



JIMMA UNIVERSITY
JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

EVALUATION ON MANAGEMENT SYSTEM OF ROAD
MAINTENANCE CONSTRUCTION: CASE STUDY
ON PROJECTS UNDER JIMMA ZONE

A Thesis submitted to School of Graduate Studies, Jimma University, Jimma Institute of Technology, Faculty of Civil and Environmental Engineering in Partial Fulfillment of the Requirements for the Degree Master of Science in Construction Engineering and Management

By

MUNA BEKELE DENGESO

April 2021
Jimma, Ethiopia

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April 2021
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DECLARATION

I declare that this research entitled “EVALUATION ON MANAGEMENT SYSTEM OF ROAD MAINTENANCE CONSTRUCTION: CASE STUDY ON PROJECTS UNDER JIMMAZONE” is my original work and has not been submitted as a requirement for the award of any degree in Jimma University or elsewhere.

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As research Adviser, I at this moment certify that I have read and evaluated this thesis paper prepared under my guidance by Muna Bekele Dengeso entitled “EVALUATION ON MANAGEMENT SYSTEM OF ROAD MAINTENANCE CONSTRUCTION: CASE STUDY ON PROJECTS UNDER JIMMAZONE” and recommend and would be accepted as a fulfilling requirement for the Degree Master of Science in Construction Engineering and Management.

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ABSTRACT

All roads require maintenance as they are subjected to daily traffic load and the forces of weather. Even with the highest possible construction quality, care is essential to get optimum service from the road structure during its design life. In Ethiopia, it is getting hard to get good roads, especially gravel roads, in the summer season. Still, it is not about the streets that did not have a maintenance budget to repair. It is due to the management system during maintenance construction. The study's main objectives are to evaluate the management system of road maintenance construction in Jimma zones, specifically investigate the poor management system, to determine the significant factor for the poor management system and the consequences on road maintenance construction projects.

The study was carried out by desk study, interview, and questioner survey. Professional contractor, consultant, and clients under Ethiopian Road Authority of Jimma road network management directorate with nine routine and periodic term maintenance projects in Jimma zone and Oromia Road Authority with 13 routine and periodic term road maintenance projects were the study population selected with the non-probability sampling method. The collected data were analyzed using origin software, Statically RII formula by Microsoft excel software. In each of the three managerial levels, the study's findings illustrated that 86% of the respondents agreed with the poor management system of road maintenance construction in the Jimma zone. The top factors were identified from the major factors for the poor management system of road maintenance construction, the Non-technical work methodology (RII=0.187), the Improper manpower allocation (RII=0.187), the Unexpected inflation/material price escalation/ (RII=0.186), and the Delay of payment for completed work (RII=0.185), are the top factors that are identified. Public complaints on-roads (RII=0.64), Discourages contractors from participating in road maintenance construction (RII=0.512), Loss of clients confidence in consultants and contractors (RII=0.496) are the top three negative outcomes of those factors on management system among seven.

The recommended ideas are proper planning and work methodology, consideration of project cost (budget) with material escalation for governmental contractors, on-time payment delivery, the timely updates unit price for the activities, and the staffing allocation in consideration with work experience.

Keywords: *Construction project, Management system, Poor management, Road maintenance, technical management.*

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ABBREVIATION

ECWC	Ethiopian Construction Work Corporation
ETB	Ethiopian Birr
EC	Ethiopian Calendar
ERA	Ethiopian Road Authority
GARBLT	General Authority of Road Bridge and Land Transportation
GC	Gregorian calendar
IRMS	Indonesia Road Management System
JRM	Jimma Road Management
JDRN	Jimma District Road Network
INEA	Instituto Nacional De Estradasde Angola
ISO	International Standardization Organization
LSC	Limited Staff Capacity
MMS	Maintenance Management System
RMMS	Road Maintenance Management System
RSDP	Road sector development program
PMMS	Pavement Maintenance Management System
PM	Project Management
PMS	Poor Management System
PRMMS	Poor Road Maintenance Management System
RSDP	Road sector developmental program
ROW	Right of Way
ORA	Oromiya Road Authority
OBS	Organization Breakdown Structure
WBS	Work Breakdown Structure
WCMC	White knight Construction Management Consultants
SANRAL	South Africa National Road Agency Ltd

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

The construction industry, the leading sector in the domestic market, is also on the track to becoming one of the leading sectors globally. About 8% of the world's gross domestic product (GDP) relies on the construction industry [1]. Many road maintenance construction projects have been undertaken throughout the Oromia Regional State as part of its regional development plans. The Ethiopian government also implemented three Road Sector Development Programs (RSDPs) from 1997-2010 with a cost of US\$ 4.12 billion funds that donors partly covered, including governments of Japan, Germany, U.K., Ireland, World Bank, et al. The primary RSDP run from 1997-2001 and the second was from 2002-2007 [2]. The whole road network in 1997 was 26,550, and it has been increased to 46,812 km in 2007. The fraction of roads in good and serviceable conditions also increased from 22% to 54% [3].

The Constructed road gets deteriorated because of the consequences of weather and traffic [4]. There are many sorts of road deterioration, namely: alligator cracking, bleeding, block cracking, bums and sags, corrugation, depression, edge cracking, joint reflection, lane/shoulder drop off, longitudinal and transverse cracking, patching and patching utility cut, polished aggregate, Potholes, railroad crossings, rutting, shoving, slippage cracking, swell weathering and raveling [5]. So, maintenance is required to keep its condition to be near its constructed state [6]. Road maintenance is also a fundamental necessity, equally important as the original road provision [7]. Good road access naturally enhances the spatial integration of markets and reduces the responsiveness of farm gate prices to local supply shocks; it has expected to cut back the chance but enhance the profitability of such inputs' appliance. Providing good road access could also enhance other policy measures geared toward altering micro-level economic incentives and creating a shift in resource allocation [8]. Improving road maintenance involves overcoming a reluctance to alter the way things are applied and financed at a systemic level; therefore, it is a slow process. Government agencies and other prominent stakeholders answerable for planning,

executing, and financing; contractors involved in polishing off the works; direct users of the roads; and beneficiaries suffering from the availability of transport services.

Additionally, the finance ministry is the backbone of the fund and its allocation [9]. Some maintenance strategies might provide a less expensive and quicker solution to an issue but might cause higher rehabilitation costs through accelerating deterioration [10]. Constructing a brand new road could be a cost that is paid once, but the price for maintenance needs to be paid over and over again. As the road gets hectic, maintenance expenses increase. Hence a sustainable funding plan for maintenance is crucial. Government borrowing and general taxation, which are the traditional income source, are providing funds for maintenance. However, since there are many needs during a society for this money, an alternative source that is more regular and less exposed to the competition from other public sectors must be searched [11]. Road maintenance construction projects will be affected by inexperienced manpower allocation management. And insufficient experienced staff hurts the overall activities, including the project's management practice. [27]

Regarding the current aspect, as traditional systems have shortcomings and supply limited access to data, the intense need for project information and effective communications by the project team cannot be met. Successively they are incapable of fulfilling project duties and objectives. Additionally, as with any construction scheme, an engineer should have detailed knowledge of the equipment [12, 13, and 14]. The progress of the project depends upon how briskly the work is applied. Hence, it becomes necessary to pick the equipment by considering all aspects of a site's working conditions. So it is necessary to create the right planning & management of equipment to use it reasonably at minimum possible cost and with maximum output productivity [15].

Despite their importance, most African roads do not seem well managed and inadequately maintained [16]. In Ethiopia, it is also customary to determine plenty of deteriorated roads in day-to-day activities. Therefore, this study's most focus is to evaluate the management system of road maintenance construction projects of the Jimma zone.

1.2 Statement of the Problem

Roads contribute a lot to developing countries' economic growth, but if the management system of maintenance construction is flawed, it will not meet all the requirements. As a result, this could cause car accidents, the difficulty of cash crop transportation, risk of the safe road, high cost of transportation, and wastage of time. Road users, passengers, pedestrians, or only in the vicinity of roads, substantial economic benefits from road transport cannot be sustained without an adequate maintenance management system [8].

The road maintenance construction management system can be affected by the construction process's inadequate managing skill [17]. The management system of road maintenance construction in Jimma zones, also affected by poor resource management, poor construction schedule management and poor planning and coordination of road maintenance projects. Therefore the system needs to be updated in finding an effective way of managing and maintaining roads

1.3 Research Questions

- What are the poor management systems of road maintenance construction of the Jimma zone?
- What are the factors that bring poor management system of road maintenance construction of Jimma zone?
- What are the negative outcomes of those factors on the management system of road maintenance construction in the Jimma zone?
- How can the management system of road maintenance construction of the Jimma zone be improved?

1.4 Objective of the study

1.3.1 General objectives of the study

To evaluate the road maintenance construction management system in a case study of Jimma zone road maintenance projects.

1.3.2 Specific objectives of the study

1. To identify the poor management system of road maintenance construction in the Jimma zone.
2. To determine the factors that brings poor management system of road maintenance construction of Jimma zone.
3. To investigate the negative outcomes of those factors on the management system of road maintenance construction of Jimma zone.
4. To comprehend what solution improves the management system of road maintenance construction in the Jimma zone

1.5 Significance of the study

Most Ethiopian roads worsen due to many problems like seasonal weather conditions, poor artistry, poor design, and heavy traffic. So, implementing proper road maintenance saves the budget and time spent on reconstruction. It also enhances the safety of passengers by reducing operating costs for vehicles. Also, the current demand for road traffic of urban and rural areas, having a massive impact on a country's economic growth and reducing an accident, cannot be met without ongoing construction and road maintenance. Hence, this study's outcome expected to reveal the road maintenance construction management system designed by planning, budgeting, scheduling, performing, and improving the road to better conditions. These, in turn, have substantial input to enhance the overall development of the zone and strengthen the economy and safekeeping of the community.

1.6 Scope of the study

The study is bounded in Jimma zones road maintenance activities. The research mainly focused on the management system of stakeholders engaged in road maintenance construction projects; identifying the poor management system of road maintenance, determining the factors for poor management system and investigating those factors negative outcomes, and finding a solution to the Jimma zone road maintenance construction projects. Particularly focused on the roads that are constructed and completed in the past four years and which are currently on going by regional budget in Jimma zone

CHAPTER TWO

LITERATURE REVIEW

2.1 Road maintenance definition

Road maintenance is an action that incorporates routine maintenance, road replacement, and reconstruction [18]. It is also an activity of minor repairs and enhancements to eliminate the reason behind defects and avoid unnecessary repetition of maintenance efforts [19]. Road maintenance refers to collecting preventive activities that are finished to limit the rates of degradation of a structure or corrective activities to stay the road during a serviceable state and retain the road safely and in useable condition [20, 21]. Road maintenance can be routine, periodic, and emergency works completed to stay pavements, shoulders, slopes, drainage facilities, and structures as near as possible to their as constructed or renewed condition to ensure its design life is attained [22].

2.1.1 Types of Road maintenance

There are three kinds of Maintenance programs [23].

