Which means that as traffic congestion problem increase by 1 percent, economic cost of congestion will increase by 0.450 times keeping the other factors constant.

Table 4.15: Hypotheses summery of indirect effect

Hypothesis	**Direct Effect β**	**Indirect Effect β**	**Result**	**Hypothesis**
RC→TCS→ECC	.390(*)	.302(*)	Partial Mediation	Failed to Reject Ha12
PP→TCS→ECC	.950(*)	.194(*)	Partial Mediation	Failed to Reject Ha13
PG→TCS→ECC	-.570(ns)	.054(**)	Perfect Mediation	Failed to Reject Ha14
PTM→TCS→ECC	.520(*)	.284(*)	Partial Mediation	Failed to Reject Ha15
VNI→TCS→ECC	.040(**)	.095(**)	Partial Mediation	Failed to Reject Ha16

*Significant at=p<0.01**significant at=p<0.050 ns= Not significant

The indirect effects of RC, PP, PG, PTM and VNI on ECC were (β=.302, $\rho < 0.01$), (β=.194, $\rho < 0.01$), (β= .054, $\rho < 0.05$), (β= .284, $\rho < 0.01$), and (β=.095, $\rho < 0.05$) respectively. In this regard, the variables act respectively as mediators in the positive effect on ECC. As the result Hypothesis 12, 13, 14, 15 and 16 posited that as the traffic congestion severity mediates the relationship of the RC, PP, PG, PTM and VNI with ECC were similarly supported as a direct

effect. The results represent that traffic congestion severity acts as the variable that further leads to economic cost of congestion.

4.5. Analyzes economic effect of traffic congestion by field measurement

Congestion is the saturation of road network capacity due to regular and irregular reductions in service quality represented by increased travel times, variation in travel times and interrupted travel (Banjo, 1984). Traffic congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trips, and increased vehicular queuing. Congestion analysis was made based on the travel time approach for the determination of congestion measures. While performing the analysis four approaches with traffic volume that found at Jemo Michael intersection urban street road network was selected for each segment are: Jemo approach, Germen approach, Ayer tena approach, Lideta approach.

In this paper economic cost effect of traffic congestion analysis was done based on the extra travel time consumption and extra fuel consumption, for this analysis the following congestion measures were analyzed. These data are; traffic volume, travel time, vehicle occupancy, average travel speed, travel rate, delay, delay rate, off peak time travel speed, off peak time travel rate, total segment delay, fuel consumption at free flow and congestion period are analysis. Accordingly, the analysis each congestion measures are presented in the following sections, in addition the output result attach in the last page (appendix).

4.5.1. Traffic volume data

Traffic volume data are highly important for traffic congestion analysis. These data can help identify critical flow time periods and pedestrians on vehicular traffic flow. Traffic volume data is the fundamental input value for this paper. Furthermore, it is extremely required to analyze the level of service of a facility and quantify the congestion amount. It gathered the data were recorded using video camera within15 minutes' time interval starting morning to night (7:00 AM–7:00 PM). The duration of traffic data was taken two days' peak time and one day off peak period, (Tuesday, Thursday and Sunday) were recorded. The daily traffic volume was converted vehicles occupancy (capacity). The Passengers cars category includes vehicle types namely; bicycles, Motor bicycles, automobile, 4WD, Small bus, Minibus, Sheger, Higher, public bus, mid bus, Anbessa bus and goods vehicles count in one categories.

Table 4.16: Traffic Volume at Jemo Michael Intersection

Date of count	Ayer Tena Approach				Lideta Approach				Jemo Approach				German Approach				Sum
17/06/2012	R	TH	L	Total	R	TH	L	Total	R	TH	L	Total	R	TH	L	Total	
7:00-7:15PM	33	105	34	172	40	109	67	216	87	93	51	231	46	73	89	208	827
7:15-7:30PM	38	121	52	211	46	150	71	267	89	129	58	276	47	80	92	219	973
7:30-7:45AM	49	196	99	344	50	156	72	278	96	182	60	338	79	111	155	345	1305
7:45-8:00AM	52	202	105	359	51	166	81	298	131	240	62	433	85	121	163	369	1459
8:00-8:15AM	39	212	114	365	64	155	89	308	140	281	56	477	93	117	178	388	1538
8:15-8:30AM	42	181	110	333	63	140	96	299	145	282	54	481	97	122	175	394	1507
8:30-8:45AM	40	207	82	330	53	133	122	308	142	275	54	471	104	107	161	372	1481
8:45-9:00AM	43	203	80	326	55	107	95	257	131	252	44	427	104	109	160	373	1383
9:00-9:15AM	37	164	77	278	50	101	98	249	107	217	39	363	101	104	153	358	1248
9:15-9:30AM	42	150	71	263	49	99	85	233	98	202	45	345	94	92	142	328	1169
9:30-9:45AM	34	139	56	229	42	94	81	217	91	194	54	339	94	89	116	299	1084
9:45-10:00AM	32	137	49	218	38	91	81	210	80	181	57	318	92	87	93	272	1018
10:00-10:15AM	33	114	48	195	38	90	77	205	77	176	42	295	80	84	88	252	947
10:15-10:30AM	48	103	39	190	35	82	70	187	69	183	52	304	78	93	83	254	935
10:30-10:45AM	34	109	37	180	30	61	69	160	57	176	57	290	74	79	72	225	855
10:45-11:00AM	30	95	38	163	31	69	60	160	66	171	60	297	60	75	70	205	825
11:00-11:15AM	31	105	44	180	31	76	92	199	81	161	51	293	51	81	91	223	895
11:15-11:30AM	21	112	48	181	32	93	90	215	91	169	45	305	57	86	89	232	933
11:30-11:45AM	33	59	38	130	45	90	87	222	91	171	53	315	55	90	97	242	909
11:45-12:00AM	41	83	46	170	52	105	104	261	104	162	48	314	45	90	106	241	986
12:00-12:15AM	43	97	32	172	41	110	106	257	108	146	46	300	69	104	110	283	1012
12:15-12:30AM	37	92	37	166	66	115	111	292	93	133	48	274	77	108	108	293	1025
12:30-12:45AM	44	59	31	134	49	110	80	239	59	120	41	220	75	98	97	270	863
12:45-1:00AM	43	63	34	140	49	108	77	234	56	94	40	190	75	95	93	263	827
1:00-1:15PM	56	68	42	166	42	105	71	218	53	92	52	197	70	81	88	239	820
1:15-1:30PM	53	49	41	143	36	111	63	210	68	90	39	197	63	76	88	227	777
1:30-1:45PM	44	49	32	125	26	128	63	217	58	90	39	187	53	67	78	198	727
1:45-2:00PM	43	47	34	124	36	105	59	200	56	79	38	173	45	65	67	177	674
2:00-2:15PM	47	50	54	151	39	117	59	215	44	92	43	179	37	60	74	171	716

2:15 - 2:30PM	51	54	59	164	41	105	46	192	46	84	38	168	51	44	69	164	688
2:30-2:45PM	45	68	57	170	39	102	47	188	45	87	44	176	45	58	77	180	717
2:45-3:00PM	46	77	52	175	44	90	42	176	48	84	39	171	30	87	82	199	721
3:00-3:15PM	50	80	50	180	44	93	45	182	50	77	32	159	40	100	110	250	771
3:15-3:30PM	65	97	67	229	58	112	40	210	56	75	32	163	35	117	137	289	891
3:30-3:45PM	60	95	75	230	63	177	41	281	60	67	29	156	30	125	155	310	977
3:45-4:00PM	75	122	82	279	73	195	43	311	71	93	43	207	55	142	192	389	1186
4:00-4:15PM	78	126	80	284	74	201	41	316	61	125	55	241	53	166	210	429	1270
4:15-4:30PM	87	120	98	305	82	203	56	341	70	96	49	215	47	220	238	505	1366
4:30-4:45PM	73	155	86	314	98	210	66	374	80	114	90	284	53	225	235	513	1485
4:45-5:00PM	85	146	96	327	94	239	68	401	84	124	83	291	68	221	225	514	1533
5:00-5:15PM	98	135	88	321	97	236	57	390	89	119	68	276	76	204	223	503	1490
5:15-5:30PM	97	139	84	320	110	229	77	416	98	113	71	282	89	144	228	461	1479
5:30-5:45PM	99	124	88	311	101	222	78	401	106	110	71	287	95	146	194	435	1434
5:45-6:00PM	104	129	72	305	92	230	79	401	115	122	81	318	99	129	177	405	1429
6:00 - 6:15PM	98	112	71	281	84	221	85	390	119	106	87	312	96	119	164	379	1362
6:15-6:30PM	92	111	66	269	83	214	95	392	105	108	86	299	86	109	135	330	1290
6:30-6:45PM	98	89	63	250	68	193	86	347	90	139	78	307	74	86	101	261	1165
6:45-7:00PM	99	77	55	231	58	180	72	310	83	116	74	273	58	90	99	247	1061
TOTAL	**11083**				**12850**				**13414**				**14683**				**52030**

Note: LT: left turn, TH: Through, and RT: Right turn

At Jemo Michael intersection the road users' demand is not balanced with current road capacity. As indicate above tables 4.16 from four approaches namely Jemo, German, Ayer- tena and Lideta segment, the total traffic volume of Jemo approach has the highest traffic volume during peak times, and the second higher approach is the German approach. The rest of the approaches have a related.

Figure 4.6: Traffic Volume Data per Hrs.

