UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

DEPARTMENT OF DESIGN AND TECHNOLOGY EDUCATION

IMPROVING MAINTENANCE MANAGEMENT WITHIN THE LOCAL GOVERNMENT SECTOR IN GHANA: PERSPECTIVE OF DESIGN CONSULTANTS.

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SEPTEMBER, 2019

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AGYEMANG JOHN

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A Dissertation In The Department Of CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION, Faculty Of TECHNICAL EDUCATION, Submitted To The School Of Graduate Studies, University Of Education, Winneba In Partial Fulfilment Of The Requirement For The Award Of The Masters Of Technology (Construction Technology) Degree.

SEPTEMBER, 2019

DECLARATION

STUDENT'S DECLARATION

I, Agyemang John, declare that this dissertation, with the exception of questions and references contained in published works which have all been identified and duly acknowledged, is entirely my own work and it has not been submitted either in part or whole for another degree elsewhere.

Agyemang John

Signature…….

Date:……

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of the dissertation was supervised in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

Name of supervisor: Dr. Nongiba Alkanam Kheni

Signature:…….

Date:…….

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DEDICATION

I dedicate this work to my beloved family for their guidance, protection, fortitude, integrity in the areas of understanding and encouragement.

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ABSTRACT

The value of public infrastructures have economic life span that can only be sustained through proper building pathology. Deterioration of infrastructure is inevitable as materials and components have finite life span. For this reason, regular attention is required to keep them in good state so that they can continue to perform their required functions and also sustain the level of utility and value derived from the facility. The aim of the study was to explore the maintenance practices of local government in the building standard of perspective of design consultants in Ghana. Quantitative research strategy was adopted through a descriptive survey research design to the target population of the study was consultant. A sample size of sixty four (64) were randomly selected. The findings suggest that a combination of planned maintenance are adopted in the maintenance process. The findings further revealed lapses in procedures for procurement of maintenance work. The lapses included, excessive bureaucracy, fraud and lack of critical evaluation of contractors at the prequalification and post qualification stage. Also, the findings of the study revealed that the key challenges to maintenance, included, lack of regular maintenance audit surveys, inadequate funds for maintenance works, poor maintenance culture as well as the aforementioned lapses in the process of maintenance works. Based on the findings, the study recommended that regular inspection programmer and planned approach to maintenance should be adopted by stakeholders including consultants in line with building standards in Ghana. Additionally, procurement of maintenance works in the public sector need to be regularly monitored by Public Procurement Authority (PPA) and more stringent internal audit system adopted.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Lack of public spending on maintenance (as opposed to "new investment) has been a recurrent problem in many developing countries. According to the World Bank (1994, p.1), technical inefficiencies in roads, railways, power and developing countries caused loses equivalent to a quarter of their annual investment in infrastructure as the early 990's. Increasingly maintenance spending would therefore help to reduce power losses, telephone faults and so on as increases in the productivity effects of public capital on private production. Thus, to the extent that maintenance expenditure affects the durability as well as the quality of public capital and it may stimulate growth. Analytical studies focusing on the growth effects maintenance expenditure as scare and include contributions by Rioja (2003s, 2003b) and Kalaitzidakis and Kalyvitis (2004). In Rioja (2003a), the quality of infrastructure and the share of public expenditure on maintenance are linearly related and the depreciation rate of public capital is constant over time. Thus, increasingly maintenance outlays raises on the productivity of all inputs used in the production process. According to Sidney, M.J.(1965),the depreciation rate is endogenous and assumed to depend on both the amount of maintenance spending and "usage" as measured by the stock of private physical capital. Maintenance therefore increased, the durability of capital, that is, it serves to maintain its effectiveness, rather than raising its efficiency. Reallocating funds from new infrastructure to maintenance can increase the growth rate. The key issue of the joint determination of the optimal share of new investment and

maintenance spending on the total government expenditure and potential trade-off between these components, cannot be addressed. Trade-off between total infrastructure spending and other components of government outlays (such as the provision of education services) cannot be addressed either, despite the obvious importance of the issues of growth depends also on the accumulation of human capital. Public infrastructures are essential factors of production in the attainment of the desired economics, social and political targets of any nation. Any inadequacy in public infrastructural facilities represent a loss in value to the nation and its citizens or even the international community. Also, it is absolutely impossible to replace or rebuild a nation's entire public infrastructure at a given time. Infrastructure in addition cannot remain new throughout their entire life. In fact before any public facility is completed, maintenance problems may have already started to set in. infrastructural maintenance constantly affects the lives of all because people's comfort and productivity depends on the performance of the infrastructure they depend on, for example roads, homes, offices, schools and markets etc. The self-evidence state of disrepair and deterioration of public infrastructure in Ghana is therefore of great cause of concern. It's no doubt that is affect productivity levels in hospitals, schools, offices, and other places. Measures will therefore have to be put in place to not only halt this states of disrepair but also to reserve the current predicament. In spite of the dark picture in this situation as present, there is a hidden opportunity within. Many public sector infrastructures are in a very deplorable state due to lack of maintenance culture or sustained programmer of maintenance. However in spite of the heavy investment made by successive governments on public infrastructure which include huge sums of

money for constructions of new facilities as well as the cost of maintenance, public employees and the general public who depend on these plan of maintenance to preserve them. The public infrastructure industry involves a high percentage of the country's investment and therefore, the need to maintain them in order for them to serve the purpose for which they were put up. According to hall, (1986), the condition and quality of buildings reflect public pride or indifference in the level of prosperity in the area, social value and behaviour and all of which influence both past and present which combine to give a community its unique character. The neglect of maintenance has accounted to rapidly increasing deterioration of the fabric and finishes of structures followed by harmful effects on the contents and occupants. Maintenance brings about improved utilization of buildings ensuring the highest safety standards. It must be emphasized that, more rather than less maintenance work is necessary if the value and amenity of the nation's building stock was to be maintained. A good maintenance system is also good disaster mitigation system. Moreover, a well operated system of maintenance for public infrastructure and equipment's has the effect of being efficient in terms of cost and facility usage. It ensure that most economical way to keep the facilities and equipment in the best of form of normal use, given the original design and materials. When public facilities are neglected, defects occurs which may result in extensive and avoidable damage to the fabric or equipment and the occupant. Apparently, the present state of most public infrastructure could be attributed to lack of maintenance, apathy, unpatriotic of occupants and neglect after being put into use.

1.2 Statement of the Problem

According to Jossop and Morrison (1994), all infrastructure or structure has an economic life span that can only be sustained through proper and regular maintenance and that lack of maintenance by local government in Ghana is due to lack of ethics in effective maintenance. Deterioration of infrastructure and other fixed structure is inevitable; for this reason, regular attention is required to keep them in good state so that they can continue to perform their required functions and also sustain the level of utility and value and derived from them. Public funds and therefore the need of preserving them in a way that would make their benefits felt over a long time which cannot be over stated. Many constructions have been done since time past up to date but due to the neglect of maintenance, a lot of these structures are in a very deplorable state. Maintenance is usually seen as a nuisance and is frequently overlooked consequently as small maintenance produce a major repair work which is very expensive to undertake. There is no gainsaying that the state of maintenance of public infrastructure in Ghana is deplorable. It is almost self-evident in places like roads, schools, hospitals, residential buildings and offices. In facts, it is not uncommon to see deep cracks in walls and floors faculty electrical and plumbing fixtures and fitting and even breaking roofs, not too long ago, a bridge over the Volta River had to close down for several weeks for emergency repair works after several years of neglect and lack of routine maintenance. Green retrofits of a structure refer to the renovation or refurbishment in an ecological and resource efficient manner so that. It is operated or reused sustainably. Sustainable buildings are designed to meet certain objectives such as protecting occupant health, improving employee productivity, using energy, water

and other resources more efficiently and reducing the overall impact on the environment. Public infrastructure have comparatively long life span for that matter measures implemented today will continue to influence their emission level into the medium and long term. The majority of public infrastructures which will be standing in 2050, have already been built, so policies should encourage authorities to retrofit their structures in such a way as to optimize emission reductions. (UNEO SBCI 2009). In Ghana, local governments are mandated by the law establishes them to oversee development projects that includes maintenance of existing infrastructure. Anecdotal evidence suggest that assemblies and coordinating councils are faced several challenges including resources and structural constraints. In spite of the importance of assemblies and coordinating councils in maintenance of infrastructure, there is the need for more research to be done in the area. These reasons underscore the aims and objectives of the present research work.

1.3 Aims and Objectives of the Study

The aim of the study is to explore the maintenance practices of local government in the perspective of design consultants to develop strategies for effective maintenance of public infrastructures. The specific objectives of the study are as follows;

- To examine the process of maintenance management of maintenance works by local government from the perspective of design consultants.
- To identify key challenges to maintenance of public infrastructures by local government from the perspective design consultant and

- To develop strategies for effective managing maintenance of public infrastructures in the government sector.