1. Routine Maintenance: this can be a regular activity that is completed as frequently as required every year. It may be done over and over per year to make sure serviceability in the slightest degree times, and altogether weathers. Road sweeping, crack sealing, repair of minor damage to carriageway surfaces, and urgent maintenance work are routine maintenance components.
2. Periodic Maintenance: this kind of maintenance is required only at intervals of years. It includes renewal or renovation of the wearing surfaces of carriageways that become worn or deformed by use, resealing of paved roads restoring of road markings.
3. Extraordinary Maintenance: maybe quiet maintenance, which is completed to return strictly deteriorated roads to their original condition. It includes road strengthening by applying one or more structural layers (overlays) to an existing pavement or finishing the reconstruction of a pavement structure that has been deteriorated.

2.2 Requirement and significance of Road maintenance

The requirement of road maintenance differs from country to country and from place to place. However, it depends on various external factors like traffic, terrain, soil types, and climate. The initial technical designs were applied during the development of the road. Therefore, the qualities of the works distributed during the development works are the foremost factors determining maintenance requirements. The lifetime of the roads gets with inadequate maintenance [24].

Consequently, operating costs and the incidence of accidents are high. In another case, inadequate maintenance was also linked with rapidly growing traffic, low road maintenance standards designs, and construction deficiencies. Periodic and timely maintenance is required to extend the road's lifetime by delaying the time required to be reconstructed. The value of maintaining a road may be a small fraction of the investment cost, usually some 2-3% for a severe paved road and 5-6% for an unpaved rural road. The economic logic for practical preventative maintenance is entirely acceptable. The development of roads while consuming large amounts of cash has little importance if there is no effective maintenance system. Long-term costs of maintaining the road network are additionally increased thanks to low road maintenance [16]. If the paved roads do not seem to be maintained on an exceedingly regular base, quite thrice maintenance costs are spent for rehabilitation every ten or twenty years [11].

In Norway, the upper deck has to have a waterproof membrane. Moreover, It might be accomplished with simple work, which requires about 0.6 million US dollars. However, because of the negligence of maintenance, after some years, the entire bridge had to be torn down and replaced by a brand-new bridge with the full cost of 15 million US dollars. In Kenya, also Nairobi-Mombasa road becomes highly vulnerable. In 1997, two bridges and several other sections of the road were damaged due to heavy rain.

Moreover, they were hard to be used during the rainy season. Consequently, national users experienced months of disruptions. Besides, in Tanzania, crossing an easy stream could not be corrected on time; consequently, 3 kilometers of the road got damaged. Thus, five times higher cost was spent to form the initial repair [11].

2.3 Factor affecting Road maintenance management system

Maintenance management was first introduced in the United States of America in the 1960s [25]. It is a significant activity for developing a road infrastructure system, an essential part of modern city expansion, ensuring smooth traffic even during heavy traffic conditions [26]. The system is classified into two. The first one is the information system, which collects, organizes, and stores data as network information. The other one is the decision-support system that includes application modules to process the data and provide the information on which decisions can be based and ultimately implemented [27]. Recently software has been developed based on Geographical Information System (GIS) to manage the traffic, road conditions, and maintenance system. When there is an organized road maintenance management system, all road networks keep open. Although the need for maintenance is widely recognized, and different countries have shown interest in researching this field, it is still not adequately done. On average, across the world spend around only 20–50 percent of what they should be spending on maintenance of their road network [26]. Improper road maintenance systems need to be improved to achieve a better transportation system [28]. Road maintenance construction management majorly deals with the roads' deterioration with heavy rain, snowfall, scorching weather & other seasonal effects on the road system. It is also concerned with developing a solution to mitigate natural calamities and human activities that cause severe failure like cracking, distortion, bleeding, flushing, and potholes. Different repairing techniques are available, which can be applied after inspecting the worthy cause of the damage [29]. The information available in this area is found in a very scattered way, and difficult to get literature to review on this yet so far. A proper study is required to show us the different available alternatives for urban road maintenance and management [30].

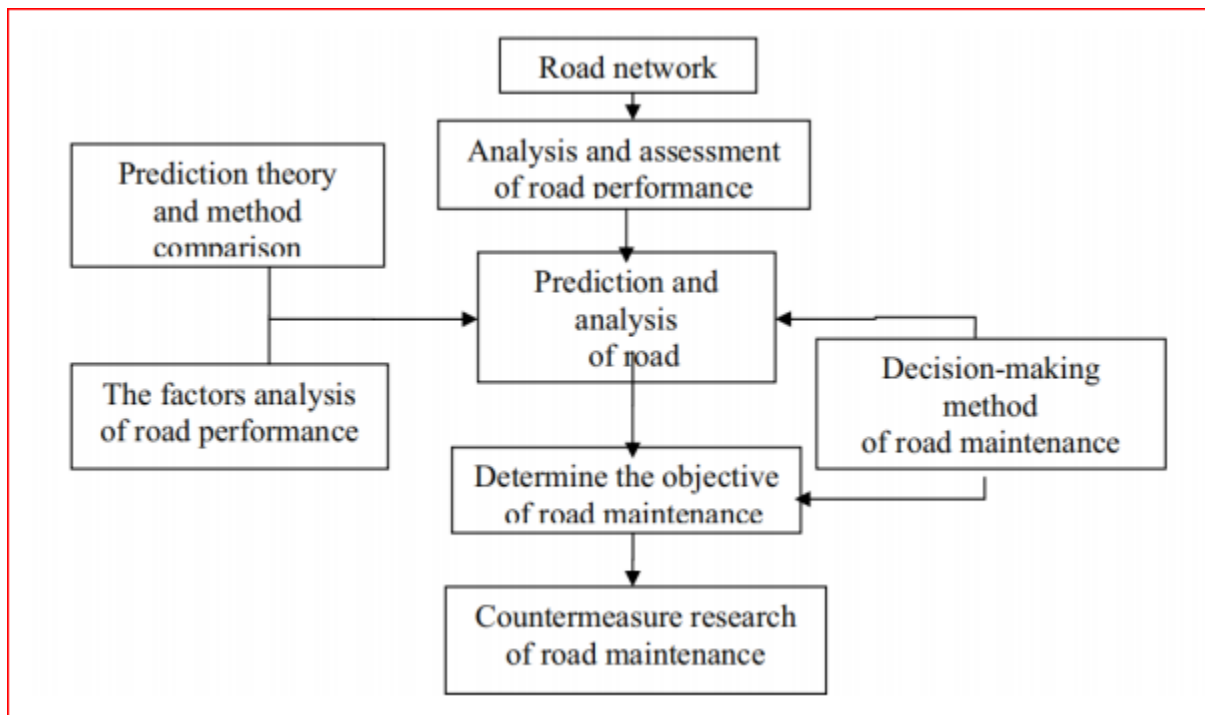


Figure 1 Typical flow chart of road maintenance management and planning

In India, fair value has not been given to maintaining roads and bridges by the states. Though some states are fully computerized and skillful at forming honest efforts to establish meaningful maintenance management systems, challenges of commitment to work the program in an exceedingly systematic approach have been noticed in many places. This experience shows that technology, political will, and discipline within the relevant agencies can practice the management approach [31]. Though the Jordan road network has suffered from continuous deterioration, pavement condition improvement has been reported as RMMS began to be implemented. However, the system was run with manual operation.

Consequently, the researchers recommended that the system be improved with the GIS and stereo vision system appliance. They also stated that an enormous endeavor, providing unique training programs, is required to alter traditional practice into simpler technology [32]. Although Nigeria has the largest road network in the geographical region and also the second-largest road network in the south of the Sahara with an estimated road length of 193,200 kilometers and spending vast sums of cash on road maintenance, thanks to the inadequate or insufficient system,

low maintenance culture, poor reporting and documenting system, and improper procurement method, the utility of the road significantly reduced.

The findings of the study done on Road Maintenance Management of Kano State identify the subsequent weakness. There no proper way of addressing the complaint to the agency, also as there is no provision of the computer for receiving the complaint, kept in the same file and sometimes may even be lost. Inspection of the roads was also carryout in traditional ways once per annual, and several other data would be lost since gathered data within the survey are documented manually [33].

2.3.1 Resource allocation and management

In construction management, the term resource referrers to a few categories: human, materials, and equipment [34]. Human resources are again divided into two. Direct human resources employed to perform a particular task like carpentry, mason, ironworkers, electricians, and supervisors' human resources who do not perform a specific task like superintendents, engineers, and project managers and secretaries are called indirect human resources. Standardize Materials resources also have direct effort for the productions of the project. Their management, including designing and monitoring all necessary activities required to ensure those materials and equipment with accurate quality and quantity, are appropriately laid out promptly and available at a logical cost. It is also required to form sure accessibility of materials as they are needed [35]. Moreover, materials management is essential to produce efficient, low-cost transport, security, and materials at construction sites [34].

Equipment resources: Equipment resources are divided into two.

1. Movable construction equipment; these are temporarily installed tools within the construction Process. Like bulldozers, backhoes, cranes, forklift
2. Immovable equipment: these are permanently installed and may be used after the project gets completed. Like heat pumps, emergency generators, equipment installed in kitchens, therefore, to perform building as per expected, planning and scheduling must be finished expertise, and due attention must be purchased resource allocation.

2.3.2 Road maintenance activities duration estimation

The scheduling process begins with a guesstimate. Though it is not usually realistic, activity duration assumes that all activities will be performed under standard working methods and hours. Accessibility of resources in the project is the main factor directly related to the estimation of duration. Road maintenance duration estimation is always somewhat uncertain. Past work and experience can be used as a guide and history to estimation. However, if the previous work is mistaken, the same factor may lead to the current duration estimation to the wrong [36].

2.3.3 Process of pavement maintenance management system

The subsequent tasks are required to implement PMMS to a particular pavement network [23].

1. The roadway network is going to be defined by breaking it into management segments (sections), and a list for every segment are going to be dispensed
2. The pavement condition is going to be inspected, and maintenance data of every segment are gathered
3. The pavement condition assessment is going to be calculated with the selected evaluation criterion.
4. The treatment strategy and value for every segment will be determined per the pavement condition.
5. Away is developed for prioritizing segments if funding limitation happens in a very pavement maintenance program.
6. Results are documented and reported.

2.3.3.1 Objective of pavement maintenance management system

A pavement maintenance management system (PMMS) could be a scientific tool required for managing the pavements to ensure effective use of resources available or form the society to be highly benefited [23]. The American structure Association (APWA) also defines a pavement maintenance management system as "a scientific method for regularly collecting, storing and retrieving the type of decision-making information needed (about pavements) to form maximum use of limited maintenance dollars [37]. It is also an activity of determining the very best strategies for existing pavement conditions by evaluating and maintaining to retain the

pavement's tolerable serviceability for the desired period. A straightforward system supported visual inspection is also sufficient [38]. PMMS is also the way of providing pavement maintenance more economically and efficiently [39]

2.4 Evaluation of the main factors for PRMMS

Calculating and filing the present traffic rate and structure is the primary step of the road management system to use valuable outputs after a few years for maintenance construction while the roads get deteriorated. Planning, which is that the most significant road project management phase, defined and determined all work to be done. This phase is accomplished with various methods like tables, work break down structure, charts, and networks. Project activities and relevant information like the duration, work dependency, starting, ending, cost, and required resources are displayed in the table. WBS is an organizational chart used for scheduling, pricing, and resource planning [18]. It makes things easier to summarize and report progress and costs.