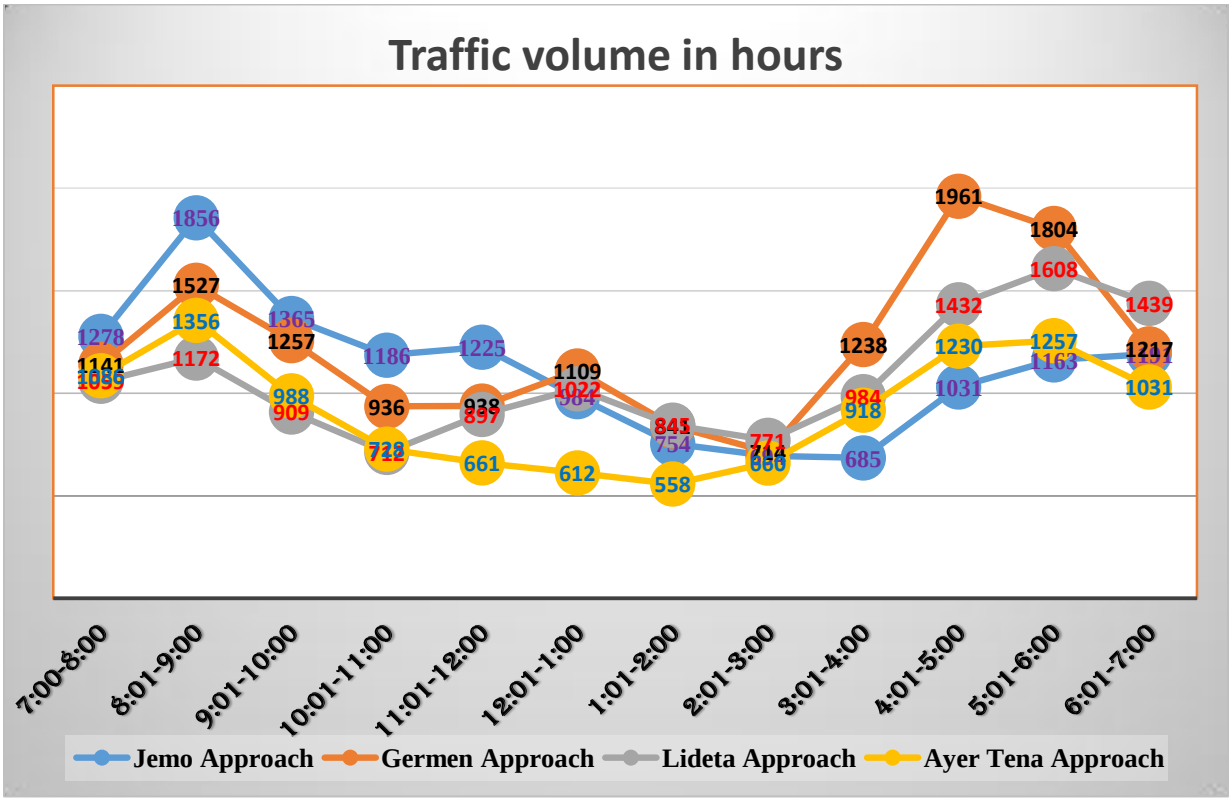
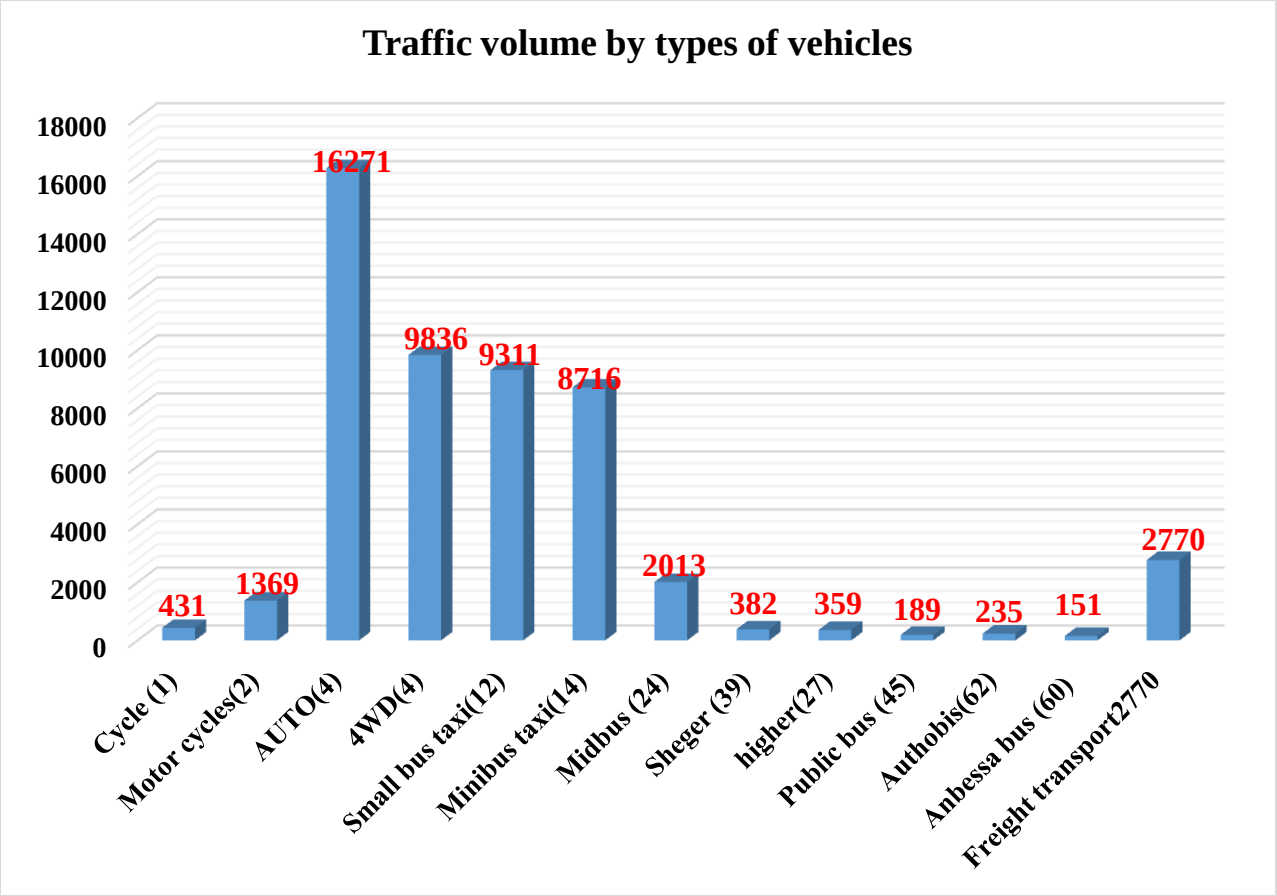


Figure 4.7: Total Vehicles Number by vehicles categories of Jemo Michael intersection

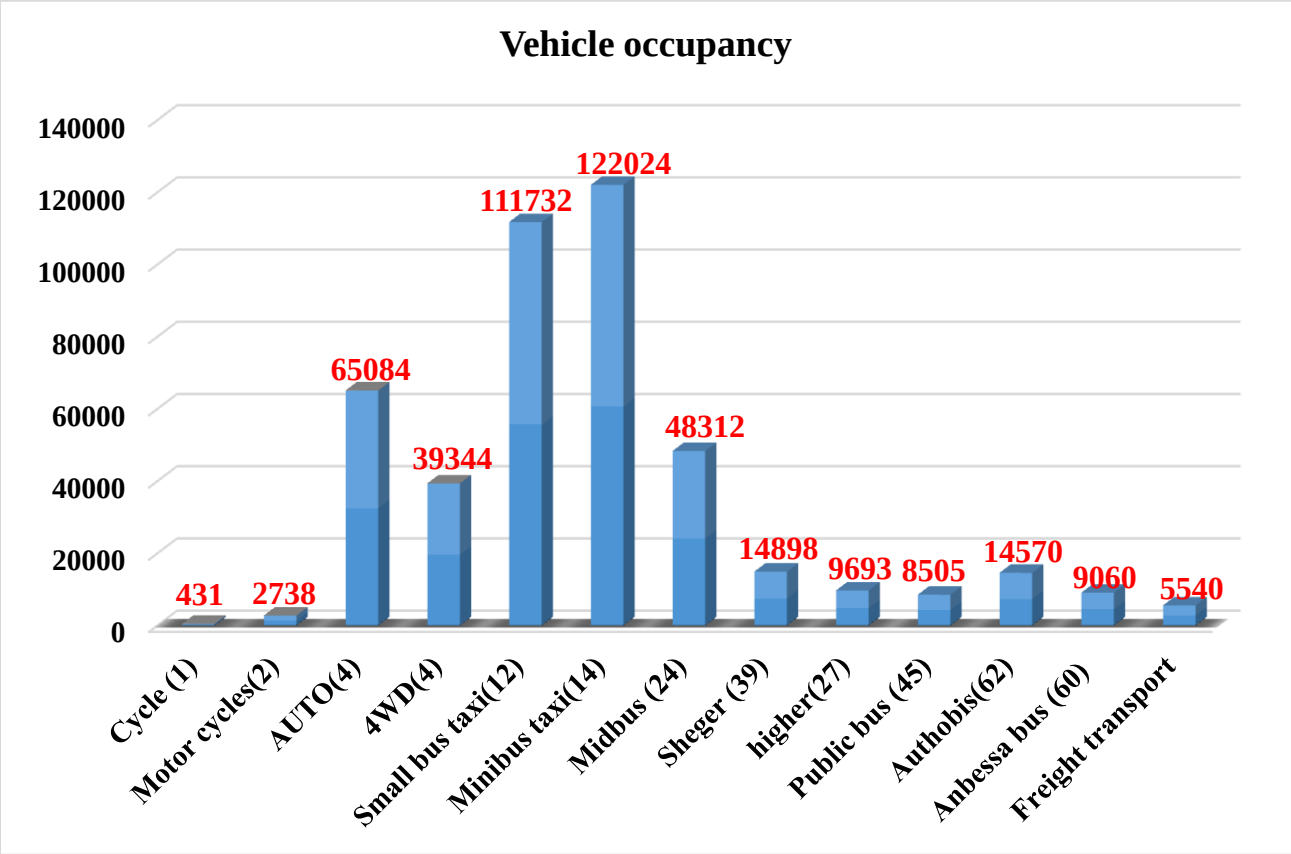


Based on above data total traffic volume of Jemo Michael four approach intersection are 52030/day. Among the different kind of vehicles volume data, Automobiles have the highest number of data in all four approaches because in this categories Lada taxi, automobile, corolla are included and in Addis Ababa more passengers have used individual automobiles. 4WD categories any closed and open Toyota, V8, Land closure and peak up are included…), Small bus taxi and Mini bus taxi are also the next higher composition value in this intersection. Mid bus and good vehicle is also the third composition value in this intersection. The rest vehicles like: cycles, motor cycles, sheger bus, higher bus, Autobus and Anbessa bus are the list numbers when to compare with others vehicles. The maximum numbers of Automobile, 4WD, Small bus and mid bus taxi flow are found from Germen and Jemo approach. Vehicles of goods found highly from Ayer tena and Lideta route, the reason is this route connect the main trade activities area like Mercato,megenagna and Ayer-tena also connect south east cash crop area of country.

4.5.2. Vehicles Occupancy (Person/Vehicles)

Vehicle occupancy which is the number of peoples per vehicles is important parameter in traffic management and transportation planning. Usually it is used to convert person trip to vehicle trip. Therefore, vehicle occupancy is very important parameter for calculating congestion amount. To calculate the vehicle occupancy is capacity of vehicle type multiply by total number of vehicles it's having capacity divided by total volume moving the segment. Researchers use in this paper all vehicles are assumed to be at its capacity throughout the day and multiplying by the vehicles occupancy of each vehicle by their number. The vehicle occupancy data shown is attached in the appendix.

Figure 4.8: Vehicles occupancy (person per vehicle)



Jemo Michael intersection four approach traffic flow per day are based on data collected for 12hrs (7:00 AM- 7:00PM) in average one day per 12 hours 52,030 vehicles and 451,931 passengers cross this intersection. As a result, the value of person per vehicle average 8.6passengers.

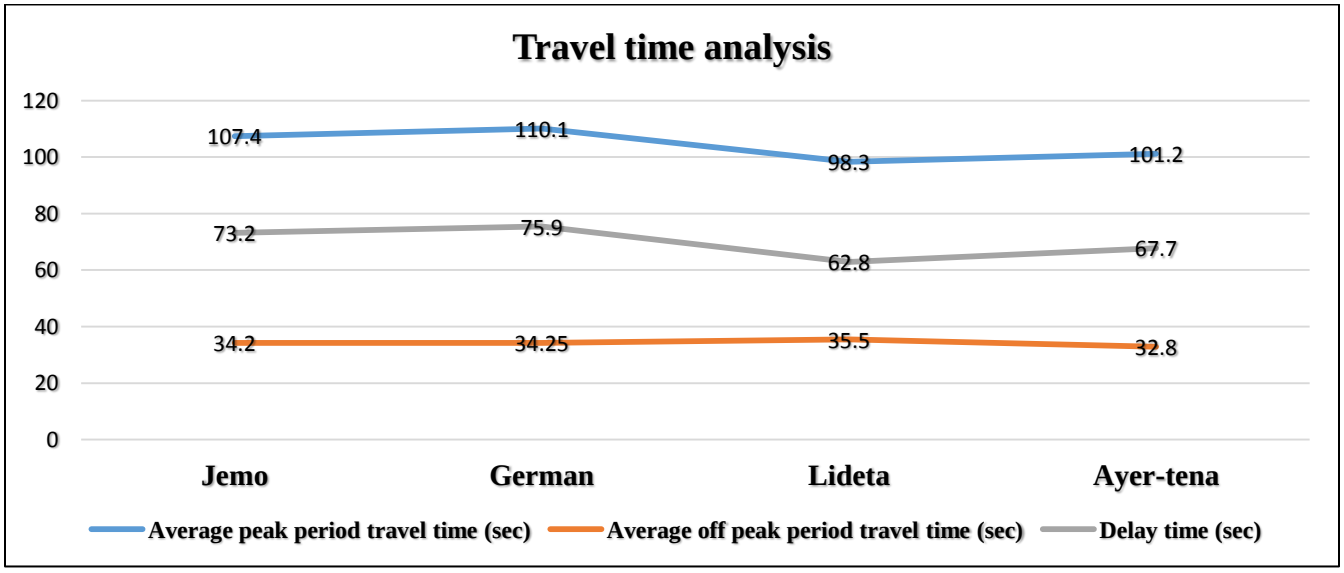
4.5.3. Travel Time Data

Travel time is the time required to traverse a route between any points and the major categories of transport costs. Travel time measures offer the best means for estimating the economic impacts of congestion. In order to collect the average travel time data at the selected sites, the procedures described on travel time data collection handbook (1998) were followed. Data of actual travel time required for vehicles to pass the section of the roads was collected for starting morning hours to night hours (7:00 AM – 7:00 PM) was measured using record time. The travel time data were recorded three days (Tuesday Thursday and Sunday) within 15 minutes' interval take 48 samples were recorded. Travel time data collect through manual system and video record. After data collect of travel time, it was taken the average travel time. According to the result, the morning and evening peak periods recorded the higher travel time and the lowest travel time recorded during the mid- day time. At peak period there is increase the numbers of vehicle volume were as at the mid-day they are decrease. The below table 4.17 shows the average travel time at 15-min interval 48 samples for the sections designated.

