

**IMPROVING FLEET MANAGEMENT SYSTEM: A CASE OF
OROMIA TRANSPORT AUTHORITY OFFICE**



Lemma Dilalessa Alula

A Thesis Submitted to
The Department of Mechanical Systems and Vehicle Engineering
School of Mechanical, Chemical and Materials Engineering

Presented in Partial Fulfillment of the Requirement for the degree of Master
of Science in Automotive Engineering

Office of Graduate Studies
Adama Science and Technology University

February, 2022 G.C
Adama, Ethiopia

**IMPROVING FLEET MANAGEMENT SYSTEM: A CASE OF
OROMIA TRANSPORT AUTHORITY OFFICE**

Lemma Dilalessa Alula

Advisor: Amana Wako (PhD)

A Thesis Submitted to

The Department of Mechanical Systems and Vehicle Engineering

School of Mechanical, Chemical and Materials Engineering

Presented in Partial Fulfillment of the Requirement for the degree of Master
of Science in Automotive Engineering

Office of Graduate Studies

Adama Science and Technology University

February, 2022 G.C

Adama, Ethiopia

APPROVAL OF BOARD OF EXAMINERS

I, the advisor of the thesis entitled “Improving Fleet Management System: A case of Oromia workers service bus of Finfine Transport Authority” and developed by Lemma Dilalessa, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Advisor	Signature	Date
---------	-----------	------

We, the undersigned, members of the Board of Examiners of the thesis by Lemma Dilalessa have read and evaluated the thesis entitled “Improving Fleet Management System: A case of Oromia workers service bus of Finfine Transport Authority” and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Automotive Engineering.

Chairperson	Signature	Date
-------------	-----------	------

Internal Examiner	Signature	Date
-------------------	-----------	------

External Examiner	Signature	Date
-------------------	-----------	------

Finally, approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

Department Head	Signature	Date
-----------------	-----------	------

School Dean	Signature	Date
-------------	-----------	------

Office of Post Graduate Studies, Dean	Signature	Date
---------------------------------------	-----------	------

CANDIDATE’S DECLARATION

I hereby declare that this Master Thesis entitled “Improving Fleet Management System: A case of Oromia workers service bus of Finfine Transport Authority” is my original work. That is, it has not been submitted for the award of any degree, diploma or certificate in any other university. All sources of material that are used for this thesis have been duly acknowledged through citation.

Name of the student

Signature

Date

RECOMMENDATION

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled “Improving Fleet Management System: A case of Oromia workers service bus of Finfine Transport Authority” prepared under our guidance by LEMA DILAESSA submitted in partial fulfillment of the requirements for the degree of Mater’s of Science in Automotive Engineering. Therefore, we recommend the submission of revised version of the thesis to the department following the applicable procedures.

Advisor

Signature

Date

ACKNOWLEDGEMENT

First of all, I would like to thank the almighty God, for giving me the knowledge and wisdom and providing me the resources to acquire education. I also want to thank all my parents without their support and guidance I wouldn't have been able to achieve what I have so far in life. And also, I want to thank all my teachers, all my friends specially (Jafer Adem and Cherinet Girma), and all the society supporting me by any things. I would like to express my sincere gratitude for my research advisor; Amana Wako (PhD) for his excellent guidance, moral support and constructive criticism, corrections and helps. Finally, I would like to thank, mechanical engineering teachers and others for their continuous support and comments.

TABLE OF CONTENTS

CONTENTS	PAGE
APPROVAL OF BOARD OF EXAMINERS	i
CANDIDATE'S DECLARATION	ii
RECOMMENDATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
ACRONYMS	x
ABSTRACT	xi
CHAPTER ONE.....	1
INTRODUCTION	1
1.1. Background	1
1.2. Statement of the problem	2
1.3. Objectives of the study	3
1.3.1. General Objective	3
1.3.2. Specific Objectives	3
1.4. Significance of the Study	3
1.5. Scope of the study	3
1.6. Limitation of the Study	4
1.7. Organization of the Study	4
CHAPTER TWO.....	5
LITERATURE REVIEW	5
2.1. Introduction	5
2.2. Fleet Management System	5
2.3. Advantages of Fleet Management Systems	6
2.4. Fleet Management Systems in the Transport Industry	8
2.6. Fleet Management Tracking.....	10
2.7. Essential Operational Stages in Fleet Management	11
2.8. Operational Efficiency	11
2.9. Vehicle Maintenance and Operations	12
2.9.1. Classification of Maintenance	13
2.9.2. Trained Maintenance Planners.....	16

2.9.3. Lines of Reporting for Maintenance	16
2.10. Vehicle Tracking System	16
2.11. Characteristics of Vehicle Operations	18
2.12. Fuel Management Systems.....	18
2.12.1. Developing Fuel Management.....	19
2.12.2. Assigning a Fuel Champion.....	19
2.12.3. Fuel Selection	20
2.13. Driver Training.....	20
2. 14. Vehicle routing and scheduling.....	23
2.15. Conceptual Framework	25
2.16. Model Specification: Ordinal Logistic Regression	25
2.17. Validity of the Study	26
2.18. Reliability of the Study	27
CHAPTER THREE	28
MATERIALS AND METHODS	28
3.1. Introduction	28
3.2. Study Design and Approach.....	28
3.3. Target Population area and Sampling Design	28
3.4. Sources of Data	29
3.5. Data Analysis	29
3.9. Ethical Consideration	30
3.10. Capital and Operating Cost	30
3.11. Discussions of the Existing Maintenance Problems	35
3.12. Major problems of the existing maintenance problems	36
3.13. Analysis of existing maintenance management system of M/S OTA.....	37
CHAPTER FOUR	38
RESULTS AND DISCUSSION.....	38
4.1. Introduction	38
4.2. Vehicle category and type	38
4.3. Response rate.....	38
4.4. Descriptive Analysis	40
4.4.1. Assessment of Employee Perspective on Vehicles Repair and Maintenance Practice.....	41
4.4.2. Assessment of Employee Perspective on Fuel Management.....	42
4.5. Hypotheses Testing	43

4.5.1. Econometrics result.....	43
4.5.2. Estimation result	44
4.6. Maintenance management systems	44
4.6.1. Standardization and codification	44
4.6.2. Codification and its application	47
4.7. Proposed For Departmental Codes.....	48
4.9. Summary	50
CHAPTER FIVE	52
CONCLUSION AND RECOMMENDATION	52
5.1. Conclusions	52
5.2. Recommendations	53
5.3. Future work	53
REFERENCES	55
APPENDIXES.....	i
Appendix A. Questionnaire	i
Appendix B. Data Collected from Oromia Transport Authority Office.....	iv
Appendix C. Technical Specification pf Tata 61 Seat Bus	vi

LIST OF TABLES

TABLE	PAGE
Table 2.1. Operational efficiency	12
Table 3.1. Type of buses and their purchase price	31
Table 3.2. Table of costs.....	34
Table 4.1. Total fleet.....	38
Table 4.2. Cross tabulation of educational level, gender and work experience	39
Table 4.3. Vehicles repair and maintaining practice	41
Table 4.4. Fuel management system	42
Table 4.5. Parameter Estimates	44
Table 4.6. Proposed departments and their codes for standardization	48
Table 4.7. Proposed equipment maintenance & sub class codifications	49
Table 4.8. Proposed preventive maintenance code.....	50
Table A.1. Questionnaire to be filled by the respondents	ii
Table C.1. Technical specification of Tata 61 Seat Bus Model	vi

LIST OF FIGURES

FIGURE	PAGE
Figure 3.1. Photo: Partial views of OTA depot	29
Figure B.1. Insurance data collected from Oromia transport authority office	iv
Figure B.2. Comparison of respondents based on gender	iv
Figure B.3. Comparison of respondents based on educational level.....	v
Figure B.4. Comparison of respondents based on work experience	v
Figure B.5. Comparison of cost per year.....	vi

ACRONYMS

EDHS	Ethiopian Demographic and Health Survey
FMS	Fleet Management System
FMSD	Fleet Management System Department
GPS	Global Positioning System
MS	Management System
OLR	Ordinal Logistic Regression
OTA	Oromia Transport Authority
PSV	Public Service Vehicles
PTS	Public Transport Service
VRP	Vehicle Routing Problem

ABSTRACT

Fleet management refers to the overall actions that take place to keep a fleet running efficiently, on time, and within budget. It can be defined as the processes used by fleet managers to monitor fleet activities and make decisions from asset management, dispatch and routing, and vehicle acquisition and disposal. It helps organization ensure compliance, improve efficiency, and reduce costs. The purpose of the thesis was to assessing the existing fleet management system of the organization, rectifying the identified problem areas, and key potential areas for the improvement of the system. In order to achieve the goal of the study, the researcher mainly used quantitative data analysis techniques. Descriptive statistics such as mean, percentage and frequency were used in the form of table, chart, graph, and other necessary methods were used to analyze the raw data. From the total population of 250 employs 200 sample was used by using availability sampling techniques. The study incorporates four independent variables in which all of them was measured on a 5-point Likert-Scale, with “1” stands for “Strongly disagree”, “2” stands for “disagree”, “3” stands for “neutral”, “4” stands for “agree”, and “5” stands for “Strongly Agree”. Apparently, mean was used as a measure of central tendency. The study also found a positive correlation among the four of the variables (repair and maintenance, fuel management, vehicle tracking and drivers’ management). Regarding the correlation, it is possible to conclude that there is a strong and positive relationship among the four variables which this study was relied. Based on the result of study operational efficiency of the transport is weak. The office should have to give a critical emphasis on assigning adequate budget for fuel cost and should manage fuel consumption and maintenance scheduling properly through developed better financial system and by recruited well educated manager by giving training for the employs of the fleet department.

Keywords: *fleet management, fuel efficiency, maintenance management, vehicle tracking.*

CHAPTER ONE

INTRODUCTION

1.1. Background

Fleet management is an administrative approach that allows companies to organize and coordinate work vehicles with the aim to improve efficiency, reduce costs, and provide compliance with government regulations. While most commonly used for vehicle tracking, fleet management includes following and recording mechanical diagnostics and driver behavior. Fleet management is used by couriers, oil and gas delivery, utilities, repair and service industry businesses to ensure responsible vehicle use, confirm safety and enable real-time tracking.

A sustainable fleet management strategy is one that aims to reduce environmental impacts through a combination of cleaner vehicles and fuels, fuel-efficient operation and driving; and by reducing the amount of road traffic it generates. In doing so the fleet minimizes fuel and vehicle costs and improves the safety and the welfare of employees especially in developing countries while reducing its exposure to the problems of overcrowding (Besiou, et al., 2012).

Nowadays, for governmental and non -governmental organization, it is favorable to have a huge fleet of vehicles, since it improves the efficiency and equal opportunity of support activities. Nevertheless, the activities and management of large fleets cannot be easy for logisticians (Huang et al., 2012).

Transport and logistics are both key components of a successful economy. Governments worldwide seek to increase their competitiveness through new or replacement of infrastructure. The transport and logistics sector plays a major role in the world economy and is a significant contributor at both the national and local level in any country. This sector underpins the economy, enabling the efficient movement of goods, services and people. The increase in the associated management requirements of vehicle fleet operations has more important than the human mental capacity as advances in the technology of vehicular dynamics and design increase year after year.

Transportation is at the center of logistics as it represents the physical movement of materials between points in a supply chain. High customer expectations and little tolerance

for inadequate performance create a competitive environment for operating a fleet, which forces fleet managers to achieve high levels of reliability and cost-efficiency.

For some organizations, their vehicle fleet management is the main activity in their value chain, and represents its major asset to provide its service. This would be the case for passenger transportation companies, ground shipping, car rentals, renting companies, taxicabs, mail services, or cleaning and trash collection services provided by city councils.

The volume of transportation, directions and nomenclature of transportations is considered by transport logistics. Defines the subjects of the commodity market, which belong to the subsystems of transportation logistics, which are managed and managed. Variants of transportation, which depend on the types of used vehicles (rail, road, water, air, pipeline), mixed transport, several types of transport, are important for transportation logistics. Thus, the development of logistics has had a significant impact on transport policy and structural changes in the nature of the enterprises of this industry, which in the late 70ies of the century turned into a kind of narrow place in the economy of industrialized countries. Transport plays the role of a connecting link in the logistic chain production in the conditions of inter-industry, and inter-sectoral integration. At the same time, transport provides transportation services on the market, for which they also make a profit. Actuality of problems of management and optimization of transport work is confirmed by the fact that the share of transport costs is 40- 50% of the total amount of logistics costs. In modern logistics of transport there are many problems. The study of these problems was dealt with and addressed by various authors of books, articles on logistics and transport logistics, and conferences on their study and decision

1.2. Statement of the problem

Unnecessarily high fuel costs, speeding fines, excessive maintenance bills, and unhappy customers discontinuing their business. All of these things lead to a fleet making less money. Fleet tracking systems helps to find out what the real problems in the business are, get the appropriate data company need to fix them and make it fleet a more profitable, less painful, venture. Fuel, insurance, vehicle maintenance the lists of costs on fleet can incur fleet management. Vehicle fleets is a business venture, and want it to turn a profit. Even if it's already turn a profit, increasing that margin can only be good for the organization, employee business and drivers. In recent times, it appears the office has been experiencing some challenges in its vehicle management and administration. The policies and regulations on vehicle use, management and control for effective and efficient running of

activities with the view of ensuring value for money has become a challenge. Recent report indicates increasing cost in vehicle running and maintenance. This notwithstanding, there has been no empirical study regarding the challenges of vehicle fleet management and control in the transport office.

1.3. Objectives of the study

1.3.1. General Objective

The general objective of this thesis is to Improving Fleet Management System: A case of Oromia Transport Authority Office.

1.3.2. Specific Objectives

The specific objectives of the study are to:

- ✓ Collect data related to maintenance of vehicle and fuel being used by each vehicle;
- ✓ Evaluate vehicle management system and to identify the causes of the existing problems;
- ✓ Access the vehicle maintenance system and critically examine problems of the existing maintenance system organization;
- ✓ Improve vehicle maintenance system.