On the other hand, the Organization Breakdown Structure could be a model required for better management with arranging resources. There is a strong interdependency between OBS and WBS [40]. The positive contribution of RMS on shifting budget towards asset preservation is not well recognized. Even within the place where systems are present and even where the full budget is increasing, it is usually allotted more at network development than asset preservation. Computers are highly required to process data and supply necessary information with the management process [41]. So, a management system makes an essential contribution to highway organizations' effective operation [42, 43]. Planning, organizing, directing, and controlling steps, which are the most management function, are supported with a structured system. Unfortunately, the implementation of the system in several counties was negatively affected by the following reasons. The primary one is user attitudes, including an absence of genuine commitment to implement and resistance to change. A cultural issue, including problems of introducing modern management practices, is additionally another factor.

Additionally, economic and financial problems, which are anxious with weak local economies and interchange shortages preventing the acquisition of even essential commodities needed to support the system. Moreover, native budgets dominated by the payment of staff salaries, with

residual funds being insufficient to get hold of maintenance work to be meted out, are considered as an explanation for the matter. Poor experience of the staff is additionally another mentioned issue for the matter to happen. Thanks to over-ambitious training programs with inadequately prepared instructors and insufficient follow-up training and revision, the system also gets weakened. Deficient computer facilities, inadequate availability of hardware, and low availability of knowledge, likewise as the too complicated system also identified causes for implementing a system to be less [27].

2.4.1 Suggestion for the management system of road maintenance

Clear deadlines must be set for the planning and programming cycle/schedule of the road maintenance management system. Executives and managers are expected to arrange annual Reports/Business Plans, using ‘Asset Value’ and other Key Performance indicators derived from the RMS. It is also essential to listen to the RMS (road management system) itself since it offers the info and improves the chance during which budget and funds are accessible to run the system.

Ministers and other high governance must be briefed regularly on the importance of asset preservation and how it is often achieved suitably. Specific and realistic key performance indicators to live asset value must be identified to preserve/enhance the worth. At the top of every year, those identified targets must be monitored to test whether or not they are achieved or not. Then proper action must be taken. Moreover, such information must be published in Annual Reports. There must be policies and procedures for data collection and quality assurance. Technical (internal and external) auditing must be administered on the systems, and also the given recommendation must be practiced on the program to make sure continual quality improvement.

2.5 Road Maintenance in Africa

The road networks of African countries that have been constructed during colonization for colonial manipulation and military power were developed and maintained to a certain degree. Although the road density is low in general, it started to increase in some countries, e.g., Madagascar, Malawi, Mozambique, and Niger. Nowadays, since the governments have struggled

to increase road density, most African countries' conditions have improved. However, the ratio of African countries that have access to all-season roads is one to three. This fact shows that road construction of the continent has not kept pace with urbanization. Due to a shortage of appropriate funds in many countries, road maintenance remains insufficient [44].

2.5.1 West African Countries: Nigeria Approach

In Nigeria, the one concerned with maintenance issues at the federal level is the Federal Road maintenance agency (FERMA). The state's ministries handle the state with different aids of the local government roads [45]. However, the maintenance implementation system of the agency needs to be checked. Because the maintenance rate could not be much with the deterioration as the financial and technical requirements for adequate maintenance, rehabilitation, and reconstruction are overwhelming. As the roads are not adequately constructed and inadequate funds, routine and extraordinary maintenance is not accomplished as required. Also, the traditional method of the FERMA and State ministries negatively impacted Nigeria's road maintenance activities. However, privatization of maintenance work with performance-based contracts is considered a cost-effective alternative [44].

2.5.2 North African Countries: Egypt Approach

Though Egypt offered adequate investment, which is 0.7% of the GDP for the national road project, road maintenance did not get enough attention. It took only 0.15% of Egypt's GDP, which is too small compared to Morocco (0.24%). This inattention enhances a traffic accident rate that causes loss of GDP by 1.5% and more. Though Since 2001, the Egyptian government raised the fund allocated to roads and railway for better transportation, more than have percent of the road requires maintenance. Moreover, 700 bridges out of 1706 were distorted because of inadequate maintenance. Subsequently, domestic and international transportation badly affected. This fact triggered the government to establish a general authority of roads, bridges, and land transportation (GARBLT) for road maintenance and development. However, due to a lack of talented human resources and tools for proper inspection and evaluation of the bridge, the authority's achievement is not satisfactory. In general, road maintenance is an unresolved issue in Egypt. So, since 2013 the structure has been changed. Thus major projects are doing well to expand motorways under the supervision of the military [44].

2.5.3 Central African Countries: Angola Approach

The total road network of Angola is 72323km. Of which 7,777 km is paved, 28,018km is gravel, and 36,528km is earth roads. Even though the government currently allotted about 4.3 billion US\$ dollar per year to reconstruction, still, much work is expected to make Angola free from the dusk of war. In 2008 and 2009, Instituto Nacionalde Estradasde Angola (INEA) is accountable for planning and managing Angola's national highway, and 5,600 km of roads were reconstructed [44]. Since most roads are found in the past war region, they did not get enough maintenance. Hence the knowledge of INEA regarding the real situation of the road and the possible rehabilitation expenses is limited. As a result, the data collection means of INEA must be improved. Rehabilitation of the national road network is the government's primary concern, but these activities directly dependent on the state budget as the road fund, which was proposed to have independent management with the participation of different stakeholders, constituting the primary source of revenue to INEA. However, it is not yet in operation [44].

2.5.4 Southern African Countries: South Africa Approach

The total road network of South Africa is approximately 746,978 km. Moreover, it is the 10th and 18th longest road in Africa and the world, respectively. Though the economic growth of South Africa is the leading in the continent, its road condition is low at 38% due to a lapse in maintenance activities [46].SANRAL was established in 1998 and responsible for handling road maintenance. Out of 92% of the national road network controlled with SANRAL, 81% are non-toll and funded directly by the national government's tax revenues. As well as 8%, which is left is tolled and developed and managed by private bodies. How the private bodies run their work was supervised with SANRAL in 1995, the toll road started to support the development and maintenance of roads in South Africa [47]. Based on the extent of achieving the aim, SNARL was regarded as successful. South Africa allotted about 80-149 billion rand for road maintenance, and SNARL utilizes it for different types of maintenance inappropriate way. Due to a lack of proper data collection and improper coordination, only municipal roads are not well managed [48].

2.5.5 Ethiopia

Ethiopian Roads Authority was established in 1951, and during this time, the entire road network was about 6,400 km. Many portions of the network were built during the Italian assault. In 1997 the amount of road network had increased to 26,550 km, out of it 3,708 km were paved., in 2007 the length of the network has reached 42,429 km, of which 5,452 km(12.8%) are paved, and 36,977 km (87.2%) are unpaved, 20,080 km regarded as the main road administered by the Federal Government (Ethiopia roads authority), and the remaining 22,349 km classified as rural roads are under the Regional Rural Roads Authorities [22]. Activities such as planning, construction, and maintenance of federal roads are accomplished with ERA. ERA has invested around 20 billion Birr in construction and maintenance. 63% of this money was obtained from an internal source like the road fund, the community, and the government, and the remaining 37% was obtained from the international community [49]. Using the separate maintenance contractors, which are recently established as a separate enterprise called ERCC, ERA has been undergoing the road's maintenance.

2.7 Road Fund Administration

2.7.1 Ethiopian Roads Authority

In 1995, only 30% of the roads of Ethiopia were in an acceptable condition. Of which 11% is paved roads, the remaining 19% is unpaved roads. Major economically important roads in accessing ports were found in bad condition. To deal with the existing problem in 1997, the government started ten-year Road Sector Development Program (RSDP). Moreover, donors were attracted and involved in the practical program of investment [49]. In 1997, a parliament road fund board's proclamation was established along with the road maintenance initiative (RMI) to improve the total fund of road maintenance. The Board is chaired by the Minister of Works and Urban Development. Three Vice Ministers, six Regional Presidents or representatives, the general manager of the Ethiopian Roads Authority, four representatives of road transport owners, and the director-general of the Office of the Road Fund Administration are included as Members of the Board, and their membership is for two years [49].

The Board is an authorized body to give direction on the issue of collection and disbursement procedures of the fund that include the recommendation of extra resources and levels of tariff's necessary for finance road maintenance) Moreover, to make sure that the revenue is collected and deposited timely. Road maintenance programs of road agencies to be financed with the fund must be reviewed by the Board and submitted to the government. The Board is responsible for ensuring the transparency and accountability of disbursements, getting and reviewing management reports from Road Agencies, and commencing financial and technical audits of road maintenance and road safety measures [49].

For a given road agency to get road fund revenues, it has to have a separate Road Fund account merely for road maintenance. It is essential to avoid mixing maintenance funds with others. It helps road fund auditing separately from other accounts, unlike the Ministry of Finance budget accounts that must be used within each budget year on a rolling basis. It is possible to use deposited money. Allocation of the fund is 65% to the Federal Roads, 25% to the regions, and 10% to selected municipalities. Based on the ratio of 80% weight to road Length and 20% weight to population the regional fund will be distributed. According to the population size and centrality to Addis Ababa, the residual money is disseminated to the municipalities [50].

2.7.2 Assessment of Road Maintenance in Ethiopia

In the early 1990s, Ethiopian roads were characterized by gully, ruts, potholes, depletion silting of side drains, Etc. Thus during this time, the overall condition of the road network was worsened. In 1995 the Spanish consultant financed by the European commission briefly showed the extent of the problem. Out of 3656 km of the paved road, only 402.16 km were considered good enough. About 41% was worsening fast, and 48% were beyond repair. Also, out of 20,156 km of the unpaved network, only 19% were found in acceptable condition, 28% and 53% were found in a mediocre and wretched state. In 2007, this critical condition was improved, in which 49% of 42,429km was found to be in good condition. Moreover, 22% of the road segments were considered fair, and 29% of the total network was Poor. In general, the percentage of the road segment in good and fair condition has increased in the year 2013 to 51 and 27 percent, respectively [50].