Table 17: Analysis Travel time of Jemo Michael Intersection in 15 minute

Approach200m	Average peak period travel time (sec)	Average off peak period travel time (sec)	Delay time (Sec)	Average travel speed at peak time Km/h	Travel rate min/km At peak time	Delay rate min/km	Average travel speed at off peak time Km/h	Travel rate min/km At-of peak time
Jemo	107.4	34.2	73.2	6.8	8.9	6.1	21.4	2.8
Lideta	98.3	35.5	62.8	7.6	7.9	5.2	20.6	2.9
German	110.1	34.2	75.9	6.9	9.1	6.3	21.41	2.8
A/tena	101.2	32.8	67.7	7.4	8.4	5.7	22.2	2.7
Jemo-intersection	104.2	34.2	70	7.1	8.6	5.8	21.42	2.8

Figure 4.9: Analysis of travel time flow

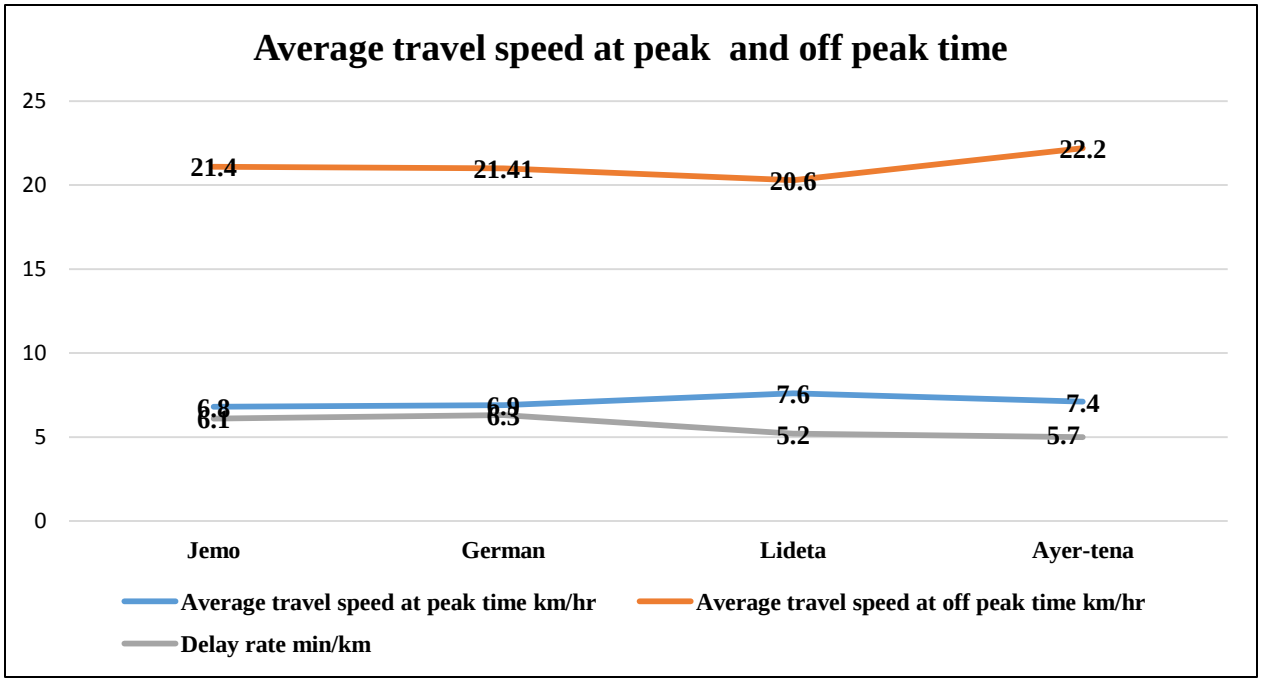


4.5.4. Travel Speed Data

Downs (2004) congestion can have defined as the situation when traffic is moving at speeds below the designed capacity of a roadway. Travel speed represents the ratio of segment length to through-movement travel time. Travel time is computed as the sum of segment running time and through movement control delay at the downstream boundary intersection. The average travel speed can be considered using the travel time and length of road section.

The results figure 4.10 below, indicate that during peak periods average travel speeds of Jemo approach 6.8km/hrs, Germen approach 6.9Km/hrs., Lideta approach 7.6km/hrs, and Ayer tena approach 7.4km/hrs. Average travel speeds during off peak period or free flow time of Jemo Michael intersection results show that average travel speeds of Jemo approach 21.4km/hrs., Germen approach 21.41Km/hrs., Lideta approach 20.6km/hrs., and Ayer tena approach 22.2km/hrs. At morning peak time from four above mentioned approach Jemo approach is high crowed.

Figure 4.10: Average travel speed



4.5.5. Delay Performance Measure

Delay is express as value of extra time consume on road due to congestion when compare to free flow conditions. Delay, speed, travel time and Level of service are the most dominant the measurement of congestion. Total delay in an urban corridor is calculated as the sum of individual segment delays. This quantity is used as an estimate of the impact of improvements on transportation systems.

4.5.5.1. Travel Time Delay

According to Kockelman (2004) Congestion is the presence of delays along a physical pathway due to presence of other users. Delay is the amount of extra time spent in congestion compared to the time it would take under free-flow conditions. It is the amount of extra time spent traveling due to congestion on the road and its calculation is based on the baseline speed which is recorded on lowest travel time throughout the day. Delay is one of the important parameter in congestion measure analysis. For the analysis of delay rate, delay ratio and delay the posted approaching speed at the intersection is used as a reference. Traffic delays consist of those under uncongested

traffic condition and those under congested traffic condition. When the traffic volume exceeds road capacity traffic congestion occurs, then results in vehicle queues and traffic delays.

According to data record on Jemo Michael intersection four approach 200m from 7:00AM-7:00PM for 12 solid hours 15 intervals and 48 samples gate indicate average travel time delay at morning, Mid-day and Night time as follow.

According to above 4.17 tables shown, Delay of Jemo approach 73.2sec/200m sample taken, that means 6.1min/km extra travel time lose, Germen approach 75.5sec per 200m, this indicate 6.3min/km, Lideta approach 62.8sec/200m and 5.2min/km extra travel time lose and Ayer tena approach 67.7sec/200m, this indicate 5.7 minute/km extra time consume. Generally, at this intersection in average 1.1minute lose per 200metre and 5.6minute extra time consume per one kilometer. Generally according to data record from 7:00AM-7:00PM (12hours) data indicate in average each vehicle 1.1 min/200m spend extra travel time on each legs of Jemo Michael intersection. According to above traffic volume data result indicate in 12hours 52030 different types of vehicles across this intersection at four approaches. Above vehicles occupancy report indicate passengers cross this intersection 451,931. After this three basic data gate average travel time delay of Jemo Michel intersection of four legs 497,124minute per day and 8285.4hours' extra travel time consume due to traffic congestion. As it indicates the travel time cost loss increasingly due to congestion. Hence based on delay analysis result congestion is high impact of economic cost peoples.

Total delay (PCU-hrs.) = [Actual travel time (hrs.) – Acceptable travel time (hrs.)] X Traffic Volume

4.5.5.2. Actual Travel Rate

Travel rate, expressed in minutes per km, is how quickly a vehicle travels over a certain segment of roadway. Travel rate is the inverse of travel speed and it is highly need practical significance to understand the level of congestion on the selected intersection since it expresses travel time for a unit segment length. The peak time travel rate for this urban segment is increasing during peak hours morning and night time but in mid-day its decrease. As shows above table the average travel speed is decrease the actual travel rate is increase during peak time.

This result indicates that, the morning and at night (work to home and home to work) time the average travel rate is increase and at mid-time is decrease. It indicates the travel speed is highly

decrease especially during peak hour time. At morning peak time Jemo and Germen approach travel rate is consuming high minute per kilometer, inversely the travel speed is highly decrease.

At peak time travel rate Jemo approach 8.9min/km, Lideta approach 7.9min/km, Germen approach 9.1min/km, ayer-tena approach 8.4min/km use at peak time. All approach uses high minute for cover one kilometer. When to look mid-day travel rate all approach are medium as compare morning & night peak time and the speed of travel in the same way, same how increase. Generally, the actual travel rate is increase the speed of vehicles is decrease. Free flow time travel rate Jemo approach 2.8min/km, Lideta approach 2.9min/km; Germen approach 2.8min/km and Ayer tena approach 2.7min/km.

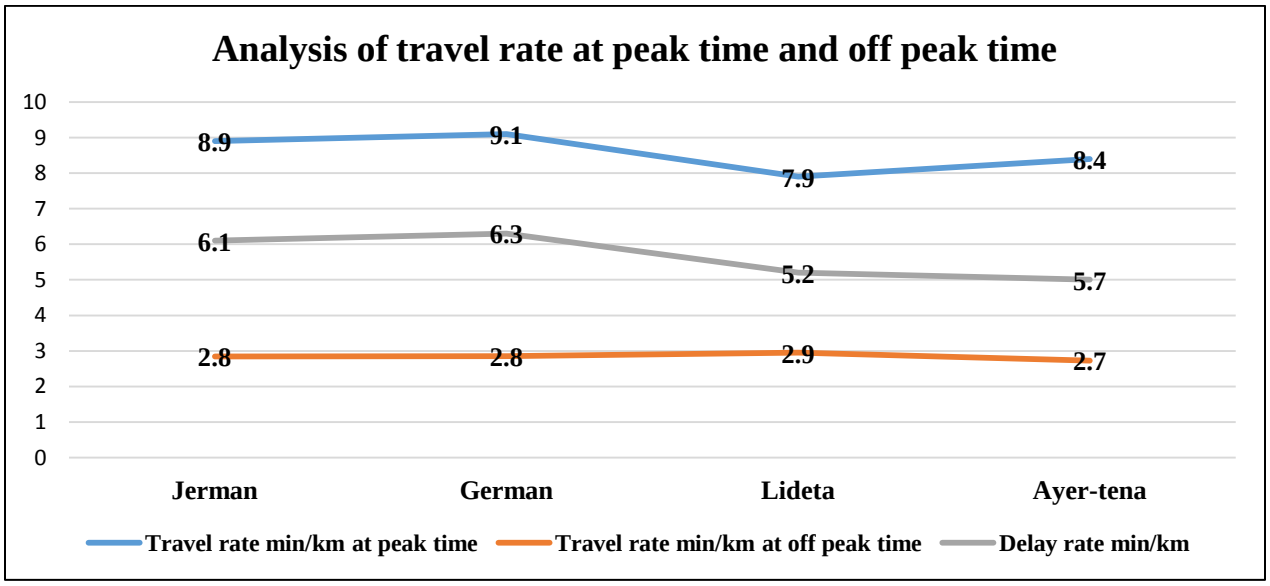
4.5.5.3. Delay Rate

Delay rate is the amount of delay in minutes per kilometer of road segment. It expresses delay in terms of a unit length than that of delay so it is much better to express congestion and to compare congestion level at road segments than delay. As shown below the figure the result of analysis of average delay rate morning and night (work to home and Home to work) is greater than the mid-day. The delay rate to relative speed of vehicles low during the peak period but delay rate increase as result of figure 4.10. Delay rate of Jemo approach 6.1min/km, Germen approach 6.3min/km, Lideta approach 5.2min/km and Ayer tena approach 5.7minute/km extra time consume. Generally, at this intersection in average 5 - 6-minute extra time consume per one kilometer.

4.5.5.4. Delay per Traveler

Delay per traveler is one of the measures of traffic congestion delay indicators. It can be analysis using the average travel time and free-flow travel time through the years. Since the average delay per traveler of Jemo Michael intersection road segment is 1.1minute at 200m road length345.2-day extravagance (1036 person fully idle). As a result, indicate peak hour delay per traveler is greater than mid-day and it indicates high congestion during morning and night.

Figure 4.11: Analysis of travel rate



4.5.5.5. Total Segment Delays

Total intersection delay is used to analyze the amount of congestion impact on people in the selected intersection because it shows how much total segment vehicles/person time is consumed due to congestion on that road segment. Total segment delay is measured in Person-hour is the measure of congestion power. It shows the congestion is serious and indicates the extent of the congestion that how much peoples being affected with the congestion. Total Jemo Michael intersection delay is also a useful measure to estimate the total duration of congestion of a road segment in urban areas, to perform economic analysis and it is easy for the public and policy makers to understand and to implement cost-effective decisions. Total delay shows the effect of congestion in terms of the amount of lost travel time and the sum of time lost on a segment of roadway due to congestion for all vehicles is represented by total delay as follows: Total delay (PCU-hrs.) = [Actual travel time (hrs.) – Acceptable travel time (hrs.)] x Traffic Volume. The total volume of vehicle increase and speed of vehicle decrease total segment delay is increase.

