ASSESSMENT OF SELECTED HIGHWAY MAINTENANCE PROJECT PERFORMANCE IN IMO STATE

BY

OSUJI UCHECHUKWU GODWIN (B.Eng)

REG NO. 20154946358

A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE (M.Sc) IN PROJECT MANAGEMENT TECHNOLOGY

FEBRUARY, 2023

@FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI.

CERTIFICATION

This is to certify that this thesis titled **"Assessment of Selected Highway Maintenance Project Performance in Imo State"** was conducted by Osuji Uchechukwu Godwin (Reg.No. 20154946358) of the Department of Project Management Technology (PMT) Federal University of Technology Owerri, in partial fulfillment for the award of the degree of Master of Science (M.Sc) in Project Management Technology.

..... 29/03/2023

Prof. E. C. Ubani — **Date**

Project Supervisor

..... 29/3/2023

Dr. I. I. Echeme — **Date**

Head of Department

....

Prof. O. T. Ebiringa — **Date**

Dean, SMAT

....

Prof. B. O. Esonu — **Date**

Dean, Post Graduate School

....

Prof. A. E. Oluleye — **Date**

External Examiner

DEDICATION

This thesis is dedicated to my wife, Maryann and my parents, Mr. & Mrs. G. F. Osuji who provided me with unyielding support and continuous encouragement throughout my years of study; also, through the process of researching and writing this thesis. The accomplishment would not have been possible without them.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to God Almighty who in his infinite mercies gave me abundant life to be able to complete this work. I also appreciate the management of Federal University of Technology Owerri (FUTO) and Project Management Technology (PMT) Department for letting me fulfill my dream of achieving Masters Degree of the University.

My sincere gratitude also goes to my supervisor, Prof. E. C. Ubani whose door was always open whenever I needed his mentorship, impart of research skills, guidance perusal and questions answered on my research efforts. He consistently steered me in the right direction to the completion of this work. I am indebtly grateful to the following staff of Project Management Department; Prof. G. E. Nworuh, Prof. G. F. Okorafor, Prof. B. C. Asiegbu, Prof. C. C. Nwachukwu, Dr. K. A. Okorocha, Dr. C. I. Anyanwu, the HOD-PMT, Dr. S. I. Okpighe, Dr. (Mrs) U. U. Moneke, Dr. I. I. Echeme, Dr. B. Amade, Dr. G. Enyinna, Dr. L. Rapheal etc. for their assistance and help in one way or the other in accomplishing this enormous task.

The fatherly and warmth correction and input of the Dean of School of Management Technology (SMAT), Prof. O. T. Ebiringa was well noted and accepted.

I would also like to thank my wife and children for their understanding, encouragement and patience acceded to me to complete this project.

May God bless all of you. Thanks.

(Reg. No: 20154946358)

ABSTRACT

This study examined the circumstances and drivers that influence assessment of selected highway maintenance project performance with prior analysis on the causes of highways deterioration. Roads are the most important assets in any country, so keeping them in good condition is obviously critical for economic development. A field survey research design was used on samples of three major highways and seventy-eight target respondents all in Imo State Nigeria. The instrument of questionnaire modeled in Likert five-point scale was used for data collection and measurement. A total of 18 causative factors of highways deterioration and 6 success determinants for the maintenance were identified. The opinions and perceptions of experts who are conversant with highway maintenance projects performance were obtained based on the identified factors. The methods of data analysis were the relative Severity Index (RSI) for causes of deteriorations and multiple regression and correlation analysis for evaluation of determinants and drivers to assessment of selected highway maintenance project performance. The results and findings from RSI indicate that lack of drainage system and underground water, poor quality of; design, construction and maintenance materials are the severest factors for highway impairment. The results of the regression analysis indicate high correlation coefficient of 88.50%. The determinants and drivers to assessment of selected highway maintenance project performance in significant ranking order are: funding level and policy, degree of physical resources, capacity of construction technology etc. Based on the conclusion, sufficient annual budgetary provision should be captured for highway maintenance projects performance considering its economic importance. FERMA should explore more decisive technical capabilities for efficient utilization of resources for timely completion, improved condition of roads, solidity and reliability of highway maintenance project performance in Imo State.

Keywords: Project performance, Drainage system, funding level, highway deterioration and maintenance, physical resources, poor quality of design and materials, technical capability.

TABLE OF CONTENTS **PAGE**

List of Tables

List of Figures

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Deplorable and dilapidated conditions of federal high ways in the South Eastern Nigeria have been worrisome to the road users. They have been in shamble for a long time due to inadequate attention and maintenance by the Federal Highways Maintenance Agency (FERMA) of Nigeria. Little maintenance efforts on these high ways suffer from failure and abandonment to shoddiness and non-reliability. The maintenance work failed to make them all seasons' accessible high ways and cannot withstand high vehicular traffic density.

A survey on the state of highways in the country was conducted for the purpose to gather pertinent information on road construction maintenance in Nigeria. According to CBN (1999), survey indicated that most of the roads especially in the Southern areas were in a very poor condition, and required complete rehabilitation.

The states within the South East geo-political zone consisting of Imo, Anambra, Abia, Enugu and Ebony States and have a total road network of approximately 3,121.7 kilometers of Federal highways. Most of the roads are in very poor conditions with potholes, gullies, erosion, flood and other forms of dilapidation on the highways. This is due mainly to lack of or shoddy highway maintenance without proper articulation of strategies for cost effective and timely completion. Quality and reliable maintenance of highways became elusive. A case in point in Imo State includes; Owerri-Okigwe, Owerri Obowo and Owerri-Mgbidi roads, all are located in Imo State. The dilapidated sections of these highways are either being rehabilitated or completed rehabilitation by Federal Road Maintenance Agency (FERMA) so as to facilitate efficient transport

system in Imo State. FERMA is a product of executive bill passed by National assembly and assented by the president.

FERMA is to ensure efficient and maintenance of all the existing federal roads, the national technical Working Group on Transport (2009) observes that an efficient transport system could enhance the socio-economic development of a nation; and the provision of an efficient and effective transport system is a social responsibility of government. However, the fulfillment of this social responsibility is threatened by inadequate fund, probably caused by the lapses inherent in funding and execution of road projects through budgetary provisions and the traditional method of direct contract award (Oni and Okanlawon, 2006). According to Merna and Njiru (2002), it is evident that road infrastructure competes with projects in other sectors and subsectors of the economy for fund; and it behooves on government to balance and spread investments amidst scarce resources. In view of this, Public Private Partnerships become viable means of bridging the funding gap in the road sector (Merna and Njiru, 2002). The ability to carry out certain transactions without any form of physical contact, made possible by a wide variety of Information and Communication Technology platforms could precipitate the questioning of the level of investment advocated for the transport sector. However, transportation is a means of breaking down the spatial barrier between production and consumption, and with good management and timely application of an appropriate flow of inputs for repairs and improvements, their long run productivity can be enhanced (Mundhe, 2008).

In Nigeria, socio-economic development goes as far as road infrastructure improvement can attained. This is simply because to connect means to grow. In order to catalyze the present rate of growth and development of the economy, the requisite road infrastructure

must be put in place. According to a report by Reforming Road Transport in Nigeria (2009), Nigeria ranks tops compared with other countries in Sub-Saharan Africa in terms of road network. The country has the largest road network in West Africa and the second largest, south of the Sahara with an estimated 200,000km of road network connecting villages to cities, the distant with the near and the inter-land with the urban market. Today, 95% of both passenger and freight movements are by road in Nigeria largely due to inadequacy of other forms of transportation, passenger and freight movements are by roads. The federal roads account for only about 17% of the total national road network but accommodate more than 80% of national vehicular and freight traffic bearing in mind a 2.533% population growth rate per annum. In addition, according to Bureau of Statistics report (2012), new vehicle importation in the country has increased by 45% in 2011, and the first half of 2012 recorded an increase by 15% compared with the same period in 2011. Apparently, Nigeria is getting more cars on the road making reformation and maintenance of the roads very essential and inevitable.

All of these indices clearly justify the need to enhance road infrastructure delivery and highways maintenance projects, so as to support the expanding populace. However, the task is enormous and requires huge investment. For a country of its size, and based on the assessment of the current state of road infrastructure, it is indicative of the fact that the country has fallen short in terms of provision and availability of good road network. Against this background, the Federal Government of Nigeria has recognized the challenges and opportunities inherent within the nation's road infrastructure sector. More so, the government of Nigeria has also identified a workable approach to

tackling the challenges facing the sector through FERMA while harnessing the economic gains of an enhanced road network.

As a proactive approach, the Federal Government has embarked on road sector reforms, which seek to improve service delivery, enhance management capacity and create a conducive institutional, legal and regulatory framework through joint participation with the private sector in financing and management of the road sector. Sadly however, efforts made towards ensuring that the roads especially the highways are properly maintained in order to allow for smooth human and vehicular movement have not recorded meaningful results. In line with the drive, the Federal Road Maintenance Agency (FERMA) was created in 2002 to tackle the challenge of road maintenance. Statistics shows that not much has been achieved by this agency of government in highway maintenance management, with attendant result on frequent accidents on the highways which in most cases have resulted to loss of life and property. Efforts have not been made by researchers to underscore the activities of FERMA in the maintenance of the highways with a view to finding areas of lapses and devising a way of ameliorating the menace. It therefore becomes imperative that a research be carried out on highway maintenance management in Nigeria with a view to identifying the shortcomings in highway maintenance and provides avenue for possible solutions to the menace.

1.2 **Problem Statement**

Nigeria has large road network that cut across the thirty-six states and federal capital territory, Abuja. The roads in Imo State Nigeria are bedeviled with deplorable dilapidation and rapid deterioration thereby making them unmotorable. The nature of the highways adversely affects the economic fortunes of the citizens in transportation of goods and logistics.

These highways in Imo State have suffered poor and inefficient maintenance, or in most cases lack of maintenance. Maintenance projects on these highways or roads; Owerri-Umuahia, Owerri-Okigwe and Owerri-Obowo were initiated very late with poor quality of design; with little consideration to their ages, climatic change with heavy rainfall, poor drainage system, high traffic density, geological terrain etc. The highway maintenance of these roads by FERMA have been abandoned in many routes, delayed or completed with shoddy finishes at exorbitant costs. A cursory examination reveals that the problem is as a consequence of many factors which have not be hypothetically traced to practices adopted in the maintenance of these roads. These factors individually and collectively contribute to the motorability or otherwise of the maintained road.

In spite of these poor road network infrastructures available in the country, vehicular movement as well as movement of human and other resources for the purpose of socio-economic development of the country, have suffered retrogression. Much success in the area of movement of goods and services has not been recorded. The intended socio-economic development has therefore remained a mirage. Regrettably, where the roads exist, they are either in bad shape and have therefore been abandoned from their intended use. They are therefore becoming hot spots for kidnapping, robbery, killings and other anti-socio-economic activities. FERMA, an agency set up by the Federal Government to undertake maintenance of these highways in Nigeria, however has not done enough regarding the purpose for which it was its setup. Leaving this condition unattended to will not only create room for the vices to thrive but also inhibit the socio-economic developmental objectives that would have been attained should the highways be put in good conditions.

Moreover, the reawakening of consciousness on agriculture as a key to the economic development by the federal government will be a wasted venture if the roads are not put in better shape for the transportation of produce from different parts of the country to their point of use.

A cursory examination reveals that the problems could be as consequences of many factors, which have not been properly identified and evaluated. However, they could be hypothetically traced to management variables and practices adopted in the maintenance of these highways. It could also be adduced therefore that certain hypothetical factors; individually or collectively could contribute to effective and successful highway maintenance projects for timely and comfortable motorability of goods, products and commuters to and from their destinations. For instance, delay in the transportation of perishable goods will lead to their damage and if unsuccessfully delivered to their points of sale, the cost of transporting such goods will be incorporated into the final market value of such goods leaving the consumers to suffer in the end. It is therefore important to conduct a study on highway maintenance management with a view to setting guidelines and decision support system for effective maintenance of highways in Nigeria; with particular emphasis to Federal highways in Imo State Nigeria through FERMA.

1.3 Objectives of the study

The main objective of the study is to assess selected highway maintenance project performance in Imo State so to avail of productivity, capacity, efficiency, quality and reliability and enhanced mobility.

Specific Objectives are:

i. To identify the causes of deterioration and failures of federal highway to serve as a guide for project performance.
ii. To assess the performance indicators of highway maintenance for effective project performance.
iii. To analyze the determinants and drivers of highway maintenance project performance in Imo State vis-à-vis; funding, physical resources, monitoring and control.
iv. To proffer solutions for achieving the goal of highway maintenance project performance in Imo State.