1.4. Research Questions

The following are the research questions:

- What is the process of procurement and management of maintenance works by local government in the perspective of design consultants?
- What the challenges of local government face in the maintenance of public infrastructures in the perspective design consultants?
- How can maintenance of public infrastructures be effective managed?

1.5 Significance of the Study

Research has shown that, the collapse of infrastructure can occur during construction or after. The failure may be very disastrous which may result in various degrees of injuries, loss of lives and loss of properties. The public has raised a lot of concerns about the non-maintenance of infrastructure especially public structures, for instance the Melcome disasters that occurred in Accra and other parts of the country, hence the need to examine the process of procurement and management of maintenance works by local government in the perspective of design consultants. The study is very important because it seeks to identify key challenges to maintenance of public infrastructures and also contribute immensely to good government in Ghana. The study will suggest pragmatic strategies for effective management maintenance of public infrastructure in the local government sectors to be put in place to improve the situation.

Furthermore, the findings of this study will contribute to creating beneficial to public institutions in the study area.

1.6 Limitations of the Study

According to Hackman, J.K. and Osei – Tutu, E.(2008), the research will be limited to the activities of construction site managers and their perspective of design consultants. It will focus on the managerial activities such as material management, labour management and plants/ equipment management on site.

Due to time and financial constraints, the research will target the following groups for necessary information;

I. Contractors

II. Labours / artisans

III. Engineers, consultants and architects

1.7 Organization of the Study

The write up has been organized into five chapters. Chapter one which gives the general over view of the intent of the project, includes statement of the problem, research questions, objectives of study, significance of the study and the limitations of the study. Chapter two deals with review of relevant literature on the problem. Chapter three deals with the methodology used to undertake the study. The write up proceeded to chapter four which deals with analysis of the data gathered. Finally, chapter five involves summary of the findings, recommendations and conclusions based on previous chapters.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the concept of Building Maintenance and its related factors. It highlights on areas such as Maintenance standards, policies and its planning. It also analyese Building defects and underscores of the need to link design with Maintenance factors.

2.2 Local Government in Ghana

2.2.1 Overview on maintenance management in Ghana

According to Hassan (2007), the facilities on the infrastructure maintenance are not in good working condition when assets like machinery, utilities, roads, sewage systems, building and vehicles are in good working order, there will be substantially less wastage of time and resources on repairs and rework, as well as fewer delay due to breakdown of assets. This in turn will lead to the improvement in service delivery. For local government, service delivery to the public is very important since the pay tax to the local government and of course they expect a good delivery of service by the local authorities. However, poor maintenance of public infrastructure tends to tarnish local authorities image besides giving much problems in repairing it in future which involve high cost. There should be a review set up to improve the maintenance process. The review process must also take into account capacity building or facilities necessary to facilitate assets management. Hassan (2007), also emphasized on the importance of inculcating the maintenance culture in Ghana and should not be treated as a peripheral function but should be considered as an integral part of projects. The construction

players should factor in the cost of maintenance of assets and budget for it. He contended that all projects and purchases of assets must include the cost of maintenance. In order for assets management to become part of Ghanaian culture, Hassan (2007) urged every country construction players to look at it in a different light. Maintenance should not just be confined to specific agency or department. Construction players should bother about the lack of maintenance of other organizations and agencies and should be able to point out the weaknesses whenever they are encountered. Maintenance and asset management is everybody's business and everybody's responsibility and explained about the importance of maintaining the infrastructure facilities as an asset in order to make sure that the facilities are in good working order. By doing this it shall improve the delivery of service to the public. Ghanaian construction players have a lack of maintenance culture due to poor understanding on the infrastructure maintenance as discussed in this study.

2.3 Concept of Physical Infrastructure

A more generic definition of infrastructure is the network of assets "where the system as a whole intended to be maintained indefinitely at a specified standard of service by the continuing replacement and refurbishment of its components". In this regard, the infrastructure works consists of roads, drains, street lights and traffic light and ere financed by the public via taxes, public charges or other. It is in any cause when the citizen who pays and of enjoys the benefits derived from their existence. Our generation must not have the burden of maintenance or replacement of two short-lived structures to future generations (Rackwitz, et al, 2004). These various elements may collectively be termed civil infrastructure, municipal infrastructure, or simply-sector or

government enterprises. According to wireman (1990), maintenance management can be defined as a combination of all technical, administrative and managerial actions during the life cycle of an item, intended to retain it or restore it to a state in which it can perform the required function. Maintenance management pays an important role to determine the successful of maintenance work carry out by one department or organization. Therefore, to ensure the effectiveness of maintenance, it is important to have good management applied to execute the maintenance work. However, according to Armstrong (1987), maintenance management defined as the organization of maintenance within an agreed policy that determine the maintenance objectives and responsibilities and how to implement them by means such as maintenance planning, maintenance control and supervision, and several improving methods including management is very aligned to other such as notions found in modern maintenance literature such as Campbell and Jardine (2001), Campbell (1995) and Shenoy Bhadury (1998). Wireman (1998), considered maintenance management as the management of all assets owned by a company, based on maximizing the return on investment in the assets. He said that maintenance management would include, but not be limited to the following: preventive maintenance (PM), inventory and procurement, work order system, computerized maintenance management system (SMMS), technical and interpersonal training, operational involvement, proactive maintenance, reliability center maintenance (RCM), total productive maintenance (TPM), statistical financial optimization and continuous improvement. Each of these initiatives is a building block of the MM process. Duffuaa et al (2000) indicated that how a maintenance system can be seen as a simple input-output system. The inputs are the manpower, management,

tools, equipment etc and the output is the equipment working reliably and well configured to reach the planned plant operation. They show that the required activities for this system to be functional are maintenance planning (philosophy, maintenance workload forecast, capacity and scheduling), maintenance organization (works design, standards, work measurement and project administration) and maintenance control or works, materials, inventories, cost and quality oriented management. Maintenance in the context of this report is defined as the work necessary to realize the original anticipated life of asset. "Repairs" are works completed to restore damage or worn out facilities and assets to their normal operating condition. Repairs are curatives, while maintenance is preventive. Maintenance management is the effective planning and execution of tasks performed to maintain the operation of equipment and facilities. It span may diverse functions and responsibilities, ranging from designing maintenance jobs to provide and manage the resources need to complete the work. Maintenance operation covers diver's areas including physical plant, production equipment, building services, equipment, building structure materials, utilities, sanitation, ground care, material handling equipment and compliance with building safety and pollution codes as well as the minimizing of energy expenditures. Sainan (2005), mentioned that accurate information on equipment to be maintained it's essential in order to success in planning the maintenance procedure. Maintenance management is not a static process but it is dynamic in the sense that the strategy and policies are continually reviewed to ensure that it is in line with the overall objectives (Coetzee, 1999). Therefore, local authorities should at the time giving concern and should out on effort for improvements to achieve its objective in order to make sure its infrastructure

facilities are in good condition. Demands by the public stakeholders and taxpayers regarding the maintenance of public infrastructure need to be addressed and series actions need to be taken. With the competitive marketplace pressure increase, business owners and managers need to find new and better ways to control the cost of doing business and the efficiency of maintenance and engineering department was been given an emphasized. Current building and infrastructures facilities are becoming critical. An appropriate maintenance management are essential in order to maintain the infrastructure facilities. Sainan (2005), informed that industry statistics show that billions of dollars were spent annually to maintain physical plants, commercial building, educational and healthcare facilities and equipment. Over one-third of all the dollars spent on maintenance was wasted due to poor or inadequate maintenance management.