1.4. Significance of the Study

Assessing the effects of fleet management has significant importance for an organization to operate the service worldwide. And also expected to have a contribution for the organization to improve their fleet management system through providing a solution for discovered problems and this study can initiate other researchers to make further study on fleet management. So, the finding and the recommendation of the study may help in decision making of the organization by understanding the existing fleet management problems to improve or fill the gap. This thesis will have significant contribution to the organization to have a well-established fleet management system and maintenance system which provides better service to the country.

1.5. Scope of the study

The scope of this study is limited to the study of the empirical research problems related to Fleet management study process involved in accomplishing the various fleet management studies carried out in Oromia transport authority fleet management and the possible implications in terms of reducing (minimizing) the risk as well as fixing in future. The study was delimited to single organization and small sample because of time constraints.

1.6. Limitation of the Study

In vehicle tracking, allocate sufficient budget for fuel cost, modern technology of GPS for vehicle tracking system, the issue of installed vehicle tracking system, assigned a person to monitor and manage the GPS tracking, supervises speed limit by GPS tracking system, provide immediate solution for problems encounter in vehicle tracking and the tracking system to manage fuel consumption and maintenance scheduling were another dimension which is deprived by the organization.

1.7. Organization of the Study

This thesis consists of five chapters. The first chapter is an introduction to the study. It includes background of the study, statement of the problem, both general and specific objectives study, significance of the study, scope of the study, limitation of the study, and organization of the study. The second chapter focused on different kinds of literature that emphasize on previous related investigation. Chapter three describe the method follow to get best result, way of data gathering and analyzing method. Chapter four consists of the results and discussions of the finding. The final chapter of the thesis consists of conclusion, recommendation, and Future work areas.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

Fleet management is the management of commercial motor vehicles such as cars, vans, trucks, specialist vehicles (such as mobile construction machinery), forklifts, and trailers, Private vehicles used for work purposes, Aviation machinery such as aircraft (planes and helicopters), Ships, Rail cars. and non-powered assets such as generators, tanks, gear boxes, dumpsters, shipping containers, trailers, excavators, and other equipment that can't run on its own power Fleet (vehicle) management can include a range of functions, such as vehicle leasing and financing, vehicle maintenance, licensing and compliance, supply chain management, accident management and subrogation, vehicle telematics (tracking and diagnostics), driver management, speed management, fuel management, health and safety management, and vehicle re-marketing. Fleet Management is a function which allows companies which rely on transportation in business to remove or minimize the risks associated with vehicle investment, improving efficiency, productivity and reducing their overall transportation and staff costs, providing 100% compliance with government legislation (duty of care) and many more. These functions can be dealt with by either an in-house fleet-management department or an outsourced fleet-management provider. The number of light duty vehicles registered in commercial fleets in Europe as of 2016 was 15 million, and 19.5 million in North America. Even with these record numbers of registration, light duty vehicles represent only 62% of all fleet sales ([http://www. Wikipedia](http://www.Wikipedia), 2017).

2.2. Fleet Management System

A fleet management system is a digital platform for monitoring and managing vehicles and technicians at the same time, a fleet management system can provide instant access to a variety of historical reports like ongoing maintenance costs, technician and driver productivity summaries, and weekly fuel or mileage logs. The timely replacement of vehicles and equipment is a process that requires the ability to predict asset lifecycles based on costing information, utilization, and asset age. Organizations prefer to use new fleet as a strategy for cost reduction where the used fleet is sold so that a new fleet is maintained. Fleet Management is a function which allows companies which rely on transportation in business to remove or

minimize the risks associated with vehicle investment, improving efficiency, productivity, and reducing their overall transportation and staff costs, providing 100% compliance with government legislation (duty of care) and many more. These functions can be dealt with by either an in-house fleet-management department or an outsourced fleet-management provider (Bekiaris et al., 2004).

Vehicle fleet management is the proactive management of an organization's vehicle assets, which may include light vehicles, heavy vehicles, specialist vehicles and motorcycles. Fleet management covers a range of functions, including vehicle procurement and financing, vehicle maintenance, vehicles telemetric (tracking and diagnostics), driver and personnel management, speed management, fuel management, and health and safety management.

In recent times, to address problems in fleet management and the ever expanding need to monitor usage of vehicles, commercial organizations have designed automated control systems and other approaches to vehicle management. Simple management systems can be designed in-house for internal use to provide a good analysis of the vehicles and driver performance.

Vehicle management systems are structured in a way that enables the capturing of information on various aspects of fleet usage, maintenance and operations. This information includes the distances travel that the car covered in a certain period of time which is the initial and final destination (location) that contain rout of operation this info showing official and private mileage.

2.3. Advantages of Fleet Management Systems

Fleet management technology offers businesses of all shapes and sizes multiple benefits. For a start, it allows them to monitor operations efficiently, serving as a digital blueprint for promoting efficient and safe driving. This can help to decrease risk and drive down costs a win-win. In many ways, it has become an essential tool for businesses.

Fleet management is done in order to enhance the quality of the company's service and to develop efficiencies to make the service more effective (Man, 1979).

Nowadays, management and planning as well as control and monitoring of various activities in transportation sectors are considered to be extremely important at a global level and can lead to further developments in economic, social, and even political fields. The fleet

management system was developed based on the above approach and made available to applicants and various users so that they could plan the mission, service, and operational vehicle based on actual and exact objective information for the purpose of providing better control and monitoring with due attention to the content of the assigned missions. The following advantages can be enumerated for this system

- Management of vehicles fuel consumption based on daily, monthly, and annual reports provided for a particular vehicle or a group of vehicles.
- Efficient and exact management of the vehicle fleet and increase supervision.

Promotion of system efficiency and considerable reduction of control and monitoring costs compared with traditional operator-based supervisory systems (Tadele, 2007).

- Receiving exact performed and operation information from the vehicles
- Increase the fleet management system efficiency
- Considerable reduction of driving violations during in-service periods
- Increase the customer satisfaction and staff transparency
- Possibility of evaluating the performance of the affiliated organizations
- Standardization of the implemented concepts and forms within the executive organizations for the purpose of correcting the existing methods and preventing subjective trends to govern various processes.
- Improves Customer Service and Satisfaction
- Improved Insurance Benefits
- Improve Safety for the Fleet
- Improve Vehicle Fuel Efficiency
- Automate Your Fleet Reports
- Monitors and records driving behavior such as speeding, hard braking and acceleration, idling and more with advanced on-board computing and, online information and tracking portal
- Generates customizable reports with data collected to see where and when drivers engage in risky driving behaviors
- Provides 24/7 access to reporting for anytime analytics and review

- Gives real-time light or sound feedback and notifications to drivers via in-cab displays when pre-defined parameters are exceeded
- Records footage via an in-cab video solution to see what occurred before, during and after any incidents on the road
- Heightens safety awareness and personal responsibility amongst drivers using driver performance apps
- Offers the opportunity to provide training and, reward and incentive programs by using vehicle and driver data to create accurate scoring

2.4. Fleet Management Systems in the Transport Industry

Fleet management is an invincible part of the logistics industry. Without proper fleet management, it's impossible to imagine a successful logistics business. Any industry is based on the flow of goods from one place to another. Any glitches in the flow can eventually lead to disruption of work, leaving behind unsatisfied clients.

In today's competitive marketplace, it is imperative that businesses operate at peak efficiency, provide timely customer service and still make a profit. Thus, in view of these realities, it is often crucial for business owners to discover those areas in terms of which cost effectiveness may be improved.

ICT systems affect competition in the logistics sector in three distinct ways. Firstly, ICT systems may change the structure of the logistics industry, and even modify the rules of competition. This is due to the fact that ICT systems offer new value-added services that previous paper-based administration could not. Moreover, the ICT systems lead to higher efficiency and effectiveness, which affect their competitiveness. Secondly, ICT may be used to create sustainable competitive advantage and provide firms with new competitive instruments. Thirdly, ICT systems do not necessarily need to change existing processes, but rather facilitate their execution within the current business model (Azevedo et al., 2007).

Technology is usually the driving force behind such discoveries. Organizations that manage fleets or a mobile sales force as well as field service organizations are facing many challenges. These challenges include improving compliance and organizational communications, reducing costs, and improving customer satisfaction. As a result, fleet management systems are perceived in terms of how they are able to benefit companies by realizing efficiency and profitability.

In the knowledge-based economy of today, the rapidly changing and uncertain environment means that transport firms are facing their biggest challenge in how to address the current situation and capture a competitive advantage. The increasing competence in the market is an important factor that drives the adoption of new technologies and innovation, as companies search for new opportunities to cut costs by improving process efficiency or by developing new products (Hidalgo & Lopez, 2009).

2.5. Dynamic fleet management

Classical fleet management problems address the development of routing and scheduling plans for the transport means with the objective of cost efficiency and customer satisfaction. However, unforeseen events could affect the performances of the transport operations, such as customer orders arriving in real-time, travel times delays, breakdowns and so on. Dynamic fleet management exploits information provided by communication technologies (mobile and satellite) in order to improve the real-time use of transport resources. Moreover, the deployment of Intelligent Transportation Systems technologies, in particular accurate positioning devices and in-vehicle computing and communication equipments, opens up the possibility of enhanced customer service and increased productivity by re-routing vehicles in real-time to serve new requests. One only needs the appropriate methodology to transform these data into accurate and timely decisions. It is thus normal that a significant line of research addresses the issues of real-time dispatching, routing, and re-routing of vehicles in response to changes in demand, travel time or other conditions of travel. This information can be conveyed via Advanced Travelers Information Systems, as well as wireless or on-board communication devices.

Zeimpekis, et al. (2007) in their book collect important advances in dynamic vehicle routing and fleet dispatching from methodological and computational point of view. Moreover, several case studies relative to different transport modes, such as air transport, intermodal transport of hazardous materials, courier fleet and city logistics, are illustrated. Cheung et al. (2008) develop and analysis a mathematical model for dynamic fleet management that captures the characteristics of modern vehicle operations. The model takes into consideration dynamic data such as vehicle locations, travel time, and incoming customer orders. The solution method includes an effective procedure for solving the static problem and an efficient re-optimization procedure for updating the route plan as dynamic information arrives.

Computational experiments show that the re-optimization procedure can generate near-optimal solutions. In this framework, the research focused on models and algorithms for the real-time vehicle routing problem. There are well-known integer programming approaches that give an almost exact solution to such a model, but they may require much longer computational time for large-size problem instances. For the dynamic-update module, the quick heuristic procedure can generate good updated solutions in seconds, and the effectiveness of the heuristic is also demonstrated computationally. In fact, a critical issue in real-time settings is that of response time. In situations such as emergency vehicle management, or when a customer is waiting for a decision, there is no time to compute an “optimal” response when a call is received. This does not preclude, however, the use of deliberate decision making to optimize the response: one simply has to find ways of anticipating future events in an effective fashion. Thus, for example, one may combine data processing and forecasting methods, optimization-simulation models, and decision heuristics into comprehensive decision-support systems. The optimization-simulation models continuously generate and evaluate future conditions and deployment scenarios, while rapid, simpler heuristics respond in real-time to customer requests or changing conditions (congestion, accidents, and so on).

2.6. Fleet Management Tracking

Aside from theft-prevention the most common use of vehicle tracking is in logistics and transport. These systems make use of GPS technology to provide precise and constant location telemetric to an individual fleet manager. These systems are typically equipped with features to monitor statistics such as; fuel consumption, average speed, current driver time and location. There has been a recent increase in demand for this technology as regulations place increased restrictions on the hour’s driver are allowed to work in a given day. It is currently limited to 9 hours per day. Companies are legally obligated to install a tachograph in any vehicle that is expected to carry goods. This obligated has led many to attempt to cauterize this potentially onerous obligation, instead turning it into a benefit. Fleet management systems utilize GPS technology. Much like other forms of trackers, although due to their nature they are equipped with more thorough diagnostic features (Dolce, 1998).

2.7. Essential Operational Stages in Fleet Management

As (Scott, 1998), the approach to operating fleets has many similarities with the management process of any operation that is in place to meet a specific service need. The essential operational stages are:

- understanding the service level requirement;
- developing a strategic plan to meet that requirement;
- understanding the external pressures that may affect the ability to deliver the service
Selecting, or reviewing, the assets, equipment, buildings and systems used to deliver the service, as well as the staff required to make the operation work;
- actively managing the operation to ensure maximum day-to-day efficiency;
- monitoring performance learning from other similar operations reviewing and amending the strategic plan in the light of measured performance, changes in service need, available resources and other factors;
- Instigating a process of continuous improvement.

A series of high-level strategic decisions needs to be taken at the outset, to set the overall framework for fleet efficiency improvements. These decisions include: Firstly, does the organization really need to run a fleet at all. If so, should the fleet be owned and Managed within the sector or should parts of the service provision be outsourced to a private sector company? Is it possible that operational collaboration with other public sector organizations and joint use of resources could reduce the overall resources required?

2.8. Operational Efficiency

In operational fleet management, the two tools that can be used to improve operational efficiency are the minimization of fuel consumption and the maximization of vehicle utilization - while still meeting required service levels (Scott, 1998).

Table 2.1. Operational efficiency

Responsible body	Tasks
Strategic manager	Reducing fuel consumption will save the organization money and allow Delivering services more efficiently. A fuel management program will Reduce the environmental impact of fleet and can improve the image of the Organization. Better vehicle utilization can reduce the need to purchase new Vehicles.
Fleet manager	A fuel management program can save money, which can be used in other Areas to improve operations. Communications and telemetric technology Can improve vehicle utilization; reduce the need for new vehicles and lower Operating costs.
Operations manager	Driver training: Driver skills development can reduce accidents and damage and allow delivering services more effectively. As the person with Front-line responsibility for drivers, it is up to you to encourage safe and Fuel-efficient driving techniques.