1.4 Research Questions

For the purpose of realizing the objectives of the study, the answers to the following research questions are necessary:

i. What are the weaknesses, causative factors and their respective severity index of highway failures and deterioration in Imo State?
ii. What are the effectiveness indicators of highway maintenance projects in Imo State?
iii. What are the drivers and determinants that will be decisive and capable to achieve effective management of highway maintenance project in Imo State?
iv. What are the suggestions enhancing effective management of highway maintenance projects in Imo State?

1.5 Hypotheses of the Study

Ho_1: The identified overall drivers and decision variables could not lead to efficient highway maintenance project performance in Imo State.

Ho_2: Method of funding employed by the government will not have significant performance impact on evolving highway maintenance projects in Imo State.

Ho_3: Capacity of construction technology will not lead to improve management of highway maintenance projects performance in Imo State.

Ho_4: The adoption of contracting maintenance procedures and regulations will not significantly lead to improve performance of highway maintenance projects.

Ho_5: The level of application of project management for planning, monitoring and control will not decisively result to improve performance of highway maintenance projects.

Ho_6: Training and manpower skill development are not significant decisive drives for effective management of highway maintenance project delivery in Imo State.

Ho_7: The level of available physical resources will not lead to effective management of highway maintenance project in Imo State.

1.6 Justification for the Study

This study shall be relevant to all highway project stakeholders as well as to the society. Project stakeholders are those that will affect or be affected by the project before, during or after its execution. It will help highway managers to know the key activities and procedures that will have the greatest impact in terms of cost, time and schedule performances of highway maintenance management. The study will ensure that the project owner's interests are well represented, their goals and objectives are realistic and aligned with that of the project charter. This study will help the project team thrive and avoid incidents associated with poor highway maintenance management in Imo State.

The significance of this project to the society cannot be over emphasized. Any project that is successfully maintained and managed creates value. Since this study will facilitate the completion of projects by maintaining and managing highways in Imo State, it will add value to society.

Effective maintained and managed highways will provide a wide range of opportunities for transportation of goods and services to different parts of the state and the country at large thereby enhancing socio-economic growth of the state through transportation of particularly agricultural produce to places of need; the benefits will also help in raising the standard of living and improving the well-being of people. The study will coordinate the activities of project participants, increase their chance of completing the project successfully and therefore, help free society of sights of abandoned highway projects.

The successful maintenance and management of highway projects is one thing, but this study has economic, academic, professional practice, documentation (library) and research importance. The society will benefit economically. Students will benefit academically, and researchers will benefit from it as it will serve as a reference material. The findings of this work would orient the highway project managers to take the analysis in changing the project communication process based on the challenges faced and what they consider as factors that positively affect highway maintenance project management.

1.7 Scope of the Study

This study focuses on assessment of selected highway maintenance project performance in Imo State, with FERMA Owerri state office as case study. Imo state with Owerri as the capital city is located in the South-East Geopolitical region of Nigeria. The state is known to be

among the states popularly known and referred to as Niger Delta states considering their location within the river belt of the Delta. Furthermore, the study draws its data from selected highway projects that are being maintained by the FERMA in Imo State. The respondents are drawn from the staff of the agency and other private individuals who are also professionals in the field of highway construction and maintenance in Imo State. The study centers on highway maintenance management performance in Nigeria with a view to identifying key activities and procedures in highway management so as to proffer possible solution to problem areas and critically assessing the success factors. Target respondents to the survey questionnaire were those in the areas of civil engineering, project and construction management, quantity surveying, consultancy administration and structural engineering.

Considering the fact that this study focuses on highway maintenance project performance, seventy-eight respondents who also double as construction personnel from the FERMA and other private professionals in highway construction and maintenance are considered in this study. Their responses through the questionnaire helped in generating primary data. Another limitation relates to data inconsistency in the end project reports, which are important for measuring the performance of projects.

The scope was also defined based on the number of deliverables mentioned in the project reports. However, as stated before, there are no clear instructions available within the organization on how to determine the number of deliverables.

The related theories employed in the study includes: Theories of contingency, fuzzy set, geographical information system etc. The time scope for the research could not be exactly ascertained due to covid-19 Pandemic and prolong ASUU strike. However, approximately twelve calendar months were used for the research.

The content scope includes; components of road maintenance, highway maintenance and infrastructures, highway maintenance measures and procedures, types of maintenance, funding arrangement for maintenance, drivers and requirements for improved management of highway maintenance projects performance.

CHAPTER TWO

LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK

2.1.1 Assessment of Selected Highway Maintenance Project Performance

Road maintenance means to protect and to repair the construction elements of the roads in order to sustain its conditions. An effective road maintenance management system (RMMS) is needed in order to organize the large database including the information of inventory and condition of road (Mogamed 2010) so policies, processes and procedures to fulfill the tasks required to achieve objectives are utilized and accomplished.

Effectiveness could be described as having the power to produce the required, decided or decisive effects. It could also be described as efficient, serviceable or operations available for useful work. In highway management, Nakhyeok and Kyuji (2017) defined effectiveness as the degree of goal attainment or the extent to which organization achieves its goals. In the contextual framework, effectiveness is the capacity for any organization to survive by obtaining or utilizing resources from environment.

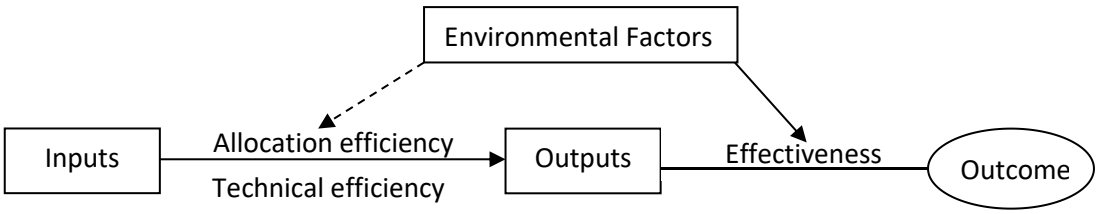


Fig. 2.1: Conceptual framework efficiency and effectiveness
Source: Mandl Dierx and Llzkovitz (2008)

The effectiveness indicators, for effective management of highway maintenance projects as identified by Ball (1993) Mandl, Dierx and Llzkovitz (2008) and other authors include; timely completion of maintenance projects within budget cost, quality and reliability, solidity/compactness, enhanced mobility and road conditions; safety, efficiency, urbanization, automobile per capita etc.

According to PMI's pulse of the profession 2020 survey, organizational agility (35%), choosing the right technologies to invest in (32%) and securing relevant skills (31%) were the top three factors that form a strong foundation for effective project management.

Management system is a set of policies, processes and procedures used by an organization to ensure that it can fulfill the tasks required to achieve its objectives. Effective project management therefore means having a firm grip on the scope, budget, resources, personnel and timeline dedicated to a project. (Udoagwu 2016)

2.1.2 **Highway Maintenance Project**

Maintenance of highways is the preserving and keeping each type of roadway, roadside, structures as nearly as possible in its original condition as constructed or as subsequently improved and the operation of highway facilities and services to provide satisfactory and safe transportation (Jamal 2017)

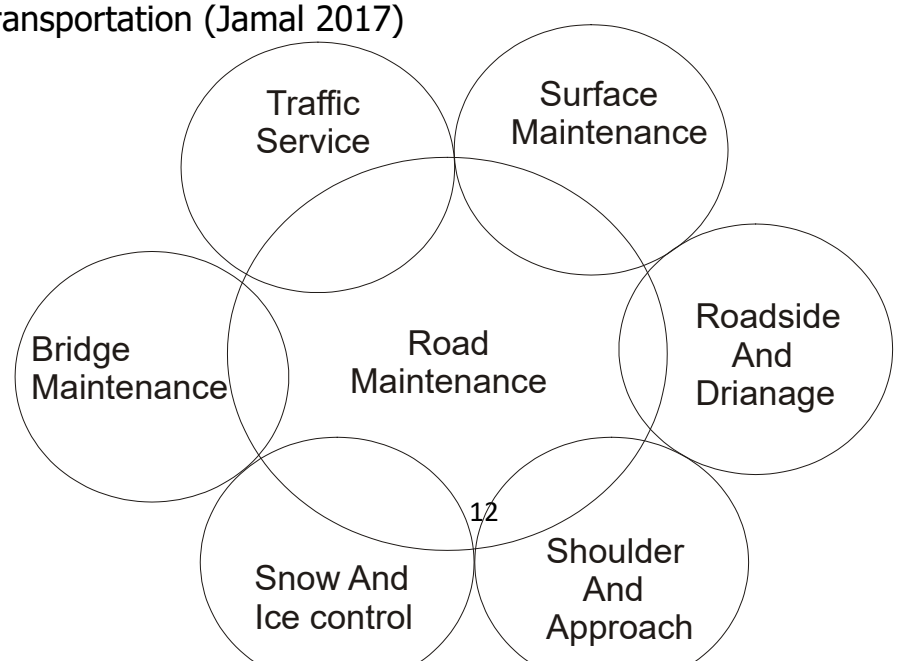


Figure: 2.2 Components of Road Maintenance

2.1.3 Highway Maintenance and Infrastructure

Infrastructure is a generic term for basic structures and facilities that are essential to the generation of economic growth and development in modern economies. It covers many facilities generally referred to as economic and social overhead capital, which include education, water supply, sewage systems, energy, postal and telecommunication services, transport systems, hospitals and roads. Efficient provision of infrastructure is usually characterized by heavy capital outlay, indivisibility of benefits and high externalities. In view of these properties, government is usually called upon to provide such facilities, especially in the developing economies. In countries where the development of these infrastructures has followed a rational, coordinated and harmonized path, growth has received a big boost (Beesley, 1973). This is because infrastructure provision and development serve as input into private sector production, thus facilitating output growth and productivity. On the other hand, where the growth of infrastructure has not followed such a harmonized path, development is usually stunted as exemplified by most African countries and other LDCs. Infrastructure provision can be through public ownership with private sector management and operations, public ownership and operation through public enterprises or government departments, private ownership/operation and community provisioning.

The provision of infrastructure in Nigeria is characterized by the predominance of public enterprises.

The extent to which a nation's land mass is covered by road network is an index of the degree of mobility of people, goods and services within the country, and the quality of the road network measures the ease and cost of that mobility. In addition, it is evident that transportation plays a crucial role in shaping the destiny of many nations because modern industry and commercial activities rest on proper, well-developed and efficient transport system. Huge sums of money have been sunk into road development in Nigeria. The road network is currently estimated at about 194,000 kilometers, with the Federal Government being responsible for about 17 percent, State Governments 16 percent and local Governments 67 percent (FMW&H, 2003). However, these roads have been plagued by a number of problems, with the major ones being faulty designs, in adequate drainage system and poor maintenance culture, which have significantly reduced the utility of the roads. There are potholes, washing away of pavements, collapsed bridges, etc., along most Nigerian roads. These problems have made it difficult, expensive and more arduous to move products and services from producers to consumers, farm produce from rural to urban centers, which often lead to loss of man-hours and high cost of goods and services. The annual loss due to bad roads is valued at N80 billion, while additional vehicle operating cost resulting from bad roads is valued at N53.8 billion, bringing the total loss per annum to N133.8 billion (Federal Ministry of Work & Housing, 2003). This figure does not take into account the man-hour losses in traffic due to bad roads and other emotional and physical trauma people go through plying the roads and the consequent loss in productivity. Overall, the poor state of roads in Nigeria impacts negatively on cost of production, and

represents a major trigger of cost-push inflation. The primary mandate of the CBN is to maintain price stability. It is evident that this mandate will not be achieved if the problem of bad roads in the country is not addressed.

2.1.4 **Highway Maintenance Measures and Procedures**

In many publications, maintenance is defined as all the technical and associated administrative functions intended to preserve an item or system in, or restore it to a state in which it can carry out its required functions. The road maintenance management system contains five main systems which include Pavement Management System (PMS), Bridge Management System (BMS), Non-pavement Management System, Database Management System and Follow-up Management System (Ralph, 2001). The management of highway maintenance activities as one of the components of highway maintenance management system is always discussed in terms of four main functions: strategic planning, programming, preparations and operations. Highway maintenance means the preserving and keeping of road structures as near as possible in their original state. It consists of correcting deficiencies that have developed as a result of age, use and the effects of the elements, and taking steps to prevent or delay the development of other deficiencies (FMW&H, 2003). Road maintenance is vital in order to prolong its life. Also well-maintained roads reduce the cost 'of operating vehicles by providing good running surface. Proper maintenance also keeps the roads open and ensures greater regularity, punctuality and safety of transport service.

No wonder Jamal (2017) avers that highway maintenance is related to the quality of original constructed roads. He added that insufficient pavement or base thickness or improper construction of these elements soon result in expensive patching or surface repair. Shoulder care

becomes a serious problem where narrow lanes force the heavy vehicle to travel with one setup of whole of the pavement.