2.4 Concept of Maintenance

Maintenance as a discipline has been defined by different schools of thoughts. The British standard (BS 3811, 1964) defines maintenance as a combination of any carried out to retain an actions carried out to retain an item or to restore it to an acceptable standard. The actions refereed to, are those associated with limitations, organization and implementation. It envisages two processes: retaining i.e. work carried out in anticipations of failure, referred to as “corrective maintenance”. There is also the concept of an “acceptable standard” which may be constructed as acceptability to the person paying for the work, the person receiving the benefits or to someone outside with the responsibility for enforcing minimum standards. Additionally, it can also be constructed more widely as acceptability to the public at large or to specific sections

of the public. Clearly however, there are no absolute standards which would be equally acceptable to everybody or which would remain acceptable to the same group of people over a period of time. The standard acceptable at the time of taking the work may be higher or lower than the initial design standard. In many cases, the standards deemed acceptable would be higher than that original provided and the work would include an element of improvement. Infrastructure, however with the passage of time are modified to accommodate new uses of it becomes increasingly unrealistic to think in term of keeping or restoring the initial standards. Clearly, the standards would be related to safety and efficiency and determined by the amount of money allocated rather than as a result of assessing the benefits obtained from maintaining the structure to a particular state. Seeley (1993), defines maintenance as the combination of all technical and associated administrative actions intended to retain an item in or restore it to a state in which it can perform its required functions to an acceptable standards. Maintenance has also been defined as "all actions taken to retain materials in or to restore it to a specified condition which includes, inspection, testing, servicing and classification as to serviceability, repair, rebuilding and reclamation". Collins English dictionary, 2003). Maintenance is everything from daily routine cleaning to preventive and emergency maintenance after storm damage or similar. In principle, maintenance starts with the design and planning of the building. Many maintenance problems can be prevented and resources saved by including maintenance strategies in the design phase before construction takes place. For instance, finding the right site and which have been thoroughly tried and tested before and using long lasting and locally available materials. A new building needs attention from the day, it is taken into use

and from that moment we are talking about maintenance and day-to-day care (East Management Unit-Ministry of Health, May, 1998 – Ghana). Maintenance therefore includes all the necessary work done to preserve a structure with its furnishes and fittings, so that it continues to provide the same or almost the same facilities, amenities and serves as it did when it was first built. It includes the expenditures necessary to maintain the rental value of the property and involves.

- Day-to-day repairs such as leaking taps and electrical defects
- Periodic up-keep such as painting and
- Major repair requiring heavy expenditures and the services of techniques experts for examples foundation works and re-roofing (Afranie and Osei-tutu, 1999).

2.5 Deterioration and Defects in Public Infrastructures

Infrastructural defect may be defined as an imperfection, deficiency or fault element or component which adversely affect its functional performance or appearance. Some defects are the natural consequences aging and normal use but to a lack of proper skills and care. It is often said that, defect start on the drawing board but in some cases they can originate at an even earlier stage. The most common fault be grouped as, failure to follow established design criteria in the choice of structural system as well as selection of materials. Factors that lead to faulty design may include;

- Ignorance of the basic physical properties of the materials eg. Failing to take allowance for difference in thermal and moisture movement of materials in used in combination
- Use of new materials
- Misjudgment of user and climatic conditions under which materials will perform

- Complex details which have a low probability of successful execution on an open building site.
- Poor communication between management, members of the design and construction term

  The condition under which construction takes place is often far from the ideal situation and coupled with an emphasis in speedy completion and result in careless and shoddy work. Defects may be caused by unintentional misused through a lack of information on the correct mode of use or by deliberate act of vandalism. The solution is to provide designers with more information on the degree of serviceability of use so that a better match can be made between the robustness of the fittings, finishes and conditions of use. Incorrect identifications of the real causes of the defect, in appropriate remedial work will not only do nothing to rectify the original defect but substantially worsen the condition of the building. In addition, lack of care in carrying out repairs and inspections may be the cause of defects in previously satisfactory elements. The general approach should be examine carefully all the symptoms, consider all the probable causes by a process of eliminations, identify the real causes and its sources, and then decide on appropriate remedial action.in many cases, a visual examination will be sufficient for an experienced inspector to determine the cause. Where this is not possible, instruments may be used for a more objective diagnosis (Reginald lee, 1992). Where the causes, is inadequate funds, bad management, poor or faulty design, ignorance of public properties, construction methods, user activities or incorrect identifications of defects, the consequences of non-maintenance are serious, very

catastrophic and potentially disastrous for the nation as whole. (Mills and Syagya, 1991).

2.6 Importance of maintenance

According to the British Standard (B.S (3811) (1974).Infrastructural maintenance is mainly done to "take care of the physical facilities so as to prolong their life span. The outcome of good maintenance can be found in many countries in all parts of the world. Typically, we can see churches, bridges, temples and historical building which have been so well maintained that they are still standing and in use today, after one hundred years of construction. The fact is that buildings can be kept and use for many generations if only preventive maintenance can be carried out on them periodically.

2.7 Types of Maintenance

Public infrastructure has been categorized into the following kinds by BS 3811:

Planned maintenance: Miline (1985), defined planned maintenance as work organized and carried out with fore thought records and control. Planned maintenance can further be divided into categories, namely;

- Planned preventive maintenance
- Planned routine maintenance
- Planned shutdown maintenance
- Planned running maintenance

2.7.1 Planned Preventive Maintenance

According to Hackman, J.K. and Osei-Tutu, E. (2008), in this type of maintenance there should be a maintenance policy in place, which aims at preventing unexpected events from occurring and takes the form of replacing parts and overhauling at regular intervals to ensure that the building or its component are functioning efficiently. In this type of planned maintenance, deterioration of the assets to the point of failure does not happen. Also, top management commitment to planned maintenance is essential for effective implementation of a planned preventive maintenance regime.

2.7.2 Planned Routine Maintenance

This type of maintenance is planned and carried out at a regular predefined interval. Regular subjective inspections and monitoring of the condition of the assets part of the regular maintenance activities.

2.7.3 Planned Shutdown Maintenance

This maintenance can be seen as preventive maintenance or corrective maintenance. It is treated under preventive maintenance when the facility is scheduled to be stopped from functioning at certain times, for maintenance work to be carried out. The source is Seeley, (1983).

2.7.4 Planned Running Maintenance

The maintenance activities are carried out to keep building and equipment operating in an efficient manner and include replacement of buried out lights, repairs of windows, door locks, light switches, leakages and other fittings and fixtures.

Unplanned Maintenance

This maintenance is carried out to predetermine plan. Lee (1995), reported in this study that unplanned maintenance is most at times seen as breakdown maintenance, corrective maintenance and emergency maintenance

2.7.5 Breakdown Maintenance

According to Hackman, J.K and Osei –Tutu,E.(2008), the facility is allowed to breakdown completely before it is rehabilitated. The rehabilitation involves repair of all the building basic systems and element of construction.

2.7.6 Corrective Maintenance

In the view of Sidney, M.J.(1965), the maintenance is carried out after a failure has occurred and intended to restore it, to the state in which it can perform its required functions.

2.7.7 Emergency Maintenance

According to Sidney, M.J.(1965), the maintenance is carried out after an urgent or emergency situation arises and its need to be maintained to function

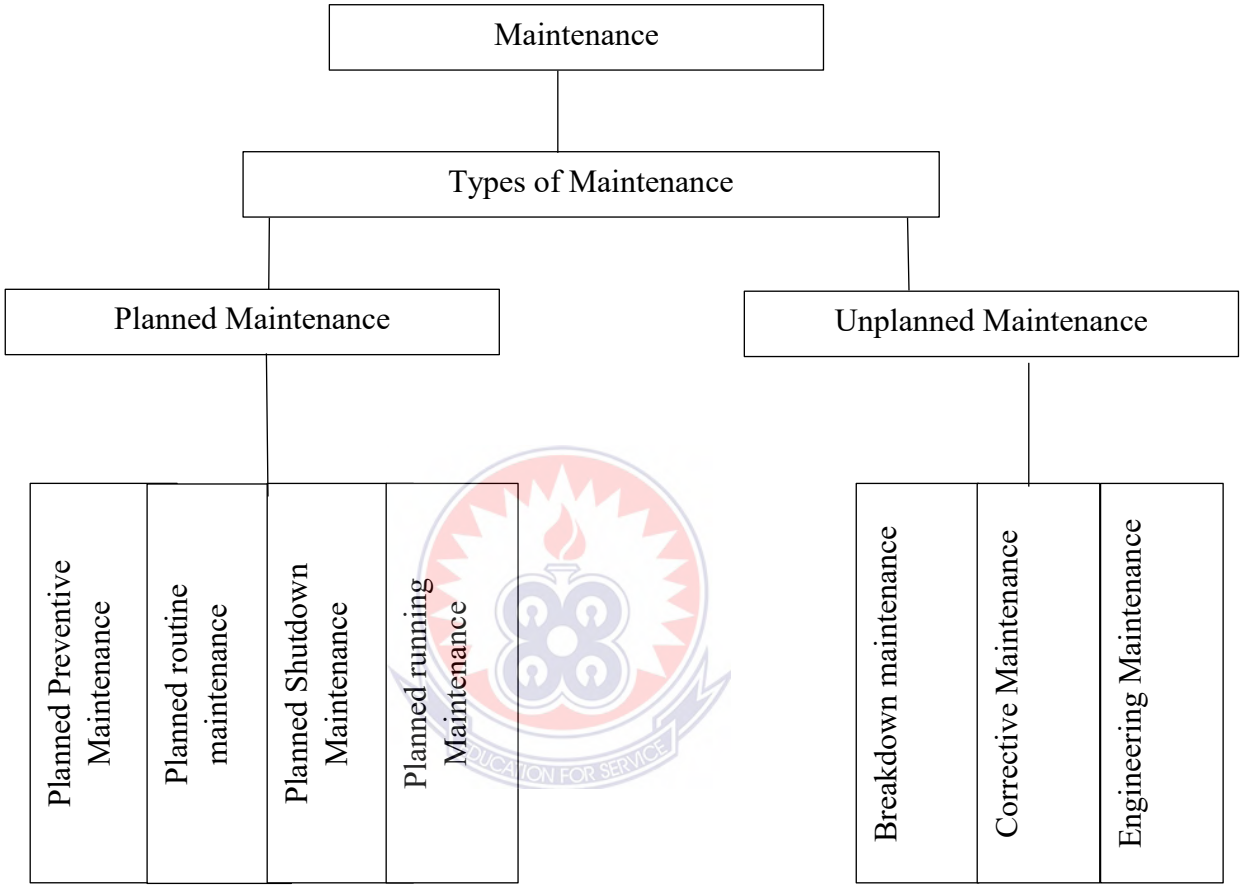

Figure 2.4: types of maintenance (source: BS 3811: 1984).