2.9. Vehicle Maintenance and Operations

Maintenance, repair and operations (MRO) involves maintaining, repairing, and replacing, if necessary, devices, equipment, machinery, building infrastructure, and supporting utilities in industrial, business, governmental, and residential installations. Over time, this has come to often include both scheduled and preventive maintenance as cost-effective practices. Scheduled inspections have also come to fall under MRO purview (Defense Logistics Agency, 2016).

More recently, 'predictive maintenance' is being employed, which uses sensor data to monitor a system, then continuously evaluates it against historical trends to predict failure before it occurs. In aircraft maintenance, maintenance, repair and overhaul services also include inspection, rebuilding, alteration and the supply of spare parts, accessories, raw materials,

adhesives, sealants, coatings and consumables for aircraft manufacturing and maintenance, repair and overhaul services. The marine transportation, offshore structures, industrial plant/equipment and commercial facilities market sectors depend on scheduled or preventive paint maintenance programmers to maintain and restore coatings applied to steel, and also concrete and masonry assets in environments subject to attack from erosion, corrosion and environmental pollution (Garcia, et al., 2006).

Although vehicle maintenance policies are predominantly governed by safety, it is important to remember that vehicle performance and fuel consumption are also affected by maintenance standards. Turbochargers, fuel injection systems, tyre, axle alignment and oil and lubricants are just a few of the factors that have an impact on fuel consumption and should always be maintained to high standards.

It is essential to remind drivers of their responsibility to undertake daily walk-around checks of vehicles. This not only helps to ensure that vehicles remain in legal roadworthy condition, but also helps identify common problems such as oil and water leaks and incorrect tyre pressure. There is also scope to make improvements in the way maintenance facilities themselves are operated (Richardson, N. 2011).

2.9.1. Classification of Maintenance

Maintenance may be categorized into the following major types:

- (1). As required maintenance:** as required maintenance is simply doing maintenance works as the need develops (arise). This type of maintenance is applied for non-critical equipments.
- (2). Conditioned based maintenance:** is a maintenance activity conducted to prevent failures before it happens using sensing, measuring, or condition monitoring devices to detect wear stages. CBM is the maintenance which is normally done when operating conditions deviate from the norm. It is done to detect incipient failures long before they occur (Veldman et al., 2011). It uses condition monitoring techniques to determine whether a problem exists in running equipment and for how long the equipment can operate before failure. This maintenance management practice detects and identify specific components in an equipment that are degrading, determine root cause of the problem and take remedial actions before failure of the equipment or operating asset (Tsang et al., 1999).
- (3). Preventive maintenance:** PM is done to prevent the occurrence of failures and to detect failures before they develop to break down or disturbances in operation (product/service).

Preventive maintenance has become a term with broad definition. The generic definition of PM is any planned maintenance activity that is designed to improve equipment life and avoid any unplanned maintenance activity. In its simplest form it can be compared to the service schedule for vehicle. There are certain tasks scheduled at varying frequencies, all designed to keep the vehicle from experiencing any unexpected breakdowns (Tadele, 2007).

2.9.1.1. Breakdown maintenance

In these programs, less concern is given to the operating condition of critical plant machinery, vehicles, or systems. Since most of the maintenance tasks are reactive to breakdowns or production interruptions, the only focus of these tasks is how quickly the system can be returned to service. Breakdown maintenance has two factors that are the primary contributors to high maintenance costs: (1) poor planning and (2) incomplete repair. The first limitation of breakdown maintenance is that most repairs are poorly planned because of the time constraints imposed by production and plant management. As a result, manpower utilization and effective use of maintenance resources are minimal. Typically, breakdown or reactive maintenance will cost three to four times more than the same repair when it is well planned. The second limitation of breakdown maintenance is that it concentrates repair on obvious symptoms of the failure, not the root cause. This normal result of breakdown maintenance is an increase in the frequency of repairs and a marked increase in maintenance costs (K.Pathak, 2002).

2.9.1.2. Preventive maintenance

PM is a planned or schedule maintenance that is done on the onset of failure to prevent or delay breakdowns and to minimize the impact of a breakdown (Wild, 2002). This maintenance management practice is based on the principle that prevention is better than cure. It consists of maintenance activities performed before equipment breaks down with the intent of keeping it operating acceptably to reduce likelihood of failure (Dilworth, 1992). The advantages of this practice are that it reduces rate of breakdowns, increases asset availability, maintain optimum efficiency of the equipment and reduces workload on maintenance staff. PM also increases productivity and safety of the workers (Murthy, 2005).

The concept of preventive maintenance has a multitude of meanings. A literal interpretation of the term is a maintenance program that is committed to the elimination or prevention of corrective and breakdown maintenance tasks. A comprehensive preventive maintenance

program will utilize regular evaluation of critical plant Vehicles, machinery, and systems to detect potential problems and immediately schedule maintenance tasks that will prevent any degradation in operating condition. In most plants, preventive maintenance is limited to periodic lubrication, adjustments, and other time-driven maintenance tasks. These programs are not true preventive programs. In fact, most continue to rely on breakdowns as the principal motivation for maintenance activities. A comprehensive preventive maintenance program will include predictive maintenance, time-driven maintenance tasks, and corrective maintenance to provide comprehensive support for all plant production or manufacturing systems. Preventive replacement: - these include the replacement of parts and components that have a definite life. Such type of replacement helps to avoid emergency situations and prolonged down time and risk of hazards associated with a sudden break down. Inspection measurement: - inspection measurements comprise jobs of preventive maintenance that aim at identifying the degradation rate and such items which are at un acceptable service conditions. This type of maintenance work requires many costly instruments and laboratory testing facilities (K.Pathak, 2002).

2.9.1.3. Corrective maintenance

The primary difference between corrective and preventive maintenance is that a problem must exist before corrective actions are taken. Preventive tasks are intended to prevent the occurrence of a problem. Corrective tasks correct existing problems. Corrective maintenance, unlike breakdown maintenance, is focused on regular, planned tasks that will maintain all critical plant machinery and systems in optimum operating conditions. Maintenance effectiveness is judged on the life-cycle costs of critical plant machinery, vehicle, and systems, not on how fast a broken machine can be returned to service. Corrective maintenance, as a subset of a comprehensive preventive maintenance program, is a proactive approach toward maintenance management. The fundamental objective of this approach is to eliminate breakdowns, deviations from optimum operating condition, and unnecessary repairs and to optimize the effectiveness of all critical plant systems. The principal concept of corrective maintenance is that proper, complete repairs of all incipient problems are made on an as-needed basis. All repairs are well planned, implemented by properly trained craftsmen, and verified before the machine or system is returned to service. Incipient problems are not restricted to electrical or mechanical problems. Instead, all deviations from optimum operating condition, that is, efficiency, production capacity and product quality, are corrected when

detected. All corrective repairs or maintenance must be well planned and scheduled to minimize both cost and interruption of the production schedule. Adequate time must be allowed to permit complete repair of the root cause and resultant damage caused by each of the identified incipient problems (Maintenance Management Accreditation Standards, 2006).

2.9.2. Trained Maintenance Planners

Many plants do not have full-time maintenance planners or their planners lack the knowledge or skills that the job demands. It is therefore imperative that proper training is provided to ensure that each planner has the skills necessary to properly plan repairs and maintenance tasks (Man, 1979).

2.9.3. Lines of Reporting for Maintenance

Many feel that a maintenance department functions best when it reports directly to top management. This is similar in concept to the philosophy of having departments with umpire-like functions reporting impartially to overall management rather than to the departments being serviced. This independence provides necessary environment to achieve objectivity in the performance of the maintenance engineering function. However, in many plants the level of reporting for the individual in charge of the maintenance engineering group has little or no bearing on effectiveness. If maintenance supervision considers itself part of production and its performance is evaluated in this light, it should report to the authority responsible for plant operations. The need for sharply defined authority is often overemphasized for service or staff groups. Performance based on the use of authority alone is not and cannot be as effective as that based on cooperative efforts. Certainly, it is not practical to permit maintenance engineering to report to someone without full authority over most of the operations that must be served by it. The lack of such authority is most troublesome in assigning priorities for work performance. Maintenance engineering should report to a level that is responsible for the plant groups which it serves-plant manager, production superintendent, or manager of manufacturing depending on the organization. The need to report to higher management or through a central engineering department should not exist so long as proper interplant relationships have been established (Man, 1979).

2.10. Vehicle Tracking System

A vehicle tracking system combines the use of automatic vehicle location in individual vehicles with software that collects these fleet data for a comprehensive picture of vehicle

locations. Modern vehicle tracking systems commonly use GPS technology for locating the vehicle, but other types of automatic vehicle location technology can also be used. Vehicle information can be viewed on electronic maps via the Internet or specialized software. Urban public transit authorities are an increasingly common user of vehicle tracking systems, particularly in large cities. Vehicle tracking systems are commonly used by fleet operators for fleet management functions such as fleet tracking, routing, dispatching, on-board information and security. Some vehicle tracking systems are bundled with or interface with fleet management software. Along with commercial fleet operators, urban transit agencies use the technology for a number of purposes, including monitoring schedule adherence of buses in service, triggering automatic changes of buses' destination sign displays once the vehicle approaches the bus terminus (or other set location along a bus route such as a particular bus stop along the route), and triggering pre-recorded (or even synthetic speech) bus stop, route (and its destination) or service announcements for passengers (Penton, 2011).

Global Positioning System (GPS) vehicle tracking has rapidly gained popularity among fleet owners as the technology becomes more affordable and easier to access. In general, GPS vehicle tracking utilizes a space-based global navigation satellite system to track time and location information of fleet vehicles. This information is then transmitted to a remote user who can monitor vehicle location, speed, routing, idle time, engine start up and shut down, and much more. This information can be used to improve a host of fleet management operations including the reduction of fuel costs. According to a study by the Aberdeen Groups (a research firm that studies the effects of technology) on business, fleets with GPS tracking installed experience a 13 percent reduction in fuel costs on average. Vehicle's maintenance is an important but also challenging task, especially if you do not have a complete maintenance solution. The first step to taking control over your fleet maintenance is to look at your options. You can choose to go with either a maintenance-focused software or GPS tracking software that includes a maintenance module. GPS tracking is a better option because not only do you get the ability to monitor maintenance, you will also have complete insight to your fleet with location intelligence for all your vehicles and heavy equipment. With custom maintenance platforms, such as the GPS Insight Maintenance Module, you can enter in any type of service based on mileage, run time hours, or dates. Maintenance reminders will be sent straight to

your team or can be displayed on the tracking software's dashboard. This can be any preventative maintenance needed.

2.11. Characteristics of Vehicle Operations

The range of goods vehicles operated is extremely broad and comprise activities are diverse. While they may not apply to all organizations, some of the key characteristics of many fleets are that: Vehicles are often driven by staff not specifically employed as drivers Vehicles are often employed on specialized operations with limited opportunities for use on other activities Vehicles tend to have relatively low average annual mileages and are frequently confined to specific geographical areas due to the specialized nature of equipment, vehicles tend to be kept in service for a long time. Additionally, fleets are often operated under a broad range of internal and external constraints, including financial, environmental and social policies (Jose, 2016).

2.12. Fuel Management Systems

Fuel management systems are used to maintain, control and monitor fuel consumption and stock in any type of industry that uses transport, including rail, road, water and air, as a means of business. Fuel management systems are designed to effectively measure and manage the use of fuel within the transportation and construction industries. They are typically used for fleets of vehicles, including railway vehicles and aircraft, as well as any vehicle that requires fuel to operate. They employ various methods and technologies to monitor and track fuel inventories, fuel purchases and fuel dispensed. This information can be then stored in computerized systems and reports generated with data to inform management practices. Online fuel management is provided through the use of web portals to provide detailed fueling data, usually the back end of an automated fuel management system. This enables consumption control, cost analysis and tax accounting for fuel purchases (Lange, 1992).

There are several types of fuel management systems. Card-based fuel management systems typically track fuel transactions based on a fueling credit card and the associated driver PIN. Reports can then be generated based on fuel consumption by driver, and data can be directly downloaded. On-site fuel management systems may employ fleet refueling services or bulk fuel tanks at the site. Fuel is tracked as it is pumped into vehicles, and on-site storage levels can be managed. Some fuel companies offer total fuel management systems whereby they

provide elements of a card-based system along with on-site fuel delivery and refueling services. Mobile fuel management refers to a fleet of fuel trucks or tankers which provide fuel supply to commercial fleets of trucks or construction equipment. The increasing use of bio-fuel has introduced another challenge in fuel management. With greater water content, there will be a risk of microbial growth depending on the storage conditions, the fuel quality will deteriorate over time, leading to clogged filters and loss of productivity (Hohn and Geoffrey M., 2011).

2.12.1. Developing Fuel Management

It is important to remember that while service delivery and road safety are paramount for fleet operations, fuel is a resource that needs to be well managed. Although fuel use varies considerably across different public and private sector fleets, it nevertheless represents a major cost in most settings. In certain operations, fuel can account for 30% or more of total operating expenses.

Establishing a formal fuel management program is an extremely effective method of making permanent and lasting reductions in the cost of the operations. Considering the size of many sectors fleets, even a minor reduction in fuel use can save thousands of pounds each year and reduce CO2 emissions by several tones (Lange,1992).

2.12.2. Assigning a Fuel Champion

It is essential to have an advocate or ‘Champion’ for your fuel management program to ensure that it is accepted throughout the organization and continues to be effective. The Fuel Champion can monitor fuel performance and provide information to the organization about the program.

Their role is to change the organization’s attitudes towards the use of fuel and encourage staff to regard fuel as one of the sector’s most valuable resources.

The key responsibilities of the Fuel Champion are:

- Understand how to gather fuel consumption information, the potential that exists to improve performance and the various ways this can be achieved
- Develop the strategies required and put them into an action plan

Investigate the factors that influence fuel consumption, such as driver performance, overloading, weather and seasonality (Hohn and Geoffrey, 2011).