According to Jamal (2017), improperly designed drainage facilities, mean error or deposition of materials and closely cleaning operation or other corrective measures for regular highways maintenance and repair, sharp ditches and steep slopes require manual maintenance as compare to cheap repair of flatter ditch and soil by machine.

The following highway maintenance policies and measures considered in this study are discussed under the following.

2.1.5 **Routine Maintenance**

According to Burningham and Stankevich (2005), routine maintenance are activities that have to be performed at least once in a year, if not more frequent. Such activities involve inspection, cleaning of drains, controlling of vegetation and filling of potholes and ruts. Routine maintenance has a lower cost in comparison with any other type of maintenance and new construction project. Routine maintenance activities are usually small-scale, widely dispersed, and often performed using manual labour. The need for routine maintenance can to a large degree be forecasted. According to Ministry of Road Transport and Highways, MRTH (2013) Routine maintenance activities are further defined as either *cyclic* or *reactive,* although the distinction between these terms is not always very clear. Cyclic activities are performed at predetermined intervals throughout the year purely as a preventive measure because of events we know will occur (e.g. cleaning drains before and during seasonal rainfall), and are scheduled at fixed times during the year. Reactive activities are performed in response to a triggering condition that requires action before the problem gets out of hand (e.g. de-silting of blocked culvert, crack sealing and pothole patching). Routine maintenance is required to be carried out continually on every road, irrespective of its engineering features or volume of

vehicular traffic. Routine maintenance expenses are treated as fixed-cost items in the maintenance budget. They include lane marking drainage clearing, bridges and culvert maintenance, vegetation control and so on.

2.1.6 Emergency Maintenance or Repairs

According to Ralph (2001), emergency maintenance refers to all activities that have to be performed immediately to save lives or prevent disastrous consequences of damaged infrastructure. Maintenance departments need unrestricted access to emergency budgets that allow them to carry out repairs that mitigate immediate dangers. According to International Road Maintenance Handbooks (1994), emergency maintenance responds to occasional, unforeseen events such as landslides, washouts, large trees or debris on the road and broken drainage structures. Emergency maintenance can be categorized into (i) temporary restoration works, re-opening safe passage on the road, and (ii) Permanent restoration, securing the stability of the road and reinstating all its components to its former (or a better) condition.

Maintenance activities are also categorized based on where the works are located:

i Off- carriage way works: This includes such works as maintaining shoulders and drains, de-silting of culvert structures, removal of debris, vegetation control. The works also include minor repairs to drainage and other structures on the roadside area, maintenance of road signs and pavement markings, side slopes and all surface areas within the road reserve.

ii On-Carriageway works: This relates to road pavement and surface repairs. This work mainly consists of maintaining a good running surface on the road, free from any obstructions and damage and with

the necessary camber or cross-fall to secure proper surface drainage (International Road Maintenance Handbooks, 1994).

Emergency maintenance is caused mainly by unexpected situations such as landslide, abrupt cutting on roads, and wash out of bridge sub-structures. Seismic factors could also lead to emergency maintenance works.

2.1.7 Periodic Maintenance and Reconstruction

These repairs that are performed less frequent. This type of maintenance includes all sorts of repairs including resurfacing, overlays and reconstruction of pavement, base and even sub-base cores. Periodic maintenance intervals vary according to the demand and may be irregular. Periodic maintenance is a major overhaul of the road typically carried out after a period of 5 to 10 years, depending on traffic levels, pavement type and geographical and weather conditions. The work involved is normally larger and require more equipment and specialist skills. As a result, this work is considerably more costly than routine works. The most common periodic maintenance activities include renewal of road surface (figure 3) and major repairs of structures. Periodic maintenance is planned in cycles covering several years, thereby describing when individual roads in the network are due for such a treatment (International Road Maintenance Handbooks, 1994). Periodic maintenance involves major repairs or rehabilitation of those parts of the highway that have deteriorated over the years. The frequency involves intervals of some years. The activities include surface dressing or resealing and re-gravelling of shoulders for paved roads and re-gravelling for unpaved roads.

Road authorities often allocate a fixed budget on the basis of an inventory that quantifies the asset in term of age, length, area or volume. The role of management at all levels includes comparing

options, organizing activities, making decision and seeing that they are applied in an efficient and economical way (Ibraheem and Gani, 2014). According to Ibraheem and Gani (2014), previous study on road maintenance showed that postponing road maintenance results in high direct and indirect costs. If road defects are required on time, the cost is usually minimal. If defects are neglected, a whole road section may full fail; requiring complete construction at three times or more the cost on average of maintenance. A study on highway maintenance projects is therefore needed to calibrate and benchmark the projects performance in terms of budgeted cost, scheduled time, quality and reliability of the highway projects Jamal (2017) identified the various maintenance functions include surface maintenance, roadside and drainage maintenance shoulder and approaches maintenance, snow and ice control, bridges maintenance and traffic service.

Pavement maintenance and rehabilitation programs restore the riding quality and maintain the structural integrity of the pavement over its full design life. Asphalt concrete pavements are subjected to various types of stresses or failures which include; alligator cracking a series of interconnecting or interlace cracks caused by fatigue of the asphalt concrete under repeated traffic leading. Crack is due to foundation movement at sub grade; others include block cracking with sharp corners or angles, transverse cracking, longitudinal cracking revealing – wearing away the pavement surface caused by dislodging of aggregates particles and binders, dip track cracking, bleeding or flushing fatting up or exuding of bitumen, corrugations, pot holes, ruts depression formed under the wheel due to heavy for loads.

The surface Methods or surface treatment for Road Maintenance may be single or multiple. According to Jamal (2017) the best type of surface course is pre-mix carpet for road maintenance. The surface

treatment methods are employed when. Intensity of traffic is not very high; the premix mixers are not easily available due to long transportation or technical reasons, and when the cost is high.

In high maintenance, for good surface treatment, Jamal (2017) asserts that it is necessary that:

i Base course is well prepared to its profile and is made more freer from pot holes

ii Excellence of surface dressing depends upon correct proportion of binder aggregates

iii Before laying the first surface dressing coat, the base should be made free from all dust loose soil etc. In all bituminous construction, it is necessary that the newly surface possess a bond with the existing base at the interface. It is also necessary that the base is nearly impervious.

Therefore;

i For maintenance of gravel roads, blading and occasional resurfacing is required.

ii For surface treatment of low type bituminous surface in maintenance of roads; patching seal coating or possible loosening oiling, remixing and relaying are involved.

iii For high type bituminous concrete and Portland cement concrete, the removal and replacement of failure areas and resurfacing are approximate treatment methods for highway maintenance.

iv Use same materials and methods for road surface maintenance as far as possible.

v Maintenance and repairs of roads must be planned for rapid performance and to cause least possible disruptions or hazards to traffic.

The above afore cited information helped in providing insight in the understanding of the subject matter, methods and procedures

approaching for acquaintance of technical ideals that could help to achieve the research objectives.

vi Decisive managerial and technical expertise with requisite resources are needed for successful maintenance projects of federal highways in Imo State.

2.1.8 Requirement for Effective Highway Maintenance

Large portion of a country's resources are devoted to highway development. There have been delayed in some cases of investments in other sectors as usually captured in the capital annual budgets. Ball (1992) asserts that for these and other reasons, government rely on skill professionals to provide expert planning and engineering counsel to ensure successful highway projects.

But the success of investment in highways depends on more than planning and engineering services. Ball (1992) avers that technical assistance in maintaining the constructed highways is critical for ensuring that the economic benefits of highways are realized. The requirements for effective highways maintenance include.

i **Institutional:** Establishing competitive environment according to Ralph (2001), increases specificity, improving organizational effectiveness and efficiency but also introduces a competitive element for the interested parties. The aim of the competition should be to gain work of sufficient quality at the most economic price. Competition can be based on price, quality, performance or the mixture of the three. However, the introduction of competition and business-oriented objectives into a public organization requires a change in culture and the implications can be threatening to existing civil or public workers.

ii **Technical**: Range of techniques used are dependent on the nature of the deterioration which comprises anything from minor potholes or

surface patches through to universal pavement construction and drainage upgrades depending on the source of the damage (Ralph, 2001).

iii **Financial:** In order to achieve the objectives of the road maintenance agency, activities require large funds. As a consequence, most agencies are now trying to improve the efficiency of their maintenance plans by adopting several new strategies (Rijn, 2006). The main target of these newer strategies is accomplishing a possible maintenance at the least possible cost. Some of these strategies include; maintenance contracting methods, improving the management of the available resources, standardizing and improving production processes, prioritizing of the work activities and implementation of new technologies. Despite the importance of roads in terms of both their intrinsic value and the role they fulfill, most are poorly managed and badly maintained in the developing world. It is estimated that in sub-Saharan Africa alone, it will in the range of $30 billion to repair all the roads requiring immediate rehabilitation and reconstruction (Rijn, 2006).

2.1.9 Structure of Roads

Integrated road: Development in Nigeria dates back to 1925, when the Road Board was established by the then colonial administration. The Board had the responsibility to evolve blueprints for trunk road network, connecting major administrative centers in the colonial time. As at 1951, 1,782km out of the total of 44,414km of road built in Nigeria was surfaced. The roads were however lacking in standard designs and were in single lane, with sharp bends and poor drainage system. The growth of economic activities prompted the need, for improvement in roads. Consequent upon this, the quality of road construction was improved as the length and network continued to increase such that by 1952, 15,785km of bituminous surface and 75,200km of earth/gravel

surface roads were already in place in Nigeria (FMW&H, 2003). The estimated current total road network is about 194,000 kilometers.

The Nigerian Road system is classified into four broad categories: according to FMW&H (2003). The Federal Trunk 'A' Roads: These are under Federal Government ownership and they are developed and maintained by the Federal Government.

The Federal Trunk 'F' Roads: These were formerly under state ownership but were taken over by the Federal Government, with a view to upgrading them to federal highway standards.

The Slate Trunk 'B' Roads. These are under the ownership and management of the component states.

The Local Government Trunk 'C' Roads: These are under Local Government ownership and management

Each tier of government has the responsibility for planning, construction and maintenance of the network of roads under its jurisdiction.

2.1.10 Funding Arrangements

According to CBN (2003), funds for road maintenance in Nigeria had been from Federal Government allocation to the Federal Ministry of Works and Housing, as well as state and local government allocations for maintenance purposes. Some states, especially those in the eastern part of the country have been engaged in local road construction and maintenance over the years. During the years of the Petroleum Trust Fund (PTF), the Fund had, as part of its mandate, the responsibility to maintain roads, especially the federal roads. These arrangements did not adequately tackle the problem of road maintenance in the country and before, a Presidential Policy Advisory Committee (PPAC) was set up in 1999 to look into the state of the national infrastructure.

The Committee recommended, among other things, that the funding of highways should be improved by establishing a *Road Fund* which will

derive its funds from the following sources: Highway Tolls, Vehicle Taxes, Truck Weigh-Bridges, Parking Fees and Petroleum Tax (formerly collected by the defunct PTF). Presently, all these funds are paid into the Federation Account and the budget for road maintenance is from budgetary provisions. In addition, an executive Bill proposing the establishment of a road maintenance agency has recently been passed by the National Assembly and assented to by the President. The responsibility of the Agency is to administer and manage the National Road Maintenance Fund in such a manner as to ensure the efficient and effective maintenance of all the existing Federal trunk roads and such other roads as may be declared from time to time as Federal trunk roads.

2.2 Theoretical Review

Theories are formulated to explain, predict, and understand phenomena and, in many cases, to challenge and extend existing knowledge within the limits of critical bounding assumptions. The theoretical framework introduces and describes the theory that explains why the research problem under study exists (libguides.usc.edu/writing guide/theoretical framework). In this research work, which focuses on highway maintenance management, the theory that supports the study is taken from the fuzzy set theory and geographical information system due to spatial planning, temporal and maintenance factors, and maintenance costs evaluation theories.

2.2.1 Contingency Theory

Contingency theory is an approach to the study of organizational behavior in which explanations are given as to how contingent factors such as technology, culture and the external environment influence the design and functionality of organizations. As well, these contingent factors influence the management of highway maintenance project. The

assumption underlying contingency theory is that no single type of organizational structure is equally applicable to all organizations. Rather, organizational effectiveness is dependent on a fit or match between the type of technology, environmental volatility, the size of the organization, the features of the organizational structure and its information system. Contingency theories were developed from the sociological functionalist theories of organization structure such as the structural approaches to organizational studies by Reid and Smith (2000), Chenhall, (2003) and Woods (2009). These studies postulated that organizational structure was contingent on contextual factors such as technology, dimensions of task environment and organizational size. In some other literature, contingency theory was still regarded as a dominant paradigm in management accounting research (Fisher, 1995; Cadez and Guiding, 2008) Contingency theory has influenced organization theory since the 1950s (Hanisch & Ward, 2012).