2.7.8 Maintenance Team

According to Seeley (1996), specifies that to supervise large maintenance contracts. It is customary to employ a clerk of the work who is constantly in touch with the job, but with smaller job, periodic supervision only can be obtained often through the medium of architects, surveys or other supervisions staff who are called the maintenance team. The maintenance team basically consists of:

- The maintenance officer
- The supervision
- Techniques
- Artisans
- Labourers

According to Seeley (1996), the work schedule of the maintenance team is as follows.

The maintenance officer

- Formulate a maintenance plane for the department
- Construct an organization and control the system which will ensure the implementation of the plan
- Negotiate and make proposals in terms of estimate, promotions remuneration, incentives etc, to motivate or be the moral of the maintenance team under his supervision.
- Report to the chief engineer about day t- day activities of the department

The supervisor

He/she has to

- Carry out any proposals maintenance plan with the maintenance team.
- Report daily activities to maintenance officer
- Make follow-up to check if the task allocated to subordinates need any help or assistance.

- Meet regularly as supervisors to deliberate on the development and lapses of the maintenance schedule in all departments.

Technicians

According to Harris, F. McCaffer, R. with Edum- Fotwe, F. (2006), he/ she has to:

- Lead the team or maintenance group to carry out any task allocated to them
- Make sure that there is effective participation of all members in the team
- Collect allocation from the supervisors.
- Co-ordinate and deliberate on department plan to keep the maintenance

Artisans

According to Harris, f. McCaffer, R. with Edum- Fotwe, F. (2006), he/she has to:

- Respond to individuals task in their field of specialization
- Assist other colleagues when the need arises.
- Report any breakdown to the leader before taking the task on

Laborers

According to Harris, F. McCaffer, R. with Edum- Fotwe, F. (2006), he/she has to:

- Take the responsibility of cleaning the workshop, machines, cars, equipment from dirt and other foreign materials.
- Assist the maintenance team in their field of carrying their work.

The diagram of figure 2.7.8 shows the maintenance team chart.

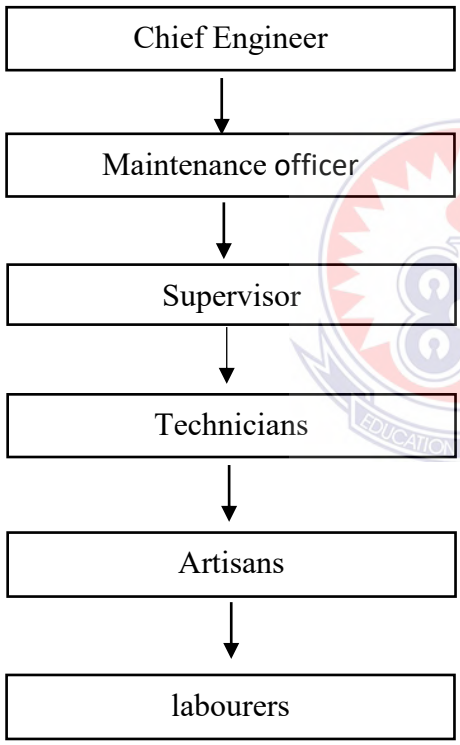

Figure 2.7.8 Maintenance Team

2.8 The Value of Preventive Maintenance

Stone (1975), reported that, it should be borne in mind that the inter-dependence and inter- relationship or initial and running cost and the great importance of the work when planning for maintenance and repair expenditure. In considering the

cost of the building, the intial cost must be considered relative to the level of maintenance that required with the choice of materials and types of construction methods

Certain preventive maintenance can be determined to it. For insufficient preventive maintenance may result in roof leaks creating conditions for mould growth and potentially affecting some user's respiratory system. The cost of poor indoor air are potentially dramatic, as exemplified recently by the capital square building in St. Paul, which had problems that forced the relocation of its occupants and led to its demolition in early 2000 (office of legislative auditor, Minnesota USA.AO). Maintenance good indoor can have direct positive effects on building occupants. As an example, one study-quantified savings from improved worker productivity and health associated with making indoor air quality improvement in government schools, and other non-industrial buildings. The study in the District of Columbia, estimated that a one-time upgrade of HVAC systems, including the preventive maintenance required to sustain the upgrade over 20years would provide net benefits of $13.31 per square foot and $11,227 per worker (Seeley, 1987). Successful preventive maintenance programs should achieve these goals:

- **Preserve taxpayers investments in public buildings:** Preventive maintenance can extend the life of building components, thus sustaining buildings value and the significance tax dollars they represent.
- **Help buildings function as they were intended and operate at peak efficiency, including minimizing energy consumption:** Because preventive maintenance

keeps equipment functioning as designed, it reduces inefficiencies in operations and energy usage.

- **Prevent failures of building system that would interrupt occupant's activities and the delivery of public services:** Structures that operate trouble-free allow public employees to do their jobs and serve the public. Because preventive maintenance includes regular inspections and replacement of equipment crucial to operate a building, maintenance staff reduces the problems that might otherwise lead to breakdown in operations.
- **Sustain a safe and healthful environment by keeping buildings and their components in good repair and structurally sound:** Protecting the physical integrity of building components through preventive maintenance preserves a safe environment for employment and the public.
- **Provide maintenance in way that are cost-effective:** Preventive maintenance can prevent minor problems from escalating into major maintenance and equipment failures that result in costly repairs. In avoiding costs of major repairs, preventive maintenance creates efficiencies. Increasing preventive maintenance can reduce time spent reacting to crises, which is the more cost-effective way to operate buildings. Deferring preventive maintenance can generate higher costs over the long term. As a result, the conditions and quality of buildings reflect public pride or indifference, the level of prosperity in the areas, social values and behaviour and all the main influences both past and present, which combine to give a country its unique characteristics.

2.8.1 Aims of Maintenance

According to the British standard (BS. (3811)(1974),the primary aim of maintenance public infrastructure is to ensure that the facilities continue to serve the purpose for which it was put up. The purposes for which maintenance are undertaken include:

- To maintain the value of the infrastructure in a better maintained public infrastructure normally has greater value, however, increased value may be marginal as location and size of site all play an important in the determination of values (Afranie and Osei Tutu, 1999).
- To ensure optimum use of facility in good maintenance should allow facility to be used to their full potential
- To create or maintain suitable appearance which can make a positive contribution to external environment and social conditions. Dilapidated public facilities can contribute, waste energy and resources and can affect the environment.
- To maximize the life of main components and materials which maintenance can reduce cost of subsequent maintenance by extending periods between repairs and replacements?
- To ensure that buildings do not deflect from surroundings and also maintain a suitable appearance.