2.12.3. Fuel Selection

Selection of fuel type is a key factor within the fuel management program, but from the outset it is always worth remembering that alternative fuels should only be considered after steps have been taken to optimize fleet performance. In recent years, a large number of public and private sector organizations have introduced alternative fuels into their operations in preference to conventional petrol and diesel, in an attempt to reduce emissions and lower fuel costs. While there are many benefits associated with alternative fuel use, there can also be a number of disadvantages. For example, compared to conventional fuels such as diesel, many alternative fuels may require a greater volume of fuel to be used for the same energy output. The key to effective use of alternative fuel lies in understanding the comparative strengths and weaknesses of different fuel types, some of which are shown in the following table below. It is important to note that the identification and trial of alternative fuels should only ever be one single element of a much more comprehensive fuel management program. When deciding on the most appropriate type of fuel (conventional petrol and diesel, or alternative) for a specific situation, it is worth considering: (Lange, 1992).

- The benefits to the organization
- The outcome of any known evaluations and trials
- The operational, financial and environmental advantages and disadvantages of each fuel type
- Supply availability, distances/tank range, and location of refill points
- Conversion costs
- Running costs
- Availability of funding for conversion or infrastructure
- Resale value

2.13. Driver Training

Unsafe driving makes up the majority of road traffic accidents – which are costly in terms of vehicle and equipment repairs, insurance, fines, property damage and, most importantly, the health and well-being of motorists and pedestrians alike.

For this reason, designing, implementing and managing an effective fleet driver safety training program is crucial. For that it has been three basic steps:

- Identify your fleet's driver training needs

- Choose an effective training approach
- Put your plan into motion

Importantly, your plan should present the initiative to drivers as a positive and beneficial part of their job.

To help you understand the steps that need to be taken to compile an effective fleet driver safety training strategy it better prepare short guide (Udham, 2015)

Step 1: Identify Training Needs

Before start to build an effective driver safety training program for fleet, it needs to understand the current risks associated with drivers, vehicles and daily operations and historical data relating to incidents, telemetric systems and collision reports should form the basis of any risk assessment. Using such fleet analysis tools will allow making the best training choices.

Developing a full profile of driver behavior and individual skill is a more effective and proactive approach. For example, information on speeding and harsh braking can help to determine what type of decision and performance errors are the leading causes of accidents.

Once identify existing problems and established performance benchmarks, it will be much easier to zero in on specific issues and the training required to effectively addressing them.

Driver management software is a great place to store all driver information and this information accessible from one central location.

Information such as accidents, license details, age, sex, location, daily mileage and more can be used to help generate risk profiles and highlight potential training requirements. Meanwhile driver training course information such as dates, duration and level can be attached to the driver record to monitor the initiatives success rate (Udham, 2015).

Step 2: Choose an Effective Training Approach

After identifying the need on the organization, driver then choosing an appropriate training approach is the next step. At this stage of the process, it's crucial to take cost into consideration. There are a variety of training solutions you can employ to achieve the desired results, and each comes with a number of benefits and disadvantages that they should consider:

Group Sessions and Training Workshops

This is a cost-effective method that allows training a large number of people at one time. They can be used to target and resolve common issues, however, do not allow for individual driver focused learning and can be limited in scope

On-road Fleet Driver Training

This method adds significant value when specialized vehicles and equipment is being operated. In such cases, on-road driver training is incredibly effective as the trainer or instructor is able work directly with each driver on a one-to-one basis to practice safe operating procedures.

The disadvantage of this type of training is that is can be time-consuming and expensive.

Driver Coaching

An incredibly effective training method and highly valuable for post incident review needs, driver coaching uses telematics and other data to reflect on the cause of an event, which leads to a better understanding of what went wrong, and the skills needed to improve decision making. The downside of driver coaching – like on-road training – is its higher cost and time requirements. Regardless of the types of training employed, each one should be routinely reviewed and updated based on an assessment of their effectiveness, and as the roles and responsibilities of company drivers change based on business activity and needs (Udham, 2015).

Step 3: Put your Plan into Motion

Implementing a training program is possibly the most crucial aspect to consider. A detailed strategy and plan for rolling out training schedules lets everyone involved know what to expect and when it will happen and a clear set of deadlines, expectations and a system for managing training completion will eliminate many issues and unanswered questions. Effective training completion begins with engagement by all parties, including the support of senior management. Showing such involvement – including ‘lead by example’ practices and taking part in training processes is a vital component of any successful training program. Drivers also need to know WHY they are required to undergo training to gain an understanding of HOW it can benefit the organization and them personally. For this reason, a full communication strategy for drivers is essential to the success of training program (Udham, 2015).

Bringing it all Together

There are clearly significant benefits to driver training. Better trained, more confident drivers help reduce vehicle; repair; legal; insurance; administrative and other costs associated with accidents.

Along with helping the bottom line by reducing costs, better-trained and safer drivers enhance and promote a company's reputation and image, and in many cases can promote sales growth. By employing an effective fleet driver safety training strategy, you will not only improve the performance of the Company, but also achieve the ultimate goal of reducing accidents, injuries and saving lives by improving the safety of your drivers and others on the road.

Driver training should be a core component of any fuel management program. If drivers are not motivated to take part it is very difficult to achieve sustained reductions in fuel consumption. This is even more crucial in both private and public sectors where vehicle drivers are not necessarily employed as such, and may feel they have more pressing priorities than fuel consumption in their primary activities. It is vital to involve these drivers from the outset and to treat them as genuine partners in the program (Kashan A. , 2012).

2. 14. Vehicle routing and scheduling

The Vehicle Routing Problem (VRP) is a general class of problems in which a fleet of vehicles with limited capacity based at one or several depots has to be routed serving a certain number of customers to minimize the number of routes and total travelling time as well as distance of all vehicles. VRP with time windows is one generalization of the VRP with additional restrictions where each customer has to be supplied in a specific time interval. More realistic problems must consider that most companies have heterogeneous vehicles and 24-hour driving/working per day is infeasible, because total daily driving and working time is limited, with total working time including total driving time, waiting time, and loading/unloading time. Nowadays, due to higher fuel prices, minimizing delivery costs has become increasingly important. Therefore, VRP receives considerable amount of attention from industries and arises as a central problem in the field of transportation, distribution and logistics (B., 2012).

In their simplest forms, VRS systems are used to create schedules for drivers and to provide route instructions for their travels. These schedules and routes were worked initially out using paper maps and calendars that showed assignments, preferred routes, and expected arrivals

and departures for drivers on those routes. The paper-and-pencil method did not account for traffic conditions, roadwork, and other factors that could significantly delay the delivery of materials and products to their destinations. Selecting the best paths for the transport mode to follow to minimize travel time or distance reduces transportation costs and improves customer service start with determining shortest possible routes based on Transit time, Distance, Cost, Incorporate restrictions etc. (Ford, 2006).

City Logistics

Another field of increasing interest is the urban freight transportation and the development of new organizational models for the management of freight movements within the city. As for any complex system, city logistics transportation systems require planning at strategic, tactical and operational levels. Moreover, the development of Intelligent Transportation Systems allows exploiting the availability of data and information provided by advanced communication technologies for better use of the transportation system, infrastructure and services and for intelligent vehicle routing and scheduling (Thompson 2004). In fact, in wide area road networks, vehicle routing is usually based on distances. However, vehicle routing in city logistics networks demands for time-dependent travel time estimates for every route section. Vehicle routing based on actual travel time estimates requires empirical traffic data as a key input, but, recently, such data arises from modern vehicular communication networks. In order to benefit from telematics-based data collection, time-dependent travel time estimates have to be integrated into time-dependent vehicle routing approaches. Whereas static approaches are well studied, time-dependent vehicle routing forms a field of potential research. Especially the preparation and the integration of time-dependent data into vehicle routing approaches is rarely focused. A holistic approach to the design and evaluation of City Logistics applications has been proposed by Barcelo et al. (2007) within an integrated framework of a decision support systems, where vehicle routing and fleet management represent the core models together with models able to include the dynamic aspects of traffic on the underlying road network., such as the AIMSUN simulation model. This is able to track individually the fleet vehicles, emulating their monitoring in a real time fleet management system and gathering dynamic data. This information allows a “Dynamic Router and Scheduler” to determine which vehicle will be assigned to the new service and its new route.

Urban public transport

The global problem faced by the urban public transport agencies consists of determining how to offer a good quality service to the passengers while maintaining reasonable asset and operating costs. The public-transport (transit) operation planning process commonly includes four basic activities, usually performed in sequence: (1) network route design, (2) frequency setting and timetable development, (3) vehicle scheduling, and (4) crew scheduling and rostering. Hickman et al. (2008) collected several contributions on vehicle routing and crew scheduling, timetabling optimization and service management for different modal public transport. With reference to the first two aforementioned activities, Zhao and Zeng (2008), present a metaheuristic method for optimizing transit networks, including route network design, vehicle headway, and timetable assignment. Given information on transit demand, the street network of the transit service area, and total fleet size, the goal is to identify a transit network that minimizes a passenger cost function. Transit network optimization is a complex combinatorial problem due to huge search spaces of route network, vehicle headways, and timetables.

2.15. Conceptual Framework

Graphical or visual depiction of the major variables of the study. According to Young (2009), conceptual framework is a diagrammatical representation that shows the relationship between dependent variable and independent variables. In the study, the conceptual framework will look at the influence of fleet management practices on service delivery in OTA adopted from (Gitahi, et al., 2014). The bases of independent variables which affect fleet managements are fuel management, vehicle tracking, and vehicle repair maintenance and driver management.

2.16. Model Specification: Ordinal Logistic Regression

If the dependent variable has ordered categories (i.e., the order of ranked variables is meaningful but the distances between them are arbitrary), you can use ordered logit. For some variables, the order is much clearer than for others, but always it is important to take care of whether it is the only possible order or if something else is there which makes sense better (Sarkisian 2004).

There are four different ways of treating the dependent variable. The first option is treating the variable as continuous and running the usual OLS regression or other techniques for

continuous variables. The second option was ignoring the ordinality and treating the variable as nominal, i.e. use multinomial logit techniques, the third option was treating the variable as measured on a true ordinal scale like the professorial ranks of Full Professor, Associate Professor and Assistance Professor, they are ordered but it may or may not reflect crude measurement of some underlying continuous variable; the last option was treating the variable as though it were measured on an ordinal scale, however, the ordinal scale represent crude measurement of interval/ratio scale; For example, the categories “High, Medium, Low”. Accordingly, this study considers the dependent variable as true ordinal scale (Williams 2015).

Link function: Logit

This study intended to investigate the effects of fleet management on operational efficiency in World Health Organization, Ethiopia Office. Particularly, how driver management, vehicles fuel management, vehicles tracking and repair and maintenance determine the operational efficiency. Furthermore, Ordinal logistic regression (Ologit) model were employed to estimate the operational efficiency.

The results of the econometric model estimation revealed that vehicle tracking, fuel management, and drivers’ management had significant effect on operational efficiency, whereas, repair and maintenance didn’t show significant relationship with operational efficiency.

In operational fleet management, the two tools that can be used to improve operational efficiency are the minimization of fuel consumption and the maximization of vehicle utilization while still meeting required service levels. Also, this finding support that as long as the vehicle tracking system become good and sustainable the operational efficiency more likely to be at the highest level of efficiency and the same is true in fuel management the more fuel management becomes good the more will be the operational efficiency (Scott, 1998).

2.17. Validity of the Study

Derived from the Latin term *validitas*, meaning “strength,” validity is a term used in both qualitative and quantitative research. It asserts that a finding can never truly be proven; it can only be argued. In quantitative research, there are several ways in which to establish validity. Here, validity assumes a different meaning to the meaning used in qualitative studies. Validity refers to how well an instrument measures what the researcher wants to evaluate (Trochim, 1999).

2.18. Reliability of the Study

The research instrument concerns the extent to which the instrument yields the same results on repeated trials. The process of pilot testing (testing and retesting) of the questionnaire assisted in ensuring reliability of the questionnaire in soliciting responses (Cook & Campbell, 1979).

CHAPTER THREE

MATERIALS AND METHODS

3.1. Introduction

Defined research methodology as a science of studying how research is done scientifically. It contains details about the research approach, research design, sample size and sampling techniques, data source, data collection instruments, data analysis, reliability and validity of the study, model specification and finally ethical considerations.

3.2. Study Design and Approach

Research design provides an overall guide for the collection and analysis of the data of a study. The importance of the research design stems from its role as a critical link between the theory and argument that informed the research and the empirical data collected. A choice of research design reflects decisions about the priority being given to a range of dimensions of the research process, and of course, it has considerable influence on lower-level methodological procedures such as sampling and statistical packages. Therefore, it is a blueprint that enables researchers to find answers to the questions being studied for any research project. Together with the clear research plan, it provides, constraints and ethical issues that a study was inevitably encounter must be taken into account. Each study follows a unique methodology in order to fulfill the purpose of the study.

The main purpose of this study was to improve fleet management system of the organization as the main concern on fuel usage maintenance problems, in order to have an effective fleet management system. The study employs explanatory research design. This causal/explanatory research design was adopted to identify the variables that influence fleet efficiency. Furthermore, descriptive research was used to describe the characteristics of the population and inferential statistics was employed. Quantitative approach is used as the major method of analysis. Quantitative surveys were designed to fit a questionnaire schedule.

3.3. Target Population area and Sampling Design

The target population area of this study was Oromia transport authority office. This office is located at Finfine, it is the capital and largest city of Ethiopia. The city's population is estimated at 2,739,551 inhabitants.



Figure 3.1. Photo: Partial views of OTA depot

A non-probability convenience sampling was chosen for the survey; a sample of convenience is a sample in which elements had been chosen from the target population on the basis of their accessibility or convenience to the researcher. The main assumption associated with convenience sampling is that the members of the target population are homogeneous. That is, there would be no difference in the research results obtained. According to Lindeman *et al.*, (1980) and Loo, (1983) cited on Kashan (2012) a minimum sample size of 100 to 200 is often recommended. Accordingly, using convenience sampling a total of 183 respondents from the organization were taken as a sample.