Maintenance budget and disbursement on the federal network (birr in a million) [48]

Table 1 Maintenance budget and disbursement on the federal network (birr in a million)

Year	Routine and Periodic Maintenance			Emergency and other Works		
	Budget (Million)	Disbursement (Million)	% Age Acc	Budget (Million)	Disbursement (Million)	% Age Acc
1997/98	158.4	117.9	74.4	10.8	5.6	51.9
1998/99	156.9	123.5	78.7	15.2	12.5	82.2
1999/00	152.0	118.2	77.8	17.0	15.2	89.4
2000/01	114.0	140.4	123.2	70.8	27.8	39.3
2001/02	119.7	176.2	147.2	178.0	31.0	17.4
2002/03	121.5	115.7	95.2	35.1	68.6	195.4
2003/04	127.0	192.8	151.8	163.2	140.5	86.1
2004/05	63.5	137.1	215.9	162.2	482.6	297.5
2005/06	144.1	172.5	119.7	112.4	298.4	265.5
2006/07	150.0	230.3	153.5	257.8	394.7	153.1
2007/08	186.7	234.8	125.7	161.3	400.6	248.3
2008/09	227.8	527.8	231.7	200.7	500.7	249.4
2009/10	223.4	516.9	251.5	196.2	491.1	250.3
2010/11	158.9	368.1	231.6	140.0	367.4	262.4
2011/12	426.9	493.1	115.5	320.3	310.9	97.1
2012/13	302.1	440.7	145.8	439.9	410.2	93.2
2013/14	516.8	577.2	111.6	370.9	376.1	101.4

Condition of roads 2014 [51]**Table 2** Road condition of Ethiopia (ERA source)

Year	Condition of Roads (%)		
	Good	Fair	Poor
1995	18	29	53
2007	49	22	29
2014	51	27	22

Since roads deteriorated to such an extent, vehicle-operating and transportation costs were increasing from time to time. Hence rather than facilitating the road were hindering the movement of people and goods. It is due to inadequate maintenance funds and unable to provide the road as per its requisite. Insufficient budget, limited equipment, spare parts, and materials, giving more focus to new construction, institutional problem, and missing maintenance planning were also problems in undertaking the periodic and routine maintenance. [54]

Therefore, it was recognized that efficient maintenance of the network is the main factor determining the significant achievement of RSDP. The road fund thoroughly covered the expense of routine maintenance.

In June 2007, about 1903.8 million was planned to be paid for regional and urban road routine maintenance. However, the amount of birr which was spent during the same period was 2471

million. Out of the total maintenance cost, 61.7%, 26.8%, and 11.5% were given for federal, regional, and urban roads, respectively. About 42,429 km is found in good condition, and 29 % is low [50].

The Government and the Ethiopian Roads Authority (ERA) have got a lesson from experience, and currently, they pay attention to maintenance tasks [50]. On average, Ethiopia's overall road network increased between 1997 and 2014 by 3.2%. Table 3 shows this fact vividly.

Change in selected indicators [50]

Table 3 Proportion of Road network of Ethiopia

Indicators	1997	2002	2007	2013
Proportion of Asphalt roads in Good Condition	17%	35%	64%	71%
Proportion of Gravel roads in Good Condition	25%	30%	49%	36%
Proportion of Total Road network in Good Condition	22%	30%	49%	51%
Road Density/ 1000 sq. km	24.1km	30.3km	38.6km	78.2km
Road Density/ 1000 Population	0.46km	0.49km	0.55km	1km
Proportion of area more than 5km from all-weather road	79%	75%	68%	46%
Average distance to all weather road	21.4km	17km	13km	6km

Source: (ERA, 2014)

The condition of the network has been changed slowly. During the first year of RSDP, 52% of the road was low, and only 22% was found in good condition. By having continuous rehabilitation, upgrading, and maintenance involvement under the program, the road section, located in good condition, has increased to 50%. The proportion of the road network found in poor condition has reduced to 22%.

Improvement of road condition from 1997-2013G.C [50]

Table 4 Road condition of Ethiopia (1997-2013)

Year	Good	Fair	Poor
1997	22	26	52
2002	30	30	40
2007	49	22	29
2013	51	27	22

2.7.3 Road Maintenance construction

First defects are identified with ERA/ORAs; it is also the ERA's/ORAs responsibility to determine the required type and level of intervention and budget allocation for each fiscal year. A series of work will then be ordered to governmental contractors to undergo specific quantities of different kinds of work in a road segment. While it obtains a specific maintenance contract (i.e., Work Order), governmental contractors like ERCC, plan road maintenance works by identifying and determining ERA's requirements and implementing all ERA/ORAs' planning procedures and guidelines while surveying the condition, defect identification, intervention planning, prioritization tools, etc. [51].

The order of priority of defects in the segment and specified quantities of different repair types is determined with governmental contractors. The report further stresses that governmental contractors undergo maintenance only when it gets a work order from ERA/ORAs. Without the authorization of the ERA/ORAs, governmental contractors shall not exceed the value of the work order. Usually, routine maintenance is not seen closely by ERA/ORAs and other clients. However, since periodic maintenance agrees with a small contract project, it is regularly supervised by an independent consultant. Also, ERA/ORAs ordered emergency maintenance and paid on a day-work basis [51].

2.7.4 Road maintenance Problem in Oromia Road Construction Projects

Jimma is one of the zones under Oromia Region, a lot of construction projects have been undertaken throughout the zone and the regional state of Oromia, as part of the government's regional development plans. One of the critical problems concerning the road maintenance projects was the frequent and lengthy delays that occur due to the management problem. The main factors for the problems to occur is construction procedure (work methodology) [63].

Besides other facts, to improve the regional roads network, the roads construction project should be completed on time. No standardized approach is utilized in all cases. The inability to complete projects on time and within budget continues to be a chronic problem in the region and is worsening; the magnitude of these problems varies considerably from project to project.

The work schedule of most of the road projects under constructions by the government enterprises and some of the projects under the construction of the private contractors was not prepared in well due to poor management.

Delay will occur due to some reasons, but the major cause of delay is low management of the road maintenance projects. The problems occurring in the construction projects are poor planning, right of way problem, and the scarcity of budget allotted by the owner. [63]

But the major causes of delay of the roads construction projects focus mainly on construction material escalation, poor planning, lack of contract administration knowledge and in efficient in equipment allocation and bid evaluation criteria [63].

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study area

Jimma Zone is located in Oromia National Regional State, South West Ethiopia, at a distance of 335 km from Addis Ababa; its geographical coordinates are approximately 7o41'N latitude and 36o 50'E longitude. The town is found in an average altitude area of about 5400 ft. (1780 m) above sea level. Jimma is generally characterized by a warm climate with a mean annual maximum temperature of 30o c and a mean annual minimum temperature of 14oc [52].

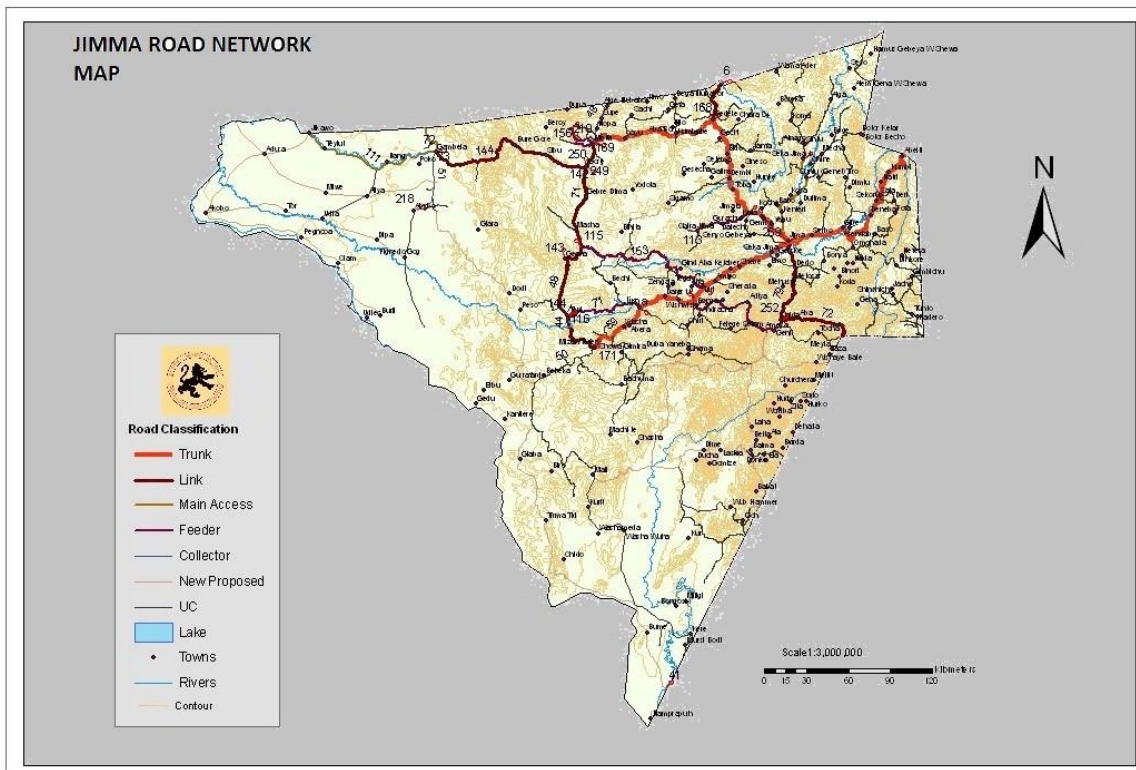


Figure 2 Jimma road network map

3.2 Research methodology

The study was carried out through both qualitative and quantitative research methodology. To focuses on in-depth examination and provides a broad understanding of issues under

investigation [53]. Thus, it is chosen to employ an in-depth assessment and measure of the stakeholders' knowledge, attitudes, and opinions regarding the management of road maintenance construction projects of the Jimma zone.

3.3 Research Design

An explanatory study was employed to investigate the problem accurately. In our country, only a few types of research were conducted on the issue. The selected design started to be implemented through reviewing secondary data. To do so, relevant literature regarding the management system of road maintenance construction and documents of the three firms' offices, namely client, contractor, and consultant who engaged in road maintenance construction, were reviewed. The specific objectives of the study were developed based on the assessed literature. The questioner was prepared as well.

3.4 Target Population

The target population of the study were parties who were involved in the road maintenance projects undertaken by Ethiopian road authority Jimma district (E.R.A.) &Oromia Roads Authority (Clients), Ethiopian construction work corporation(governmental contractor), private consultant, government consultant, and private contractor.

3.5 Sampling technique

Purposive sampling is a strategy in which particular settings or events are selected deliberately to provide important information that cannot be obtained from other choices [53]. Hence, the purposive sampling technique was employed to provide more reliable and accurate information for the study.

3.6 Sample Size

Based on having significant and relevant knowledge regarding the study, 16 respondents from the client, 15 respondents from the consultant, and 24 respondents from the contractor were selected. Therefore, the study comprises Professionals including district managers, Team leaders,

Project managers, site engineers, office engineers, supervisor engineers, project coordinators, and experts who have engaged in near past and current road maintenance construction projects.

3.7 Data Gathering Method and Instrument

This study utilized both primary and secondary data. Interviews, questionnaires, and desk studies were employed to gather data.

The primary data was collected through questionnaires and interviews. The secondary data were collected from published literature and documented data from Ethiopian road authority under Jimma road network management directorate, ECWC, ORA, Jimma district, and from the consulting company under the project mentioned above.