2.9 Factors Influencing Decision to Undertake Maintenance

Stapleton (1994), mention that it is generally acknowledged that inadequate finances is a major constraints on effective property management, partly because maintenance

budgets are the easiest to cut when money is scarce. According to him, maintenance expenditure where it may account for as little as 0.5% of turnover, but even in these cases maintenance is taken for granted except when, it threatens productions or profitability. However, the situation is more serious in the public sector when damaging effects of poor maintenance are less immediately obvious. Also in the cases of housing estates, it is common for organizations to emphasize the provision of new houses, with repairs are neglected, but efforts at improvements and rehabilitation are considered lower priority than new construction. This problem of inadequate finance indeed result in deterioration of existing stock resulting in increases in the demand for new house because poorly maintenance houses are not only unpopular, but they soon reach the stage where the structure itself deteriorates and rebuilding has to be considered. According to harper (1969), bad management influence decision refers to the idleness and waste among maintenance personnel. Harper (1969), further emphasized that poor public infrastructure design influence decision to undertake maintenance. It is not uncommon to find that buildings are inherently expensive to maintain because of inappropriate priorities applied during the design phase. Poor detailing and the specification of unsuitable components and materials are common complaints. In addition constructions errors arising from inadequate drawings and specification, coupled with poor workmanship because of contracts awarded to incompetents contracts are frequent causes of rapid physical deterioration in public infrastructures. Good design should allow accessibility and adequate working space for essential maintenance such as cleaning, and minor repairs to pipes, ducts and

cables. Stapleton (1994), in Afranie and Osei-Tutu (1999), relates than the decision to carry out maintenance which is affected by many factors, among which are;

- Cost-investors would want to have the most economic method for carrying out maintenance work, whether corrective or preventive, thus they look at.
- Actual costs of maintenance of the building to the cost of maintenance in similar building
- Consideration of money spent to achieve acceptable standard at present.
- Cost of maintenance, same standard in future and economics of replacing facilities.
- Amount of available and priority of work to be executed.
- Availability or non-availability of physical resources affect decisions in that, when suitable materials for maintenance are not available, it becomes difficult to undertake maintenance. Again even if suitable materials are available but not in adequate quantities and the alternatives materials are not available, it will defer people from undertaking maintenance activities. The level of craftsmanship in terms of both skills and efficient numbers can also affect decisions to carry out maintenance.
- Urgency of work also affect decisions on maintenance in that investors consider whether delayed work in the short run will require more expensive work at a later stage. This usually takes account the safety of the infrastructure users and the possible damage to structure and finishes used in the public structures.

- Interference with activities carried out in the facilities. Seeley (1993), on the other hand, according to Afranie and Osei tutu (1999), summarizes the principal criteria which could influence the decision to carry out maintenance briefly as, cost, age and condition of property, availability of adequate resources urgency, future use and sociological considerations.

2.10 Components of Maintenance

Maintenance involves a considerations amount of work which harper (1969) as cited in (Afranie and Osei-tutu, 1999) has been categorized into three components. Namely; servicing, rectification and replacement.

2.10.1 Servicing

According to Hackman, J.K. and Osei- Tutu, E. (2008), servicing in building are facilities that make it safe and confortable, which comes under the life span of building services in Ghana. The essential parts are undertaken at regular intervals which varying the frequent day to day maintenance.

1.10.2 Rectification

According to Seeley (1995), rectification work usually occurs fairly early in the life of a facility, but it can also occur sometimes within the life span of any public infrastructure. It arises from shortcoming in design, inherent fault in or unsuitability of component, damage of goods in transit or installation an incorrect assembly. Rectification represent a fruitful point at which to reduce the cost of maintenance, because it is available. All that is necessary at any rate in theory is to ensure that

components and materials are suitable for their purposes and are correctly installed. Rectification work could be reduced by the development and use of performance specifications and codes of installation. Rectification is the response to inherent defects in design, construction or installation stages of the building process. This provides an opportunity to "trade off" current capital expenditure against future maintenance costs.

2.10.3 Replacement

Replacement occurs at all public infrastructures. It is inevitable because service conditions cause materials to decay at different rate. Much replacement work stems not so much from physical breakdown of the materials or elements as from deterioration of the appearance (Seeley, 1987). This is because the extent of exposure of materials to the vagaries of the weather varies and the weather in specific locations also varies whilst the capacity of elements of structure in withstanding changes and different intensities of the weather vary. This therefore becomes necessary as a result of materials decay due to these differential rates of weather conditions. Physical breakdown of materials or elements as well as deterioration appearance may necessitate replacement. However, this bring the problem of distinguishing between maintenance and improvement. This has not been resolved satisfactorily by many definitions. It is however, generally conceded that maintenance should include reasonable elements of improvement, for example, the replacement of worn out component with up to date version. Where the intention of work done is to increase efficiency in the use of the structure by adding facilities, which were not previous present, the work should be classified as improvement. However, it is logical therefore

to extend the meaning of maintenance to cover some localized improvement (lee, 1987). Maintenance can also embrace renovations which consist of work down to restore a structure, service and equipment by a major overhaul to the original design and specification, or to improve the original design. This may include limited additions and extensions to the original facilities.

2.11 Other Maintenance-Related Concepts and Definitions

It entails protecting facilities by controlling its environment thus preventing agents to decay and damage from becoming active. It involves clearing schedules, good housekeeping and proper structural management by local government.

2.11.1 Consolidation

According to Sidney, M.J. (1965), consolidation is the physical addition or application of adhesive or supportive materials unto the actual fabric in order to ensure its continue durability or structural integrity.

2.11.2 Rehabilitation

In the view of Hackman, J.K. and Osei-Tutu, E. (2008), it involves the repair of all the building basic systems and elements of construction. Repairs may include replacement or strengthening of deficient or damaged structural elements.

2.11.3 Repair

According to Sidney, M.J. (1965), it is the reinstate of a building into its original state so that it will function as it was first built. Repair may include replacement or strengthening of deficient or damaged structural elements.

2.11.4 Renovation

According to Hackman, J.K. and Osei- Tutu, E. (2008), this work is done to restore a structure, service and equipment by a major overhauls to the original design and specification or to improve on the original design. The work may include substantial addition and extensions to the original structure

2.11.5 Refurbishment

In the view of Sidney, M.J. (1965),it is the term used to describe a process of improving cleaning, decorating and re-equipping a facility to improve its outlook and efficiency. eg providing more furniture, painting and cleaning.

2.11.6 Extension

In the view of Hackman, J.K. and Osei- Tutu ,E. (2008), it is carried out to add more apartment to a facility such as adding more rooms to a structure, to accommodate more people or goods.

2.12 Technology of Maintenance

In the view of Ahmad (2003), the understanding of a good building design always relates to the shape of the building and its appearances. In many occasions, this perception has neglected the actual function of why the building was built in the first place. The inability of the building to serve its purpose which has automatically ignored by the public because of the exotic and attractive design of the building without even considering for economic reasons, or for safety, usability and maintainability. The more unique which a building is being designed, the more it would again obtain artistic value, thus appealing and very much appreciated. Most people look only for its form and shape to regard it as a good designed of building

rather than considering its proper function and performance as needed by the occupants. Without much objection, designers tend to spruced- up their building above ground with various shape, some with spiralled form, inclined, distorted, top heavy shaped and so forth, which encourages high cost of maintenance. According to Sidney, M.J. (1965), deterioration of structures generally caused by tensile stresses in excess of the tensile strength of the material, produced by externally applied loads or internal movement arising from temperature or moisture changes other important concept of the maintenance can be illustrated by reference to roof construction. A good roof which is well maintained should last the life of a building and it is false economy to save money on roof during construction, because if it ever requires replacement, it will cause serious dislocation of production, occupancy or other activities within the building. A leaking roof apart from causing considerable inconvenience to users can lead to accelerated deterioration of other part of the building such as ceiling floors and walls can serious damage to decorations and electrical installation. Traffic over a roof should be kept to a minimum and where it is essential, appropriate walkways and access ladders must be provided. To ensure that roofs are adequately maintained, they would ideally be inspected in every three (3) years or alternatively third each year.

2.12.1 Economic and Social Significance of Maintenance

In the view of Hackman, J.K. and Osei- Tutu, E. (2008), an important part of the role of the designer is to enable creative solutions latent in and conceived by the client or community to emerge. Such a designer, while becoming closely identified with the goals and objectives of those for whom he works, retains with the distinction of having powerful specialist tools and techniques at his or her command. These relate

to the imaginative expression of latent solutions, simulation and prediction of consequences in terms of technology and resource. The designer should be able to predict the ultimate effects of a proposed design scheme to user and society as a whole so that the objective of satisfaction and value for money can be achieved.

According to Stone (1975), furthermore, we also depend on mostly on built environment for comfort as well as economic survival. A prime aim of maintenance is to preserve a structure in its initial state as far as practicable, so that, it effectively and constantly services to its purposes. Considering the points above it could be seen that, without maintenance the objectives of the investors will end on the dead rocks as it would be impossible for him or her to retrieve the capital invested. The built environment expresses in physical form as the complex, social and economic factors which give structures life to a community. The condition and quality of building reflect public pride, the level of prosperity in the area, social value and behaviour and so on. (Reginald lee, maintenance management). Without maintenance, building will have to be abandoned, which will be an economically sound and wise to put up new buildings all in the time without carrying out repairs and maintenance works on the existing ones. Frequent maintenance of the built environment brings such benefits as comfort and satisfaction to its inhabitants. Maintaining physical structures of a property ensure that investment made does not only yield the highest possible returns over the life of the property but also fulfils the ultimate responsibility of providing the needed human satisfaction and comfort. A structure, according to Dave (2002), as cited in (Afranie and Osei tutu, 1999) is regarding as an economic asset, which must be maintained to ensure that, it appropriates in the value and results in a return, either

socially or economically, to the owner. In effect the primary aims of maintaining a facility it to preserve it in its original state as practicable as possible so that it effectively serves that purposes. As a rule, the capital assets of a structure is so valuable and often appreciating so that in practice, maintenance should frequently be directed to prolong effective life. Therefore the purpose for maintaining the structure are: retaining the value of investment, maintaining the structure in a condition in which it continues to fulfil its functions and presenting good appearance. No wonder many writers on the economic and social significance of maintenance content that built environment expresses in physical form, the complex social and economic factors, which give structure the life of the community. As a result, the condition and quality of facility reflect public pride or indifference, the level of prosperity in the area, social values and behaviour and all the many influences both past and present, which combines to give the country its unique characteristics.