In operational management, the study of contingency theory gradually emerged during the last two decades. Project management research has only recently started to consider context factors. In this area, applications of contingency theory still represent a fragmented field with a non-uniform use of technology. Fully utilizing the contingency theory approach requires a systematic foundation (Hanisch & Ward, 2012). Contingency theory argues that there is no "one best way" to organize. The theory believes that everything depends on something. In general, the contingency theory advocates that there is no absolute best way to organize and organization, to lead a firm, or make decisions, and that the optimal course of action is dependent or contingent on the internal and external factors (Kormane, 2019).

2.2.2. Fuzzy Set Theory

Fuzzy set theory among other was developed for determining the best type of maintenance period length and replacement time. The decision of replacement time.

The decision of replacement, is based on cost consideration and maintenance type is based on the maintenance factor (Chaudhure and Suresh 1995). Selecting optional maintenance strategy under fuzzy environment is not a trivial task. Verma Srividya, Rajesh, Gaonkar (2007) presented an illustration of multi-criteria maintenance strategy selection under fuzzy environment. Fuzzy sets/number and fuzzy set operation have been carried out a – cut method.

2.2.3 Geographical Information System Theory

A Geographic Information System (GIS) is a system designed to capture, store, manipulate, analyze, manage and present all types of geographical data in other words, data that is in some way referred to location on earth. It has many applications related to engineering, planning, management, transport/logistics, insurance, telecommunication and business. GIS can be used to demonstrate the spatial temporal representation of project data and can lead to early identification of potential overlaps during the highway maintenance planning phase. According to France-Mensah, Brien, Khwaja and Bussel (2017) in a broader context, such geospatial visualization effects and knowledge inputs in the development of spatial decision support systems. The research visualized and integrated project data is a GIS to address planning challenges a typical highway agency. Among the lessons learned are the potential uses of GIS which include detecting spatially and temporally overlapping projects, supporting integrated planning and improving communication among functional groups within a state highway agency.

GIS integrates five key components, which include; Hardware, software, data, people and methods. At the end of the research therefore, it will be demonstrated that the various methods applied in highway maintenance management is influenced greatly by some internal and external factors and is therefore not dependent on a particular approach.

2.3 Empirical Review

Importance of transport infrastructure cannot be over emphasized due to the role it plays in the economic, social, and state of all countries in the world. The success and prosperity of this sector achieved attracted other sectors to be included, and therefore there is a strong relation between growth in the transportation sector and the country's economic growth as a whole (Olatunji and Diugwu, 2013). Transport infrastructure like all other technical facilities, needs maintenance and reconstruction so that it can serve its users' needs properly. The users' comfort and travel time are in proportional to the effectiveness of those works (Okigbo, 2012). In a study conducted by Mandl, Dierx, and Llzkovitz (2008) on effectiveness and efficiency of public spending, the findings suggest that effectiveness is determined by expenditure and other conditions such as level of urbanization, the number of automobiles and drivers; and spatial factors while controlling other variables that affect expenditures at the first stage. Likewise in Nigeria, road transport system is the most important means of transportation and indeed in many developing countries. This is because roads are the major connecting links of states, towns, cities and villages. It has been estimated that road transportation represents about 85% of passenger and delivery activities in Nigeria. It has been said that Nigeria has the largest road network in West Africa and second largest road network

south of the Sahara with an estimated road length of 193200 kilometres. Flug and Oesch, (1986) pointed out that the highway network represents a huge investment and each year the financial restraints on highway maintenance become more critical. World Bank in its study on road policy estimated that $45billion worth of road infrastructure had been lost due to the absence of adequate maintenance in the 85 developing countries. The study also suggested that such a loss could easily have been avoided by spending $12billion (or equivalent of 25% of the impact of the lack of maintenance) on preventative maintenance. According to Rijn (2006), worldwide, it is considered to be a political advantage to be in favour of investing money in constructing new roads. Speaking further, he attested that maintenance does not have the same prominence or does not offer the same opportunity to stakeholders or decision-makers to present themselves to the public.

Okigbo (2012) on his study on the causes of highway failure in Nigerian highways listed out some of the factors that cause these failures as;

i Poor design and construction
ii Poor maintenance of already built highways
iii Use of low-quality materials in construction
iv Poor workmanship and supervision of construction work and
v The applying of heavy traffic that were not meant for the road.

Also, France-Mensh (2017) identified the factors affecting highways maintenance and failures as:

i Traffic intensity
ii Thickness of pavement
iii Number of lanes

Furthermore, he suggested that the following also led to highway failures; poor highway facilities, no knowledge base, inadequate sanction for highway failure, no local standard of practice, poor

laboratory and in-situ tests on soil and weak local professional bodies in highway design, construction and management. Tarawneh and Sarireh, (2013) in their study categorized some factors that contribute to the road deterioration and such factors are effect of cracks and structural failure, effect of standards/specifications and policy, effect of traffic load and volume, properties and effect of construction conditions, effect of drainage system and ground water, aggregate properties, effect of alignment and geometry of road, flexible pavement layers thickness, and effect of pavement width.

Pflug and Oesch, (1986) pointed out that the highway network represents a huge investment and each year the financial restraints on highway maintenance become more critical. Similarly, in the report of the executive meeting of Kano state government, it was estimated that the amount of money spent on road maintenance in just Kano metropolitan is almost in millions of naira, which is quite a lot. Therefore, the need to find out rational management system for highway maintenance is important. One of these systems is to find solutions on how to carry carryout systematic and on-line reporting and inspection systems for the collection of the characteristics data relative to the deterioration of the highways. Traditionally road engineers periodically monitor the current conditions of road systems to detect any defects and then commence the appropriate maintenance & rehabilitation (M&R) activities. This procedure is complex and prone to human error.

Only about 15% of Nigerian roads are paved and of these 28% are not motorable, building roads in Nigeria is also expensive, costing multiples per kilometer on average compared to our sub-Saharan neighbors. "Every year, Federal roads carry 70% of the total freight traffic across the country. Lack of maintenance culture has seen the roads fall into

state of disrepair and road transport across the country is dreaded by all. Train transport which could have served as alternative to road transport is still at the design stage. "Today, only a pitiable 15% of Nigerian road network is safe and motorable. Nigerian road users pay a lot yearly to rehabilitate their vehicles for plying the decadent roads across the country while many others have paid the ultimate price instead.

The Nigerian Road network comprises Federal roads, State roads and Local Government roads. The problem of maintaining those roads has been given as one of the major factors leading to accidents, increasing road user cost and decreasing the economy of this nation. Okigbo (2012) in his study on the causes of highway failure in Nigerian highways listed out some of the factors that causes these failures and these factors were; poor design and construction, poor maintenance of already built highways, use of low-quality materials in construction, poor workmanship and poor supervision of construction work and the applying of heavy traffic that were not meant for the road. Furthermore, he also suggest that the following will lead to highway failure such as; poor highway facilities, no knowledge base, in adequate sanction for highway failure, no local standard of practice, poor laboratory in situ tests on soil and weak local professional bodies in highway design, construction and management. Tarawneh and Sarireh, (2013) in their study categorized some factors that contribute to the road deterioration and such factors are effect of cracks and structural failure, effect of standards/specifications and policy, effect of traffic load and volume, properties and effect of construction conditions, effect of drainage system and ground water, aggregate properties, effect of alignment and geometry of road, flexible pavement layers thickness, and effect of

pavement with highway maintenance is closely related to quality to construction of original road.

2.4 Analytical Review

Status of Highway Maintenance in Nigeria Highway maintenance means the preserving and keeping of road structures as near as possible in their original state. It consists of correcting deficiencies that have developed as a result of age, use and the effects of the elements, and taking steps to prevent or delay the development of other deficiencies (FMW&H). Road maintenance is vital in order to prolong its life. Also well-maintained roads reduce the cost of operating vehicles by providing good running surface. Proper maintenance also keeps the roads open and ensures greater regularity, punctuality and safety of transport services. Road maintenance is classified into the following categories:

i Routine Maintenance: Routine maintenance is required to be carried out continually on every road, irrespective of its engineering features or volume of vehicular traffic. Routine maintenance expenses are treated as fixed-cost items in the maintenance budget. They include lane marking, drainage clearing, bridges and culvert maintenance, grass cutting and so on.

ii Recurrent Maintenance: This is required at intervals during the year. The frequency of this maintenance depends on the topographic and climatic characteristics of the area and the volume of traffic on the road. It involves maintenance of pavements for paved roads, repairing of potholes and grading for unpaved roads.

iii Periodic Maintenance: This involves major repairs or rehabilitation of those parts of the highway that have deteriorated over the years. The frequency involves intervals of some years. The activities include

surface dressing or resealing and re-gravelling of shoulders for paved roads and re-gravelling for unpaved roads.

iv Emergency/Special Repair: This maintenance is carried out beyond routine, recurrent and periodic maintenance. It is caused mainly by unexpected substantial landslide, when a road is abruptly cut or a bridge washout occurs or it could be due to some seismic factors.

2.5 Summary of Literature Review

Conceptual, theoretical frameworks and empirical review have been elucidated from the literature. Hypothetical factors of highway maintenance and decision variables identified include Jamal (2017) on the factors affecting maintenance of pavement as; increase in the intensity of traffic and it is described as the most important factor; inadequate thickness of pavement; which result to frequent pavement failure, unevenness and heavy patches and effects on number of lane, thus road distress and maintenance on single lane pavement are higher than double lane pavement. It could be on these premises that the national and local highway networks deteriorate easily. According to Ball (1992) the success of investment in highways depends on more than planning and engineering services. Technical assistance in maintaining the constructed highways is critical for ensuring that the economic benefits of highways are realized.

This technical assistance can take various forms:

i Economic studies to establish proper funding levels.

ii Projects to develop and implement systems for managing maintenance.

iii Assistance in procuring all the required physical resources for highway maintenance.

iv Training programs for all levels of personal.

v Assistance in establishing effective procedures for contracting maintenance.

vi Construction Technology equipment and machines.

For public sector highway maintenance projects, political and government supports through budgeting provisions are necessary drivers and Sine quo non for the consideration of other factors.

Considering the findings of researches conducted by France-Mensah et al (2017) Verma et al (2007) and Ball (1992), etc the following factors were identified and propositional for successful highway maintenance projects in Imo State Nigeria under the cliency of FERMA and as representative of Federal Ministry of Works and Housing:

i Funding level

ii Project management and contracting procedures

iii Procurement of physical resources

iv Training program

v Construction technology and capacity

The study also determined and ranked the relative severity index (RSI) of factors that adversely affect and contribute to highway failure and deterioration. Similarly the causative factors and factors influencing highway maintenance as opined by Tarawneh and Sarireh (2013) Okigbo (2012) and France-Menach (2017) include; effects of cracks and structural failure, standards/specification policy, traffic load and volume, properties, construction conditions, drainage system and underground water, alignment and geometry of roads, flexible pavement, layer thickness, pavement with high maintenance, poor design and construction, poor maintenance of already/existing but highways, low quality materials in construction, poor workmanship, poor supervision of construction works, heavy traffic not meant for the road, poor highways facilities, no knowledge based, inadequate sanction for highways failures, no local standard of practice, poor laboratory in-situ test on soil and week local professional bodies in highway design, construction and

management, traffic intensity, number of lanes, thickness of pavements. Some of these factors from different authorities share similarities with each other and therefore summarized for RSI analysis.

2.6 Research Gap

Deterioration and failure of constructed highways in Imo State are very rampant though with poor or no maintenance attention. The issue of highway maintenance that will withstand the taste of time has not been addressed. There is a gap in determining the overall success factors that will be managed and control so as to deliver highway maintenance projects on schedules, within budgeted cost and with specified quality, reliability and durations of intended services.

CHAPTER THREE

METHODOLOGY

3.1 Overview of Research Methodology

This chapter deals extensively with the research/methodology of the research, and the produce employed in this study; thus describing, explaining and giving justification for the methods used in the analysis and technique adopted in data collection; thereby discussing the research design, population of the study and administration of the instruction etc.

It presents the methods, tools and techniques adopted for identification study of highway maintenance management projects for effective performance of land mode of transportation in Nigeria. In addition, the effectiveness and success of this research work is based on adequate and proper availability and analysis of needed information respectively, which gave rise to the result of the research.

3.2 Research Design

This study is a descriptive study survey. The research involved the use of structured questionnaires administered to firms carrying out oil and projects in Nigeria to obtain information from a considerable number of highway maintenance managers, quality assurance and control professionals and other experts in this field of research. The survey is a type of descriptive study in which information is obtained from a sample or respondents for answering research questions and testing hypothesis concerning a study of highway maintenance management Imo State of Nigeria.

In addition to the information obtained through questionnaire, personal interviews were conducted on some of the target respondents. These include key professional personnels in highway maintenance projects and FERMA technical staff.