3.4. Sources of Data

The study used both primary and secondary sources of data. Primary data collected through questioners, from the sample respondents of the organization. The secondary source of data included documents, data and information from previous studies such as existing official reports and documents from the named entities, journals, other empirical researches in the area and any other relevant document from the libraries and online source.

3.5. Data Analysis

The study utilized mainly quantitative data analysis techniques. Descriptive statistics such as mean, percentage and frequency tables were used to describe the data. Inferential statistics such as ordered logit model were employed in order to answer the basic question and test the

hypothesis respectively. The study incorporates four independent variables in which all of them was measured on a 5-point Likert-Scale, with “1” stands for “Strongly Disagree” and “5” stands for “Strongly Agree”. Apparently, mean was used as a measure of central tendency.

In this study, fleet efficiency was measured using a single-item measure. Respondents were asked to rate how much it’s efficient with a five-point Likert scale, ‘Strongly Disagree’, ‘Disagree’, ‘Undecided’, ‘Agree’ and ‘Strongly Agree’. Since the outcome respondent response were ordered and categorical, the most appropriate econometric estimation method to apply is ordinal logistic regression. The ordered logit models have come in to wide use as a framework of analyzing ranked responses. Furthermore, ordered logit models are among the most popular ordinal regression techniques, however, the assumptions of these models are often violated, the parallel lines/proportional odds assumption often does not hold. Hence, this study employs ordinal logistic regression model and the functional form of ordered logit model for the efficiency of fleet management.

The draft research question had been reviewed by different expertise and practitioners. The research framework also constructed by reviewing different related published literatures.

For this research, the respondents were selected from Oromia transport office from head quarter. Accordingly, reliable response was reacted for the research question stated at the beginning of the study.

3.9. Ethical Consideration

First the research respondents were informed about the purpose and intention of the study and verbal consult was obtained for better participation engaged in the study. Participants were also informed their right not to participate in the study at any time. Participants were informed the benefit of the research and thus research has no risk. Participants had the right to ask the question for clarification and refuse to give information in any time in the research process.

3.10. Capital and Operating Cost

Capital costs are bus operator and authority expenditures incurred to purchase the busses required to provide bus service. These include vehicles, maintenance workshops and bus garage facilities, and supporting infrastructure requirements. The authority often approves and purchases these assets (PPIA, 2006).

Operating costs: The financial model has three primary operating cost categories:

1. Operation
2. Maintenance
3. Management and administration

Some of these costs are fixed regardless of the number of buses in operation and others will vary with the level of service. The authority may require the bus operator to prepare financial reports that it can readily use to measure bus system progress on selected operating cost benchmarks and indicators (PPIA, 2006).

Vehicle operating costs

- Wages and salaries (it may be useful to break these down by staff category: drivers, conductors, etc.)
- Fuel, lubricants and grease
- Depreciation or fleet replacement provision
- Vehicle insurance
- Licenses and permits
- Bus station and other infrastructure charges
- Other vehicle operating expenses

Accordingly, the following Table 3.1. Showed that the fuel consumption of those buses in the organization.

Table 3.1. Type of buses and their purchase price

No	Types of Vehicles	Purchased Year	Year of Manufacturing	Seat /Capacity	Each Price	Number of Vehicles	Fuel Consumption
1	Tata	2008 E.C	2016 GC	61	1,844,693.13	10	2.7 Km/Lit
2	Bishoftu	2005 E.C		61	2,415,000	4	2.6 Km/Lit
3	Daewoo	2004 E.C	2011 GC	63	2,400,000	4	2 Km/Lit
4	Sunlong	2002 E.C		61	1,700,000	5	2Km/Lit

A. Interest cost

$$I = \left[\frac{P + S + D}{2} \right] * Interest\ rate \quad (1)$$

Where:

I = Interest rate

P = Purchased price

S = Salvage value (which is 10 percent of current list price)

D = Depreciation

B. Depreciation cost

Depreciation is considered a non-cash charge because it doesn't represent an actual cash outflow (Frank, 1991).

$$AAD = \frac{P-S}{L} \quad (2)$$

Where:

AAD = annual average depreciation

P = purchased price of the machine

S = salvage value (current list price * remaining value of the machine)

L = economic life of the machine

C. Tax

Tax is included in the purchase price (Lazarus, 2012).

$$Tax = \left[\frac{purchased\ price}{2} \right] * 0.55 * tax\ rate \quad (3)$$

D. Insurance

The cost of car insurance changes by state due to the different risk level each state poses for drivers. Some states are prone to natural disasters or higher levels of property crime, and these factors affect the cost of insurance (Lazarus, 2012).

$$I = \frac{[P + S + D]}{2} * \text{insurancerate} \quad (4)$$

Where: I = insurance

P = purchased price

S = salvage value

E. Repair and maintenance cost

$$ARM_n = RF1 * CLP_n * \left[\frac{AH_n}{1000} \right]^{RF2} \quad (5)$$

Where: ARM = accumulated repair and maintenance cost for n year as a function of accumulated hours

CLP (PP) = current list price

AH = accumulated hours

RF = repair factor

n = number of years (age of the machines) in which RM cost is determined.

F. Fuel cost

Fuel costs depend on the hour of operation to determine hourly fuel consumption and multiply power take off horsepower by constant (Frank, 1991).

$$FC = \text{max. P.T. Ohp} * 0.044 * \text{price of deesel} * \text{hour of use} \quad (6)$$

G. Lubrication (Oil) cost

To estimate lubricant costs, multiply the fuel costs by 0.15 (Frank, 1991).

$$LC = 5\% \text{ of } FC \quad (7)$$

Where:

LC = lubrication cost

FC = fuel cost

For vehicle depreciation costs are being calculated taking into account, besides the cost itself, the time when the vehicle and license were purchased as well as the funding scheme that was

selected. All other costs are inserted on an annual basis, for the reference year, and according to the number of kilometers travelled by the bus under consideration, for that year, the total fixed operating cost per km can be estimated for a specific urban or national transport route (Lazarus, 2012).

Fuel costs are being calculated based on the current, to that time, fuel price as well as on the average fuel consumption considering three different congestion levels (free flow, medium congested network, highly congested network) both for urban and national freight transport routes. Costs for maintenance and repair as well as taxes, fines, cargo claims and subscriptions (where applicable) are inserted on an annual basis for the reference year. Costs for tolls and ferry tickets are case specific and depend on the route under consideration, so they are calculated as such. Costs for tires are being calculated per km based on the type of tires used and the number of kilometers they are designed for. All other costs are being inserted on a monthly basis and are being projected to the reference year. To this end and based on the number of kilometers travelled by the truck under consideration, for that year, the total variable operating cost per km can be estimated. The total operating cost per km is then calculated as a sum of the fixed and variable costs. To this end, and based on the total distance travelled for the route under consideration, the total operating cost for that route can be estimated. As indicated above, all costs are being calculated for a specific truck operating on a specific urban or national freight transport route (Lazarus, 2012).

Table 3.2. Table of costs

No.	Types of Vehicles	Purchased Year	Each Price	Quantity	Selvage Value for Each	Annual Average Depreciation for Each
1	Tata	2008 EC	1,844,693.13	29	1106815.87	61489.77
2	Bishoftu	2005 EC	2,415,000	8	2173500	20125
3	Daewoo	2004 EC	2,400,000	8	240000	180000
4	Sunlong	2002 EC	1,700,000	10	204000	124666.67
	Total (birr)		109,016,100.77			

Source from transport authority office

The above Table showed that, total initial price one hundred nine million sixty thousand one hundred (109, 016, 100) birr.

3.11. Discussions of the Existing Maintenance Problems

Implementation of improved maintenance system needs top management commitment. Due to lack of well-established maintenance management system, the organization is subjected to loss of Birr in millions which has caused the organization to run in loss rather than profit.

The problems encountered due to improper maintenance management system practiced in OTA office are summarized as follows:

1. Lower operational performance of the buses than normal.
2. Higher Maintenance Day than normal and hence increased garage loads. The main reasons for this were described below:
 - 2.1. The organization does not have its own machine shop to perform repairs and recondition activities like cylinder re boring operation, crank shaft grinding operation and chassis aligning tools.
 - 2.2. The longer chain of managerial functions to perform maintenance activities.
 - 2.3. The shortage of spare parts due to lack of well-planned and control of spare parts in the store. Since high frequency of break down occurs the cost of spare part becomes much higher than the capacity of the organization.
 - 2.4. There is no priority of jobs in the organization. It is observed that many buses were wasting their time due to minor problems which can be solved easily. In general, the higher down time of the trucks is highly affecting the income of the organization.
3. Lack of well-trained maintenance staff.
4. Incomplete maintenance. The main reason for incomplete maintenance observed in the organization is the higher garage loads. When the garage loads become increased the maintenance manager forces the maintenance technicians to complete the job at any cost with fall in the quality. The other reason is higher frequency of break down. Since the mode of maintenance is just fixing or replacing the failed parts in the vehicle without considering related parts, the frequency of breakdown of major components in engine and transmission box is very high.
5. Lack of well-organized workshops. Maintenance workshops were scattered at longer distance from each other. Much time is wasted by traveling among these workshops. This

has caused high lead time to perform maintenance operation. In order to avoid the existing problems due to poor and inefficient management of fleet maintenance and spare parts, it is very essential to establish appropriate maintenance management system.

6. Higher fuel consumption than normal with decreased routes coverage.

3.12. Major problems of the existing maintenance problems

- One of the most problems in the OTA office maintenance department is that the effort and attitudes of the organization towards the improvement of maintenance function is very low. If the commitments of top managers concerning the improvements of maintenance activities are low it will be very difficult to attain the goal of the organization.
- The availability of maintenance tools/equipment's in both quality and quantity in the work shop is very low. The available work shop tools are also centralized for scattered workshops. This is one of the factors which increase the down time of the buses in the work shop. Lack of proper tools and instruments for repair and diagnosis of failure is also the other cause for most maintenance delay.
- No safety precautions such as fire extinguisher, ventilators & air conditioners are available in the workshops.
- No vehicle disposal and replacement regulation according to manufacturer's manual is applicable.
- Almost no clear application of codification and standardization of vehicles, tools and equipment in maintenance activities are available. These have caused the speed of maintenance function that is carried out in the work shop very low.
- Most of the maintenance activities carried out in the organization is incomplete. High garage load and lack of skilled man power are the main reasons for this incomplete maintenance.
- On the other hand the managerial chain in making decision on the existing maintenance activities is not comfortable

- No adequate training program is arranged for each category of workers including managers and supervisors. Therefore, in this type of working environment adequate training has to be given to encourage people to attain the objectives of the organization
- Finally, availability & application of Job order description in the organization is not satisfactory. If the maintenance job is not described and reported well, the significance of maintenance departments cannot be seen or analyzed. They do not know exactly how high the maintenance cost is. corrective actions should be taken to make the maintenance system so as to fulfil the goal of the maintenance department of the organization.

3.13. Analysis of existing maintenance management system of M/S OTA

In the existing situation of M/s of OTA office, the extent of maintenance shop works areas arrangement is not good to carry out effective maintenance. Without logical shop arrangement, it is very difficult to speed up the maintenance task; and as the result the down time of vehicles will be increased which greatly affects the round trip of the vehicles. One of the most problems in M/s of OTA office maintenance department is that the effort and attitudes of the organization towards the improvement of maintenance function is very low. If the commitments of top managers concerning the improvements of maintenance activities are low it will be very difficult to fulfil the goal of the organization.

From the observed problems the following points are the major challenges of Oromia Transport Authority Office which hinders the application of Preventive Maintenance system:

1. Less Attention to maintenance function
2. The maintenance shop works areas arrangement
3. Availability of Maintenance tools/equipments or machines
4. Lack of adequate training program
5. Lack of clear vehicle disposal and replacement regulation.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Introduction

This chapter deals with data presentation, interpretation, and analysis of the study. It has two main parts: the first part is demography of the respondents; the second part consist of data collected from the respondents through questionnaires. In order to address the research questions and hypothesis, 200 questionnaires were prepared and randomly distributed to OTA employees, out of these questionnaires 183 were filled and returned, the rest 17 questionnaires were unreturned and no questionnaires were discarded due to missing data.

4.2. Vehicle category and type

Oromia transport office manages and operates around 74 cars for transporting passenger and goods. See (Table 4.1).

Table 4.1. Total fleet

No.	Category	Amount	Type of Fuel
1	Automobile	1	Petrol
2	Pickup double cub	11	Diesel
3	Station wagon	3	Diesel
4	Bus	59	Diesel
	Total	74	

The above Table 4.1. Shows that the total fleet. The largest amount from the entire fleet 61 seat express bus which is 59(83.09%) of population these buses basically for the service purpose of the employee in side Addis Ababa city and around Addis. The second largest population is pickup double cub (11) for the field operation. There are three station wagons and only one automobile in the office.

4.3. Response rate

A total of 183 responses out of the 200 questionnaires sent out were received, achieving an acceptable response rate of 90.5%. All the questionnaires were edited and checked for completeness and used in the data analysis. See Table 4.2. below.

Table 4.2. Cross tabulation of educational level, gender and work experience

No	Description	Frequency	Percent	
1	Gender	Male	142	77.59
		Female	41	22.41
		Total	183	100.0
2	Educational level	MSc/MA	19	10.38
		BSc/BA	80	43.72
		Diploma	53	28.96
		Certificate	31	16.94
		Total	183	100
3	Work Experience	<5 Years	27	14.75
		5-10 Years	52	28.41
		10-15 Years	59	32.24
		>15 Years	45	24.59
		Total	183	100

Table 4.2. Showed that there were 142 (77.59%) male and 41 (22.41%) female respondents. Furthermore, 10.38% of the respondents were master's degree holders, 43.72% of them were degree holders and the rest 28.96% & 16.94% of them were diploma and certificate holders respectively. In terms of proportion, majority of male respondents were diploma holders followed by degree, certificate and master's degree. Likewise, majority of female respondents were diploma holders followed by degree, masters and certificate.