3.7.1 Desk study

Published relevant studies, newspaper, and office working papers were used as secondary data sources for the study. The data was gathered from three maintenance project bureaus. Relevant data concerning the poor management system of maintenance construction, major factors for the poor management system, the negative outcomes of those factors and the possible remedial action that should be taken to improve the system was selected from site diary, consultant's monthly and annual reports as well as contract document of the consultant bureau.

3.7.2 Interviews

An interview was done with the senior project manager, senior resident engineer, and the division manager from the contractor, consultant, and client. The selected top management staffs were asked about the management system of road maintenance looks like, the poor management problems, a factor that brings a poor management system of road maintenance, the negative outcomes of those factors on the management system of road maintenance construction, and the possible solution which can improve the management system of road maintenance.

3.7.3 Questionnaire

The questionnaire was designed based on the specific objectives of the study. It was given to purposively selected respondents. Out of 55 questioners which were prepared, 16 of them

distributed to the client (district manager (1), Team leaders (3), supervisor's engineers (10), junior supervisor's engineers (2)).14 of them were given to be filled by the consultant (Resident Engineer (2), Assistance Resident Engineer (1), Senior Supervisors (7), and Site Inspectors (4). The remaining 20 questionnaires were distributed to contractors (Project Managers (1), Office Engineer Head (2) Office Engineer (4) Site Engineers (13).

The questionnaire has five parts. The first section contains general information about the respondent. The second section includes yes or no questions, marking the under listed items and listing of answers for the asked questions about the poor management system of road maintenance construction projects. The third section is scale measurement for the frequency of the factors that brings poor management system of road maintenance construction projects. The fourth section deals with the negative outcomes of those factors on the management system of road maintenance construction projects. The last and the fifth section of the questionnaire were all about personal opinions, judgments that indicate the possible remedial actions which can minimize the problems.

3.8 Reliability of the study

The study's reliability and validity demonstrate and communicate the research process's rigor and the findings' trustworthiness. The results depended on the initial research question, how data are collected, how it is analyzed, and what conclusions are drawn [62].

Validity is a subtler concept. It is about the closeness of what we believe we measure to what we intend to measure [62].Cronbach's coefficient alpha [66] is designed as a measure of internal consistency, that is, do all items within the instrument measure the same thing? Cronbach's alpha is used here to measure the reliability of the questionnaire between each field. The normal range of Cronbach's alpha value between 0.0 and + 1.0. The closer the Alpha is to 1, the greater the instrument's internal consistency in the instrument is assumed.

3.8.1 Reliability Test

Cronbach's Alpha for each filed and for the entire questionnaire, can be said that the data is reliable when the alpha value is higher than 0.70. As the value of alpha is 0.942, so data is highly

reliable. Thus, all the factors were valid, and hence all the factors were accepted for this study. Alpha indicates excellent reliability of the entire questionnaire. Thereby, it can be said that it is proved that the questionnaire is valid and reliable.

Table 5: Reliability of Data

S/No	Factors	No of items	Cronbach alpha	Remark
			Value	
1	poor management system of road maintenance construction	8	0.884	Accepted
2	factors that bring poor management system of road maintenance construction	10	0.979	Accepted
3	negative outcomes of the road maintenance construction management systems	7	0.947	Accepted
Overall		25	0.942	Accepted

3.9 Data Analysis

Data analysis started with eyeballing to keep its quality. In this study, data collected from the questionnaires was analyzed by collecting all the relative data, assimilating and categorizing similar responses and summarizing the responses. The data entry, cleaning and analysis were done using the engineering software called origin and Excel 2007 statistical software. The first and second sections of the questionnaire's findings were analyzed using Microsoft excel and the software of Origin and presented by graph, pie graph and tables and. The outcomes of the third and fourth sections of the questionnaire were weighted with the Relative important index (R.I.I.) and presented by tables. The findings of the fifth section were presented by pie graph. The finding of the interview was also presented in a table.

$$RII = \frac{\sum w_i x_i}{\sum x_i}$$

Equation {1}

Where:

i = response category index which is 1, 2,3,4,5

W_i = weight assigned to the i^{th} response, which is 1, 2,3,4,5

X_i = frequency of the response given as a percentage of the total response for each cause

3.10 Ethical consideration

Ethical permission was obtained from the Research and Ethical Review Board of the College of engineering of Jimma University, each company/agency. Legal acceptance was also given from local authorities. During data collection, informed consent was obtained before the session of the interview started.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Respondents Profile

Fifty-five questioners were distributed to contractors, clients, and consultants. Of which 50 of them were valid for data analysis, and 91% of response rate was achieved.

4.1.1 Organizational Categories

Table 6 Questioners' Response rate with Organizational Categories

Respondent group	No. of distributed questioners	No. of the returned questioner	Valid Percent	Valid responses in %
Client	16	16	32%	100%
Consultant	15	14	28%	93%
Contractor	24	20	40%	83%
Total	55	50	100%	91%

As indicated in Table 6, concerning organizational categories of respondent's larger proportion, 40 % of them were Contractor followed by 32% of Client and 28 % were Consultant categories. This could suggest that contractors, who have more interactions with the management system of road maintenance were the larger groups among the study participants.

4.1.2 Managerial Level

The position of respondents concerning managerial level affected particular tasks which were specifically related to the knowledge of respondents who specialized for those particular tasks

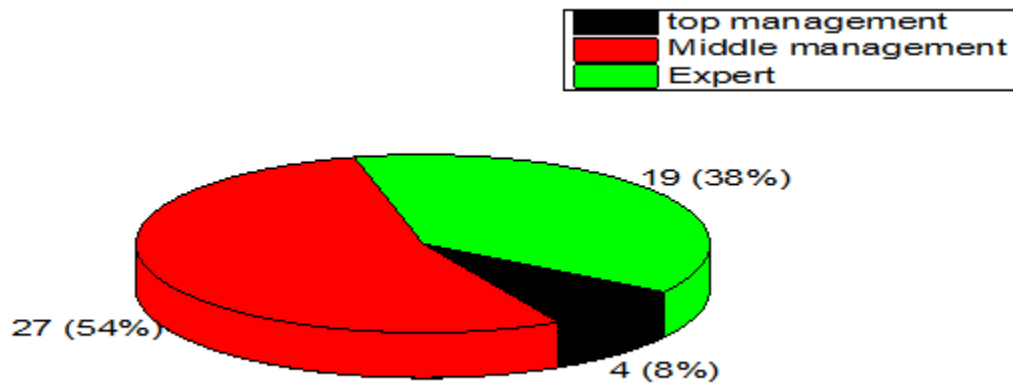


Figure 3 Respondent's Position with the Managerial Level

As shown in Figure 3, the respondents' position from the three stakeholders, i.e., Clients consultants and contractors, 54% were from the middle management level, 38% and 8% were experts and top managers.

4.1.3 Respondent Education status and experience

The respondents' level of education' influences how well the respondents can execute the job and furtherer provide feedback when need be. The respondents' level of education was summarized in Table 7

Table 7 Education Status and Experience of the Respondent

Socio demography		Frequency	Percentage (%)
Educational status	MSc	15	30
	BSc	33	66
	Diploma	2	4
Total		50	100
Experience in the sectors	<5	25	50
	6-10	19	38
	>10	6	12
		50	100

Service year of respondents could be determined respondents' were staying in work, which was suggested as respondents are familiar with the work they were able to decide on the events that might be happening on the project work from their experience. Regarding educational status, most (66%) of them have BSc. Concerning expertise in the sector, half (50%) have less than five years' experience. This finding is different from the study of Worku and Jha, [56], 32.29% of respondents have 5- 10 years of experience. The above results suggested that most of the respondents were technical and supportive working groups in the project.

4.1.4 Number of road maintenance project involvement

A number of road maintenance projects that the respondent involved affected particular tasks related to respondents' experience specializing in those particular projects.

Table 8 Number of Projects the Respondents Involved

number of maintenance project involvement	Frequency	Percentage
>5	6	12%
6-10	23	46%
<10	21	42%

As shown in Table 8 regarding the number of road maintenance projects that the respondent involved, larger proportions 46% of them were found between six and ten projects, which shows that most of the respondent involved more than 5 road maintenance projects. The next larger group 42% which means the respondent has more than ten-year experience on road maintenance projects on the zone, the last one has 12% which is less than 5 Year experience on Road maintenance projects.

4.2 The Poor management system on road maintenance construction in Jimma zone

The roads have to be maintained to prolong their lives and satisfy the need of the road users. Non-maintained roads can quickly fall into disrepair, leading to increased costs for road users in vehicle operation, time, reliability, and safety leading to the maintenance construction's poor management system. Here, in this section, the study has explained the extent to which the management system of road maintenance construction is not satisfying.

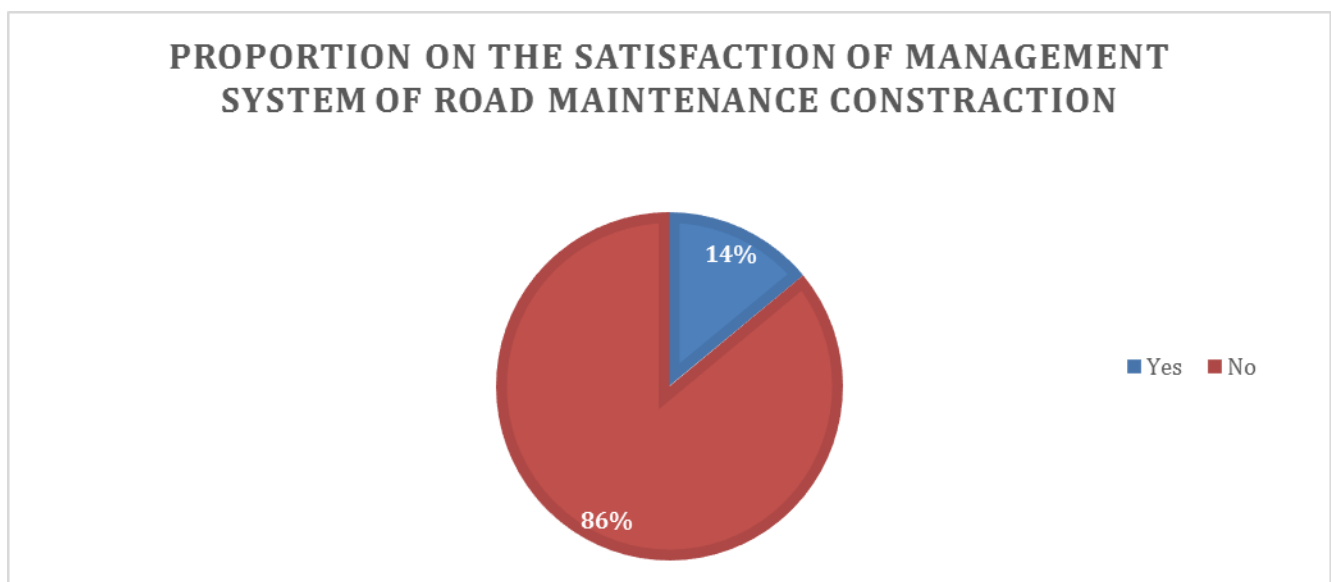


Figure 4 Respondents Opinion towards the Satisfaction of Road Maintenance Construction Management System

As indicated in Figure 4, the majority of 86% of the respondents were not satisfied with the management system of road maintenance in the zone. The considerable remaining proportions, 14%, were satisfied with the road maintenance construction management system in the zone. These significant proportions of respondents do not believe the issue is compared to the other zones where they rate the management system in the expected track.