3.3 Types and Sources of Data

In carrying out this research, information was obtained basically from two main sources, namely viz:

Primary source

Secondary source

3.3.1 Primary Sources of Data

These are the main sources available for collecting data/information by the research through the proficient use of structured questionnaires, Personal interview and data garnered via personal observation and consultations. The reason for personal interview and consultations is obviously for obtaining relevant information from experienced highway maintenance management professionals and consultants as well as engineers of FERMA handling dilapidated portions of Owerri-Onitsha, Owerri-Umuahia, and Owerri- Okigwe Roads detailed response is given to the questions asked and sought for, thereby enabling the researcher to get anticipated response considered appropriate for the research. Data and information's were obtained directly from the questionnaires made available directly to FERMA technical staff and the consultants. These form the fulcrum of the research as other information's obtained from other sources were subsumed under, that generated from FERMA. Hence specific data were generated directly from FERMA technical staff and consultant upon which other information were anchored on.

3.3.2 Secondary Sources of Data

The need for the secondary sources of data for this kind of research cannot be over emphasized. Secondary source of information is known for providing good foundation for coherent and logical research work. The secondary data were obtained from highway maintenance records of FERMA on the 3 sampled maintenance projects along the Owerri-

Onitsha, Owerri-Umuahia, and Owerri-Okigwe Roads, library sources, internet search engines/websites. This information's are in the form of computer typed documents. Such as journals, books, reports, magazines, exhibits and periodicals etc. however, such data were not found suitable for relevant data analysis; rather for elucidation of research information.

3.4 Population of The Study

The population referred to by the researcher is totality of highway maintenance projects and persons involved in the study. The population of this study was chosen from the highway maintenance units of FERMA and related consulting firms in Nigerian. The result of this study will be of interest to the population. It will not only create awareness of various highway maintenance management success avenues, but also proffer the best way each success factor can be best integrated into other facets of highway maintenance in Nigeria comparable to those in the international best practices.

Due to limitation in resource, it was difficult to conduct total enumeration. The option limited the study to some of the highway maintenance sections along Owerri-Onitsha, Owerri-Umuahia, and Owerri-Okigwe Roads as the population. Sample of the projects was used with a view to extending our findings to the entire population.

In this research, the researcher followed a subjective approach, which ensures that the sample is representative of the population and at the same time uses an economically feasible subset of it. There are many companies involved in highway maintenance management operations located in various parts of the Nigeria. The FERMA and its consulting companies have professionals with several years of experience in highway maintenance operation of dilapidated road infrastructure contracts and other related jobs. Instead of getting responses from all

professional in all the companies, the researcher selected a few with relevant skills to represent the entire population. This decision was made due to limited number of technical experts in the area of road and highway maintenance projects.

3.5 Sampling Procedure and Techniques

For the purpose of this study, the researcher based on this desire to limit the population of the study to organizations and professionals in Imo State Nigeria, and also due to the fact that there is no accessible exiting database for the total number of FERMA and consultants maintenance experts and QAC personnel in the Imo state of Nigeria. From the personnel data base of FERMA and its consulting firm, the technical and managerial staff captured as the target respondents were 89 in number. This therefore formed the population size N of the respondents and N for the highways is 3. Since N is relatively small in both, they were used as sample sizes. This sample size determination from its population size using Yaro Yamane formula could applied as follows when the population sizes are high:

$n = \frac{\mathrm{N}}{1+N2}$ …… Equation 3.1

This formula was not used because the N=n for the study; since N is comparatively small.

Where n=sample size

N=population size

é=error margin to be selected. Therefore n=N=89

A total of 89 copies of questionnaires were distributed to experts who are knowledgeable in the selected areas. The targeted respondents are professionals and experts in the area of highway maintenance project and include; civil engineers, project managers, construction technologist and quantity surveyors.

Sampled Highway Maintenance Projects Used for the Study include:

1. General Maintenance and Pavement Strengthening of Owerri – Onitsha Dual Carriageway between Km 7 + 000 – Km 25 + 000 (Both Bounds) in Imo State
2. Repairs/Raising of Low-Lying Location Along Owerri – Obowo Road in Imo State: The Owerri – Obowo road is a section of the Owerri – Umuahia Federal Highway
3. General Maintenance of Owerri – Okigwe Road between km 43 + 200 – km 55 + 300 in Imo State

The sampling technique adopted in this work is that of the probabilistic sampling technique which gives every respondent equal opportunity to express opinion and ensures reliability of information obtained. In particular, the randomization sampling technique was utilized in obtaining information from the sample by removing all elements of bias and favoritism for particular class or sections of people/professionals. The sampled dilapidate highway maintenance road projects subjectively selected for study were; Owerri-Onitsha, Owerri-Umuahia, and Owerri- Okigwe Roads. They were selected because of their high severity index and traffic density in addition to their economic importance in the movement of commuters, goods and services to various destinations.

3.6 Administration of The Instruments for Data Collection

Copies of questionnaire which are the instrument used for the data collections were designed in Likert five-point scale. The scoring model is as follows: Very effective = 5 points, effective = 4 points, neutral = 3 points, ineffective = 2 points, and very ineffective = 1point. They were produced and given to target respondents in FERMA and consulting

firms each of the organizations/establishment selected has professionals. The filled copies of the questionnaire were collected a week after its administration. There was instrument mortality with some copies of the administered copies of questionnaire.

3.7 Reliability of Research Instrument

Reliability indicates the extent to which an instrument could be used repeatedly in a similar research without errors in the results. It is a measure of the consistency of a research instrument (Creswell, 2002). According to Marshal (1996), reliability of the interval is a function of how representative a sample is, as regards to the entire population and the various subgroups expected to be investigated.

In a qualitative study like this, a research instrument could be considered reliable if it can be used repeatedly without giving variance results (Trochim, 2006). For quantitative data, reliability can be estimated statistically by calculating the cronbach for the factors investigated. Cronbach's Alpha coefficient, is a measure of internal consistencies or how closely related a set of items are, in a group of factors being investigated. It is determined for questions with two possible responses or multi-scaled questions such as those with Likert scales. Nunally (1978) gives the lowest acceptable reliability as 0.7.

However, the earlier works gives lower values. Nunally (1978) in Aiyetan (2010) gives an interpretation of the alpha ($\propto$) values as stated below:

i Alpha values less than 0.5 imply poor reliability.

ii Alpha values between 0.5 and 0.7 indicate sufficient reliability.

iii Alpha values above 0.7 imply good reliability.

In this research, a reliability test was properly done and conducted, with a reliability index of ... 0.78=78%.

3.8 Validity of The Research Instrument

Validity is an important consider in a research instrument (Leedy & Ormrod, 2005). Trochim (2006), states that" validity is a measure of truthfulness of a measurement whereas reliability is the ability of a research instrument to be used to obtain a valid data in a similar research".

After developing the instrument, the face and validity of the instrument was carried out by the researcher's supervisor, so as to determine the degree to which the researcher measured the effectiveness of highway maintenance success factors on the sampled dilapidated roads, in Imo state; Nigeria. The research questions, hypotheses and questionnaire were sent to the supervisors and necessary corrections were effected and incorporated.

3.9 Method of Data Analysis

Generally, the ultimate goal of every researcher or scientific analysis is to find the relations between variables. In philosophy of science, it is stated that there is no way of representing" meaning" except through relation between some quantities or qualities" (Marshall 1996). In a qualitative research, data analysis consists of data preparation, descriptive and inferential statistics (Trochim, 2006). The methods of data analysis employed in the study were; Relative Severity Index for assessing the severity of factors adversely affecting highways maintenance projects in Imo State. Computer-based multiple regression and correlation analysis via SPSS version 21 were used in the evaluation of factors influencing the successful execution of highways maintenance projects performance. To study explored the collective and individual relationship of these factors to highway maintenance project success.

The analytical tools that were used to analyze the primary data obtained in the course of the study from SPSS version 21. The SPSS

software sorted out the independent T-test, one way analysis of variance (ANOVA), multiple linear regressions of the primary data inputs to the system.

3.9.1 Relative Severity Index (RSI)

This was used to ascertain the degree of adverse effects of each of the causative and factors affecting highway maintenance caused failure to highways and their maintenance projects.

RSI = $\sum_1^n \frac{WiFi}{w}$ x $\frac{100}{1}$ 3.2

Where Wi = weighted score of individual causative factor

3.9.2 Multiple Linear Regressions and Correlation Analyses

Multiple regressions approximate real-life problems, where it measures the relationship existing between three or two variables. The multiple regressions help to understand the complexity of the interaction in business world.

Again, the aim of multiple regressions is to examine the nature of the relationship between a given dependent variable success of highway maintenance and two or more independent variables in a regression function. The concepts and techniques for analyzing the relationships between a dependent variable and several independent variables, are a straight forward extension of these involved in simple regression, the computations are however more complex and tedious, but with the help of electronic computer, via SPSS version 21 used it becomes easy. Multiple regression analysis and correlation analyses were used to estimate the extent of relationship between the identified success factors of highway maintenance and successful project delivery. In multiple regressions, as in simple regression, the model describing the relationship between dependent variables y and a set k independent variable $X_I, X_2 \ldots X_K$ can be expressed as:

$$\boldsymbol{Y = b_0 + b_1X_1 + b_2X_2 + b_3 + X_3 + b_4X_4 + b_5X_5} \_\_\_ \boldsymbol{Equation} \ldots\ldots\ldots 3.3$$

Where

$x_1 = Funding\ level$ and policy.

$$x2 = Construction\ technology$$

$x3 = Contracting\ Maintenance\ Procedures$ and regulations.

$$x4 = Project\ Management; monitoring\ and\ control$$

$x5 = Training$ and manpower skill development.

$$x6 = Degree\ of\ Physical\ Resources$$

Where y= Effective management of highway Maintenance Project.

3.9.3 Decision Rule

The test of hypothesis was conducted at 0.05 (5%) level of significance. A computer software called statistical program for Social Science (SPSS) version 21 was used in the data analysis and interpretation. The decision rule is that when the P-value (sig.) is $\leq$ 0.05 (the chosen level of significance), the null hypothesis is rejected while the alternative hypothesis is accepted, and vice versa.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

The data obtained from the field survey were presented and analyzed. The results generated from the data analysis were discussed in this chapter with deductions and inferences. The data obtained and analyzed were based on the highway maintenance management project in Imo state Nigeria. The areas of specialization of the expert respondents are civil engineering, construction technology, project management and quantity surveying.

4.1.1 Data Presentation

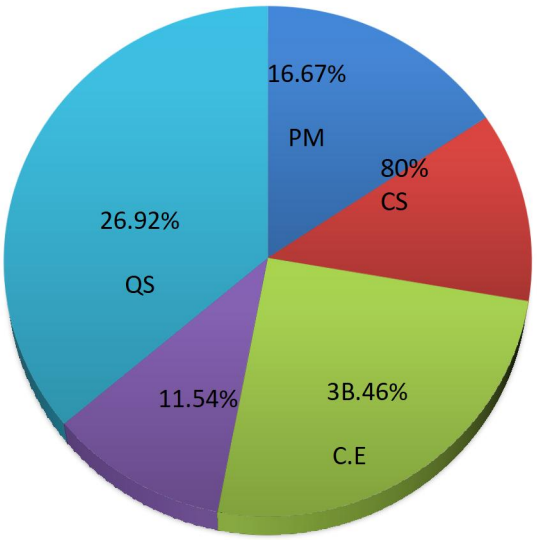
Specific Objectives are:

i. To identify the causes of deterioration and failures of federal highway to serve as a guide for project performance.
ii. To assess the performance indicators of highway maintenance for effective project performance.
iii. To analyze the determinants and drivers of highway maintenance project performance in Imo State vis-à-vis; funding, physical resources, monitoring and control.
iv. To proffer solutions for achieving the goal of highway maintenance project performance in Imo State.

The research data was therefore analyzed to achieve the above stated objective. Effective highway Maintenance Management Project enhances road condition for economic mobility and land mode of transport facilities which necessary for optimal economic activities, and construction logistics solution of highways in Imo state. The data generated from field survey were distributed and returned as shown on table 4.1 below.

Table 4.1 Questionnaire Distribution and Return

S/N	FERMA Staff and Consultants	Distributed	Return	% Returned
1.	Civil Engineers	15	14	93.33
2.	Construction technologist	12	10	83.33
3.	Project Managers	13	13	100.00
4.	Quantity Surveyor	10	9	90.00
5.	Consultants	15	12	80.00
6.	Quantity Surveyors	14	11	78.57
7.	Structural Engineers	10	9	90.00
	Total	**89**	**78**	**87.64**



3rd Qtr, 26.92

Fig 4.1 Chart showing the distribution of professional expertise of various category of technical staff in highway maintenance project

CE=Civil engineers, PM = Project Managers,

PM= Project Managers

CT=Construction Tech.