Table.4.1 also showed that, there were four categories of work experience; less than 5 year, 5 to 10 years, 10 to 15 years' experience and greater than 15 years. Accordingly, the first category accounts 14.75% of the respondents; the second group who had 5 to 10 years of experience was 28.41% of the respondents. The rest 32.24% & 24.59% of the respondents had 10 to 15 and greater than 15 years of work experience.

From the demographic characteristics of respondents, the lion share is taken by (77.59%) was male and the remaining (22.41%) were female respondents. Besides, the large number of respondents who participated in the study was from the Oromia transport office and service department.

In relation to their qualification level, 10.38% of the respondents were master's degree holders, 28.96% of them were degree holders and the rest 43.72% and 16.94% were diploma and certificate holders respectively. Moreover, the work experience of the respondents indicates that, 32.24% of the respondents had 10 to 15 years of experience were adequate exposure to the work area and had a potential of bringing change to the organization. The questionnaire it contains gender, level of education, and year of experience of the employees.

4.4. Descriptive Analysis

As a rule of thumb to create equal intervals for a range of five points Likert scale (that ranges from strongly disagree to strongly agree in the survey questionnaire). A calculated mean value that ranges from 1 to 1.80 implies strong disagreement, a mean range from 1.81 to 2.6, from 2.61 to 3.4, from 3.41 to 4.2 and from 4.21 to 5.00 represented respondents' perceptions of somewhat disagree, neutral, somewhat agree and strongly agree respectively.

Accordingly, the 0.8 was a result found by dividing the difference between the maximum (5) and minimum (1) scores to the maximum score (5) of the questionnaire. In the process of examining of the data, standard deviation was used. Small standard deviations (relative to the value of the mean itself) indicate that data are close to the mean whereas a large standard deviation (relative to the mean) indicates that the data points are far from the mean. The mean is a poor fit of the data. Standard deviation is a measure of how well the mean represents the data. All of the variables were measured using a five-point likert scale where; 1 stands for Strongly Disagree, 2 stand for Disagree, 3 stands for Neutral, 4 stands for Agree, and 5 stands of Strongly Agree. Therefore, the interpretation made using the mean of each variable, as a matter of fact the mean falls between the two ranges (between 1 and 5), hence if the mean approaches to 1 the interpretation would be the respondents didn't agree on the raised issue or variable and if it approaches to 5 the reverse would be true (Mesfin, 2016).

4.4.1. Assessment of Employee Perspective on Vehicles Repair and Maintenance Practice

Table 4.3. Vehicles repair and maintaining practice

Description	N	Mean	Std. Deviation
The organization has successful vehicles repair and Maintaining system	183	3.0077	.99997
The organization has well organized control mechanism	183	2.86	1.293
The organization has professional fleet manager & Maintenance controller	183	2.58	1.275
The repair & maintenance garage complete the service on time	183	3.0615	1.17304
The vehicles of the organization have frequent technical Failure after service & maintenance	183	2.85	1.114
Drivers of the organization gives proper feedback for fleet Department	183	3.36	.996
The fleet department handles complaint regarding service Maintenance	183	3.02	1.089
Repair	183	3.02	.79485
Valid N (list wise)	183		

Table 4.3. Showed that, most of the respondents were somewhat signifying vehicles repair and maintaining system disagreement to those challenges that the researcher used to determine the challenges of practices. The first challenge which drivers of the organization gives proper feedback for fleet department which is the mean score of 3.36 , also the question rose about successful vehicles repair and maintaining system which is the mean score of 3.00, the repair & maintenance garage complete the service on time which is the mean score of 3.06, and the fleet department handles complaint regarding service maintenance which is the mean score of 3.02 and also, respondents disagreed with questions arise about well-organized control mechanism with mean scores of 2.86, has professional fleet manager and maintenance controller with mean of 2.58 and the vehicles of the organization have frequent technical failure after service & maintenance with mean of 2. 85 and the average mean for repair and maintenance had a mean score of 3.02, which is almost the score of these variable falls

between the two extremes at neutral level. Accordingly, the analysis shows that repair and maintenance had a means score of 3.02, which almost the score of these variable falls between the two extremes at neutral level. Therefore, repair and maintenance were one of the anticipated variables that are assumed to affect operational period.

4.4.2. Assessment of Employee Perspective on Fuel Management

Table 4.4. Fuel management system

Descriptive statistics	N	Mean	Std. Deviation
The organization is successful in fuel management system	183	3.25	.981
The organization has set a standard on fuel consumption rate per Vehicle	183	3.38	.975
The organization allocates enough fuel coupons for field missions	183	3.35	1.085
The organization has an independent fuel controller	183	3.08	1.125
There is a timely follow up for fuel consumption	183	3.28	1.086
The organization has potential fuel sources(suppliers) all over the Regions	183	2.98	1.042
The organization allocate sufficient budget for fuel cost	183	3.469	1.0053
Fuel management	183	3.25	.71947

Table 4.4. Showed that, fuel management was one of the predictable variables that is imagined to have an effect on operational efficiency, the first challenge which the respondents gave higher mean score was the question supposed that, the organization allocate sufficient budget for fuel cost which is the mean score of 3.46, the organization has set a standard on fuel consumption rate per vehicle which is the mean score of 3.38 , also the question rose about allocation of enough fuel coupons for field missions which is the mean score of 3.35, there is a timely follow up for fuel consumption which is the mean score of 3.28, and the organization is successful in fuel management system which is the mean score of 3.25, the organization has an independent fuel controller which is the mean score of 3.08 and also, respondents disagreed with questions arise about the organization has potential fuel sources(suppliers) all over the regions with mean scores of 2.98 and the average mean for repair and maintenance had a mean score of 3.25, which indicate the score of this variable nearly assign of agree level. As a result,

the analysis shows that fuel management had a means score of 3.25 therefore, Fuel management were one of the predictable variables that are imagine having an effect on operational efficiency. As a result, the analysis shows that fuel management had a mean score of 3.25, which indicate the score of this variable comparatively assign for agree level.

4.5. Hypotheses Testing

The first hypothesis of the study was reviled that, the Ch-square test indicates that, there is the existence of a relationship between employees' response on repair and maintenance and Fleet efficiency, $X^2(100, N=130) = 194.95, p < .001$. Therefore, the null hypothesis H_0 : vehicles repair and maintenance influences fleet efficiency has been accepted.

The second hypothesis was; about employees' perception on effect of fuel management on fleet efficiency. In this regard, since, the Ch-square test indicates that, the relationship between fleet efficiency and fuel management, $X^2(100, N=130) = 171.7, p < .001$, as a result, the null hypothesis H_0 : fuel management have significant stress on fleet efficiency has been accepted.

The Third hypothesis was; H_0 : employees' response on vehicle tracking has significant effect on fleet efficiency of the organization because the Ch-square test indicates relationship exist between fleet efficiency and vehicle tracking, $X^2(100, N=130) = 169.3, p < .001$ imply statistically significant influence on fleet efficiency of the organization. Therefore, the third null hypothesis was accepted and the study concluded that vehicles tracking persuade fleet efficiency will be conventional.

The fourth hypothesis was; H_0 : employees' response on driver management has influence on fleet efficiency of the organization since, the Ch-square test indicates the existence of relationship between fleet efficiency and drivers' management, $X^2(100, N=130) = 180.5, p < .001$ implies statistically significant influence on fleet efficiency of the organization. The fourth null hypothesis was therefore accepted and the study concluded that driver management influences on fleet efficiency has been acceptable (Wireman, 1994)

4.5.1. Econometrics result

Before running the regression, a pre-test of Multi collinearity and Heteroscedasticity were performed. Accordingly, a VIF test suggested that there is no a multicollinearity problem in

the data, the maximum VIF was 1.41; in order to have a multicollinearity problem the results VIF should be greater than 10. Likewise, Breusch-Pagan/Cook-Weisberg test was performed in order to test the existence of Heteroscedasticity, fortunately, the data didn't have a problem of error term variance (Gudjrat, 2003).

4.5.2. Estimation result

The following (Table 4.5.) below shows the estimation parameter

Table 4.5. Parameter Estimates

		Estimate	Std. Error	Wald	D. F	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
	[OE1 = 1]	5.16	0.989	27.243	1	0	3.222	7.098
	[OE1= 2]	6.571	1.039	40.011	1	0	4.535	8.606
Threshold								
	[OE1 = 3]	7.723	1.1	49.291	1	0	5.567	9.879
	[OE1 = 4]	10.295	1.331	59.833	1	0	7.687	12.904
	Repair	0.014	0.03	0.23	1	0.631	-0.044	0.073
Location								
	Fuel Mgt.	0.117	0.039	8.907	1	0.003	0.04	0.194
	Vehicle T	0.099	0.031	10.212	1	0.001	0.038	0.159
	Drivers Mgt.	0.063	0.03	4.292	1	0.038	0.003	0.122

4.6. Maintenance management systems

4.6.1. Standardization and codification

Standardization is briefly described as grouping of similar equipment and vehicles according to their application, model or size (K.Pathak, 2002).

4.6.1.1. Maintenance Standards

Equipment maintenance standards indicate methods for measuring equipment deterioration (inspection and testing), arresting the progress of deterioration (daily routine maintenance), and restoring equipment (repair). Maintenance work procedures are the work procedures, methods, and times for inspection, servicing repairs and other types of maintenance work.

Equipment maintenance standards include inspection, servicing and repair standards. There are various types of standards. Among these are

- Equipment design standards or simply equipment standards;
- Equipment performance standards or equipment specifications;
- Equipment materials procurement standards;
- Equipment materials inspection standards.

Test run and acceptance standards are the most common standards applicable in different organizations (K.Pathak, 2002).

4.6.1.2. Inspection standards

These are standards for inspecting equipment, in other words techniques for measuring the extent of deterioration.

4.6.1.3. Servicing standards

These standards specify how servicing and routine maintenance done with hand tools. They include methods and guidelines for different types of servicing, such as cleaning, lubrication, adjustment and parts replacement.

Categorization of equipments and vehicles by their application (duties) are the major classes in which equipment of similar function are grouped together. In the case of M/S OTA, standardization can be done in the following way:

4.6.1.4. Standardization by age

Very old TATA, old BISHOFTU, and old DAEWOO can be the basic operational buses. To solve the existing problems, the thesis aims to follow the recommended maintenance based up on this standard. The complete grouping and standardization of the existing buses. It is recommended that the two categories i.e., new BISHOFTU, SUNLONG, and DAEWOO should follow preventive maintenance. In the same fashion additional buses which are ordered should be categorized in order to follow appropriate maintenance system. Since the most of

the TATA are very old, it is recommended to replace them in order to save the organization from unnecessary cost. Furthermore, the enterprise can make detailed standards like standards for each model for example 1990, 2000, etc. And service vehicles in future when more service buses are added to the organization.

The classification of size based on weight, power of engine, load carrying capacity and some other engineering measures are some of the bases for vehicles and equipments standardization. Thus, the categorization of equipment's/vehicles into sub-classes that helps to utilize the same parts and subassemblies are one of the final goals of standardizing system development.

Since there are few varieties of vehicles, standardization is not a big problem for M/S OTA, but it is wise to understand that coding is more facilitating. In this section the factors that should be considered in establishing the system and the merit of its effective and efficient applications are to be forwarded. Furthermore, the maintenance system should also make the job easier.

From the current situation at M/S OTA, it was observed that there was no clear standardization regarding the maintenance system due to unplanned maintenance system even though there were no excessive varieties of vehicles or equipment's in the organization.

According to (Maintenance Management Accreditation Standards, 2006) Excessive variety and lack of standardization create the following problems:

- Larger downtime due to waiting for spare parts
- Higher maintenance cost due to small lot size of spare parts
- Large amount of paper work to order parts
- Large number of idle equipment/vehicles that are waiting for repair and spare parts supply
- Higher investment cost
- Higher stock value
- Higher lead time of spare orders etc.

In order to minimize such problems, it is necessary to develop and implement good standardization. The economic benefits gained through establishing and implementing standardization system are presented below:

1. Reduction in the equipment and spare parts: When equipment and vehicles are closely related by good standardization, it is possible to reduce investment costs. Investment cost

reduction is obtained by holding lower stock values of spare parts. and minimum down time cost (Tadele, 2007).

2. Cheaper and less difficulty to the supply of spare parts: Standardization helps to reduce the paper work to order and purchase parts. Due to fewer varieties of stored parts and subassemblies due to effective standardization system developed carrying cost is undoubtedly reduced (Tadele, 2007).

3. Low stock values of subassemblies and repair kits to be stored: When well organized and good equipment standardization system is developed, it is possible that subassemblies and repair kits are commonly utilized. This helps to store minimum stock values of subassemblies and repair kits that may be stored unlike the case of the equipment's varying in size, model and make (Tadele, 2007).

4. Lower maintenance cost: When owned equipment/vehicles are closely related, the technician will maintain similar equipment's and vehicles and become specialized in repairs as well as in trouble shooting. Thus, standardization aids to lower training costs than when equipment and vehicles vary in size, make and model (Tadele, 2007).

5. Lower operating cost: When equipment and vehicles are closely related in size, make and model, it is easier to replace operators in case of illness, absence or retirement. Thus, effective and efficient standardization results in lower training of operators and overhead costs. But due to lack of maintenance management system M/S OTA did not make use of such advantages. Even though the organization has no several varieties of vehicles, standardizing the existing system will benefit it in the future. Hence, it is recommended that the company should develop a good standardization system based on make, model, size and function of the vehicles etc. This can undoubtedly contribute to minimize the existing problems of maintenance management system (Tadele, 2007).

4.6.2. Codification and its application

Equipment codification: It is a systematic grouping of equipment/vehicles in the organization to give particular identification. In the organization, even if there are few varieties of equipment and vehicles with limited makes, purpose, model and size, it is very important to develop codification. There are various systems of codification that can be adopted. Numerical as well as alphabetical codes can be used for the purpose of identification of different items (Man, 1979).