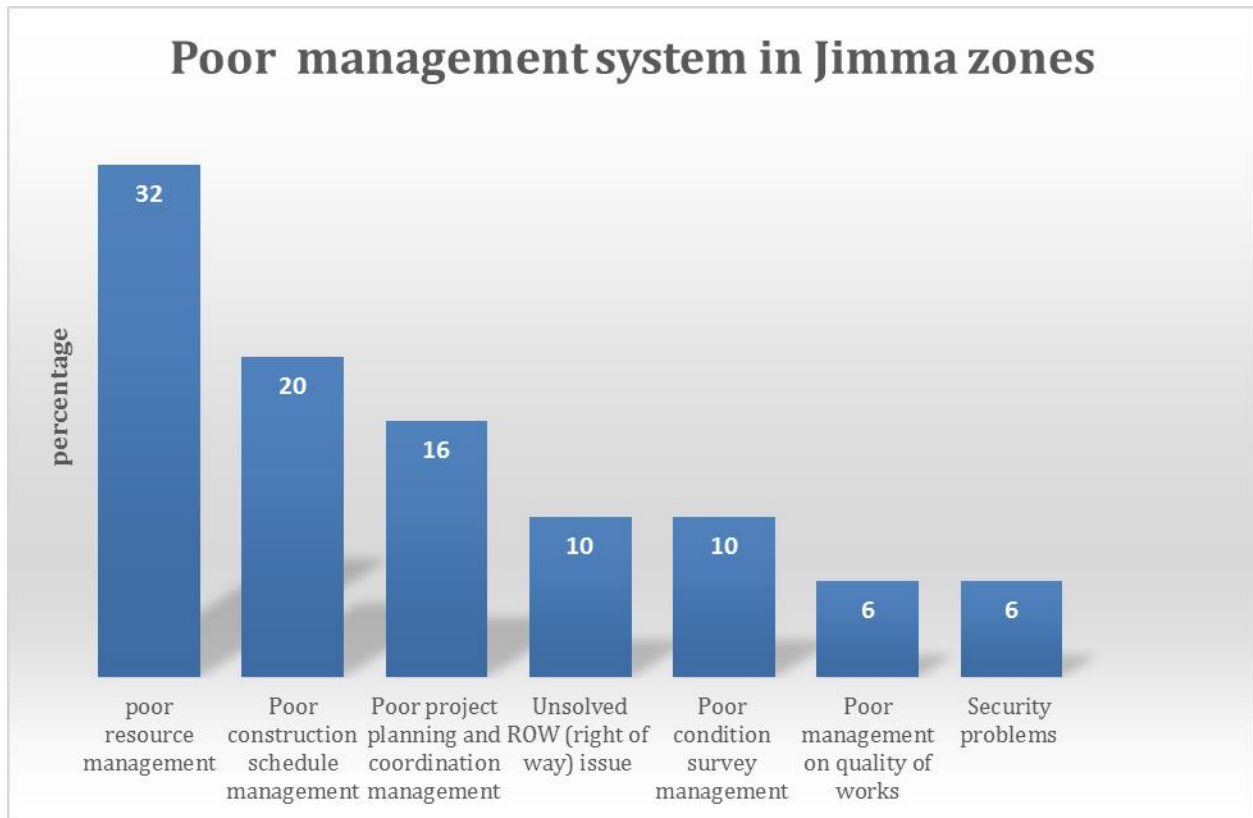


Figure 5 List of dissatisfying management system of road maintenance construction in Jimma zone

According to the study's findings, as shown in Figure 5, the majority (32 %) of respondents believed that management problems have occurred on road maintenance projects of the Jimma zone due to poor resource management, 20% was because of poor schedule, 16% was by poor project planning and coordination of maintenance projects, 10 % was by poor ROW solving, poor condition survey management, and 6% was by poor management on quality of works and security problem on the construction sites. According to Daniel [57], unlike the present findings, most respondents who participated in a study that has been conducted on the Assessment of road maintenance management practice of Addis Ababa city road authority agreed that inadequate fund is a significant problem implementation of road maintenance management.

Top manager’s management gap (8%)

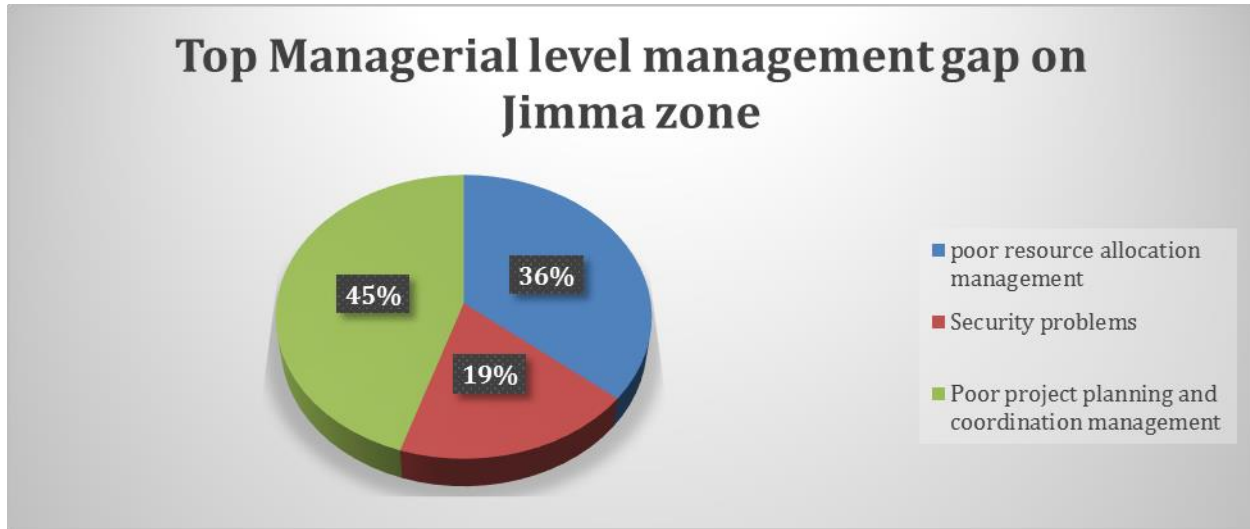


Figure 6 Percentages of poor management on the top managerial level on Jimma zone

Figure 6 represents the calculated percentage of the top managerial level management gap. According to the result, the most investigated management gap of these managerial hierarchies (45%) is by Poor Project planning and coordination, 36% is by poor resource management and 19% by poor solving of security problem faced on the road maintenance construction projects.

Middle managers management gap (54%)

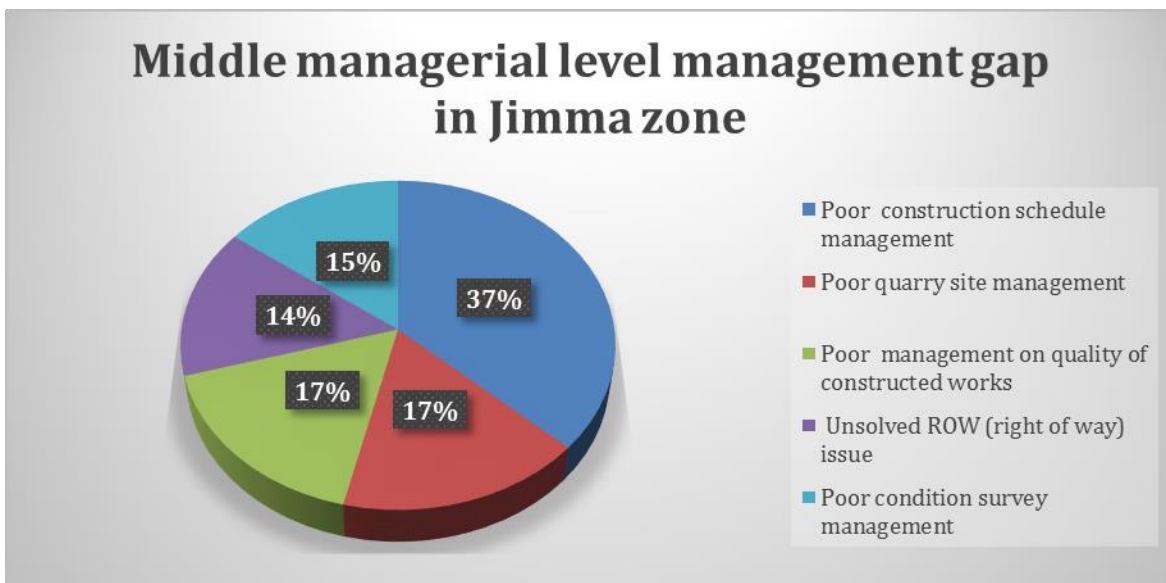


Figure 7 Percentages of poor management on the middle managerial level on Jimma zone

This is the second level of management and responsible for carrying out the program set by top managers. According to the result shown in Figure 7, the most investigated management gap of this managerial hierarchy (37%) is by Poor construction schedule management, 17% is by poor management on the quality of constructed works and quarry site management, 14% by poor capacity on the right of way problem solving, and lastly, 15% is by poor management on condition survey.