2.13 Summary

Different perspective have been given by different local authorities during conducting the case studies, however, generally it has highlighted that maintenance management practices carry out by the local authorities is not the main obstacle or major problems for the local authorities in carrying out infrastructure maintenance works. There are other constraints which may hinder the effectiveness of the maintenance works carrying out by the local authorities as highlighted by the maintenance personnel. Approach used by most of the local authorities in taking action on the maintenance of infrastructures works are almost the same except their different ways of selecting or appointing the contractors are a bit different. The method of appointing the contractors

is important because for instance, if tender process is being chose, it shall take a long time due to it has to go through a long processes of tendering. Current practices in carrying out the maintenance work can be accepted however they have to choose right method of selecting the contractors to carry out their maintenance works. Views from the maintenance personnel regarding the obstacles arises in carrying the maintenance works need to be addressed correctly so that the maintenance works for the infrastructure facilities can be carried out effectively. Maintenance (planned and unplanned) can make the necessary impact only if the financial regulator of the structure through correct diagnosis of defects ensures that funds are made available for such a purpose. Failure to undertaken maintenance of public infrastructure will ultimately result in reducing the life span of the structure will however ensure consequently result in demolition.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is a way to systematically solve in the research problem. Research methodology does not consider only the research methods but it also look at the logic behind the methods we use in the context of our research study and explain why we are using a particular method or technique and why we are not using other so that research result are capable of being evaluated either by the researcher himself or by others. This chapter covers the research methodology that would be employed for the study. The methodology was carried out to meet the research objectives and address data gathering problems imminent in research. The major components of this chapter are the study design, research populations, sample and sampling techniques, data sources, data collection process, as well as the statistical techniques and tools to be sued for analyzing the data from the field.

3.2 research design

Research designs are plan and procedures for research that spans the decisions from assumptions to detailed methods of data collections and analysis (Creswell 2012). Quantitative research approach was adapted for the study. According to Creswell (2010), quantitative research encompasses several approaches to research, yet all have two things in common. The first is that they focus on the phenomena that occurs in natural setting and the second involves studying those phenomena in all their complexity. For the purpose of this research, case study which looks at a particular programme, individuals or events and studies in-depth for a defined period of time

was used. This is a more appropriate research design for the study. Questionnaires were employed to collect data in order to provide answer to the research questions, meet the objectives set for the study, and finally to satisfy the main purposes i=of this study. The sample were classified into segment groups of location according to the population.

3.2.1 The Nature of Quantitative Research and Its Evidence

Quantitative research is a mode of inquiry used often for deductive, when the goals is to test theories or hypothesis, gather descriptive, or examine relationships among variables. These variables are measured and yield numeric data that can be analyzed statistically. Quantitative data have the potential to provide measureable evidence, to help establish (probable) cause and effect, to yield efficient data collection procedures to create the possibility replication and generalization to a population to facilitate the comparison of groups and to provide insight into a breadth of experiences. Typical quantitative approaches used in the construction fields are descriptive surveys, observational studies, case-control studies etc. for this study both descriptive survey and observational studies were used.

3.3 Target Population

Population as contented by shank (2002) is a groups of people or objects with common characteristics upon with the researcher in interested in. the target population for this study was building engineers or consultants in the perspective of design consultants. The population of engineers/consultants in the perspectives of designs consultants were 64.

3.4 Sampling Procedures and Sample Size Determination

This section outlines the processes and procedures through which the research participants were selected for the study and the number of participants selected for the study. The perspective of design consultants are about 169 procurement members consisting of 8 members in the tender committee and 5 members in the evaluation committee under the procurement act. A sampling frame consisting of 76 members was used. To determine the sample size, the Slovin formula (Urma, 2000) was used:

Formula n $\frac{N}{1+N(e)^2}$

Where

n= Sample Size

N= Population Size (number)

e = significance level in percentages for error that is allowed is five percent (0.05).

Formula n $\frac{N}{1+N(e)^2}$

= n $\frac{76}{1+76(0.05)^2}$

Ans = n=64

The sample size of any research has a significance impact on the accuracy and precision of the results obtained, where sample size are perceived to produce more accurate results. Although, larger sample size positively affects the accuracy of a research findings, the accuracy is further determined by how representative the sampling techniques employed in sampling respondents (Saunders et al, 2009). Thus

as the critical question in practice, the decision about the size of the sample needs to be considered with respect to time and cost, the need of precision and a variety of further considerations. Stratified sampling was used to sample the engineers and procurement members to be interviewed for the study. The population was stratified according to the perspective design of consultants. The engineers and procurement members who were employed are selected as the proportion of respondents to be interviewed. The choice of this sampling techniques, stratified sampling was due to the distribution of the population under study. The population is heterogeneously distributed within the perspective of design consultants. Details of the sample allocations presented in statement and formula at content 3.4.

3.5 Data collection

Data collection is a term used to describe a process of preparing and collecting data and purpose of these processes to obtain information to keep on record, to make decisions about important issues and to pass information on to others (Sarantako 1997). The data collected for the research were primary and secondary data.

3.5.1 Primary Data

The primary data was collected by the use of structured questionnaire to gather information from contractors.

3.5.2 Secondary Data

Secondary data was obtained by the review literature. The sources of the literature were from both published and unpublished work on the subjects matter gathered from thesis, reports, articles, bulletins, newsletter and journals and from the internet. The developed questionnaires were distributed and to receive from construction officers

and active construction sites in person. This process of distribution and retrieving of the questionnaires in person was taken for two reasons as suggested by Ahadzie (2007), first, to make sure that the questionnaires gets to the intended recipient and secondly, to help improve the responses rates.

3.5.3 Design and Development of Standard Questionnaires

To achieve the aims of this project, questionnaires deigned in line with the project objectives were used as a means of collecting field data. The questions were in the form of multiple choices for cases of answering and as much as possible, open ended questions were also included.

3.5.4 Structure of Questionnaires

Structured questionnaires were used as the main tool for data collections, although interviews were also used. The questionnaires was used to elicit information from the respondents. The reasons why the questionnaires was found as the most appropriate tool were that besides its potential to produce information from any respondents within a short time, it was quite inexpensive in terms of time. It could also be completed at the respondent's convenience. According to Creswell (2002) closed-ended questionnaires have certain disadvantages. The first is that they do not allow for probing, prompting and clarification of answers given. The second is that they do not provide opportunity to collect additional information from the respondents. These limitations were addressed by providing open-ended items to enable the respondents explain opinion and make elaborations on the questionnaires. Two questionnaires were developed in relation to the research objectives including questionnaires for building

contractors and distributions workers. Each questionnaires was structured into parts in relation to the research questions. However, the first parts of the questionnaires focusses on eliciting the demographic profile of the respondents. The variable included gender, age, educational background, number of years of working. In term of working of questions, both the closed and open-ended items were used. Close-ended items limited the respondents to the set of alternatives being offered, while opened-ended items allowed the respondents to express an opinion without being influenced by the researcher (Creswell, 2002). Thus the opened-ended items allowed respondents to include more information, including feeling, attitude and understanding of the subjects.

3.6 Data Analysis

Descriptive statistical methods such as tables, bar charts, pie charts etc. were used to analyze the responses from the questionnaires. Data collected from the study were analyzed using statistical product and services solution (SPSS) version 20.0 and Microsoft comparison method. This method was chosen to give clear and intelligent analysis to the data.

CHAPTER FOUR

PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discusses on the findings of the survey conducted in relations to the examination of maintenance of public infrastructure by local government in Ghana. The study exploited the process of procurement and management of maintenance of public infrastructure in the perspective of design consultants and effective maintenance of public infrastructure.

4.2 Response Rate

In all, sixty four (64) respondents were given questionnaires in the perspective of design consultants. Out of this, sixty (60) questionnaires were completed and returned by respondents, representing 93.8% responses rate. This was an encouragement responses.