Based on above table 4.16 traffic volume data result indicate in 12hours 52030 different type of vehicles across this intersection at four approach. Above vehicles occupancy report indicate

passengers cross this intersection 451,931 and according to above data of travel time delay indicate in averages 1.1minute extra minute consume per each passenger. Then all passengers multiply by delay(1.1minute), Total segment delay data of travel time at Jemo Michel intersection of four legs 497,124minute per day (8285.4hours) extra travel time consume due to traffic congestion.

4.5.6. Total Costs of Traffic Congestion

Traffic congestion refers to the incremental costs resulting from interference among road users (VTPI, 2005). In this paper it can be seen from different cost of traffic congestion; travel time cost and fuel consumption cost. The researcher assumes different values, the fuel consumption data under congested condition, it has try to collect sample in peak time and off peak time using minibus taxi but, it's not gate full information, therefore due to gate data has perfect for this research researcher gate fuel consumption standard of vehicles per kilometer under free of congestion and crowed period. Additionally, made some assumption were regarding the value of fuel consumption under congested state that it will increased by 50% of the value at steady state condition. As we can see in the previous topic under travel time speed, the travel time value at congested condition is higher than the uncongested one, which is almost double at off-peak time and above. Errampalli, et al (2014) as the travel time increases, the travel speed fuel consumption of the vehicles is highly dependent on the vehicles operating speed and also the road geometry characteristics namely roughness, rise, smooth and fall etc. If travel speed increase, fuel consumption inversely decreases, this means if travel time increase also fuel consumption of vehicles increases.

4.5.6.1. Economic cost of extra fuel consumption at congestion

Annually wasted fuel at different congested and free flow conditions is calculated by fuel consumed under congested minus fuel consumed in free flow and multiplying using annual conversation factor. Therefore, the fuel which is wasted due to congestion is the difference of fuel wasted at the different congested conditions and its free flow speed.

Annual Fuel Wasted due to congestion	**=**	**Annual Fuel consumed Free Flow Speed**	**- Annual Fuel consumed in**

So, after calculating annual fuel wasted due to congestion, the next step is converting wasted fuel into monetary value.

T

Annual Fuel Cost (ETB)	=	**Annual Fuel Wasted due to congestion(Lit)**	X	**Fuel Cost (Birr/Lit)**

- ✓ Average fuel cost of 1Lit 20ETB
- ✓ The peak time fuel consumption is higher than the off-peak time, by 50%incremental value because of higher in travel time and lower in average travel speed.
- ✓ The Annual working day is 250 days;
- ✓ The vehicles occupancy is the current Average number of peoples who can be seen in different modes of transportation of Addis Ababa city
- ✓ The approaching distance for intersections is taken as 200m

Table 4.19: Off peak time (normal) fuel consumption

	Off peak time fuel consumption	**Vehicles categories**			
		Large bus(Anbessa, Autobus	Mid-bus (Higher bus, mid	Mini-bus (4WD, Automobi	Two wheel
1	Average fuel consumption (Lit/100km)	69.10	50.55	12.20	5
2	Average fuel consumption (Lit/1km)	0.691	0.5055	0.122	0.05
3	Average fuel consumption (Lit/200m)	0.1382	0.1	0.0244	0.01
4	Average fuel price (ETB/Lit)	20	20	20	20
5	Number of vehicles cross Jemo intersection for 12hrs	957	5142	44,134	1,369
6	Numbers working day/year	250	250	250	250
7	Length of vehicles fleet at approach (km travel)	0.2 (200m)	0.2 (200m)	0.2 (200m)	0.2 (200m)
8	General Liter fuel used per day at 200m	132.25	514.2	1,076.86	13.69
9	General Liter fuel used per year	33,064.35	128,550	269,217.4	3,422.5
10	Total daily fuel consumption cost per 200m	2645	10,284	21,537.2	273.8
11	Total annually fuel consumption cost per 200m	661,287	2,571,000	5,384,348	68,450

Source: Netsanet A, (2017)

Notes: Freight vehicles categorized under medium vehicles, Because of in Addis Ababa city heavy transport does not permission of flow from morning 1:00AM – Night 1:00 PM. Therefore, only light (medium) freight transport categories include in this table.

Table 4.20: Peak time (crowed period) fuel consumption

	Peak period fuel consumption	**Vehicles categories**			
		Large-bus (Anbessa, Autobus, Sheger bus & public bus	Mid-bus (Higher bus, mid bus, Good vehicles)	Mini-bus (4WD, Automobile, Small-bus, mini-bus)	Two wheel motor cycles
1	Average fuel consumption (Lit/100km)	103.65	75.53	18.30	8.25
2	Average fuel consumption (Lit/1km)	1.0365	0.75	0.18	0.0825
3	Average fuel consumption (Lit/200m)	0.2073	0.15	0.0366	0.0165
4	Average fuel price (ETB/Lit)	20	20	20	20
5	Number of vehicles cross Jemo intersection for 12hrs	957	5142	44,134	1,369
6	Numbers of working day/Year	250	250	250	250
7	Length of vehicles fleet (km travel)	0.2(200m)	0.2(200m)	0.2(200m)	0.2(200m)
8	All vehicles fuel used per day at 200m in Liter	198.38	771.3	1615.3	22.58
9	General Liter fuel used per year	49,596.5	192,825	403,826.1	5647.1
10	Total daily fuel consumption cost per 200m	3967.6	15,426	32,306	451.6
11	Total annually fuel consumption cost per 200m	991,930	3,856,480	8,076,522	112,942

Source: Netsanet, A, (2017)

Table 4.21: Total Extra fuel cost consumption

1	**All vehicles extra fuel used per day at 200m in Liter**	**66.13**	**257.1**	**538.44**	**8.89**
2	General Liter offuel Extra used per year	16,532.5	64,275	134,608.7	2,224.91
1	Total daily Extra fuel consumption cost per 200m	1322.6	5142	10,768.8	177.8
2	Total annually Extra fuel consumption cost per 200m	330,650	1,285,500	2,692,174	44,498.2

A. The Difference between off peak period (normal time) and peak time at 200m length

I, off peak period

-Daily fuel used 1737Lit/200m/day/52030

-Annual fuel used 434,254.25Lit/200m/year/52030

-Daily cost of used fuel 34,740ETB/200m/day/52030

-Annual cost of consumed fuel 8,685,085ETB/200m/year/52030

II. Peak period

-Daily fuel used 2607.56Lit/200m/day

-Annual fuel used 651,894.7Lit/200m/year

-Daily cost of used fuel 52,151.2ETB/200m/day

-Annual cost of consumed fuel 13,037,894ETB/200m/year

III. Extra fuel consumption cost due to traffic congestion at Jemo Michael intersection

- Daily fuel used 870.56Lit/200m/day

-Annual fuel used 217,640.7Lit/200m/year

-Daily cost of used fuel 17,411.2ETB/200m/day

-Annual cost of consumed fuel 4,352,814ETB/200m/year

Annual Fuel Wasted = Due to Congestion	Annual Fuel Consumed - in congestion	Annual Fuel Consumed in Free Flow Speed

✓ Annual Fuel Wasted = 651,894.7Lit - 434,254.25Lit

- ✓ Annual Fuel Wasted= **<u>217,640.7Lit/200m/year</u>**

Annual Fuel Cost (Birr)	=	Annual Fuel Wasted due to congestion (Lit)	X Fuel Cost (Birr/Lit)

- ✓ Annual Fuel Cost(birr)= 217,640.7Lit x 20(birr/lit)
- ✓ Annual Fuel Cost(birr)=4,352,814ETBextra fuel cost consume due to congestion

4.5.6.2. Economic cost of travel time at congestion

Congestion is affects the economic situation where in urban area. In this section, researcher analyses the cost of congestion having considered extra travel time consumption. Traffic congestion has an enormous cost effect on the production and the general work life of many people. The congestion cost value is difficult to simply determine the fact value. In Addis Ababa Nifas silk Lafto sub city Jemo Michael intersection road high congested especially during peak hours due to peoples travel to work area and back to home. The method of calculating congestion costs is based on comparing the speed at free flow (off peak time) conditions with the speed in congestion flow situations. Since, time at free-flow speed minus time at congested speed multiplied by hourly volume and multiplies by value of time.

4.5.6.2.1. Value of time

There are many types of costs which are result due to congestion. In this paper, researcher analyzing the value of time lost to road users as a result of serious congestion. Value of time is the amount that a typical traveler would be willing to pay to save on travel time. Value of time measures a direct economic benefit, putting a value on the benefits to a business of reduced travel times, in terms of greater productivity less time travelling means more time available for productivity activity, improved access to suppliers, customers and a wider potential market. European academic research (2015) the average value of time in Ethiopia for business trip is taken as the hourly income of ETB 19 per hourly.

Researcher use to investigating value of time was gate through asking target population (driver, passenger and traffic police) income and gate average value of time (income per day).For this research the value of time can be consider based on the target populations average income. After that, it changes to hourly volume that means we have to consider 8 work hours of in a day and 22

working days in a month. Average daily earnings per person in Addis Ababa focused the trip from our study area is 100ETB, based on this hourly income12.5ETB.

4.5.6.2.2. Passenger delay cost

Passenger delay cost is the cost of passengers incurred due to traffic congestion and it was calculated using the following formula:

Annual passenger Delay cost	=	Daily Passenger Vehicle Hrs. of Delay	X	Value of person time	X	Vehicle Occupancy	X	Annual Conversation

As table 4.16results indicate the average travel time peak period at 200m four approach length(Jemo Michael intersection) are 104.2 sec, this means the average travel speed at peak time 7 km/hrs and also travel rate is 8.6minute/km. By another side Average travel time at off peak time (at free flow time) are 34.15 second the average travel speed at off peak time 21.3km/hrs. Above data of travel time at peak period (congested) time and un-congested time big difference. If you look average intersection delay average travel time at peak period (congestion period) minus average travel time at free flow (off peak period) the result is average delay of Jemo intersection indicate 70.35 sec (1.1minute/200m) per vehicles/day, this indicate delay rate are 5.5min/km. Let as look the result of passenger delay cost as below;

4.5.6.2.3. Daily Passenger Delay Cost

For daily passenger delay cost calculation first it need average daily delay time, numbers of passengers per day across Jemo Michael intersection, Value of time per day, working day are required. In this paper this all data are available and mentioned in above result one by one. Daily passengers across the intersection obtained from the above result of vehicles occupancy data (451,931passenger/day), average delay time 1.1min/200m, working day 250/year, value of person time is equal to 12.5birr/hr. Vehicle occupancy data is obtained by multiplying the capacity of each vehicles by their number. Annual conversation factor is 250working days in a year. On Sunday, Saturday and holidays, there is slight congestion. There are 52 Saturday, 52 Sundays and 11 holidays per year in Ethiopia. Therefore, annual conversation factor is equals to be 365 minus 115 which are 250day.

Assumption:

- ✓ Working day in the year 250

- ✓ Vehicles occupancy data is multiply by their capacity
- ✓ Value of time according to Ethiopia labor force per hours12.5/ hours.

Daily passenger = Average daily passenger X Person/veh X Value of person time delay cost vehicles hrs. of delay (birr/hrs.)

DPDC =0. 01833hr.or (1.1minute) **x451, 931x** 12.5ETB/hr.

DPDC =8283.9hrs **x**12.5ETB/hrs.

DPDC =103,548.7ETB/day

As above result daily passenger delay cost at Jemo Michael four legs (Germen, Jemo, Lideta and Ayer tena approach) result 103,548.7ETB. This result indicates at this intersection ever passengers high extra travel time consumed due to traffic congestion. If you look via individual of passengers, every passenger individually at 200m distances almost 0.23birr loss per day. Each passenger how long distance travel per day then simple convert to the distance to daily travel and gate how many birr loss every movement is you can. When to look the result of cost per vehicles, 2 ETB losses 200m length road at Jemo intersection. As above average vehicles occupancy result indicate 8.68 numbers of traveler in each vehicle.