4.7. Proposed For Departmental Codes

Based up on the existing system it will be difficult to control and improve maintenance management system. This codification will play a great role when the maintenance management will be used with computer application.

Table 4.6. Proposed departments and their codes for standardization

Code	Assigned departments/ office of M/S Oromia Transport	
OT	General manager (belongs to the organization)	
OT0	Maintenance department	
	OT01	General maintenance
	OT011	Planned maintenance
	OT0111	Grease & Lubrication
	OT0112	Tire & Running Gear
	OT012	Break down maintenance
	OT0121	Road call
	OT0122	Unplanned maintenance
	OT0123	Heavy maintenance
	OT0124	Light Maintenance
	OT0125	Body and upholstery maintenance
	OT0126	Rebuilding section
	OT01261	Engine & Transmission
	OT01262	Component rebuilding and repair
	OT0127	Machine shop
	OT02	Electrical maintenance
	OT021	Automotive electrical maintenance
	OT022	Industrial electrical maintenance
	OT023	Battery Section
	OT03	Preventive maintenance
	OT1	Inspection & planning
OT11		Inspection & maintenance control

	OT12	Spare part planning and control
OT2	Finance and personnel administration	
OT3	Plan and follow up	
OT4	Internal audit and inspection	
OT5	Operations department	

Table 4.7. Proposed equipment maintenance & sub class codifications

Code	Assigned equipment/Vehicle class	
1	Service buses	
	Code	Equipment/Vehicle class
	11	Tata
	12	Bishoftu
	13	Daewoo
	14	Sunlong
2	Workshop equipment's	
3	Office facilities and utilities	
4	Workshop tools	
5	Spare parts	

In the proposed codification system, the code recommended to represent equipment/vehicle/sub-classes follows the code assigned to main classes. Equipment/ vehicles having the same equipment main class are supposed to have similar functions. Therefore, it can be applicable to adopt similar maintenance plan or cycles depending on manufacturer recommendations, working conditions and age for the equipment/vehicle categorized in the same main class. This simplifies the task of maintenance activities. Besides, maintenance planning and control activities can be easily done by computer.

In addition to the above advantages M/S OTA can easily identify the equipment/vehicle/ to order parts and hold in stock by the aid of the code assigned to subclasses.

In the designation the first digit represents the enterprise asset, second departmental location; the third digit stands for main class and the fourth one represents sub-class classifications. The remaining is for identification number.

Example1: OT0- 34 (001) represents: **OT-** Oromia Transport Authority property (asset), **0-** belongs to Organization **3-** belongs to heavy duty vehicles, **4-**Sino truck, and **001-** vehicle identification number.

Example 2: OT1- 2 (003) represents **OT-** Oromia Transport Authority, **1-** belongs to maintenance department, **2-**light vehicle, **003-**identification number. In doing so the organization can easily identify its property for the inventory purpose, for maintenance aid etc.

Table 4.8. Proposed preventive maintenance code

Code	Description
PM01	Preventive program class A for heavy vehicle
PM02	Preventive program class B for heavy vehicle
PM03	Preventive program class C for Heavy duty vehicle
PM04	Partial over haul for heavy duty vehicle
PM05	Full overhaul for heavy-duty vehicles
PM06	Maintenance program one for light duty
PM07	Maintenance programs two for light duty vehicles
PM08	Maintenance program three for light duty vehicles
PM09	Partial overhaul for small vehicles
PM10	Full overhaul for light vehicles

4.9. Summary

Service transport for Oromia government office started in 2002 E.C. with ten (10) buses and now above 55 busses are operating and above 8000 Oromia government office employers were used these buses for service transport.

The research was anticipated to improve the fleet management systems on fleet operational efficiency in Oromia regional government transport office through the main variables including; fuel management, driver’s management, and repair and maintenance management. In order to accomplish these objectives, data were collected from the employees of the organization and processed in both quantitative and qualitative approach of descriptive approach. From the demographic characteristics of respondents, the lion share is taken by (77.59%) was male and the remaining (22.41%) were female respondents. Besides, the large

number of respondents who participated in the study were from the department of maintenance and dispatch. In relation to their qualification level, the respondents had 10.38% of the respondents were master's degree holders, 43.72% of them were degree holders and the rest 28.96% and 16.94% of them were diploma and certificate holders respectively. Moreover, the work experience of the respondents indicates that, 32.24% of the respondents had 10 to 15 which is they had adequate exposure to the work area and had a potential of bringing change to the organization. In order to test the hypothesis, the logit model was employed to answer the basic question. The study incorporates four independent variables in which all of them were measured on a 5-point Likert-Scale, with "1" stands for "Strongly Disagree" and "5" stands for "Strongly Agree". Apparently, mean was used as a measure of central tendency. The analysis result shows that the mean score values for operational efficiency was to the minimum the average mean value (only between 2.39 and 3.02) which really indicates the operational efficiency is weak. The study also found a positive correlation among the three of the variables (repair and maintenance, fuel management, vehicle tracking and drivers management). Furthermore, the value of regression analysis shows that the results of the model estimation revealed that, fuel management, and drivers' management had significant effect on operational efficiency, whereas, repair and maintenance vehicle tracking didn't show significant relationship with operational efficiency.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusions

Fleet management has become integral to the success of vehicle movement in institutions and must be a priority for organizations. Based on the findings in the previous sections, Oromia transport office manages and operates around 74 buses for transporting employees and goods fleet management system of OTA office. Accordingly, the findings revealed about fleet management system of the OTA office in general the following conclusions are drawn:

- Over-aged vehicles should be withdrawn and be replaced with new ones to reduce frequent breakdowns, high maintenance cost and high fuel consumption.
- The FMSD could consider the usage of fuel coupons to relieve staff who usually goes through stress of bureaucratic procedures to acquire fuel for official duties.
- Fleet managers and drivers can keep fleet vehicles properly maintained to improve fuel economy.
- This study finds out the causes of high frequency of breakdowns and down times so as to find means to minimize them in order to increase the availability of the buses.
- In order to change themselves to understand and do their works efficiently, the department must arrange a training program for each category of workers including supervisors.
- Maintenance personal should undertake repair and servicing of vehicles and must be aware of the importance of preventive maintenance to reduce vehicle breakdowns.
- To speed up the maintenance function that is carried out in the work shop, the code simplifies the whole process and makes the maintenance activities to be efficient.
- There should be clear and appropriate disposals and equipment replacements applied in the organization.

Generally, implementing preventive maintenance, having replacement and disposal plans, proper spare parts planning and controlling system, use of proper technology and adopting appropriate training, having reasonable manpower and sound organizational structure, improving recording and reporting methods with management information system and motivating employees can minimize the problems stated. As it is the main objective to

improve the fleet management system of the organization, this paper proposes as a model specially for the maintenance department of the organization (the workflow system of the maintenance activity, test equipments, maintenance procedures standardization, and codification) and the overall structure of maintenance management system considering the existing problems.

5.2. Recommendations

By relying on the study findings, the researcher suggests the following points as credible recommendations to the problem.

- Modern automotive technology is vital for the development of transport Service Company; therefore, modern technology of GPS for vehicle tracking system is essential to the improvement fleet efficiency in the office.
- Fleet department should control speed limit by GPS tracking system and there must be someone consigned always to monitor the tracking system online.
- There must be serious control mechanism on genuine spare parts and good maintenance during service.
- The office should employ professional fleet manager and maintenance controller to have better fleet efficiency.
- The office should review and critically realize their fuel supplier because there are inadequate potential fuel sources all over the region.
- The office has to motivate drivers because motivation and reward plays a significant role for any organizational culture.
- The office should have to give a critical emphasis on assigning adequate budget for fuel cost and should manage fuel consumption and maintenance scheduling properly through developed better financial system and by recruited well educated manager by giving training for the employs of the fleet department.
- The organization should give emphasis for solution for problems encountered in the tracking system.

5.3. Future work

Here most of the data were taken from different responsible administrative office employees and respondents, the analysis was made only for the improvement of fleet management system.

If any additional it is necessary to work on it, as a future work area any one can do on the improvement of fleet management system of OTA office vehicle routing and scheduling and by integrating all controlling mechanisms with computerized systems which is controlled by an authorized person.

It is difficult to do this thesis since no body has done it which makes it difficult for me but, now it is already proposed in this thesis so as this work is the first work many more things and modifications can be done while the references obtained are related issues.

REFERENCES

- A.F. Iyinama, S. I. (2000). Analysis of Relationship Between Highway Safety and Road Geometric Design Elements: Turkish Case. *Technical University of Istanbul, Faculty of Civil Engineering, 34469 Istanbul, Turkey.*
- B., H. (2012). *Models for relief routing: Equity, efficiency and efficacy.* Huang B.
- Daniel J. Findley, J. E. (2011). Modeling the impact of spatial relationships on horizontal curve safety. *Elsevier.*
- Ford, J. (2006). *Routing & Scheduling.* James Ford.
- Frank, R. T. (1991). Estimating Agricultural Field Machinery Costs. 7.
- GOV.UK, E. r. (2017). *Www.gov.uk., "Drivers' hours".* EU rules - GOV.UK.
- Hohn, M. (2011). "Computerized Fuel Management System for a Foss Tugboat". *University of Washington, 146.*
- Huang, e. a. (2012). Models for relief routing.
- Inmaculada Melchor, A. N.-Z.-S.-F.-A. (2015). Trends in mortality due to motor vehicle traffic accident injuries between 1987 and 2011 in a Spanish region (Comunitat Valenciana). *Elsevier Ltd.*
- Jose. (2016). *Introduction to fleet management.* Jose.
- K, R. (1985). *Traffic Collision.* From Wikipedia, the free encyclopedia.
- K.Pathak, R. M. (2002). *Maintenance Engineering and Management.* New Delhi.
- Kashan, A. (2012). Measuring Student Satisfaction of Master Level Students. *School of Doctoral Studies (European Union) Journal,* (pp. 216-222). Pakistan.
- Kashan, A. (2012). Measuring Student Satisfaction of Master Level Students . 216-222.
- Kebede, T. (2012). *The improvement of road traffic management system in case of Adama city.* ASTU: Unpublished.
- Lange, H. e. (1992). "Development of fuel oil management system software: Phase 1, Tank management module.
- Lazarus, W. F. (2012). Machinery Cost Estimates.
(2006). *Maintenance Management Accreditation Standards.* USA.
- Makrajep, C. J. (1999). The effect of rural road geometry on safety in southern Africa.
- Man, J. E. (1979). *The Complete Handbook of Maintenance Management.*
- Maurizio, e. a. (2019). *Trends in Models and Algorithms for Fleet Management.*

- Mugenda, M. (2008). *Predicting the Unpredictable-Demand Forecasting International Humanitarian Response*. Nairobi.
- Nachmias. (2008). *Research methods in the social sciences (7th ed.)*. New York.
- Neuman TR, G. J. (1983). Functional analysis of stopping-sight-distance requirements. *Transportation Research Board*, 57-64.
- Oates, B. (2006). *Researching information systems and computing*. London: SAGE Publications.
- Penton. (2011). "Pay-as-you-go tracking".
- PPIA, T. W. (2006). *Tools and options for Reforming Urban Bus Systems*. The World Bank Group and PPIAF.
- Prashant Singh, M. A. (2020). Movement of Autonomous Vehicles in Work Zone Using New Pavement Marking: A New Approach. *Journal of Transportation Technologies*.
- (2011). *Preventive Maintenance, Rebuilding, and Alteration*. United States Code of Federal Regulations .
- Ross, K. (2005). *Sample design for educational survey research*.
- Ruman K. (1985). *Traffic collision*. From Wikipedia, the free encyclopedia.
- Sarbaz Othman, R. T. (2009). *Identifying Critical Road Geometry Parameters Affecting Crash Rate and Crash Type*. Sweden: Swedish National Road and Transport Research Institute.
- Sarkisian, N. (2004). *Topics in Multivariate Statistics: Ordered Logit*.
- Tadele, T. (2007). *Improvement of Maintenance Management System: A Case Study on Walia Intercity Bus Service Enterprise*. Addis Ababa: Teklehaimanot Tadele.
- Transportation Research. (2002). *GRA 19003: Master Thesis* .
- Trochim, W. (1999). *The research methods knowledge base (2nd ed.)The-UNHCR-Fleet-Management-Handbook.pdf*. Ithaca, NY: Cornell.
- Udham, e. a. (2015). *Vehicle Tracking System for Security and Analyzing Transportation Vehicle Information*. Udham, et. al.
- Williams, R. (2015). *A Complete Documentation on Vehicle Tracking System on Ordered Logit Models – Overview*.
- Wireman, T. (1994). *Computerized Maintenance Management Systems*. New York: Industrial Press.
- www.dla.mil. (2016). "Defense Logistics Agency".

Yulong, D. J. (2011-2015). Influence of Road Conditions on Traffic Accidents and Safety Countermeasures. *Science and Education*.

APPENDIXES

Appendix A. Questionnaire

Adama Science and Technology University
School of Mechanical, Chemical and Materials Engineering
Department of Mechanical Systems and Vehicle Engineering

Questionnaire to be filled by respondents

Dear respondents:

I would like to express my deep gratitude for your cooperation and honesty in answering the following research questions. The aim of this questionnaire is gathering data used for a thesis on the title of “Improving Fleet Management System: A case of Oromia workers service bus of Finfine Transport Authority” for the partial fulfillment of the requirements for the Masters of Automotive Engineering. Your genuine reply is significantly appreciated and will contribute a lot to the accuracy of this thesis. The information collected from this questioner will merely be used for academic purpose and will be treated with strict confidentiality.

Thank you in advance.

Instruction: Don't write your name in the answering sheet

Please, put a tick (x) mark in which you want to select

PART – I

Respondent's profile

The following questions are about the respondent's profile. Kindly indicate the appropriate characteristics of the respondent's profile using (x).