4.3 Demographic Characteristics of Respondents

The background information of the perspective of design consultants focus on their gender, age, category, highest qualification and working experiences of respondents. Comprehending the behavioural attitude of the respondents is essential when examining of maintenance of public infrastructure by local government in Ghana.

4.3.1 Gender Respondents

From the study, it is obvious that the males outnumbered their female counterparts confirming the dominance in places of work. Majority (60.0%) of the respondents were male whiles their female counterparts formed (40.0%). What this implies is that

in the perspective of design consultants, male constitute the majority in decision making. **Table 4.1 portrays male and females representation of the respondents.**

Table 4.1 gender respondents.

		Frequency	Percentage	Valid percent	Cumulative percent
Valid	Male	36	60.0	60.0	60.0
	Female	24	40.0	40.0	100.00
Total		**60**	**100.00**	**100.00**	

Source: Researcher Field Work, 2019.

4.3.2 Age Category of Respondents

Age distribution is the proportionate number of persons in successive age categories in a given population. The researcher wanted to see the respondent's categorization of the age bracket as they responded to the questionnaires. Table 4.2 shows the ages of respondents in the study area. From table 4.2, majority of the respondents who responded to the questionnaires had their ages raging between 31-40 years, bringing the percentages to 50.0%. This is followed by ages between 41-50 years constituting 30.0%. The range between 51-60 years had 15.0% and the group of above 61 years also had 5.0% representing the majority of the respondents.

Table 4.2 Age Category of Respondents

	Frequency	Percentage	Valid percent	Cumulative percent
Valid 31-40 years	30	50.0	50.0	50.0
41-50 years	18	30.0	30.0	80.00
51-60 years	9	15.0	15.0	95.0
Above 61 years	3	5.0	5.0	100.0
Total	**60**	**100.00**	**100.00**	

Source: Researcher Field Work, 2019.

4.3.3 Educational Qualification of Respondents

Some of the staffs in perspective of design consultants completed were very educated and well informed people. The data gathered confirmed this facts on the field. Majority (62.0%) representation were first holders whiles 13.0 and 15.0 were advance craft and HND holders respectively. Additionally, 10.0% of the respondents were also master's degree holders. Table 4.3 represent this information.

Table 4.3 Highest Qualification of Respondents

	Frequency	Percentage	Valid percent	Cumulative percent
Valid master degree	6	10.0	10.0	10.0
Advance craft	8	13.0	13.0	23.0
First degree	37	62.0	62.0	85

HND	9	51.0	15.0	100.0
Total	**60**	**100.00**	**100.00**	

Source: Researcher Field Work, 2019.

4.3.4 Working Experience of Respondents

The study also investigated the respondents' work experience specifically in the perspective of design consultants. Over half (55.0%) of the survey respondents have worked in the perspective of design consultants for 6-10years (table 4.4); the second largest proportion (35.0%) of respondents have worked in the perspective of design consultants for 1-5years, some section (10.0%) of the respondents have worked in the perspective of design consultants for over 10years. This implies that most of the workers in the perspective of design consultants in Ghana are experience, proficient and capable of exercising good judgment and as such of the responses provided by them could be relied upon.

Table 4.4: Working Experiences of Respondents in the Department

	Frequency	**Percentage**	**Valid percent**	**Cumulative percent**
Valid 1-5 years	21	35.0	35.0	35.0
6-10 years	33	55.0	55.0	90.00
Over 10 years	6	10.0	10.0	100.0
Total	**60**	**100.00**	**100.00**	

Source: Researcher Field Work, 2019.

4.4 Process of Procurement and Management of Maintenance Works

The need for an efficient, non-corrupt and transparent public purchasing system is of the main drives behinds most procurement practices reforms. Every year funds are spend by government of developed countries (such as Ghana) to procure goods and services. According to Hinja (2003), compliance with procurement laws increases public confidence. An equally important reason for complying with procurement lass, procedures and processes in the view of Evennett and Hoekman (2003) is that, it is a condition for gaining access to foreign markets, loans and grants. With this, table 4.5 attempted to address the public procurement process in the perspective of design consultants in Ghana. The importance index score (1-strongly disagree) (SD), 2=disagree (D), 3=undecided (U), 4=agree (A) and 5=strongly agree (SA) was used to rank the variables. The result etc) is confirmed before payment is made has the highest means score of 4.30. this implies that invoice document by the vendors to the perspective of design consultants to request the payment for materials or service provided are confirmed to the term of payment agreed in the purchase order (PO). Thus, the perspective of design consultants verify whether the invoice information (such as price, terms of payment etc,) is the same with the purchase order (PO) and whether the PO, item has been received (GR/SA). Also, specifying the required material or service, quantity and date to the supplier/service provider has the second means score of 4.22. This reveals that purchase requisition of the perspective of design consultants contain clear information about the description and quantity of the material/service, the required date and other information. Interestingly monitoring delivered material/service at the right time on the right place has the mean score of

4.8. This means that after the purchase over (PO) has been sent to the vendor, the perspective of design consultants monitor whether the vendor perspective of design consultants monitor whether the vendor delivers the material/service at the right time on the right place. Moreover, performing good receipt (GR) or service acceptance (SA) transaction has the mean score of 4.14. This implies that when the vendors delivers the material or perform the service, the responsible person of the perspective of design consultants perform the goods receipt (GR) or service acceptance (SA) transaction. In addition, specifying and determining possible sources of supply of material service has the mean 3.76. this affairs that the purchasing/procurement department of the perspective of design consultants process the purchase requisition (PR) to determine the possible source of supply of the material/service specified in the PR. However, evaluating suppliers before selection has the means score of 3.68. this indicate that if there are some outline agreement or information record documents that are used as references to creates a purchase order (PO), for which the perspective of design consultants can select or choose vendor that will provide the material/service needed. If there is no outline agreement or information record documents that can be used as reference to create PO, the perspective of design consultants send the request for quotation (RFQ) document to one or some vendors to supply them with the required material/services needed. This means that vendors will send their quotations which include the information about the price, delivery term, terms of payment etc. that they offered to the perspective of design consultants. Conversely, request for requisition from user department has the least mean score of 3.52. This shows that purchase requisition (PR) is used to give notification to responsible department about

the requirement of material/service and to keep track of such requirement. Thus the user department in the perspective of design consultants are made to specify the materials/services they will require during the subsequent period under review. The public procurement act 663 provides for the activity of planning under part 3 section 21. The regulations requires that the procurement planning process is fully integrated with applicable budget process and circulars issued by the public procurement board and budget preparation instructions of the ministry of finance. Adequate procurement process is needed to ensure value for money. The content of the procurement process shall include: a detailed breakdown of the goods, works and services required and schedule of the delivery, implementation or completion dates for all goods, works and services required and the sources of funding. According to Sarpong (2007), procurement if the management of sustainable acquisition of goods, works and services to optimize value for money through a professional, auditable and transparent framework.

Table 4.5 Process of Procurement and Management of Maintenance

Procurement	**Mean**	**Sts. Deviation**	**Ration**
Invoice information (such as price, term of payment etc) is cross check before payment is made.	4.30	.463	1st
Required materials or services, quantity and date is described to the supplier/services provider	4.22	.545	2nd
Delivered material/services at the right time on the right place is monitored.	4.18	.661	3rd

Good receipt (GR) or services acceptance (SA) transaction us performed.	4.14	.883	4th
Possible sources of supply of material/service is a specified and determined	3.76	1.255	5th
Suppliers are evaluated before selection	3.68	1.077	6th
Requisition from user department is determined.	3.52	1.111	7th

Source: research field work, 2019 x-bar≥ 3.5 = *greed* key: SD=Strongly disagree, D=Disagree, U=Undecided, A=Agree, SA= Strongly agree

4.5 Challenges to Maintenance of Public Infrastructure

According to harper (1969), bad management influences decision to undertake maintenance. Maintenance of public infrastructure is faced by numerous challenges. Poor detailing and the specification of unsuitable components and materials are common complaints. In addition, construction errors arising from inadequate drawings and specifications, coupled with poor workmanship because of contracts awarded for incompetent contractors are frequent causes or rapid physical to maintenance of public infrastructures. Table 4.6 shows the challenges to maintenance of public infrastructure.