4.5.6.2.4. Annual Passenger Delay Cost

Passenger delay cost is the cost of passengers incurred due to traffic congestion and it was calculated using the following formula:

Annual Passenger =Daily Passenger Delay Cost	X Value of Vehicle Hrs. of Delay	X Person time	Vehicle Occupancy	X Annual Conversation Factor

As above annual passenger delay cost at Jemo Michael four legs (Germen, Jemo, Lideta and Ayer tena approach) result 25,887,172.5ETB. This result indicates at Jemo intersection ever passengers high extra travel time consumed due to traffic congestion. If you look by individual of passengers, every passenger individually at 200m distances almost 57.28birr loss per year. Each passenger how long distance travel per day then simply convert to the distance to daily

travel and gate how many birr loss every movement is you can gate. When to lookthe economic cost per vehicles, 497.2birr/year loss only 200m length road at Jemo Michael intersection.

4.6. Level of service

According to HCM (2000) defines six levels of service, ranging from A to F. In this paper the result of level of service indicate as following; first we look few parameters researcher gate from high way capacity manual 2000, LOS A means no congestion, it is free flow the travel speed over 60 miles/hours, flow of vehicles per hour per lane under 700veh, density vehicles per mile under 12 and delay at signalized intersection less than 10 second. LOSB means slightly congested with some reduced maneuverability and still know well flow the travel speed57-60 mile/hrs., flow of vehicles per hour per lane 700-1100veh, density vehicles per mile 12-20 and delay at signalized intersection 10-20second. LOSC means the presence of other vehicles begin to restrict the maneuverability within the traffic stream, the travel speed 54-57 mile/hrs., flow of vehicles per hour per lane 1100-1550veh, density vehicles per mile 20-30 and delay at signalized intersection 20-35second.LOSDtravel speed is same what reduced maneuverability limited and typical urban peak period highway condition, the travel speed 46-54 mile/hrs., flow of vehicles per hour per lane 1550-1850veh, density vehicles per mile 30-42 and delay at signalized intersection 35-55second.

LOS E inter-section approach delays and low average speeds already congestion occurs, the travel speed 30-46 mile/hrs., flow of vehicles per hour per lane 1850-2000veh, density vehicles per mile 42-67 and delay at signalized intersection 55-80second. LOS F means travel time is unpredictable and extremely congestion, flow is forced with frequent drops in speed to nearly zero mph, the travel speed under 30 miles/hrs., flow of vehicles per hour per lane unstable, density vehicles per mile max 67 and delay at signalized intersection above 80second. Generally, A Los represents the best operating conditions from the traveler's perspective and LOS F the worst. In order to determine congestion at intersections, level of service analyze at intersections were performed using above criteria. To calculate the level of service, the following data are necessary: Traffic volume, travel speed, travel time delay, density of vehicles and pedestrian volume. All data is obtained using video camera and secondary data from Addis Ababa traffic management agency, Nifas silk Lafto sub city transport and road authority, Addis Ababa traffic

police officer hayaluet megenagna and Gotera Pepsi traffic police office. These values are tabulated in table below.

Table 4.22: Analysis LOS of Jemo Michael Intersection

Approach 200m	Los	Description
Jemo	F	Extremely low speeds caused by intersection congestion, high delay and adverse signal progression. Additionally, Volume of traffic flow is greater than road capacity.
Lideta	E	Operations with significant intersection approach delays and low average speeds. it is high travel time delay, but in some way reduce severity from F LOS.
German	F	Extremely low speeds caused by intersection congestion, high delay and adverse signal progression. Additionally, Volume of traffic flow is greater than road capacity.
Ayer-tena	E	Operations with significant intersection approach delays and low average speeds. it is high travel time delay, but in some way reduce severity from F LOS.

The above Level of service result analysis based on Highway capacity manual 2000 LOS criteria. Based on result, Jemo Michael signalized intersection by these criteria all approach is crowed. Specially, during morning time (1:30-3:30AM and night time after 4:00PM-6:00PM above 55sec delay. At mid-day Los of all approach is D (average delay time 35-55sec), this means travel speed is same what reduced maneuverability limited and typical urban peak period highway condition. Generally, through travel speed, density vehicles/mile, travel time delay, travel rate and delay rate criteria Jemo and Germen approach are F level of service. Ayer tena and Lideta approach are E level of service. Level of analysis for the intersections indicates that most of the intersections are performing above their capacity. Which means vehicles are moving at extremely low speeds occurrence of high delays and high volumes at morning and night peak period.

CHAPTERFIVE
CONCULUSONSANDRECOMMENDATION

5. Introduction

This chapter provides the summary of the findings and conclusions. It furthermore gives the recommendations and suggestions for area of future research as far as this study is concerned.

5.1. Summary of the Findings

The main purpose of the study was to examine mediating effect of traffic congestion severity on economic cost in Nifas Silk Lafto Sub city Addis Ababa Ethiopia. Traffic congestion is one of the significantly recognized urban transport problems. It is continuing to remain a major problem in most cities around the world; especially in developing regions resulting in considerable delays, high fuel wastage and time losses. The problem of traffic congestion in Addis Ababa city is becoming a serious challenge to effective flow of people and goods in the city. Based on the results of the study the summary of major findings was provided here.

In this study, the traffic congestion was investigated to indicate its presence and its level of severity. Based on the conclusion from the result it was proved as traffic congestion exist at this intersection with mean value of 3.65 which suggests the respondents' agreement the presence of traffic congestion at Jemo Michael intersection with low variation in agreement from common mean. When this result has triangulated with Highway Traffic Capacity manual (2000) criteria indicated in chapter two table 2.1 the finding result of 49.9% respondents says very high traffic congestion at this intersection (F level of service), 27.5% respondents agreed exist high traffic congestion (E level of service), 13.8% respondent's slight high(D level of service), 8.4% slight low (C level of service), 3.4% low (B level of service) and 2% of respondents say very low (A level of service or free flow without any obstacles). When this concept was generalized, there are a very high traffic congestion which consume extra travel time and fuel that leads to economic cost at Jemo Michael intersection

Based on finding of the study: road condition, parking problem, population increase, poor traffic management and vehicles number increase has caused for occur traffic congestion severity. This result was identified by using mean score of each causes of traffic congestion which include; the vehicles number increase with a mean score (3.64), population increase (3.93), road condition (3.67), parking problem (3.65) and poor traffic management practices (3.72)in which the respondents commonly hold an agreement on these point. Similarly, the finding result indicates that, at this intersection there are high economic lose due to travel time and fuel consumption by consequences of travel time delay and fuel use. The large economic cost of congestion due to traffic congestion severity was identified with mean value of 3.67 which indicates the respondent agreements near more than average value.

The output result of correlation coefficients indicated as there were a significant positive relationship between independent variables and mediating variable with a coefficient and significant value of: road condition ($r = .521$, $p < .001$), population increase ($r = .219$, $p < .001$), parking problem ($r = .413$, $p < .001$), poor traffic management (($r = .327$, $p < .001$), vehicles number increase ($r = .356$, $p < .001$). In the same manner, a significant positive correlation between independent variables and dependent variable (economic cost) was obtained in such a way that road condition ($r = .568$, $p < .001$), population increase ($r = .248$, $p < .001$), parking problem ($r = .502$, $p < .001$), poor traffic management (($r = .401$, $p < .001$), vehicles number increase ($r = .491$, $p < .001$) indicates positive and significant relationship between them. In addition, traffic congestion severity which is mediating variable with the value of $r = .667$ and $p < .001$ has a significant positive correlation with dependent variable (economic cost of congestion).

The study result also suggested based on the regression value to analyze the direct and indirect effect IV variable on DV. The value of direct effect when independent variable explaining economic cost of congestion without mediating variable, result of adjusting R squared become 0.59 which implies that 59% variation in economic cost of congestion was affected by these independent variable. The model is significant at ($F(5, 350) = 74.145$, $p < 0.001$) with Durbin-Watson value of 1.880 indicating the absence of autocorrelation problem.

The regression result also indicated to identify the indirect effect of IV on DV at the presence of the mediating variables. According to this, the value of adjusting R squared 0.68 indicates that 68%variation in economic cost (dependent variable)explained by independent variables in the

presence of mediating variable used in the model. The model is besides significant at ($F(6, 349) = 91.896$, $p < 0.001$) with Durbin-Watson value of 1.989 indicating the absence of autocorrelation problem.

The direct effects of β-value and coefficient value for each variable RC, PP, PG, PTM and VNI on TCS were ($\beta=.670$, $\rho < 0.01$), ($\beta=.430$, $\rho < 0.01$), ($\beta= .120$, $\rho, < 0.01$), ($\beta= .630$, $\rho < 0.01$), and ($\beta=.210$, $\rho < 0.05$) respectively. This indicates the value of Hypothesis 1, 3, 5, 7 and 9 have a direct effect on mediating variable traffic congestion severity. The results depict that acts as the independent variable that further leads to traffic congestion severity

Similarly, β-value and coefficient value for direct effects of RC, PP, PG, PTM and VNI on ECC were ($\beta=.390$, $\rho < 0.01$),), ($\beta= .095$, $\rho < 0.05$), ($\beta= -.570$, $\rho < 0.01$), ($\beta= .520$, $\rho < 0.01$), ($\beta=.040$, $\rho < 0.01$and ($\beta=.450$, $\rho < 0.05$) respectively. In this regard, the variables act respectively as direct positive effect on dependent variable-economic cost of congestion (ECC). Again the result of Hypothesis 2, 4, 6, 8, 10 and 11 posited that direct effect on ECC with mediating traffic congestion severity. The relationship of the RC, PP, PG, PTM and VNI with ECC were also supported as an indirect effect. The results depict that all independent variable and mediating variable acts as the variable that further leads to economic cost of congestion.

The result of analysis also shows the IV (road condition, population growth, parking problem, poor traffic management and vehicles number increase) has a significant effect on DV in the presence of mediating variables. The respective value of each effect of IV: RC, PP, PG, PTM and VNI on DV (ECC) were ($\beta=.302$, $\rho < 0.01$), ($\beta=.194$, $\rho < 0.01$), ($\beta= .054$, $\rho < 0.05$), ($\beta= .284$, $\rho < 0.01$), and ($\beta=.095$, $\rho < 0.05$) respectively. Based on this Hypothesis 12, 13, 14, 15 and 16 suggested that the traffic congestion severity mediates the relationship of the RC, PP, PG, PTM and VNI with ECC were also supported as an indirect effect. The results depict that traffic congestion severity acts as the variable that further leads to economic cost of congestion

The result analyzed through scientific measurement to identify Level of service by using traffic volume data. Its result has been indicated as both Jemo and Germen approach very highly crowded. The left Ayer tena and Lideta approach are highly crowded, but in smaller extent relative to Jemo and Germen approach. Therefore, the result of this finding was triangulated with result concluded from respondent's response analyzed.

The economic effect of traffic congestion severity at Jemo intersection due to extra fuel consumption 217,640L with the cost 4,352,814ETBper year. Additionally, the total extra travel time loss 497,124.1minute or 8285.4hours with cost of congestion 25,891,656.25ETB/year wasted at Jemo Michael intersection.

5.2. Conclusions

This thesis discusses on mediating effect of traffic congestion severity on economic cost. The study similarly focused on the mediating effect of traffic congestion severity on economic cost. Based on this research finding the following conclusion was made.

- As result indicate the key cause of traffic congestion severity at Jemo intersection are: first, road condition, this means imbalance of vehicle volume and road capacity with insufficient alternative road around Jemo Michael intersection. Secondly, increase vehicles numbers. Thirdly, insufficient traffic management. Fourthly population increase, fifth parking problem, this means parking of passenger cars for loading and unloading of passengers near intersection entry and exit with on street parking on walkways and road ways which forces passengers to use roadways and conflict with drivers are the major causes of traffic congestion severity.
- Level of analysis for the intersections indicates that most of the intersections are performing above their capacity which indicates vehicles are moving at very low speeds, occurrence of high delays and high volumes.
- The economic cost of traffic congestion at Jemo intersection is high effect on both passengers and drivers. Traffic congestion during the morning and night peak hour is more than the mid-day. At this time the consumption of extra fuel and loss of time is high relative to free flow time. Due to road traffic congestion severity wastage of time (increase delay) and increase wastage of fuel.
- Delay is the first thing many people think and stressed when it arises to Jemo intersection road. Due to road traffic congestion, which results late arrival for employment, meeting, education (reduce academic on students), late arrival to appointment place, resulting in lost business, inability to forecast travel time accurately etc.
- The average travel speed of the vehicle during the morning and night time is 8.3 Km/hr. But during mid-day the average travel speed is 20.1 km/hrs. The total average speed of vehicles

through the segment is14.2 km/hr. This means during morning and night peak period average travel rate 7.2min/km, But during mid-day (off peak period) the average travel rate 2.98min/km. The total average travel rate at Jemo Michael intersection is 4.2minute/km

- The average travel speed is decrease during the peak period but travel rate, delay rate, delay per traveler, travel time, total segment delay, and delay ratio are increase. The total delay of Jemo Michael intersection at four segments of road 8285.4hours per 200m per day.
- Generally, transportation in Nifas silk Lafto Jemo Michael intersection is inefficient, ineffective, dangerous, unproductive, chaotic, and does not satisfy commuters.