Experts gap (38%)

Usually, it is called the 3rd managerial level, and according to Jimma zone road maintenance construction manpower structure, it includes Forman's, superintendent, crew leader, and junior office and site engineers. Consultants' experts are site inspectors and surveyors. Client experts are junior supervisors. Experts in road maintenance construction are responsible for the day to day management activities

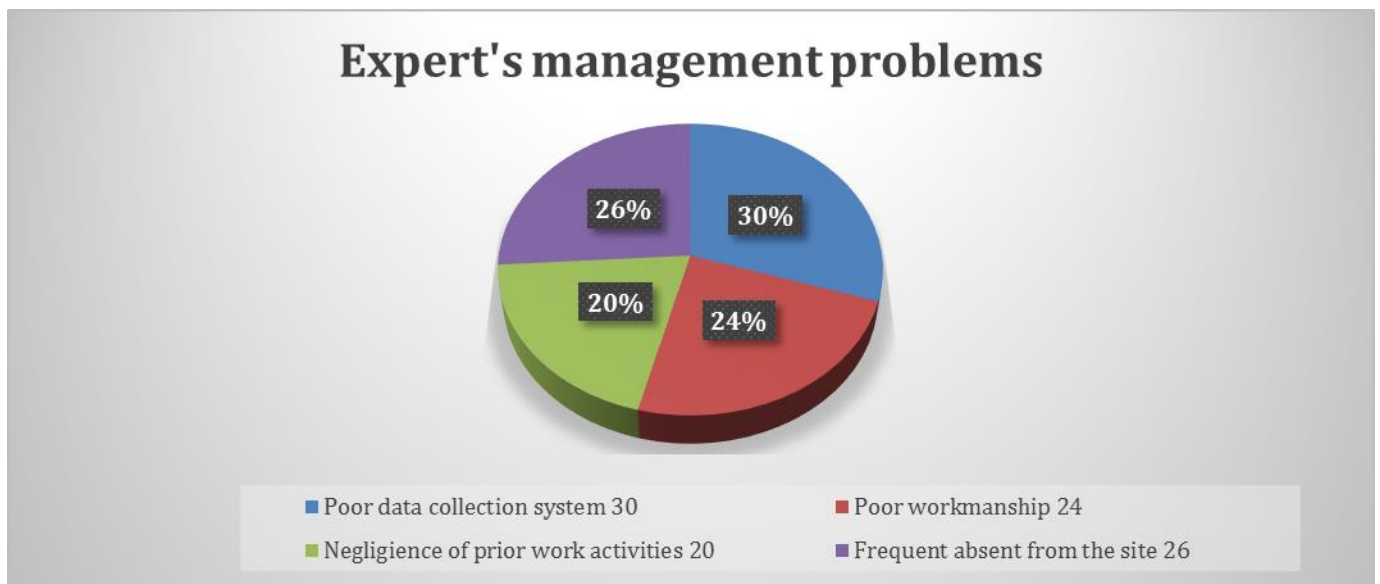


Figure 8 Experts managing gap on Jimma zone

According to the result shown in Figure 8, the investigated problems of these managerial hierarchy Poor workmanship (24%), frequent absence from the construction site (26), poor data collection system (30%), and negligence of prior activities (20).

4.3 The major factor that brings poor management system of road maintenance in Jimma zone

This section dealt with factors for poor management system analyzed by Microsoft excels and ranked with their relative index results. The stakeholders (i.e., client, consultants, and contractors) were analyzed separately and in combination.

A. Client group

Table 9 Factor that brings poor management system by Client group

The major factor causing poor management system	RII of client	Rank
Non-technical work methodology	0.202	1
The communication gap between stakeholders	0.189	2
Weather condition effect	0.186	3
Unexpected inflation/material price escalation/	0.186	3
The political situation of the county	0.182	4
Improper manpower allocation	0.177	5
Delay of payment for completed work	0.169	6
Non-Updated unit price	0.163	7
Bureaucracy on the working environment	0.148	8
Limited budget for projects from the government	0.138	9

As Table 9 shows, among the client's listed factors and ranked with R.I.I, the top most critical factor for the poor management system of road maintenance is deprived non-technical work methodology R.I.I value 0. 202. According to (Woreku et al. [56] lack of skill in construction management is also the 6th mentioned factor from the client's side for road construction delays.

B. Consultants group**Table 10 Factor that brings poor management system by consultant group**

The major factor causing poor management system	RII of consultant	Rank
Non-technical work methodology	0.159	1
Improper manpower allocation	0.157	2
Non-Updated unit price	0.155	3
Delay of payment for completed work	0.155	3
Weather condition effect	0.148	4
The communication gap between stakeholders	0.148	4
Bureaucracy on the working environment	0.130	5
Limited budget for projects from the government	0.142	5
The political situation of the county	0.140	6
Unexpected inflation/material price escalation/	0.120	7

As Table 10 revealed among the listed factors mentioned by the consultant group and ranked with R.I.I. the significant factor here also non-technical work methodology with the R.I.I. value 0.159 similarly, the findings of Werkuet al. [56] from the side of the contractor, it was revealed that ineffective project planning, scheduling, and resource management was the most critical factor for construction delays.

C. Constructors group

Table 11 Factor that brings poor management system by contractor group

The major factor causing poor management system	RII of contractor	Rank
Unexpected inflation/material price escalation/	0.253	1
Non-Updated unit price	0.232	2
The communication gap between stakeholders	0.232	2
Delay of payment for completed work	0.227	3
Limited budget for projects from the government	0.224	4
Improper manpower allocation	0.213	5
Weather condition effect	0.211	6
Bureaucracy on the working environment	0.203	7
Non-technical work methodology	0.200	8
The political situation of the county	0.171	9

Based on Table 11, as per the contractors' perceptions, the most critical factor for poor road maintenance construction project management was unexpected inflation/material price escalation with an RII value of 0.253.

Responses of the three parties concerning the cause of poor management system on road maintenance construction

This section summarizes the significant Factors for poor management system on road maintenance construction on Jimma zones by combining the three groups' response and their R.I.I. value.

Table 12 Ranking factors for poor management system by three parties (combined).

The major factor causing poor management system	RII of contractor	Rank	RII of client	Rank	RII of consultant	Rank	Total of the three parties RII	Rank
Unexpected inflation/material price escalation/	0.253	1	0.186	3	0.120	7	0.186	2
Non Updated unit price	0.232	2	0.163	7	0.155	3	0.183	4
Delay of payment for completed work	0.232	2	0.169	6	0.155	3	0.185	3
Improper manpower allocation	0.227	3	0.177	5	0.157	2	0.187	1
Limited budget for projects from the government	0.224	4	0.138	9	0.142	5	0.168	6
Communication gap between stakeholders	0.213	5	0.189	2	0.148	4	0.183	4
Weather condition effect	0.211	6	0.186	3	0.148	4	0.182	5
Bureaucracy on the working environment	0.203	7	0.148	8	0.130	5	0.161	8
Non-technical work methodology	0.200	8	0.202	1	0.159	1	0.187	1
Political situation of the county	0.171	9	0.182	4	0.140	6	0.164	7

According to the finding shown in table 12, obtained from the three parties' combined response, the three most critical factors for the poor management system of road maintenance construction project of Jimma zone are Non-technical work methodology, improper manpower allocation,

unexpected inflation/material price escalation\ and Delay of payment for completed work with the value of RII 0.187, 0.186 and 0.185 respectively.

4.4 The negative outcomes of those factors on the management system of road maintenance construction of Jimma zone

Table 13 Possible outcomes of the poor Management system of Road maintenance

Possible outcomes of the poor Management system of Road maintenance	R.I.I.	Rank
The public complains	0.640	1
Discourages contractors to participate in maintenance construction	0.512	2
Loss of clients confidence in consultants and contractors	0.496	3
Loss of profit to the contractor	0.488	4
Delay of project	0.448	5
Suspension of work	0.440	6
Dispute among parties	0.088	7

As shown in Table 13, according to the findings of the study, the main negative outcomes of the factors mentioned on section 4.3 for the poor management system of road maintenance construction projects of Jimma zone were Public complaint on-roads poor progress and inaccessible road due to the maintenance construction, Reject contractors to not participate in maintenance construction, loss of clients confidence in consultants and contractors, Loss of profit to the contractor, delay of the project, Suspension of work and dispute among parties with R.I.I. value 0.640, 0.512, 0.496, 0.488, 0.448, 0.440 and 0.088 respectively. Khalid et al. [59] also showed that Dispute, Arbitration, and Litigation are the outcomes of road construction delays caused by various reasons.

4.5 How the management system of road maintenance construction of the Jimma zone should be improved

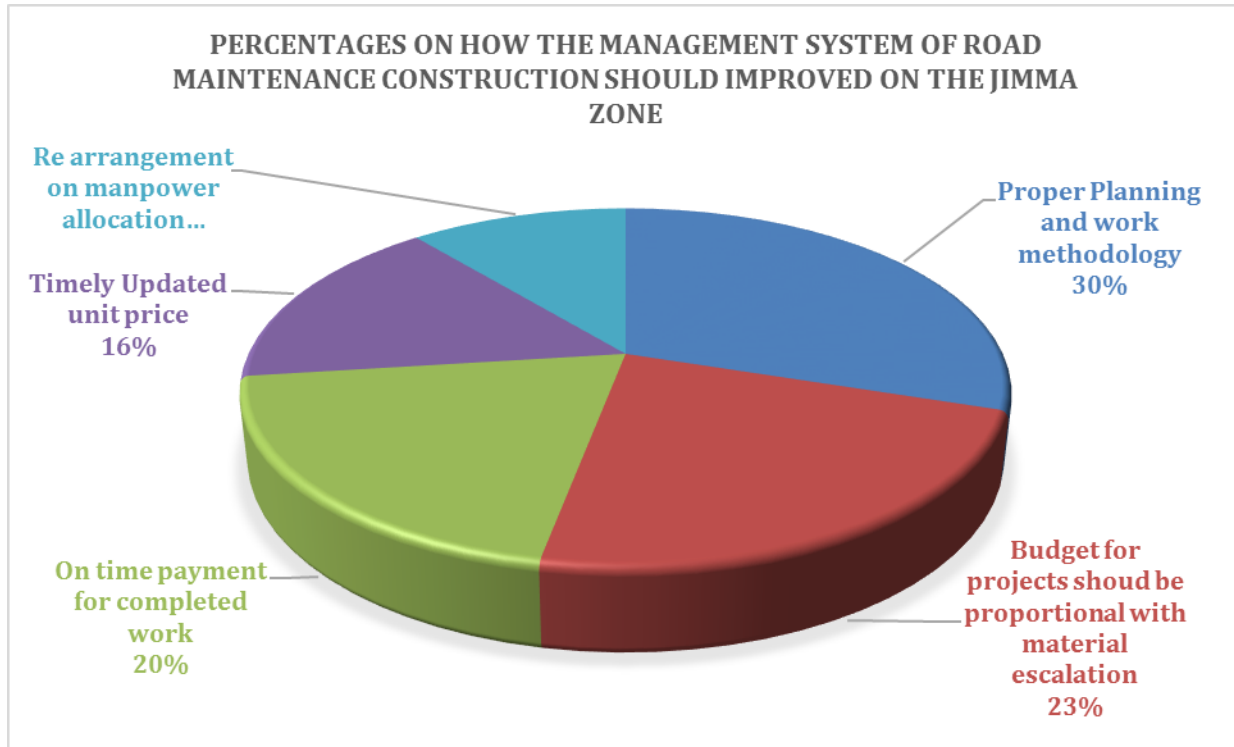


Figure 9 Percentages of the respondent recommendation

Figure 9 illustrates that the management problem identified in the zone can be improved by providing the proper planning and work methodology (30%) that is suitable for the work environment of the zone; the project cost(budget) should consider the current material escalation(23%),the payment for contractors as well as for consultants should be delivered on time(20%), the timely updates unit price for the activities(16%), most of the position occupied on road maintenance construction on the zones is not considered work experience, so the manpower allocation should be revised and based on work experience.