QS=Quantity Surveyors.

SE= Structural Engineers.

CE = Consultants

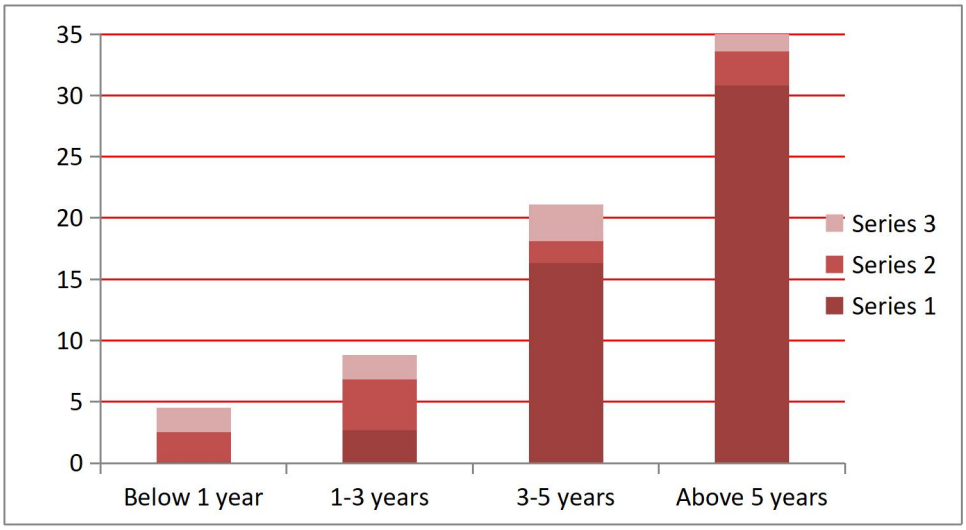


Fig 4.2 Bar chart showing years of working experience of target respondents.

Analysis of Relative Severity Index (RSI) of factors and causes of highway failures of federal roads in Imo state Nigeria; using equation 3.2 as follows:

RSI = $\sum \frac{Wifi}{W}$ $\boldsymbol{where\ Wi} =$ Individual weight in which: SD = i point D = 2 points.

N = 3 points A =4 points, SA = 5 points

W = sum of maximum weight = 450, Fi =frequency or number of respondents for each weight

Code	CAUSATIVE FACTORS OF HIGHWAY FAILURE	Frequency					Total score $\sum Wifi$	RSI (%)	Rank
		SD	D	N	A	SA			
S1	Cracks and structural failure	8	10	22	18	20	266	59.11	6th
S2	Standards / specifications policies	8	20	14	18	18	252	56.00	8th
S3	Traffic density / load	8	26	10	14	20	246	54.67	9th
S4	Construction conditions	28	18	15	10	7	184	40.89	16th
S5	Drainage systems and underground water	2	8	8	20	40	322	71.56	1st
S6	Alignment and geometry of roads	22	18	18	10	10	202	44.89	13th
S7	Flexible pavement	31	19	14	6	8	175	38.89	15th
S8	Layers thickness	10	8	8	24	26	276	61.33	4th
S9	Poor design and construction	3	5	10	24	36	319	70.89	2nd
S10	Lack of effective maintenance culture	17	20	18	8	14	213	47.33	12th
S11	Low quality materials	2	6	18	22	30	306	68.00	3rd
S12	Poor workmanship and supervision	10	8	14	26	20	252	56.00	5th
S13	Poor highways facilities	30	18	12	8	10	184	40.89	14th
S14	No knowledge based in maintenance	9	10	20	20	19	264	58.67	7th
S15	Inadequate sanction for highway offenders	44	15	10	3	6	146	32.44	17th
S16	Poor laboratory institute test	16	22	8	18	14	226	50.22	11th
S17	Weak local professional bodies	50	15	7	5	1	126	28.00	18th

Table 4.2: Relative Severity index of causative factors of frequent highways deterioration

S18	Inadequate number of lanes	18	10	10	24	16	244	54.22	10th

Table 4.3 Summary of Weighted Responses of the Respondents to the Questions used to Carryout Regression Analysis

Respondent	X_1	X_2	X_3	X_4	X_5	X_6	Y
1	20	12	8	16	5	15	44
2	22	16	11	13	14	20	50
3	15	12	10	16	8	18	38
4	23	17	12	15	11	20	52
5	18	20	8	13	8	15	45
6	24	15	6	10	12	19	42
7	20	18	8	13	16	15	48
8	12	14	10	12	5	10	45
9	18	15	12	17	7	16	47
10	22	20	14	16	13	20	57
11	24	19	10	18	15	21	48
12	20	17	8	15	6	18	55
13	15	18	14	13	12	20	34
14	18	16	18	14	17	15	48
15	20	15	7	12	8	18	49
16	18	16	13	14	12	16	52
17	22	18	10	16	11	20	46
18	16	20	12	17	13	15	44
19	22	23	14	16	15	21	48
20	19	20	17	18	12	18	57
21	23	22	14	23	16	20	23
22	18	12	13	15	12	18	42
23	13	20	11	17	10	15	32
24	24	20	15	12	13	22	48
25	17	18	13	18	14	15	51
26	21	20	14	8	16	18	26
27	18	15	12	13	10	16	47
28	24	15	16	14	12	22	50
29	18	16	13	14	8	18	46
30	15	20	16	16	13	14	33
31	22	18	8	17	10	20	52
32	23	19	15	16	8	22	41
33	15	20	12	14	13	18	38
34	20	17	14	16	12	20	48
35	23	16	12	14	15	18	56
36	18	15	8	12	12	16	47
37	21	18	12	14	9	20	50
38	18	16	15	10	13	16	45
39	15	15	18	20	14	13	48

40	23	20	14	18	16	21	37
41	15	20	16	18	12	20	30
42	20	15	12	10	8	21	48
43	25	18	10	15	12	18	58
44	22	15	18	20	16	20	56
45	20	18	12	16	9	21	42
46	18	20	14	21	15	18	36
47	24	21	16	18	17	22	47
48	16	20	15	19	12	17	45
49	23	18	16	15	14	20	27
50	18	21	17	19	17	22	33
51	24	20	16	18	20	22	46
52	20	22	12	15	8	21	50
53	14	18	14	12	10	20	47
54	22	15	8	10	18	18	33
55	18	14	6	12	10	16	40
56	21	18	12	20	15	20	46
57	23	20	17	18	14	20	58
58	17	15	9	14	12	15	35
59	20	21	16	15	17	18	48
60	22	20	14	18	16	21	24
61	18	16	15	17	15	18	45
62	24	21	16	18	15	20	48
63	15	17	14	12	10	18	49
64	22	19	17	18	16	21	36
65	18	16	8	15	14	15	34
66	15	18	10	14	15	20	22
67	23	21	15	18	16	22	47
68	20	17	14	12	8	18	50
69	18	20	16	18	12	17	46
70	15	12	10	14	9	10	35
71	23	20	12	18	12	22	48
72	19	14	15	12	5	20	57
73	16	18	13	15	10	12	35
74	23	20	15	18	15	21	56
75	18	17	14	16	15	20	44
76	23	20	15	18	12	21	57
77	20	15	12	15	13	18	48
78	22	18	20	18	16	23	53

Source: Field Survey Report

Table 4.4 Model Summary and ANOVA for multiple Regression and Correlation Analysis

i. Model Summary

Model	R	R-square	Adjusted-R	Standard Error of the Estimate	Change Statistics			
					R square Change	Dfl	Df2	Sig F Change
1	885[a]	783	760	1.13618	2.47898	6	58[a]	.000

ii. ANOVA

Model	Sum of Square	DF	Mean square	F-ratio	Sig.
Regression	154.856	6	25.809	34.818	0.000
Residual	2131.362	72	30.019		
Total	2286.362	78			

Table 4.5 Coefficients

CONSTANT	UNSTANDARDIZED COEFFICIENTS		STANDARDIZED COEFFICIENTS BETA	T- VALUE	SIG.(P-VALUE)
	B	STD. ERROR			
Y	2.099	1.305		1.608	0.113
X_1	0.663	0.126	0.353	5.263	0.000
X_2	0.576	0.160	0.263	3.596	0.001
X_3	0.304	0.134	0.141	2.166	0.043
X_4	0.308	0.138	0.158	2.229	0.030
X_5	0.257	0.186	0.102	1.383	0.172
X_6	0.670	0.152	0.309	4.393	0.000

Dependent Variable y

The fitted regression equation: $Y = 2.099 + 0.663x_1 + 0.576x_2 + 0.304x_3 + 0.308x_4 + 0.257x_5 + 0.670x_6$ 4.1

The fitted regression equation could be inferred to lead to effective management of highway maintenance projects by FERMA in Imo State when the independent variable; $x_1, x_2, x_3, x_4, x_5, x_6,$ are properly managed and kept under the control of a decision maker.

4.1.2 Test of Research Hypothesis

Ho_1: The identified overall drivers and decision variables could not lead to improved highway maintenance project performance in Imo State.

From table 4.3, the significance of F-ratio value = 0.000 < 0.05. The null hypothesis is rejected in favour of alternative hypothesis.

This implies that the result of the test is significant at 5% level of significance

Ho_2: Method of funding employed by the government will not have significant performance impact on evolving highway maintenance projects in Imo State.

From table 4.4, the P-value (sig.) of the test, 0.000 < 0.05, hence, the test is significant for managerial decision making.

Ho_3: Capacity of construction technology will not lead to improve management of highway maintenance projects performance in Imo State.

From table 4.4, the sig. = 0.001 < 0.05. The test is also significant as non hypothesis is rejected in favour of alternative hypothesis.

Ho_4: The adoption of contracting maintenance procedures and regulations will not significantly lead to improve performance of highway maintenance projects.

From table 4.4, the P-value for x_3 = 0.043<0.05. The test is also significant to be used for formulating maintenance project policies.

Ho_5: The level of application of project management for planning, monitoring and control will not decisively result to improve performance of highway maintenance projects.

From table 4.4, the P-value for x_4 = 0.030 > 0.05. The test is not significant. The null hypothesis is therefore rejected for x_4, while the alternative hypothesis is accepted for decision making.

Ho_6: Training and manpower skill development are not significant decisive drives for effective management of highway maintenance project delivery in Imo State.

From table 4.4, the P-value for x_5 = 0.172<0.05. The test result indicates that the null hypothesis is accepted while the alternative hypothesis is rejected. Hence x_5 could not be used for decision making.

Ho_7: The level of available physical resources will not lead to effective management of highway maintenance project in Imo State.

From table 4.4, the P-value (sig.) for x_6 = 0.000<0.05. The test result is significant for decision making while the null hypothesis is rejected.

Table 4.6: Ranking of Success Factors for Highway Maintenance Project Performance by FERMA in Imo State Nigeria

CODE	Drivers and determinants	Dog.	T -value	Rank	Remark
X_1	Funding Level	0.000	5.263	1^{ST}	Significant
X6	Degree of Physical Resource	0.000	4.393	2^{ND}	Significant
X2	Capacity of Construction Technology	0.001	3.596	3^{RD}	Significant
X4	Project Planning, monitoring and control	0.030	2.229	4^{TH}	Significant
X3	Contracting Maintenance Procedures and regulation	0.043	2.166	5^{TH}	Significant
X5	Training and Manpower Development	0.172	1.383	6^{TH}	Not Significant

4.1.3 Data Obtained from Secondary Sources:

For the purpose of this research work, some Secondary data were obtained from FERMA Owerri on the sampled highway maintenance projects. Such data were not found suitable for relevant data analysis; rather for elucidation of research information. These data are attached as

Appendix. It was observed that the failures on the carriageway of the roads under consideration were consistent with the following causative factors: poor drainage system, stagnation of run-off on the carriageway, Silting of concrete lined drains, increased volume of axle load on the road. Summary of the findings are detailed below:

1. General Maintenance and Pavement Strengthening of Owerri – Onitsha Dual Carriageway between Km 7 + 000 – Km 25 + 000 (Both Bounds) in Imo State

The Km 7 + 000 – Km 25 + 000 of the Owerri – Onitsha Dual Carriageway lies within Owerri – Mgbidi section of the road. The dual carriageway consists of 7.3m width of asphaltic concrete carriageway, with 2.75m and 1.5m width of asphaltic concrete outer and inner shoulders, respectively. The road is a major arterial route linking major towns in Rivers, Imo, Anambra and Delta States, respectively and beyond. The information obtained on the project showed that the causative factors of the failure on the carriageway between km 7 + 000 – km 25 + 000 along the road include:

i. Blockage of box culvert at various locations
ii. Unlinked concrete lined drains
iii. Surface run-off stagnating on the carriageway and shoulder thereby weakening the asphalt surface and
iv Increased volume of high axle vehicle along the road