5.3. Recommendations

Traffic congestion is not fully protecting, but we can reduce severity of congestion and effect of congestion. Similarly, traffic congestion is dynamic in nature, mitigation measures differ from place to place. Based on the conclusions drawn from the major findings of the study with respect to the mediating effect of traffic congestion severity on economic cost, the following recommendations are made and forwarded to different concerned bodies to solve the problems in the study area.

1. **Improve road capacity**

At Jemo intersection the width of the road is narrow, it has no parking place, Illegal traders of different goods exchange on road are there. There are situations which forces the vehicles to stop anywhere on the road for passengers to board and offload. It becomes the results of congestion, and affects the travel time of people and extra fuel consume. At this intersection main mitigation road traffic congestion problem is the need to improve width of the existing road capacity and building new alternative road. To minimize the number of pedestrians those are crossing through this intersection. Addis Ababa Road Authority need to building by bridges and separate pedestrians lane from vehicles. A collaborative plan and action is needed from Addis Ababa municipality, Federal government, participation of private investors and donors to improve road capacity.

Additionally, traffic flow road need separated according to different classes of vehicles, heavily loaded trucks should not be allowed into the main passenger and market area and separate route must be specified for these during peak hours. Also for fast transit passengers bus lane separate

from other vehicles. This is starting to construct from Jemo to Gulalle by government budget and expand to other area.

2. **Provide sufficient parking area and improve parking management system**

As observed the study result there is a big parking problem at Jemo Michael intersection for loading and unloading purposes on the road way. Therefore, responsible bodies are recommended to create effective parking management strategies, especially at the exit and entry of intersections. Addis Ababa city Administration and Addis Ababa Traffic Police are advised to offer safe parking area for vehicles and create smooth movement for vehicles through the lane. By road users also expected to gate parking service, loading and unloading in correct and appropriate way.

3. **Encourage mass transportation system and discourage private transport**

In Addis Ababa, private transport is highly increasing daily, and inversely the number of public transport is not that much. This is also big reason for traffic congestion. Public transport has the potential to transport more people than individual cars for given amount of road space. A bus can be accommodate for people as much as provided by many cars and occupy less space on roads. It is possible to discourage people from the private car is very easy in low-income area and ultimately reduce traffic load and congestion. Then promotion of public transport remains a fundamentally important congestion management strategy. When public transport provides quality, efficient and effective service, it can maintain a high level of access throughout urban areas with a drop in overall car usage. So, governments have to recommend increasing the amount of public transport and enterprise bus with qualities service.

Similarly, among the different measures required, increasing the capacity of LRT is found to be important. This do by collaboration of Federal government and other country fund.

4. **Work on capacity building of traffic management and improve traffic management strategies**

Traffic management refers to the direction, control and supervision of all vehicular and pedestrian traffic around congested road. Good traffic management is a key to achieving the goal of road traffic management for safe and efficient road network for urban congested road. This involves management and control of road signals, road spaces, parking spaces and road users.

So, training and education for these staff members also warrant due attention. If desire for traffic management to be effective, broader and better coordinated must be sufficient, competent and skilled human resource. Therefore, a continuous human resource development program should be established for the existing as well the recently employed staffs. This capacity building offer by Addis Ababa transport authorities, Traffic management agency, police officers, and Addis Ababa road authority.

Additionally, at this intersection observed irresponsible driving due to violation of traffic rules, there are drivers who show little respect for other road users. Many drivers try to cut a few moments off their journey times by forcing their way into intersections and blocking the passage of other motorists, thus causing economic losses to others which are much greater than their own gains. As a result, Addis Ababa transport management and traffic police need to strongly work on change the behavior of drivers and develop skill of drivers. Furthermore, work on rule of law or give penalties for every mistake made in order to disappoint these misbehaviors.

5.4. Recommendation for Further Future Researchers

- Further research should be conducted to extend all aspects of this research, such as by collecting more data the whole city in order to improve results, improve this research by touching un touched variables in cause of congestion and economic effect of congestion like: social effect, political effect and economic effect that untouched variables in this paper.
- During collecting travel speed and travel time modernized data collection method are better than manual method and to minimize the error and the work to simplify.
- To better traffic congestion mitigation schemes in order to generate economic cost in Addis Ababa, further researches have to be done in the whole Addis Ababa to minimize congestion costs and enhance safe, economical and convenient traffic flow since this thesis only allocated with the North-South corridor only one sub city from ten sub city of Addis Ababa city.
- In this study the traffic volume count was done for three day, due to time and budget limitations. Therefore, it is recommended to count at least for three to seven days.

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Appendices:A

I. Questionnaire for Respondents

Subject: <u>Request for Participation in a Research Study</u>

Dear respondents:

Thank you for taking part in this study. I am a Postgraduate student at Jimma University in College of Business and Economics. As partial fulfillment for the Masters of Logistics and transport management, I am conducting a research study on "The mediating effect of traffic congestion effect on economic cost: case study in Nifas silk Lafto sub-city, Addis Ababa Ethiopia". Therefore, I would appreciate if you could spare a few minutes of your time to answer the following questions according to your experience and your personal understanding. All the information provided will be purely used for academic purposes and your identity will be treated with utmost confidentiality. Your assistance will be highly appreciated and thank you in advance. If you have, any question and comments contact to me with the following address:

Habtamu Kassa

Email: - ***habtekassa4@gmail.com***

Phone: - 0917005155

Thank you for your cooperation!

- ***Tick only one box***

Part One: <u>General Background of Respondents (Demographic Information</u>)

1**.** Sex**:** Male ☐ Female ☐

2. Qualification**:** Below grade 12 ☐ Grade 12 complete ☐

Diploma/LEV ☐ BSC ☐ MSC ☐ PhD and above ☐

3. Age: below 20 ☐, 20-30 ☐ , 31-40 ☐ , 41-50 ☐ , Above 50 ☐

4. Jobs: Government employment ☐ Self-employment ☐ private employment ☐ Student ☐

Part Two: <u>Respondent's perception towards traffic congestion cause and economic effect</u>

Please indicate the degree to which you agree with the following statements regarding the mediating effect of traffic congestion effect on economic cost of having of five points scale with "✓"mark where **1**= Strongly Disagree, **2**= disagree, **3**=Neutral, **4**= agree and **5**= Strongly Agree

S. no	**Existence Of Traffic congestion Severity**	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	**2**	**3**	**4**	**5**
1.1	There is traffic congestion problem at Jemo intersection					
1.2	Volume of traffic flow is greater than to maximum capacity					
1.3	There is low speed of traffic flow at the Jemo intersection					
1.4	Vehicles continuously flow by forming a queuing at Jemo intersection					
1.5	Vehicles flow are fully stopped for periods of time at Jemo intersection road					
1.6	Vehicles are use highly Jemo intersection at the same time					
1.7	There is no free movement of vehicles at Jemo intersection					

S.no	**Cause of traffic congestion Severity**	Strongly Disagree	Dis agree	Neutral	Agree	Strongly Agree
1.	**Road condition**	1	2	3	4	5
1.1	There is insufficient road width at Jemo Michael road					
1.2	Jemo road intersection is uncomfortable road for travel					
1.3	Imbalance between demand and supply of road space					
1.4	There is broken road at Jemo intersection					
1.5	There is illegal goods exchange (trade on road) at Jemo intersection road					

1.6	There is no alternative road near to Jemo intersection					
1.7	There is insufficient pedestrian road at Jemo					
2.	**Population growth**	**1**	**2**	**3**	**4**	**5**
2.1	The size of population is increased around Jemo road					
2.2	The demand for transport has increased at Jemo road					
2.3	Activities of peoples increase around Jemo road					
2.4	More peoples live and work around Jemo road area					
2.5	There are high numbers of Pedestrian use Jemo intersection					
3.	**Parking problem**	**1**	**2**	**3**	**4**	**5**
3.1	There is parking problem at Jemo road intersection					
3.2	There is inadequate parking space at Jemo road					
3.3	Drivers use road sections to park vehicles					
3.4	There is uncomfortable parking place at Jemo road					
3.5	Parking area is exposed to risk along the road					
3.6	Operator load and unload passenger at any place of road					
4.	**Traffic management**	**1**	**2**	**3**	**4**	**5**
4.1	There is no enough functional traffic lights at Jemo Michael intersection					
4.2	There is no enough road signals on Jemo Michael intersection					
4.3	Traffic police enforce (penalty) not sufficient at this road					
4.4	Driver violet traffic regulation at Jemo intersection					
4.5	Pedestrian Insufficient awareness on traffic rule					
4.6	There is old traffic sign at Jemo intersection					
5.	**Vehicles number increases**	**1**	**2**	**3**	**4**	**5**
5.1	There is an increase vehicles numbers at this road					
5.2	Volume of vehicles flow is greater than available					

	capacity					
5.3	Vehicles flow continuously by overcrowding queue form					
5.4	Different types(heterogeneous) of vehicles use this road					
5.5	Many vehicles at the same time use Jemo road segment					

- ✓ **Economic Cost Effect of traffic congestion Severity**

From the following alternative choose only one point and "✓"thick only on one where you agreement level is satisfy **1**= Very Low, **2**= Low, **3**= Slight High, **4**= High, 5=Very High

No	**Economic Cost traffic congestion**	**Very Low**	**Low**	**Slight High**	**High**	**Very High**
1.	**Travel time delay**	**1**	**2**	**3**	**4**	**5**
1.1	There is travel time delay at Jemo intersection					
1.2	Passenger lately arrival to work place					
1.3	Drivers need more time to cover given distance					
1.4	Passenger pass through this intersection route not enables to forecast travel time accurately					
1.5	Traveler use this road late arrive appointment place					
1.6	Student use this road late arrival to school					
2	**Extra fuel consumption**	**1**	**2**	**3**	**4**	**5**
2.1	There is extra fuel consumption at this Intersection					
2.2	Operator loss income by extra fuel cost					
2.3.	Commuters to pay more money by reason of extra fuel consumption					
2.4	Vehicles out (consume) more energy					

3. What are levels of congestion severity at Jemo Michael Intersection? Please choice only one answer from the following.

A. Very Low B. Low C. Slight Low D. Slight High E. High F. Very High

II. Interviews

1. What are the relation road condition problem with traffic congestion severity and their economic cost of congestion.
2. What are the relation population increase with traffic congestion severity and their economic cost of congestion
3. What make relation parking problem with traffic congestion severity and their economic cost of congestion.
4. What make relation poor traffic management with traffic congestion severity and their economic cost of congestion.
5. What make relation vehicles number increase with traffic congestion and their effect on economic.
6. What make relation travel time delay with traffic congestion severity and their economic cost of congestion.

ጅማዩኒቨርሲቲ

በቢዝነስናኢኮኖሚክስኮሌጅ

የማኔጅመንት(አሰተዳደር) ትምህርትክፍል

ለደህረ ምረቃትምህርትፕሮግራምመምጀየ ቀረበማጠይቀ

ወድየ ማጠይቁ መላሾች:

ይህማጠይቅበጅማዩኒቨርሲቲበቢዝነስናኢኮኖሚክስኮሌጅየ ለጀስቲክስናየ ትራንስፖርትማንጅመንትተማሪሀብታመካ ሣለድህርምረቃየ ትምህርትፕሮግራምየ መመርቂያፅሁፍማምጀየ ተዘጋጀነው፡፡ ጥናቱምባ "T*he* mediating effect of traffic congestion severity on economic cost*: case study in Nifas silk Lafto sub-city, Addis Ababa Ethiopia*" በሚልርዕስላይእየ ተካሄደይገኛል፡፡

በመሆኑምጥቂትጊዜወስደወብጥናታዊጽሑፍየ ቀረቡጥያቄዎችን ካሎትተሞኪሮናወጠታማ ትማጠይቁንበታማኝነ ትበመሙላትእጅግየ ጎላድርሻዎትንእንዲወጠብአከብሮትእንጥይቃለን፡፡

በዚህማጠይቅላይየ ሚሰጠወማንኛወምምላሽለትምህርታዊአገልግሎትብቻየ ሚወልናሚስጥራዊነ ቱየ ተጠበቀመሆኑንበአ ከበሮትእገልፃለሁ፡፡

መጠይቁበአድስአበባከተማበንፍስስልክላፍቶክፍለከተማበጀሞሚኤልሚቀለኛመንገድላይየ ትራፊክፍስትሚጬፍነ ቅመሴዎችናበኢኮኖሚእንቅስቃሴላይየ ሚ መጣውተፅህኖለማጥናትየ ተዘጋጀጥናታዊጽሑፍ (Research) ነው፡፡

ጊዜስጥተወለቀርቡትጥያቀተገቢወን ምላሽበማጠትስለተባበሩንእጅግእናማሰግናለን፡፡

ተጨሜሪጥያቄናአስተያየ ትካሎትከዚህበታችባለወአድራሻያገኙናል፡፡

- *ሀብታመካሳ*
- ስልክ 0917005155
- ኢሜይል- habtekassa4@gmailcom.