1. Gender

Male

Female

2. State your highest level of education?

MA/MSc

BA/BSc

Diploma

Certificate

3. How long have you been working in the Oromia Transport Authority?

Less than 5 years

Between 10 and 15 years

Between 5 and 10 years

Over 15 years

PART – II

Questioner for respondents:

The following questions are about how your association has been implementing fleet management on operational fleet efficiency. Please indicate the level of your agreement or disagreement using (x) on the following statements based on your experience in your company on fleet management practices. The rating is from 1- Strongly Disagree 2- Disagree 3- Neutral 4 - Agree 5- Strongly Agree as shown below

Table A.1. Questionnaire to be filled by the respondents

No.	Description	1	2	3	4	5
1	The office has successful and competent Fleet efficiency					
2	The office has usual Vehicle servicing time (Mileage) program					
3	The office has well organized control mechanism for genuine spare part					
4	The office has professional fleet manager and maintenance controller					
5	The garage service and maintenance operation perform on time.					
6	After service and maintenance, the frequency of the vehicle is very low					
7	Drivers of the office gives proper feedback for fleet department about service and maintenance of the assigned vehicle					
8	The fleet department of the office handles complaint regarding service and maintenance appropriately.					
9	The office has set a standard on fuel consumption rate for each vehicle					
10	The office allocates enough fuel coupons for field missions					

11	The office has an depot					
12	The office allocates enough budget for fuel cost					
13	There is a timely follow up for fuel consumption					
14	The office is using the vehicle tracking or GPS					
15	The office has installed vehicle tracking system on all vehicles					
16	The office assigned a person to monitor and manage the GPS tracking system					
17	The office provide immediate solution for problems encounter in vehicle tracking					
18	The office used the Tracking system to manage fuel consumption and maintenance scheduling.					
19	The office has supervision method on drivers					
20	The office has assigned a responsible officer for handling drivers' assessment					
21	There is a practice to motivate an exemplary employee					
22	The office has successful performance evaluation system for drivers					
23	There is employee skill development program (driver, garage, fleet department)					
24	Drivers always fill and properly maintain vehicle log book for all the distance traveled					
25	The office has successful vehicles repair and maintenance control system					

Source: Oromia transport authority office

Appendix B. Data Collected from Oromia Transport Authority Office

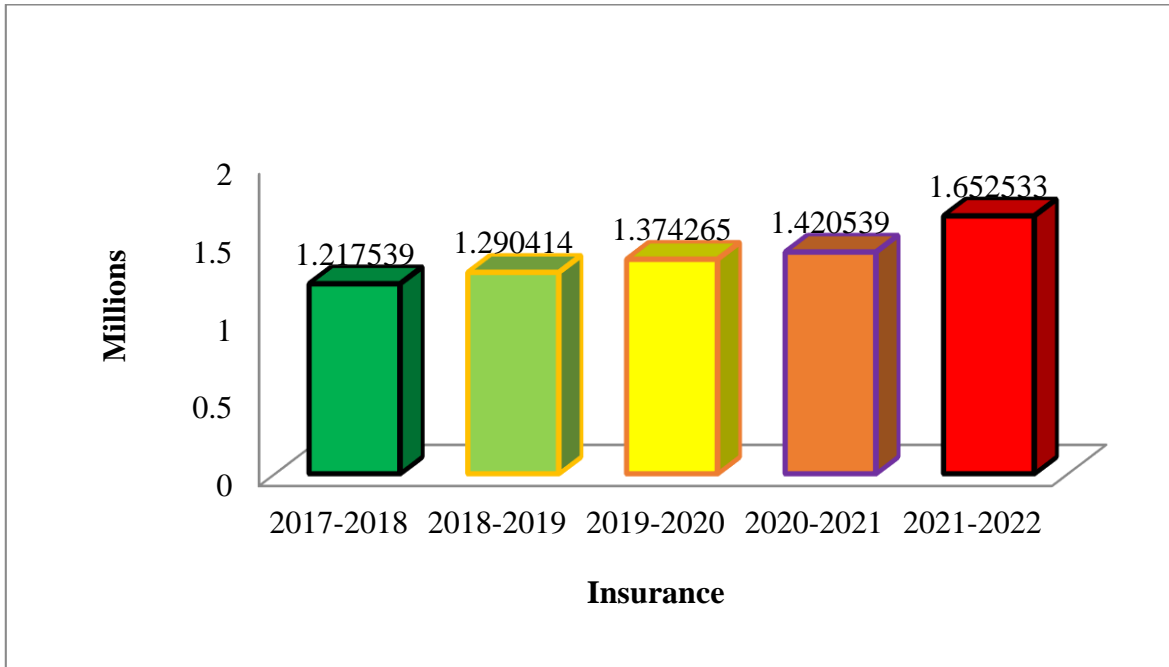


Figure B.1. Insurance data collected from Oromia transport authority office

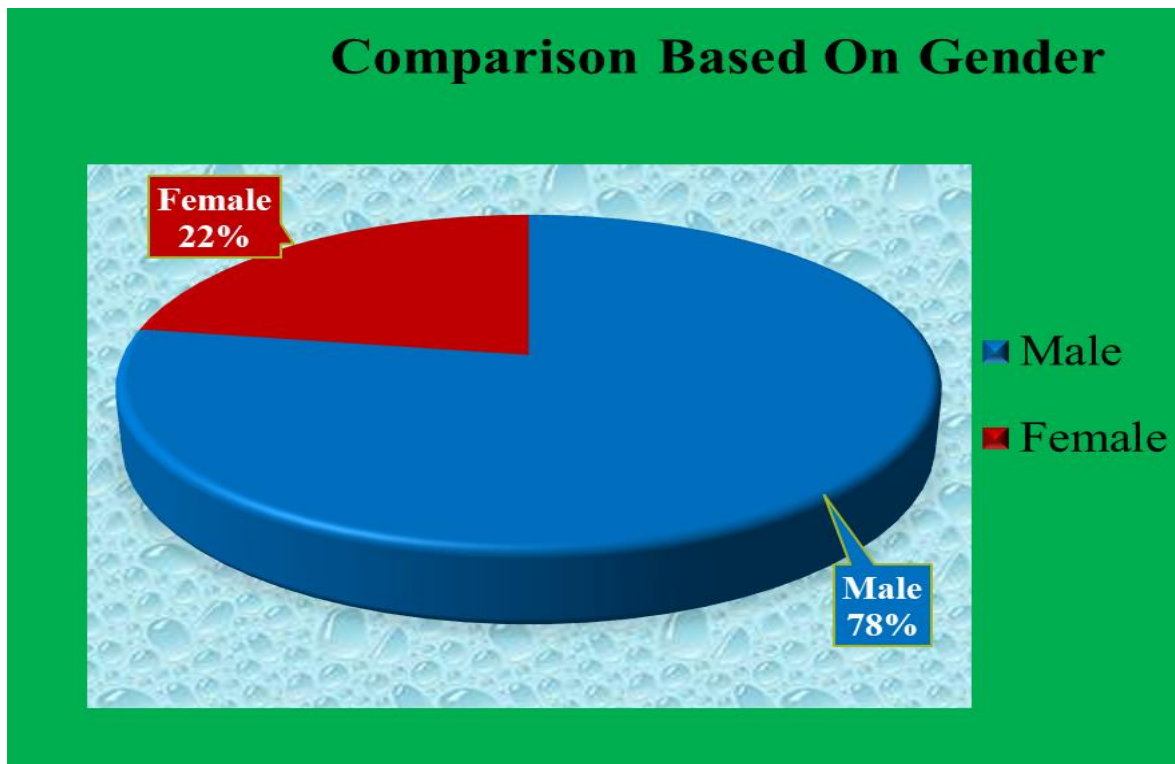


Figure B.2. Comparison of respondents based on gender

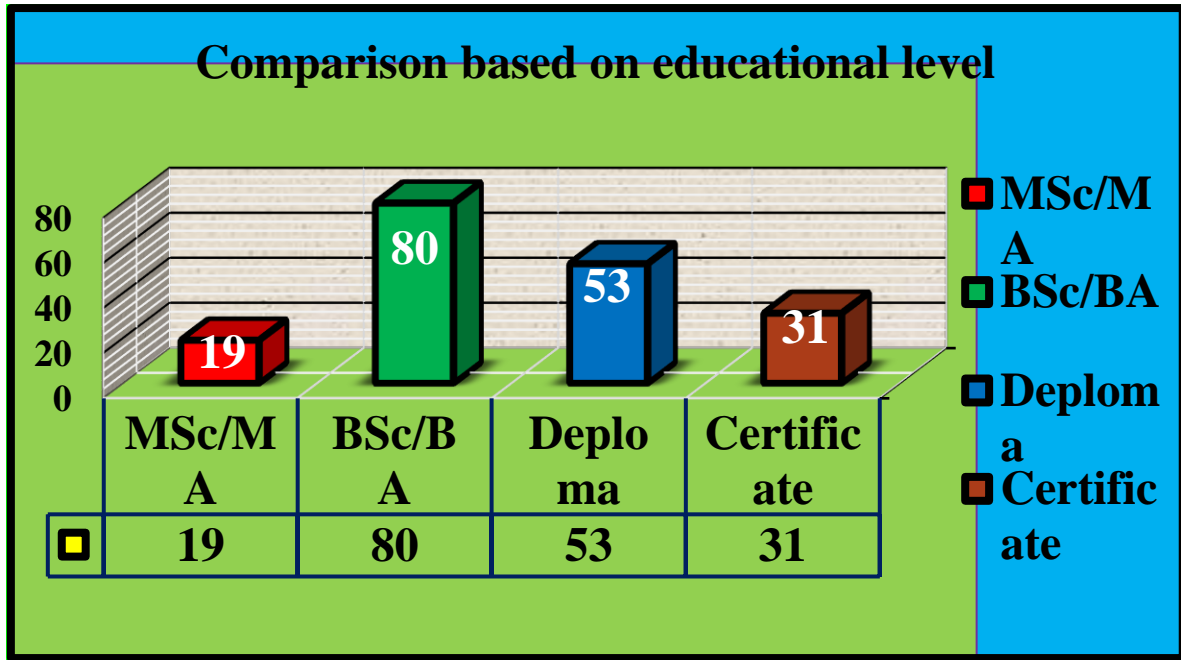


Figure B.3. Comparison of respondents based on educational level

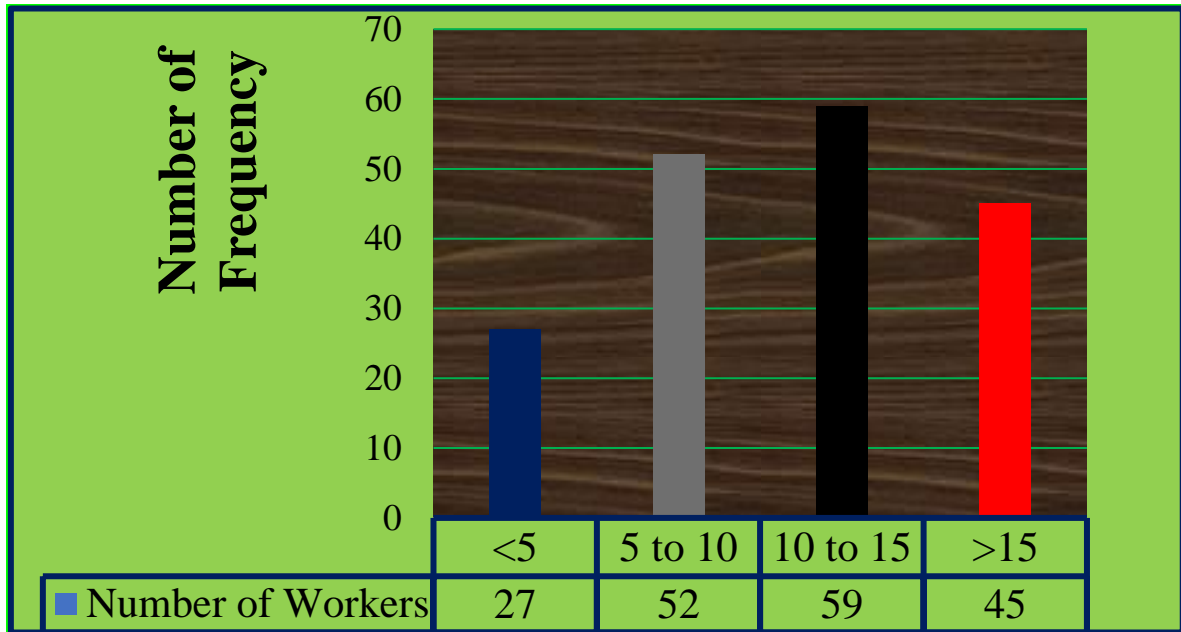


Figure B.4. Comparison of respondents based on work experience



Figure B.5. Comparison of cost per year

Appendix C. Technical Specification pf Tata 61 Seat Bus

Table C.1. Technical specification of Tata 61 Seat Bus Model

No.	Technical specification of Tata 61 Seat Bus Model	Remark
1	Bus Model LPO 1618 BS VI	
2	Chassis Plat form LPO 1618/62	
3	Engine Tata Cummins B 5.6	
4	Engine Power139 kW (186 hp) @ 2300 r/min	
5	Engine Torque850 Nm @ 1000-1600 r/min	
6	Clutch Diameter (mm)380	
7	Gearbox G 750 OD 6F + 1R	
8	Brakes Dual circuit full air S-cam brake with Retarder Option	
9	Suspension Front – Weveller /Pneumatic; Rear - Weveller/Pneumatic	
10	Steering Tilt and Telescopic Power Steering	
11	Battery2x12 V, 150 Ah	
12	Alternator100 A	

13	Tyres 295/80R22.5	
14	Fuel Tank Capacity (l) 350	
15	Turning Circle Diameter (mm) 21100	
16	Max. GVW (kg) 16200	
17	Wheelbase (mm) 6200	
18	Length (mm) 11865	
19	Rear Overhang (mm) 3400	
20	Front Overhang (mm) 2265	
21	Overall, Height (mm) 1890	
22	Max. Width (mm) 2585	
23	Seating Capacity & Layout "61+D"	