2. Repairs/Raising of Low-Lying Location Along Owerri – Obowo Road in Imo State:

The Owerri – Obowo road is a section of the Owerri – Umuahia Federal Highway. The road consists of varying width of between 7.3m – 11m of asphaltic concrete carriageway with 2.75m width of eroded surface dressed shoulder on either side of the carriageway. The low-lying location falls within km 32 + 000 of the road. The causative factors of

the failure of the carriageway and shoulders were identified from the obtained information on the road to include:

i. Low-lying nature of the road at km 32 + 000
ii. Stagnation of water by the road verges persistently seeping into the sub grade.
iii. Nature and blockage of the concrete lined drains

3. General Maintenance of Owerri – Okigwe Road between km 43 + 200 – km 55 + 300 in Imo State

The km 43 + 200 – km 55 + 300 of the Owerri – Okigwe road lies within Owerri – Anara section of the road. The Owerri – Okigwe Federal Highway is about 56km long and is adjoining to Enugu–Port Harcourt Expressway. The cross section of the road consists of 7.3m width of asphaltic concrete carriageway with 2.75m graded and eroded surface dressed shoulders at some sections. The road is a major arterial route linking major towns and communities in Imo, Abia and Enugu States, respectively and beyond. The causative factors of the failure on the carriageway between km 43 + 200 – km 55 + 300 along the road include the following:

i. Stagnation of surface run-off on the carriageway and shoulder which weakened the asphaltic surface causing water to permeate to the underlying soil
ii. Inadequate provision of concrete lined drains
iii. Increased volume of high axle vehicles on the road
iv. Silted concrete lined drain at various locations

4.1.4 Proffered Control Measures for Selected Highway Maintenance Projects Performance

Based on the results and findings from the data analysis, the study alludes the following control measures to ensure improved and effective,

sustainable and reliable highway maintenance projects performance in Imo State.

i Periodic monitoring of highway to arrest the dilapidation issues from the point of defects before it aggravates to crack initiation and propagation.

ii Quality of materials inputs should be monitored, tested and controlled prior to usage in the maintenance projects. Poor quality inputs usually result to poor and shoddy outputs.

iii Drainage system should be incorporated into the highway maintenance project design and implemented so as to ensure sustainable and robust maintenance work with high reliability index.

iv Maintenance project crew/team members should be motivated and rewarded accordingly so that they can put in their best to ensure quality deliverables from time to time.

v Institution of periodic monitoring of the maintenance projects based on established milestone scheduled should be included in the project design and audit plans.

4.2 Discussion of The Results and Findings

From the result of analysis of the study, the findings in table 4.4, indicate that funding level is the most significant success factor that could lead to effective maintenance management of highways in Imo State by FERMA. It could be adduced that late or non-release of funds is one of the major constraints to highways maintenance projects performance leading to abandonment, delays, cost and time overruns, low quality, disaffections by the citizenry and users' un-satisfactions. Project funding deals with the systematic and effective release of money budgeted for the projects as and when due to maximize projects owner's objectives in terms of cost, schedules and quality performance. Adequate funding pattern makes the wheel of project implementation to go round and is very importance for projects success and avoid

abandonment. However, funding level should align with budget and cost breakdown structure meant for the highways maintenance project so as to ensure that enough fund is available for the execution and completion of each stage or work breakdown structure of the project. Funding will also ensure that all necessary steps are undertaken to sustain the flow of budgeted funds to the highway maintenance project performance execution and completion. Table 4.2; Indicates that poor or lack of drainage system, poor quality of maintenance design and construction, poor quality materials and then pavement layer thickness are the major causative factors of highways failures and deterioration. Significant funding level and budgets are therefore needed to integrate, consider and include these factors in the design and implementation of highway maintenance projects. Table 4.4; also attests that availability and timely supply of physical resources are significant factors that could lead to effective highway maintenance project success. The availability and on the site timely supply of quality physical resources are inferred to be significant to the successful highway maintenance projects performance by FERMA in Imo State. However, resources availability, timely and scheduled supplies to the dilapidated sections of the sampled highways are very crucial and proactive to the maintenance projects. Resource scheduling is a process of converting a project plan into a working schedule that takes account of resources which can be made available (lock 1997) as and at when due.

Resources for scheduling include labour, bulk materials, plant, machinery and money. The concept of network time analysis is however, used to determine activity priorities, which in turn decides how scarce resources should be allocated. Bulk material resources such as chippings, bitumen, reinforced/structural steels, laterites, water etc., are very crucial for highway maintenance project delivery. The

availability and use of well-maintained and functional construction equipment in the category of; earth-moving plants, concreting equipment, materials handling equipment, transportation, fleet and utility services equipment will lead to effective highways maintenance projects delivery in Imo State. However, the projects managers should formulate action plans on the best way of using available resources so as to give rise to efficiency in the course of highway maintenance projects. Efficiency in the use of resources is measured in terms of amount and quality of highway maintenance tasks. Table 4.1 has already indicated poor quality construction materials as one of the major causes of failure from table 4.4.

The results of the analysis indicate that construction technology ranks third as a significant factor that will lead to successful management of highways maintenance projects performance. According to Akanmi and Akpomiemie (2014) the appropriate construction technology can be measured by the availability of locally made plant and equipment, skilled manpower resources, extent of local materials resources and degree of utilization of such local construction materials. However, Nigeria usually depends on imported and foreign construction technology in some key areas. There is need therefore to encourage and develop local technology so as to improve and sustain the success of highway maintenance projects.

The lack of technological know-how and shortage of managerial manpower were considered to be one of the major constraints and problems facing the nation. Akanni and Akpomiemie (2014) maintained that as at 1980, the situation was described thus; lack of basic knowledge of production methods and design techniques for machinery constitute a serious constraint to rapid industrialization of the country. As at today, the country still remains a net importer of technical

manpower, virtual most spare parts are imported and most investment in research and development are made abroad, except those sponsored by the government in public owned institutions. Highways maintenance projects performance success could be recorded if construction materials are locally sourced, exploited and processed, equipment, machineries and spare parts are locally designed, fabricated, maintained and sustained with locally manpower and skill development in the area of highway maintenance projects so as to be in tandem with local environment sustainability.

From Table 4.4; the adaptation of project management techniques in planning, monitoring and control of highways maintenance projects was found to be a decisive driver to improved and effective project delivery. To be proactive to successful management of highway projects, project managers in addition to their traditional functions, must develop a skill to scan the environment, to identify potential problems and try to establish strong relationships that can help in the management of key actors and factors on which successful implementation of highways maintenance projects on which successful implementation of highways maintenance projects depends. With the emerging global opportunities, Chitkara (2006) avers that; projects cross geographical boundaries, corporate channels, traditional systems and cultural diversities. He maintained that the knowledge areas needed to manage such projects comprise project management techniques, general management practices and technological related subjects. The project management techniques of planning, scheduling, monitoring and controlling are the tools and devices that bind the subject's knowledge areas. He concluded that these techniques can be applied to all types of projects. Some of these project scheduling management techniques include; Critical Path Method (CPM) Program Evaluation and Review Technique

(PERT), Gantt chart etc. CPM and PERT are important and essential to manage effectively projects through proper planning, scheduling, and control. Telsang (2010) concurred that network scheduling technique is a technique used for planning and scheduling large projects in the fields of construction, maintenance, fabrication and other areas. Contracting maintenance proceedings is also a significant success factor of highway maintenance project management that must be complied with. Project management requires teamwork among the three principal contracting parties. Members of the owners' team must provide the project needs, the level of quality expectation, a permissible budget and the required schedule. They must also provide the overall direction of the project. The designer's team must develop a set of highways maintenance contract documents that meet the client's needs budgets, required level of quality and schedule. In the addition, the work specified in the contract document must be constructible. The contractors' team must efficiently manage the physical work required to build the projects in accordance with the contract documents. (Stevenson 2000). However, contract penalties usually exist to ensure compliance and contract discipline so as to achieve success of highways maintenance projects. Late completion can invoke the ignominy of contract cost penalties. According to lock (1997), some contracts contain a penalty clause which provides the purchaser with sanction of a cost penalty against the contractor for each day or each week by which the contractor fails to meet the contracted delivery obligation. Training and manpower development did not indicate significant evidence and contributions to effective management of highways maintenance projects in Imo State by FERMA. Either there are no training programmes available or the available ones lack the capacity as most of the skills are usually imported into the country alongside with construction technology. Also,

many of the highway maintenance projects are characterized by short durations and transition from one site to another because of small scope in each site.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

Highway maintenance is closely related to the quality of construction of original road. To cope and effectively handle highway maintenance projects with skills; it requires some salient decision variables that need to be analyzed and synthesized in order to come up with a model that will serve as a managerial decision support system. This is so because shoddy and insufficient pavement or base thickness or improper construction of these elements soon results in expensive patching or surface repairs. It therefore leverages on decisive managerial actions and control so as to deliver highway maintenance projects effectively.

This study in its broad spectrum sought to determine the action plans and knowledge –based strategies for effective maintenance management of Federal highways in Imo State by FERMA. The Federal highways in Imo State for the study include dilapidated sections of; Owerri-Onitsha, Owerri-Umuahia, and Owerri- Okigwe Roads. These highways suffer shoddy completion, abandonment, failures and delays in their maintenance projects. The completed portions of the highway were bedeviled with failures and rapid deterioration, due to some factors and therefore subjected them to relative severity index (RSI) test. The four major causative factors adduced to the problems were inferred. The study also identified some decision variables that were hypothesized for effective management of highway maintenance projects in Imo State. These decision variables were categorized under six clusters of: funding level, physical resources, construction technology capacity, project management skill level, contracting maintenance procedures and regulation, training and manpower skill development. These drivers were quantitatively analyzed, evaluated and

subjected to tests of research hypotheses using SPSS version 21 of multiple regression and correlation analysis. The study established the significant evidence of decisive impacts of these drivers and determinants on the effective management of highway maintenance project success. Effectiveness parameters include; completion within budgeted costs, scheduled completion, quality and reliability indexes of completed highway maintenance projects, condition of highways, enhanced access mobility, compactness/solidity, urbanization etc.

Based on the results and findings of the study, the results provided significant evidence at 95% confidence level that proper highway maintenance project performance success could be achieved with the following in ordered ranking significant level based on the level of effectiveness between the variables. These are; funding level, availability and efficient utilization of physical resources, capacity of construction technology, project planning, monitoring and control, and maintenance contract management and regulations. However, training and manpower skill development were not found to be significant drivers to effective highway maintenance project success. This might be due to timeline and seasonal variations that influence the duration of the projects.

5.2 Conclusion

Based on the finding made in this study, the following conclusion are made. Highway failures and dilapidation are serious threat to economy of Imo State with resultant impediments to movement of commuters, goods and services; hence retrogressive to the economic development of the state.

Many causative factors are found to be responsible for highway failure and dilapidation and the major ones are; poor drainage systems and

effects of underground water, poor design and construction of the highway maintenance projects, low quality input materials and thin base thickness of the pavement, surface run-off stagnating on the carriageway and shoulder thereby weakening the asphalt surface, unlinked concrete lined drains, increased volume of traffic, silted concrete lined drain at various locations. Highway maintenance projects could be effectively managed by enhanced funding level, availability and efficient utilization of physical resources, capacity of construction technology etc.

Efficient and periodic maintenance of highways in Imo State could improve the economic fortunes of the State and ensure free and unhindered movement of commuters, goods and services from source to destinations.

Highway maintenance strategies from this study can achieve significant improvement on the existing land mode of transportation in Imo State. Salient control measures for sustainability and reliability of maintenance or existing highways were eluded and proffered.

5.3 Recommendations

Based on the findings of this study, the following recommendations were made. Since many of these roads are neglected for maintenance until such catastrophic stage, preventive and predictive maintenance policies are recommended because delays cause more devastations.

Realistic budgets with seamless release of fund as and when due are recommended since insufficient budgets and funding level lead to highway maintenance project abandonment and failure. Uncompleted road maintenance is washed away by rainfall and road users, thus resulting to colossal waste of resources.

Drainage system should as well be included in highway maintenance design and back-up with adequate funding for implementation and inclusion. The FERMA should set up a highway monitoring and inspection team to identify point of defects along the highways and prevent them from propagation and further deterioration, dilapidation or failure propagation along the highways. The quality of physical inputs such as materials and machines should be inspected and evaluated prior to utilization so as to contain shoddy output or repeat work.

5.4 Contributions to Knowledge

i Causative factors responsible for 70% of highway failures and dilapidation have been evaluated and identified in line with pareto law distribution. The result could be used as inputs in decision making process for maintenance projects. These include; poor drainage system, poor quality of design, low quality materials used in maintenance and thin layer thickness of the pavement. They will therefore require rigid and strict attention in their design, implementation and control in the course of highway maintenance project.

ii The study identified, evaluated and deduced efficient determinants and decisive drivers to effective management of Federal highway maintenance projects by FERMA in Imo State.

iii A fitted multiple regression model was developed to explore and predict level of effective management of highway maintenance project at the design stage when the independent variables are taken into consideration. The independent variable inferred in the study include the degrees of; physical resources, construction technology, project management dexterity and contracting procedures and regulations in highway maintenance projects etc.