ክፍልአንድ: ከዚህቀጥለኣርስዎንአስመልክቶየ ቀረቡአጠቃላይጥያቅዎችንየ "√" ምልክትበማድረግይመልሱ፡፡

1. ***ፆታ*** : ወንድ ☐ ሴት ☐
2. **እድሜ**: ከ 20 በታች ☐ 20-30 ☐ 31-40 ☐ 41-50 ☐ ከ51 በላይ ☐
3. **የትምህርትደረጃ:** - 12 ክፍልያላጠና ቀቀ ☐ - የመጀሚያድግሪ ☐

- 12ክፍልያጠናቀቀ ☐ - የሁለተኛዲግሪ ☐

- ዲፕሎማ(ለቨል) ☐ - ፕችዲ/ደክትሮትናበለያ ☐

4. **የስራሁኔታ:-** የመንግስትተቀጣሪ ☐ - የንግድ /ድርጀት/ ባለቤት ☐

- የግልድርጅትተቀጣሪ ☐ - ተማሪ ☐

ክፍልሁለት: የማነይቁማኦችየተሸከርካረ (የተራፊክ)

ሜጩፍነቅመነሴዎችናበኢኮኖሚይየሚያመጣዉተፅኖበራሳችሁኢስተያያትየሚሞሉትጥያቄ

እባኮትንከዚህበታችበቀረቡትጥያቄዎችላይእርሶበሚመጣዉትየስምማ ትደረጃከቀርቡትአምስትየመስመሚደረጃ ዎችወይምአመራጮችአንዱላይ "√" ምልክትበሚድርግይምርጡ ፡

✓ **<u>የሥምምነ ትደርጃወም</u>**: 1= በጣምአልስመምም 2= አልስመምም 3 = ገለልተኛ 4=እስመማሁ

5 = በጣምእስመማሁ

<u>ጥናቱየሚከሄድበትመንገድ:</u> <u>በጀሞጣኢልመስቀለኛመንገድ</u>

ተ.ቁ	የተሸከርካር (የትራፊክ) ፋስትሜጩፍነቅ	1	2	3	4	5
1.1.	በጀሞነዳና /መንገድየትራፊክ (የተሸከርካር) ሜጩፍነቅአለ					
1.2	የተሸከርከርፍስትመንገዱመያዝከሚቻለሁኔቅምጣለይነው					
1.3	በመንገዱየተሸከርካርፋጥነ ትአነስተኛነው					
1.4	በመንገዱያለምንምመቋርጥተሸከርከርበተጩፍነቀስልፍይጓዛል					
1.5	ለተወሰነጊዜየ ተሸከርካሪፍሰትመሉበመሉይቋረጣል					
1.6	ብዙአሽከርካርዎችበተመጣጣይሰዓትመንገዱንይጠቀመታል					
1.7	በመንገዱነፃየ ተሸከርካሪፍሰትየለም					
ተ.ቁ	**የተሸከርካርሜጩፍነቅመነሴ**					
1	**የመንገዱሁኔታ**	**1**	**2**	**3**	**4**	**5**
1.1	የመንገዱሰፍትበቂአይደለም					
1.2	መንገዱለጉዞምቹአይደለም					
1.3	የመንገዱስፋትአቅርቦትናፍላጎትአለመጣጣምአለ					

1.4	መንገዱያረጀናየተሰባበርነው					
1.5	በመንገዱህገወጥየመንገድለይንግድይከናወናል					
1.6	በጀሞመንገድአቅራቢያሌላአማራጭመንገድየለም					
1.7	የእግረኛመንገድእጥረትአለ					
2	**የሕዝብቁጥርጫጩር**	**1**	**2**	**3**	**4**	**5**
2.1	በመንገዱአከባቢየተጠቃሚህዝብቁጥርጨምሮአል					
2.2	በአከባቢወብተሸከርካርየመንቀሳቀስፍለጉትጨምሮአል					
2.3	በአካባቢወየስዎችእንቅሰቃሴጨምሮአል					
2.4	በአካባቢውብዙሰዎችይኖራሉለስራምይንቀሳቀሳሉ					
2.5	በተመሳሳይሰዓትብዙእገረኞችመንገዱንይጠቀሙታል					
3	**የመኪናማቆሚያ (ፓርክ) ችግር**	**1**	**2**	**3**	**4**	**5**
3.1	በአካባቢወየተሸከርካርማቆሚያችግርአለ					
3.2	በአካባቢወየተሸከርካርማቆምያእጥርትአለ					
3.3	በስፊራውአሽከርካርዎችተሸከርካሪንመንገድለይያቆሚሉ					
3.4	የተሸከርካርማቆሚያስፊራምቹአይደለም					
3.5	የተሸከርካርማቆሚያዎችለአደጋየተጋለጠፍቸው					
3.6	አሽከርከርዎችባልተፍቀደበትስፊራሁሉተሳፋሪዎችንይጫፍሉያወርዳሉ					
4	**የትራፊክአስተዳደር (ማነጀመንት)**	1	2	3	4	5
4.1	በመንገዱለይበአግባቡየሚሰራየትራፊክመበራትየለም					
4.2	በስፊራወብቂየትራፊክምልክትየለም					
4.3	ትራፊኮችየህግበላይነትን /የተቀማጠህጎችንበበቂሁኔታአያስከብሩም					
4.4	አሽከርካርዎችየትራፊክህግይጥሳሉ					
4.5	እገረኞችየትራፊክህግለያበቅግንዛቤየላቸወም					
4.6	በስፊራወያለወየትራፊክምልክትአሮጌእንጂዘመናዊአይደለም					
5	**የተሸከርካርቁጥርጫጩር**	1	2	3	4	5
5.1	በመንገዱየተሸከርካርቁጥርጨምሮአል					

5.2	የተሽከርካሪብዛትናፍሰትከመንገዱምዕዝአቅምበላይነው					
5.3	በመንገዱየተሽከርካሪዎችፍስትበተጨናነቀሁኔታይከናወናል					
5.4	የተለያዩዓይነትተሽርካሪዎችመንገዱንይጠቀማሉ					
5.5	ብዙተሽከርካሪበተመሳሳይጊዜናሰዓትመንገዱንይጠቀማሉ					

(III)<u>የትራፍክ (ተሽከርካሪ) መጨናነቅበኢኮኖሚያዊ የሚያመጣውተፅዕኖ/ጉዳት</u>

ከዚህበታችለቀረቡትጥያቄዎችከ1-6 ከቀረቡትአማራጮችየ "√" ምልክትበማድረግይሙሉ::

✓ ***ምረጫዎም*** 1= በጣምአነስተኛ 2= አነስተኛ

3= ከፍተኛ 4= በጣምከፍተኛ 5= እጅግበጣምከፍተኛ

ተ.ቁ	በኢኮኖሚያዊ የሚያመጣውተፅዕኖ					
1	**የጉዞሰዓትመዛግየት**	1	2	3	4	5
1.1	በመንገዱላይየጉዞሰዓትመዛግየትአለ					
1.2	መንገዱንየምጠቀሙተሰፋሪዎችየስራቦታአረፈዶይድረሳሉ					
1.3	መንገዱንየምጠቀምአሽከርካሪየተሰጠውንርቀትለማሻፍንተጨማሪሰዓትይወሰድብታል					
1.4	መንገዱንየሚጠቀሙተጓዦችየጉዞሰዓትበትክክልመተንበይአይችሉም					
1.5	መንገዱንተማሪዎችትምህርትቤትአርፈዶያደርሳሉ					
2	**ተጨማሪናዳጅመጂጀት**	1	2	3	4	5
2.1	በመንገዱተሽከርካሪዎችተጨማሪነዳጅይጠቀማሉ					
2.2	በመንገዱአሽከርካሪዎችበተጨማሪየነዳጅዋጋምክንያትገቢያጣሉ					
2.3	በመንገዱበተጨማሪየነዳጅዋጋምክንያትየባለንብረቱገቢይቀንስአለ					
2.4	በመንገዱተሽከርካሪውብዙጉልበትይጠቀማል					

4. የጀሞሜኢልሚቀለናመንገድየትራፊክመቸናነቅደርጃምንያህልነው?

A. እጅግበጣምአነስተኛ**B.**በጣምአነስተኛ**C.** አነስተኛD. ከፍተኛ**E.**በጣምከፍተኛ**F.** እጅግበጣምከፍተኛ

እጅግበጣምአመሰግናለሁ!!

Appendix B: Research questionnaires statistical results

A. : Reliability Statistics

Table 3.1: Reliability Statistics

Construct	Number of item	Cronbach's alpha
Existence of traffic congestion	7	.912
Road condition	7	.761
Population increase	5	.934
Parking problem	6	.871
Poor traffic management	6	.811
Vehicle number increase	5	.870
Economic cost of congestion	10	.835
Total	46	.951

B. The Pearson's correlation coefficient between variables

Composite variables		**RC**	**PG**	**PP**	**PTM**	**VNI**	**TC**	**TTD**
Road condition (**RC**)	Pearson Correl.	1						
	Sig. (2-tailed)							
Population Growth(**PG**)	Pearson Correl.	.247**	1					
	Sig. (2-tailed)	.000						
Parking Problem (**PP**)	Pearson Correl.	.348**	.172**	1				
	Sig. (2-tailed)	.000	.001					
Poor Traffic Management(**PTM**)	Pearson Correl.	.266**	.139**	.315**	1			
	Sig. (2-tailed)	.000	.009	.000				
Vehicles Number Increase(**VNI**)	Pearson Correl.	.582**	.208**	.386**	.258**	1		
	Sig. (2-tailed)	.000	.000	.000	.000			
Traffic Congestion (**TC**)	Pearson Correl.	.521**	.219**	.413**	.327**	.356**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
Travel time delay (**TTD**)	Pearson Correl.	.568**	.248**	.502**	.401**	.491**	.667**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
** Correlation is significant at the 0.01 level and * = significant at the 0.05 level (2-tailed).								