4.6 Analysis of data from Interviews.

Table 14 educational status and experience of Interviewer

Respondent title	Organization	Educational background	Work experience on road maintenance construction
Project manager	Contractor	M.S.C.	>10 year
Resident engineer	Consultant	B.S.C.	>10 year
Division manager	Client	M.S.C.	>10 year

As Table 14 shows, all participants have above ten years of experience, and 66.6% are MSc holders.

What is the Management looks like

Contractors	Consultants	Clients
Very difficult	Not satisfied	Not satisfied

Table 15 Responses on Interviews with the Top Management

What are poor management systems of road maintenance construction in Jimma zone?

Contractors	Consultants	Clients
R.O.W. (right of way problem)	Poor scheduling and planning of the work activities of contractors	poor management on solving right of way issues
Resource allocation management	R.O.W. (right of way problem)	poor planning and monitoring of contractors on the road projects
material purchasing system on the governmental contractor	Poor Manpower allocation	poor management on Time, manpower and machinery resources

Table 16 Responses on Interviews with the Top Management

What are the major factors (for poor management) that affect the management system of road maintenance?

Contractors	Consultants	Clients
security problem	absence of scheduling and planning for the activities of contractors	limited budget for the maintenance construction
quarry material source limitation	the unexpected weather condition of the Zone	Contractors poor motivation
construction material escalation	poor experienced professionals assigned by the contractors	Consultants poor supervision
equipment limitation	poor project supervision	
insufficient payment for the worker	carelessness in data recording	
payment delay	poor facility management	
the un-updated unit price of the activities		

Table 17 Responses on Interviews with the Top Management

What are the losses (Negative outcomes) due to the poor management system of road maintenance?

Contractors	Consultants	Clients
unprofitable finishing of the construction	under the quality of construction work	Public complains
delay of project duration	loose of confidence on consultants firm	Economic loss for the country due to blockage of the roads
Termination from projects	road blockage	
Delay of payments from the client	Reworks	
loose of government confidence in the contractor	Termination of the consultant firm from projects	

Table 18 Responses on Interviews with the Top Management

How can the management system be improved on on-road maintenance construction?

Contractors	Consultants	Clients
adequate budget allocation	assign professionals according to their experience	training for every level management
the unit rate should be updated	experience sharing for the skill gap	assigning full material resource that is needed for the professionals
bureaucracy from the consultant and client should be removed	proper allocation of resources	adequate allowance for the supervisors
good communication	proper planning and scheduling system on road maintenance projects	proper follow up on construction sites

Table 19 Responses on Interviews with the Top Management

What will you recommend on the overall management system on maintenance construction?

Contractors	Consultants	Clients
material escalation should be under control	attention and quick response for any issue of road maintenance project form the clients	Adequate budget from the road fund is needed.
unnecessary bureaucracy should be removed on approval issues and payment certification process	The rate for the consulting firms should be revised because it leads to limited manpower resource allocation.	Special attention should be given at the beginning of the bids.
		Assigning the experienced consulting firms on maintenance construction is the best.

Table 20 Responses on Interviews with the Top Management

Based on Table 14 to Table 19, the participants from the contractor's side convinced the management system of road maintenance construction of the Jimma zone was very difficult. According to their response, security problems and quarry material source limitation were among the factors for poor management systems. Ibrahim et al. [60] also revealed that the political situation was also a major factor in road construction delays. According to the Interviewer, unprofitable finishing of construction, delay of project duration, termination from projects, and

delay of payments from the client are among the poor management system outcomes. Providing an adequate budget, updating unit rate, removing bureaucracy from the consultant and client, and creating good communication among the sector parties were suggested solutions to solve the problem. The other participant from the consultant's side also expressed dissatisfaction with the management system of road maintenance construction projects of the Jimma zone. According to the response, poor scheduling and planning for contractors' activities, unbalanced manpower allocation and ROW problems were among the problems. And likely recommended solutions were assigning experienced professionals proper allocation of resources, proper planning, and a scheduling system. The findings of Khalid et al. [61] also recommend project managers with sufficient knowledge and experience of project management and the use of appropriate tools and techniques are chosen to minimize delays in road construction projects. The last Interviewer also articulated the unhappiness with the management system. And poor management of problem-solving, limited budget and poor project planning were among the causes. Besides, they suggested providing training for every management level, providing a resource that the professional required, and offering an adequate allowance for the supervisors as a solution.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The research's primary objectives were evaluating the management system of road maintenance construction in Jimma zone, identifying the weaknesses and the challenges faced during implementation of the road maintenance management system, and poor management system of road maintenance construction identified and it has a significant impact on projects of Jimma zone road.

The study identified management problems on road maintenance construction projects in the Jimma zone based on the questionnaire and interview findings. According to the results obtained from the questioner, 86% of respondents were not satisfied with the management system of road maintenance construction of the Jimma Zone and agreed with the occurrence of management problems on the road maintenance construction projects. Moreover, all interviewed top managers of the client, consultant, and contractor accepted gaps in the management system.

Besides the major factors that contribute to the low management system, Non-technical work methodology, Improper manpower allocation, unexpected inflation/material price escalation, Non-Updated unit price, Delay of payment for completed work, and Weather conditions effect are among the most.

The negative outcomes by those listed in the above factors are, Public complaint on in accessible road and low progress of the road maintenance construction, Reject contractors to not participate in maintenance construction, loss of clients confidence in consultants and contractors, Loss of profit to the contractor, delay of the project, Suspension of work, and dispute among parties are identified by the study.

The management problem identified in the zone can be improved by providing the proper planning and work methodology, the project cost (budget) should consider the current material escalation, the payment for contractors as well as for consultants should be deliver on time, the

timely updates unit price for the activities, most of the position occupied on road maintenance construction on the zones is not considered work experience, Therefore, the management system of road maintenance construction under Jimm zone is poor.

5.2 RECOMMENDATIONS

Based on the findings of this study and the conclusion made, the study makes the following recommendations

For the effective performance on the management system of a road maintenance project in the Jimma Zone, the stakeholder with different managerial hierarchy should solve all the factors and implementation the workable system and give an emphasis to the problems like planning before construction, Introduce different work methodology, proper resource allocation, proper schedule management, training for the capacity building.

The client should create mutual communication with communities to satisfy the need and solve disputes among parties. The public complains about on-road maintenances constructions and Delay of the project. Contractors are the key stakeholders on road maintenance construction projects. They should focus on the available resource rather than expectations and remove the suspended work and profit for the properly completed projects. The consultants also should have a role in regulating the proper management system by assisting the contractor in what they want based on the contract document and should build clients' confidence in the firms.

The study also recommends further research on related topics to identify and minimize road maintenance construction projects' poor management systems.

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APPENDIX

QUESTIONNAIRES

Date _____

Good day/evening.

My name is **MunaBekele**, and I am a student of **Masters of Science in Construction Engineering and Management at the School of Graduate Studies of Jimma Universities**. This questionnaire aims to **evaluate the management system of road maintenance construction (in Jimma zone)**. This questioner will be filled in considering projects of the past four years and for current road maintenance projects. The study's findings will be used for the stakeholder involved in this business, including the road owner. The results of this study will be used for academic purposes only. All responses will be confidential.

SECTION 1: GENERAL ABOUT RESPONDENT PROFILE

1.1 Organization Name

1.2 Position

Top management Middle management Expert

1.3 Educational status

1. BSc. 2. MSc. 3. Others specify _____

1.4 How long have you been involved in the road maintenance projects sector?

Less than five years 6-10 year More than ten years

1.5 How many road maintenance projects have you been involved in?

Less than five projects 6-10 projects more than ten projects

SECTION 2: QUESTIONS ABOUT THE POOR MANAGEMENT SYSTEMS OF ROAD MAINTENANCE IN JIMMA ZONE.

2.1 Did you find the management system of road maintenance construction in the sector is satisfactory?

Yes No

2.2 If your answer is **yes**, please specify why

2.3 Table 1 If your answer is **No**, please mark the unsatisfactory poor management system listed below and list any other management problem on your projects

No	management problem on Jimma zones	make (✓)
1	Poor resource management	
2	Poor schedule management	
3	Poor project planning and coordination management	
4	Poor quarry site management	
5	Poor condition survey management	
6	Poor ROW (right of way) problem solving	
7	Poor construction quality management	
8	Security problems	

Any other management problem

2.4 In your organization, please list the top managerial level's poor management system from your construction projects above lists.

2.5 In your organization, please list the Middle managerial level's poor management system from your construction projects above lists.

2.6 In your organization, please list the poor management system of Experts from the above lists and your construction projects

SECTION 3: QUESTIONS ON THE FACTORS THAT BRINGS POOR MANAGEMENT SYSTEM OF ROAD MAINTENANCE IN JIMMA ZONE.

3.1 The following tables consist of lists of factors that bring poor management system of road maintenance construction projects identified from literature and desk study. Please rate your answer based on the occurrence rate (frequency of occurrence) by marking (√) under each preference.

Table 2 Frequencies of occurrence

Scale	Rating	Meaning/Interpretation
1	Not at all	0% probability to happen
2	Unlikely	25% Probability to happen
3	Likely	50% Probability to happen
4	Almost certain	75% Probability to happen
5	Certain	100% probability of happening

Table 3 Lists of factors that challenges the management system of maintenance construction projects identified from literature and desk study

List of factors that brings poor management system of road maintenance Construction Projects (Please rate these factors)	Rate of occurrence				
	1	2	3	4	5
Non-technical work methodology					
Improper manpower allocation					
Non-Updated unit price					
Weather condition effect					
The communication gap between stakeholders					
Bureaucracy on the working environment					
Unexpected inflation/material price escalation/					
Delay of payment for completed work					
Limited budget for projects from the government					
The political situation of the county					

Any other factors

4 THE NEGATIVE OUTCOMES OF THE ABOVE FACTORS ON THE MANAGEMENT SYSTEM OF ROAD MAINTENANCE CONSTRUCTION

The following table consists of a list of negative outcomes of the road maintenance construction management systems' identified from the literature. Based on your experience, among the following lists, please indicate the most recurrent impact in Jimma zone road maintenance construction projects as ranked from 1-5 (when five represents "very high," 4 illustrates "High," three represents "Average," 2 represents "minor "and one is "never") by marking (√) under each preference.

Table 4, list of the Negative outcomes of factors listed in “Table 2 ” on the Management system of Road maintenance construction identified from the literature

Negative outcomes of factors listed in “Table 2 ” on the Management system of Road maintenance construction	Please indicate the Negative outcomes of factors listed in “Table 2 ” on the Management system of Road maintenance construction ranked from 1-5 By marking (√) under each preference.					Please enumerate the possible Remedial measures to be taken To minimize these negative outcomes.
	1	2	3	4	5	
Non-quality finishing of roads						
Delay of project						
Loss of profit to the contractor						
Loss of clients' confidence in consultants and contractors						
Dispute among parties						
Discourages contractors to participate in road maintenance construction projects						
The public complains on-road						

SECTION 5 QUESTIONS ON HOW THE MANAGEMENT SYSTEM COULD BE IMPROVED

5.1, please suggest how the management system of road maintenance construction in the Jimma zone can be improved