REFERENCES

Adebusuji B. S. (1994) Financing State Government Projects through the Capital Market. Problems and Prospects. CBN Economic *and Financial Review* Vol. 32(2)

Akanni P.O, Oke O.E. and Akpomiemie O.A. (2014) Impact of Environmental Factors on Building Project Performance in Delta State, Nigeria *Housing and Building National Research Centers HBRC Journal.* http://ces.elsevier.com/hbrc.

Ball J.R. (1992) Highway Maintenance Management *Transportation Research Board.* http://trid.trb.org/view/3

Beesley M.E. (1973) Urban Transportation: Studies in Economic Policy.

Bureau of Statistics Report (2012), Reports on New Vehicle Importation in Nigeria.

Burnigham S. and Stankevich N. (2005) Why Road Maintenance is Important and How to Get it Done. Pp 1 – 10

Cadez S., Guilding C. (2008), An Exploratory Investigation of an Integrated Contingency Model of Strategic Management. *Accounting* 33 (7/8) 836-863

CBN (1999), A Study by the Research Department and international Economics Relation Department CBN. *Infrastructural Expenditure policy and Private Sector Output in Nigeria*.

Central Bank of Nigeria (2003) Highway Maintenance in Nigeria. Lessons from other Countries in Occasional Paper No. 272003. *Research Department Central Bank of Nigeria (CBN) Abuja*.

Chaudhuri D. and Suresh P.V., (1995), An Algorithm for Maintenance and Replacement Policy Using Fuzzy Set Theory. *Reliability, Engineering and System Safety*. Vol. 50 issue I.

Chenhall R. H. (2003), Management Control System Design within its Organizational Context. *Findings from Contingency-Based Research and Direction for the Future*. 28(2/3): 127-168

Chitkara K.K. (2006) *Construction Project Management. Planning, Scheduling and Controlling*. Tata Graw-hill Publishing Company Limited, New Delhi.

Federal Ministry of Works and Housing (2003) Abuja Task Force for Road Maintenance.

Federal Emergency Road Maintenance Agency (2020). General Road Maintenance and Pavement Strengthening.

Fisher J. (1995) Contingency-Based Research on Management Control Systems. Categorization by Level of Complexity. *Journal of Account* 14:24-53

Franc-Mensah, J., Brien P.K. Khwaja S. E. and Bussal P. (2017) Geographical Integrated Highway Maintenance and Construction Planning. *A Case Study of Forth Worth Texas. Springer Visualization in Engineering.*

Harnisch B. and Ward A (2012) A Biblometri View on the use of Contingency Theory in Project Management Research Project. *Management Journal* 43(3), 4 – 23.

Ibraheem A. and Gani S. (2014), Evaluation of Common Maintenance Methods for Flexible Pavement. *American Journal of Engineering and Applied Science* 4(3) 413-424

International Road Maintenance Handbook (1994) PIARC, Overseas *Development Agency*.

Jamal H. (2017), Road Maintenance, Highway Maintenance Transportation engineering. http://www.aboutcivil.orgmtcofhwsrd.html.

Kormane F.P (2019) Project Management and Organizational Performance of Manufacturing Firms in Nigeria. *Unpublished Thesis*.

Lock D. (1996) *Introduction to Project Management*, 6th Edition Willey Publishers New York.

Mandle U, Dierx A and Llzkovitz F. (2008). The Effectiveness and Efficiency of Public Spending, Directorate General, Economic and Financial Affairs, European Commission, Brussels Belgium. Nakhyeok.choi@gmail.com.

Merna T. and Njiru C. (2002) Financing Infrastructure Projects Thomas Telford, London.

Ministry of Road Transport and Highways (2013) Basic Road Statistics of India 2011-2012.

Mohamed A. W. (2010) Road Maintenance Management System. A case Study at Public Works Department http://www.researchgate.net

Mundhe R. (2008) Infrastructure Concession Contract: An Introduction in viewpoint 1-3. *CUTS Centre for Competition, Investment and Economic Regulation Jaipur India*.

Nakhyeok C. and Kyujin J (2017) Measuring Efficiency and Effectiveness of Highway Management in Sustainability. Community Wellbeing Research Centre, Graduate School of Public Administration Seoul National University, Seoul 08826 Korea.

National Technical Working Group on Transport (2009). Nigeria Vision 2020. Reports of the Transport National Technical Working Group Abuja.

Okigbo N. (2012) Causes of Highway Failure in Nigeria. Vol. 4(11) PP 4695 – 4703.

Okonta H. N. (2003) Financing Highways Privatization in Nigeria. *Paper Presented at the International Seminar on Private Sector Participation in Road Management at the federal Palace Hotel Lagos* 25th – 27th.

Olatunji M. and Diugwu I. A (2013), A Project Management Perspective to the Management of Federal Roads in Nigeria. A Case of Minna – Bida Road, *journal of Construction Management*. Vol. 1 (4) Pp. 54 – 61.

Oni S. and Okanlawon K. (2006) Nigeria's Transport Infrastructural Development. an Integral Part of the National Economic Empowerment and Development Strategy. (NEEDS). *Journal of Social and Policy Issues*. 3(2) 7 – 13.

Plug B. L. and Oesch S. (1986), Moire Applied to Real-Time Inspection of Highways. Vol. 112, No. 2 Pp. 163 – 171.

Ralph H. (2001), Reinventing the Pavement Management Wheel. Fifth *International Conference on Managing Pavement*.

Reforming Road Transport in Nigeria (2009). Report on Nigeria Road Transport System and Performance.

Reid G. C. and Smith J.A (2000) The Impact of Contingencies on Management Accounting System Development. *The Managers* 11 (4) 427 – 450.

Stevensons W. J. (2010) *Operations Management*. International Edition. McGraw – Hill, Irwin.

Tarawneh S. and Sarireh M. (2013) Causes of Cracks and Deterioration of Pavement on Highways in Jordan from Contractors' Perspective Vol. 3 (10) Pp. 16 – 27.

Telsang M. (2010) *Industrial Engineering and Production Management*. S. Chand and Company, Ram Nagar, New Delhi.

Udoagwu K. (2016) 4 Steps to More Effective Project Management. Wrike. http://wrike.com.

Verma A. K., Srividya A and Prabhu R.S (2017). Fuzzy Set Solutions for Optimal Maintenance Strategy Selection. *Springer Link, technical note*. Vol. 44, Issue 3 PP. 261 – 276.

Woods M. (2009) A Contingency Theory Perspective on the Risk Management Control System within Birmingham City. *Manager* 11 (4) 427 – 450.

APPENDIX

Department of Project
Management Technology,
Federal university of Technology,
Owerri – Nigeria,
18th April, 2020

Dear Sir/Madam

A FIELD SURVEY ON: ASSESSMENT OF SELECTED HIGHWAY MAINTENANCE PROJECT PERFORMANCE IN IMO STATE. A CASE OF FERMA

A field research survey is being conducted on the above title for award of Masters Degree (MSc.) in Project Management technology of Federal University of Technology Owerri. You have been nominated for me as a Professional and expert in Highway maintenance management and engineering.

I would be grateful if you could be kindly answer and complete the questionnaire attached below for me. Your responses will be treated strictly confidential because the research is exclusively for academic purposes.

Thank you in anticipation.

Osuji Uchechkwu C.
20154946358

SECTION A

Name and address (optional) .....

How long have you worked in Highway maintenance projects?

1 – 2 years ☐ 3 – 5 years ☐, 6 – 10 years, above 10 years ☐

In what capacity/professional skills have you works

Project/Construction Manager ☐ Civil Engineer ☐

Quantity Surveyor ☐, Cost Accountant ☐

SECTION B

In this section, you are humbly required to indicate the extent to which you agree or disagree with the following questions on causative factors of highway dilapidation and success drivers and determinants that would lead to assessment of highway maintenance project performance in Imo State Nigeria; in terms of quality and reliability, solidity and compactness, access mobility, enhanced land mode of transportation. Conditions of roads urbanization etc.

A five-point Likert scale has been provided and you are requested to tick (/) at any point that represent you opinion and perception based on you attitude and subjective intuitive reasoning; on the level of achievable effectiveness on management with the variables presented below.

The point and scoring scale for the questions contained in the questionnaire are as follows:

VE	=	Very effective	=	1 point
EF	=	Effective	=	2 points
NE	=	Neutral	=	3 points
IN	=	Ineffective	=	4 points
VI	=	Very ineffective	=	5 points

CODE	CAUSATIVE FACTORS OF HIGHWAYS FAILURE AND DILAPIDATION	SCORING POINTS					
		SD	D	N	A	SA	
S1	Cracks and structural failure						
S2	Standards/specifications policies						
S3	Traffic density/load						
S4	Construction conditions						
S5	Drainage system and underground water						
S6	Alignment and geometry of roads						
S7	Flexible pavement						
S8	Layers thickness						
S9	Poor design and construction						
S10	Lack of effective maintenance culture						
S11	Low of quality materials						
S12	Poor workmanship and supervision						
S13	Poor highways facilities						
S14	No knowledge based in maintenance						
S15	Inadequate sanction for highway offenders						
S16	Poor laboratory insitu test						
S17	Weak local professional bodies						
S18	Inadequate number of lanes						

CODE	DRIVERS TO ASSESSMENT OF SELECTIVE HIGHWAY MAINTENANCE PROJECT PERFORMANCE	SCORING POINTS				
		VI	IN	NE	EF	VE
X1	Funding level of highway maintenance projects 1. Government policy to release fund for FERMA 2. Funding of highway maintenance is not usually captured in the capital project budget. 3. Government bureaucracy does not impede timely release of fund. 4. FERMA usually misappropriate funds meant for highway maintenance project, hence low quality and reliability index. 5. Inflation usually results to deficit budgets hence poor funding for highways maintenance project.					
X2	Degree of physical resources. 6. Insufficient labour for highway maintenance projects 7. Cheapens and sand are always available 8. Ashalts are always scarce in supply 9. Frequent breakdown of earth moving equipment 10. Most of the equipment are imported at high cost 11. Manual concrete mixing machines and asphalt blending					

X3	Capacity of construction technology 12. The contractors have sufficient construction equipment and machinery 13. Locally fabricated equipment is also available to complement the imported ones 14. Equipment and machinery used appear fragile and suffer from frequent breakdown 15. Availability of skillful professionals who operate the machines effectively and optimally 16. Poor quality of designs of highway maintenance projects without design review.					
X4	Project Management: Planting, monitoring and control 17. There is no professional and experts in Project Management 18. Highways maintenance projects are planned with Gantt Chart and CPM 19. Highway maintenance projects are usually completed within scheduled with efficiency. 20. Highway maintenance projects are usually characterized with cost overrun because of funding pattern and policy 21. The projects scope and work breakdown structure are not properly articulated and defined. 22. The projects usually suffer from scope creep					
X5	Contracting maintenance procedure 23. Highway maintenance contractors are usually mobilized very late 24. Team work exists among the FERMA and contracting parties 25. Contract penalties exist to ensure compliance and discipline 26. Highway maintenance contract documents are not usually available. 27. FERMA periodically monitor the progress of maintenance project and proffer suggestion for improvement.					
X6	Training and manpower skill development 28. FERMA has policy on training and manpower development 29. No training allowance is paid to motivate team members on training. 30. Resource persons for training and manpower development are not always available when needed 31. The maintenance project contractors usually used unskilled manpower 32. Training facilities abound in FERMA					

CODE	Y = ASSESSMENT OF SELECTED HIGHWAY MAINTENANCE PROJECT	SCORING POINTS				
		SD	D	N	A	SA
1.	Highway maintenance projects are usually bedevilled with late an insufficient funding.					
2.	Sound incentive and motivational scheme exist in FERMA.					
3.	The quality of local construction materials will lead to quality highway maintenance project delivery.					
4.	Functional workshop for timely repair and upgrading of machinery and equipment.					
5.	Constricting firms for highway maintenance project have enough machines and equipment.					
6.	Highway maintenance projects are usually characterized by the low labour productivity.					
7.	Lack of project management skill in highway maintenance will not lead to project failure.					
8.	Modern project management tools are used in planning, scheduling and control of highway maintenance projects.					
9.	There is no mechanism and action plan for checking and containment of contract scam.					
10.	Contracts terms and conditions are usually compromised in highway maintenance projects.					
11.	The cost of training and manpower development will adversely affect effective management of highway maintenance projects success.					
12.	Top management support training and manpower development in the management of highway maintenance projects.					