APPENDIX B. – Research results Done through Scientifics way

C. Traffic Volume at Jemo Michael Intersection

Date of count	Ayer Tena Approach	Lideta Approach	Jemo Approach	German Approach	Total

17/06/2012	R	TH	L	Total	R	TH	L	Total	R	TH	L	Total	R	TH	L	Total	
7:00-7:15AM	33	105	34	172	40	109	67	216	87	93	51	231	46	73	89	208	827
7:15-7:30AM	38	121	52	211	46	150	71	267	89	129	58	276	47	80	92	219	973
7:30-7:45AM	49	196	99	344	50	156	72	278	96	182	60	338	79	111	155	345	1305
7:45-8:00AM	52	202	105	359	51	166	81	298	131	240	62	433	85	121	163	369	1459
8:00-8:15AM	39	212	114	365	64	155	89	308	140	281	56	477	93	117	178	388	1538
8:15-8:30AM	42	181	110	333	63	140	96	299	145	282	54	481	97	122	175	394	1507
8:30-8:45AM	40	207	82	330	53	133	122	308	142	275	54	471	104	107	161	372	1481
8:45-9:00AM	43	203	80	326	55	107	95	257	131	252	44	427	104	109	160	373	1383
9:00-9:15AM	37	164	77	278	50	101	98	249	107	217	39	363	101	104	153	358	1248
9:15-9:30AM	42	150	71	263	49	99	85	233	98	202	45	345	94	92	142	328	1169
9:30-9:45AM	34	139	56	229	42	94	81	217	91	194	54	339	94	89	116	299	1084
9:45-10:00AM	32	137	49	218	38	91	81	210	80	181	57	318	92	87	93	272	1018
10:00-10:15AM	33	114	48	195	38	90	77	205	77	176	42	295	80	84	88	252	947
10:15-10:30AM	48	103	39	190	35	82	70	187	69	183	52	304	78	93	83	254	935
10:30-10:45AM	34	109	37	180	30	61	69	160	57	176	57	290	74	79	72	225	855
10:45-11:00AM	30	95	38	163	31	69	60	160	66	171	60	297	60	75	70	205	825
11:00-11:15AM	31	105	44	180	31	76	92	199	81	161	51	293	51	81	91	223	895
11:15-11:30AM	21	112	48	181	32	93	90	215	91	169	45	305	57	86	89	232	933
11:30-11:45AM	33	59	38	130	45	90	87	222	91	171	53	315	55	90	97	242	909
11:45-12:00AM	41	83	46	170	52	105	104	261	104	162	48	314	45	90	106	241	986
12:00-12:15AM	43	97	32	172	41	110	106	257	108	146	46	300	69	104	110	283	1012
12:15-12:30AM	37	92	37	166	66	115	111	292	93	133	48	274	77	108	108	293	1025
12:30-12:45AM	44	59	31	134	49	110	80	239	59	120	41	220	75	98	97	270	863
12:45-1:00AM	43	63	34	140	49	108	77	234	56	94	40	190	75	95	93	263	827
1:00-1:15PM	56	68	42	166	42	105	71	218	53	92	52	197	70	81	88	239	820
1:15-1:30PM	53	49	41	143	36	111	63	210	68	90	39	197	63	76	88	227	777
1:30-1:45PM	44	49	32	125	26	128	63	217	58	90	39	187	53	67	78	198	727
1:45-2:00PM	43	47	34	124	36	105	59	200	56	79	38	173	45	65	67	177	674
2:00-2:15PM	47	50	54	151	39	117	59	215	44	92	43	179	37	60	74	171	716
2:15 - 2:30PM	51	54	59	164	41	105	46	192	46	84	38	168	51	44	69	164	688
2:30-2:45PM	45	68	57	170	39	102	47	188	45	87	44	176	45	58	77	180	717
2:45-3:00PM	46	77	52	175	44	90	42	176	48	84	39	171	30	87	82	199	721
3:00-3:15PM	50	80	50	180	44	93	45	182	50	77	32	159	40	100	110	250	771
3:15-3:30PM	65	97	67	229	58	112	40	210	56	75	32	163	35	117	137	289	891
3:30-3:45PM	60	95	75	230	63	177	41	281	60	67	29	156	30	125	155	310	977
3:45-4:00PM	75	122	82	279	73	195	43	311	71	93	43	207	55	142	192	389	1186

4:00-4:15PM	78	126	80	284	74	201	41	316	61	125	55	241	53	166	210	429	1270
4:15-4:30PM	87	120	98	305	82	203	56	341	70	96	49	215	47	220	238	505	1366
4:30-4:45PM	73	155	86	314	98	210	66	374	80	114	90	284	53	225	235	513	1485
4:45-5:00PM	85	146	96	327	94	239	68	401	84	124	83	291	68	221	225	514	1533
5:00-5:15PM	98	135	88	321	97	236	57	390	89	119	68	276	76	204	223	503	1490
5:15-5:30PM	97	139	84	320	110	229	77	416	98	113	71	282	89	144	228	461	1479
5:30-5:45PM	99	124	88	311	101	222	78	401	106	110	71	287	95	146	194	435	1434
5:45-6:00PM	104	129	72	305	92	230	79	401	115	122	81	318	99	129	177	405	1429
6:00 - 6:15PM	98	112	71	281	84	221	85	390	119	106	87	312	96	119	164	379	1362
6:15-6:30PM	92	111	66	269	83	214	95	392	105	108	86	299	86	109	135	330	1290
6:30-6:45PM	98	89	63	250	68	193	86	347	90	139	78	307	74	86	101	261	1165
6:45-7:00PM	99	77	55	231	58	180	72	310	83	116	74	273	58	90	99	247	1061
				11083				**12850**				**13414**				**14683**	**52030**

D. Jemo Michael intersection traffic volume data per hour for all approach

	Jemo Michael intersection name				
Time	Ayer-tena approach	Lideta approach	Jemo approach	Germen approach	Jemo Michael intersection
7:00- 8:00AM	1086	1059	1278	1141	4564
8:00-9:00AM	1356	1172	1856	1527	5911
9:00-10:00AM	988	909	1365	1257	4519
10:00-11:00AM	728	712	1186	936	3562
11:00-12:00AM	661	897	1225	938	3721
12:00-1:00AM	612	1022	984	1109	3727
1:00-2:00PM	558	845	754	841	2998
2:00-3:00PM	660	771	694	714	2839
3:00-4:00PM	918	984	685	1238	3825
4:00-5:00PM	1230	1432	1031	1961	5654
5:00-6:00PM	1257	1608	1163	1804	5832
6:00-7:00P M	1031	1439	1191	1217	4878`
7:00AM-7:00PM	11085	12850	13412	14683	52030

E. Level of service of Jemo Michael intersection

	Jemo Michael intersection name				
Time	Ayer tena approach	Lideta approach	Jemo approach	Germen approach	Jemo Michael intersection
7:00- 8:00AM	1086	1059	1278	1141	4564
8:00-9:00AM	1356	1172	1856	1527	5911
9:00-10:00AM	988	909	1365	1257	4519
10:00-11:00AM	728	712	1186	936	3562
11:00-12:00AM	661	897	1225	938	3721
12:00-1:00AM	612	1022	984	1109	3727
1:00-2:00PM	558	845	754	841	2998
2:00-3:00PM	660	771	694	714	2839
3:00-4:00PM	918	984	685	1238	3825
4:00-5:00PM	1230	1432	1031	1961	5654
5:00-6:00PM	1257	1608	1163	1804	5832
6:00-7:00PM	1031	1439	1191	1217	4878

F. Vehicle occupancy(Person/vehicle) Jemo Michael intersection

Intersection	**Bicycles(1)**		**Motor Bicycles (2)**		**Automobiles (4)**		**4WD (4)**		**Small bus taxi (12)**		**Minibus taxi (14)**	
	No of veh	No of passenger	No of veh.	No of passenger	No of veh.	No of passenger	No of veh	No of passenger	No of veh	No of passenger	No of veh	No of passenger
Jemo Michael intersection	431	431	1,369	2,738	16,271	65084	9836	39344	9311	111,732	8716	122,024

B. Vehicle occupancy(Person/vehicle) Jemo Michael intersection

Intersection Name	Midbus(24)		Sheger (39)		Higher (27)		Public bus(45)		Cross country autobus (62seats)		Anbessa bus(60seats)		Goods vehicles(2)	
	No of veh	No of passenger	No of veh.	No of passenger	No of veh.	No of passenger	No of veh	No of passenger	No of veh	No of passenger	No of veh	No of passenger	No of veh	No of passenger
Jemo Michael intersection	2013	48,312	382	14,898	359	9693	189	8,505	235	14,570	151	9060	2770	5540

G. : Average travel time at peak period analysis in 200m length by second

Approach	Morning time	Mid-day time	Night time
Jemo	155.1	60.3	132.1
Lideta	126.5	76.2	161.6
German	134.5	81.6	172.4
Ayer tena	122.1	92.3	144.4

H. Delay

Approach	Morning time	Mid-day time	Night time	In average
Jemo	108.2	40.3	88.8	78.6
Lideta	94.8	36.7	72.9	68.1
German	95.1	42.1	90.2	75.8
Ayer tena	84.4	35.1	82.8	67.4

I. : Average off peak period (Sunday) travel time in second

Approach	Morning time	Mid-day time	Night time
Jemo	46.9	34.5	44.1
Lideta	39.2	29.5	38.1
German	38.5	31.5	40.5
Ayer tena	36.9	30.2	38.1

J. Average travel speed (km/hr.) of Jemo Michael intersection

Approach	Morning time	Mid-day time	Night time
Jemo	4.6	11.9	5.4

Lideta	5.7	9.5	4.4
German	5.3	9	4.2
Ayer tena	5.9	7.7	5

K. Average travel speed (km/hr.) at off peak time (Sunday)

Approach	Morning time	Mid-day time	Night time
Jemo	15.3	20.9	16.2
Lideta	18.7	24.4	18.75
German	18.8	23	17.8
Ayer tena	19.5	24	18.75

L. Average travel rate of Jemo Michael intersection (min/km)

Approach	Morning time	Mid-day time	Night time
Jemo	12	5.4	8.8
Lideta	10	6.6	7.4
German	11.2	7.1	11.1
Ayer tena	9.4	7.3	9.4

M. Average delay rate of Jemo Michael intersection (min/km)

Approach	Morning time	Mid-day time	Night time
Jemo	9.1	3.2	7.1
Lideta	6.9	3.1	6.2
German	8.2	3.8	7.9
Ayer tena	7.4	3.8	5.7

Appendix of Amos

			S.E.	C.R.	P
Traffic_congestion_Severity	<---	Road condition_		.670	***
Traffic_congestion_Severity	<---	Parking_problem_	.128	.430	***
Traffic_congestion_Severity	<---	popn_growth	.097	.120	.098
Traffic_congestion_Severity	<---	Traffic_mgnt	.067	.630	***
Traffic_congestion_Severity	<---	Vehicles_no_increase	.144	.210	***
Economic Cost	<---	Road condition_	.092	.390	***

Economic Cost	<---	Vehicles_no_increase	.135	.040	***
Economic Cost	<---	Parking_problem_	.103	.950	***
Economic Cost	<---	popn_growth	.104	.-570	.267
Economic Cost	<---	Traffic_mgnt	.071	.520	***
Economic Cost	<---	Traffic_congestion_Severity	.154	.450	***
			.073		

Standardized Regression Weights:

			Estimate
Traffic_congestion_Severity	<---	Road condition_	.418
Traffic_congestion_Severity	<---	Parking_problem_	.134
Traffic_congestion_Severity	<---	popn_growth	.004
Traffic_congestion_Severity	<---	Traffic_mgnt	-.068
Traffic_congestion_Severity	<---	Vehicles_no_increase	-.040
Economic Cost	<---	Road condition_	.245
Economic Cost	<---	Vehicles_no_increase	.489
Economic Cost	<---	Parking_problem_	-.119
Economic Cost	<---	popn_growth	-.121
Economic Cost	<---	Traffic_mgnt	.093
Economic Cost	<---	Traffic_congestion_Severity	-.156
RC6	<---	Road condition_	.307
RC5	<---	Road condition_	.398
RC4	<---	Road condition_	.561
RC3	<---	Road condition_	.517
RC2	<---	Road condition_	.744
RC1	<---	Road condition_	.618
PP6	<---	Parking_problem_	.721
PP5	<---	Parking_problem_	.727
PP4	<---	Parking_problem_	.638
PP3	<---	Parking_problem_	.827
PP2	<---	Parking_problem_	.670
PP1	<---	Parking_problem_	.777
PG5	<---	popn_growth	.663
PG4	<---	popn_growth	.636
PG3	<---	popn_growth	.837
PG2	<---	popn_growth	.774
PG1	<---	popn_growth	.787
VN5	<---	Vehicles_no_increase	.478
VN4	<---	Vehicles_no_increase	.527
VN3	<---	Vehicles_no_increase	.738
TT1	<---	Economic Cost	.754
TT2	<---	Economic Cost	.780
TT3	<---	Economic Cost	.609
TT4	<---	Economic Cost	.489

TT5	<---	Economic Cost	.769
TT6	<---	Economic Cost	.661
TC1	<---	Traffic_congestion_Severity	.667
TC2	<---	Traffic_congestion_Severity	.749
TC3	<---	Traffic_congestion_Severity	.651
TC4	<---	Traffic_congestion_Severity	.728
TC5	<---	Traffic_congestion_Severity	.685
TC6	<---	Traffic_congestion_Severity	.605
RC7	<---	Road condition_	.470
TC7	<---	Traffic_congestion_Severity	.517
VN1	<---	Vehicles_no_increase	.805
VN2	<---	Vehicles_no_increase	.758
PTM5	<---	Traffic_mgnt	.319
PTM4	<---	Traffic_mgnt	.391
PTM3	<---	Traffic_mgnt	.451
PTM1	<---	Traffic_mgnt	.741
PTM2	<---	Traffic_mgnt	.494
PTM6	<---	Traffic_mgnt	.659
FC1	<---	Economic Cost	-.062
FC2	<---	Economic Cost	.022
FC3	<---	Economic Cost	.020
FC4	<---	Economic Cost	.088