To ascertain the challenges to maintenance of public infrastructure, respondents were given a five point likert questionnaires to respond to. The scoring was based on the five point likert scale of measurement of strongly agreed (SA), disagree (D), undecided (u), agree (A) and strongly agree (SA). The options of the items were weighted in the likert format with SD=1, D=2,U=3,A=4 and SA=5. The response from the importance index ranking indicated that inadequate monitoring of infrastructure maintenance and projects mismanagement of funds were ranked first with the mean

score of 4.32, followed by inadequate funds to carry out maintenance of infrastructure with the mean score of 4.30. However, adoption of inappropriate procurement methods/procedures has a mean score of 4.16 and indiscipline resulting in abuse of approved systems and procedures has a mean score of 3.94. Moreover, poor maintenance culture of the perspective of design consultants has a means score of 3.62, while wide spread corruption in the procurement process has a mean of 3.56. the study further reveals that diversion of approved maintenance of infrastructure funds for other uses and lack of proper planning of maintenance works has the means score of 3.46 and 2.86 respectively. Again, lack of skilled construction professional to carry out maintenance infrastructure has the least mean score of 2.86. The study confirms with as study conducted by Hamimah, et al, (2012) that actors such as short of budget being allocated, insufficient staff, lack of competence contractors and inexperience maintenance staff, complicated process of preparing documentation would impact the proper maintenance of infrastructure being carrying out. Stapleton (1994), in Afranie and Osei Tutu (1999), relate the decision to carry out maintenance which is affected by many factors among which are;

- Cost-investors would want to have the economic method for carrying out maintenance work whether, corrective or preventive.
- Availability or non-availability of physical resources affects decisions in that, when suitable materials for maintenance are not available, it becomes difficult to undertake maintenance. Again even if suitable materials are available but not in adequate quantities and the alternative materials are not available, it will deter people from undertaking maintenance activities.

- Urgency of work also affects decisions on maintenance in that investors consider whether delayed work in the short run will require more expensive work at a later stage.
- Interference with activities carried out in the facility.

Seeley (19930 on the other hand according to Afranie and Osei tutu (1999), summarizes the principal criteria which could influence the decision to carry out maintenance briefly as cost, and condition of property, availability of adequate resources, urgency, future use and sociological consideration.

Table 4.6 Challenges to Maintenance of Public Infrastructure

Procurement	**Mean**	**St. Deviation**	**Ration**
Inadequate funds to carry out maintenance of infrastructure	4.30	.614	1st
Adoption of inappropriate procurement methods/procedure	4.16	.842	2nd
Indiscipline resulting in abuse approved systems and procedures	3.94	.843	3rd
Poor maintenance culture of perspective of design consultants	3.62	1.260	4th
Wild spread corruption in the procurement process	3.56	1.343	5th
Diversion of approved maintenance of infrastructure funds for use	3.46	.994	6th
Lack of planning of maintenance works	2.86	1.262	7th

Lack of skilled construction professionals to carry out maintenance of infrastructure	2.28	1.310	8th

Source: Research Field Work, 2019 x-bar≥ 3.5 = *greed* key: SD=Strongly disagree, D=Disagree, U=Undecided, A=Agree, SA= Strongly agree

4.6 Ways for Effective Managing Maintenance of Public Infrastructure

Maintenance management is not a static process, but it is dynamic in the sense that it is in line with the overall objectives (Coetzee, 1999). Therefore, local authorities should all the time giving concern and should put an effort for improvement to achieve its objectives in order to make sure its infrastructure facilities are in good condition. Demands by the public as a stakeholders and taxpayers regarding the maintenance of public infrastructure need to be addressed and serious actions need to be taken. Table, it is empirically obvious that the all the mean score for all the variables are greater than the cut off mean score of 3.5. Given about the grand mean score of 4.17 is also greater than the cut-off mean score of 3.5. It is empirically proven that these variables represent the key elements of effectively managing maintenance of pubic infrastructures. It thus implies that the way for effectively managing maintenance of public infrastructures. Given the findings of this study, it was observed that releasing of appropriate funds on time (x=4.50, SD=.505), dealing effectively with condition information from observation (x=4.38, SD=.602) SD=.855), employing personnel with maintenance background (x=4.38, SD=.602), putting comprehensive maintenance plan in place (x=4.32, SD=.683), using standard and quality materials in maintenance work (x=4.28, SD=.607), regular inspections of maintenance work (x=4.24, SD=.591), simplifying appropriate procedures or further improvement in maintenance work

processes (x=4.14,sd=.729), effective implementation of public procurement act (x=4.12, SD=.594), keeping records and information (SD=3.88, SD=1.154) and long term financial planning and ring fenced budget for maintenance (x=3.50, SD= 1.529) are ways for effectively managing maintenance of public infrastructure in the perspective of design consultants in Ghana. According to Hassan (2007), facilities on the infrastructures maintenance are not in good working condition when assets like machinery, utilities, roads,, sewages system, buildings and vehicles are in good working order, there will be substantially less wastage of time and resources on repairs and rework, as well as fewer due to breakdown of assets. Tis in turn will lead to the improvement in service delivery. According to Hassan (2007), service delivery to the public is very important since the public pay tax to local authorities and of course they expect a good delivery of service by the local authorities. However, poor maintenance of public infrastructure tends to tarnish local authorities' image besides giving much problems in a repairing it in future which involve high cost. There should be a review being set up to improve the maintenance process. The review process must also take into account capacity building of facilities necessary to facilitate effective assets management.

Table 4.7 Suggestions for Effective Managing Maintenance of Public Infrastructure

Strategies	Mean	St. Deviation	Ration
Dealing effectively with condition information from observation	4.38	.855	1st
Employing personnel with maintenance background	4.38	.602	2nd
Putting comprehensive maintenance plan in plan	4.32	.683	3rd

Using standard and quality materials in maintenance work	4.28	.607	4th
Regular inspections of maintenance work	4.24	.591	5th
Simplifying appropriate procedures or further improvement in maintenance work processes	4.14	.729	6th
Effective implementation of public procurement act	4.12	.594	7th
Keeping records and information	3.88	1.154	8th
Long term financial planning and fenced budgets for maintenance.	3.50	1.529	9th

Source: Research Field Work, 2019 x-bar≥ 3.5 = *greed* key: SD=Strongly disagree, D=Disagree, U=Undecided, A=Agree, SA= Strongly agree

Hassan (2007), further emphasized the importance of inculcating the maintenance culture and should be treated as a peripheral function but should be consider as an integral part of project. The construction players should in the cost of maintenance of assets and budgets for it. He contended that all projects and purchases of assets must include the cost of maintenance. Maintenance should not just be confined agency or department. Maintenance and assets management is everybody's business and everybody's responsibility and explained about the importance of maintaining the infrastructure facilities as an assets in order to make sure that the facilities are in good working order. By doing this, it shall improve the delivery of service to the public.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study. It covers the major findings, conclusions arrived at and the recommendation made.

5.2 Summary of Findings

The following are findings of the study:

- The study has revealed that the level of awareness was reduced towards the importance of maintenance works within the local government sector in Ghana.
- The study has shown that, due to lack of effective implementation of public procurement act for maintenance work, many of the public maintenance works could not be done effectively.
- The study has also shown that, due to lack of shilled construction professionals to carry out maintenance of infrastructure, many of the public maintenance works could not be done effectively.
- The study motivated that, due to lack of regular maintenance audit surveys, many of the public maintenance works could not be done on schedule.
- The study identified that, due to lack of proper preparation of records concerning the cost involved in the maintenance, the public maintenance works could not be done properly.
- The study has also indicated that, due to inadequate funds for maintenance works, many of the public maintenance works could not be done on schedule.

5.3 Conclusions

The study includes that the perspective of design consultants verify invoice information (such as price, term of payment etc) before payment is made, describing the required materials or services, quantity and date to the supplier/services provider, monitoring delivered material/services at the right time on right place and performing good receipt (GR) or services acceptance (SA) transaction when procuring good or services. The study concludes that factors such as inadequate monitoring in infrastructure maintenance and projects mismanagement of funds, inadequate funds to carry out maintenance of infrastructure, adoption of inappropriate procurement method/procedures, indiscipline resulting in abuse of approved system and procedures, poor maintenance culture of the perspective of design consultants, and wide spread corruption in the procurement process would impact the proper maintenance of infrastructure being carrying out in the perspective of design consultants. The study found out that releasing of appropriate funds on time, dealing effectively with condition information from observation, employing personnel with maintenance background, putting comprehensive maintenance plan in plan, using standard and quality materials in maintenance work, regular inspections of maintenance work, effective implementation of public procurement act, and simplifying appropriate procedures or further improvement in maintenance work processes can help in effective managing maintenance of public infrastructure.

5.4 Recommendations

The following recommendations are made to address the fundings:

- It is recommended that there should be an effort to increase level of awareness towards the importance of maintenance works within the local government in Ghana.
- The study recommends that effective implementation of public procurement act should adopted by the perspective of design consultants in acquiring good and services from vendors.
- The local authorities should look into the problems or obstacles listed by the maintenance personnel as derived in this study. The challenges in carrying out maintenance on infrastructure facilities that was highlighted in this study is not having skilled construction professionals to carry out maintenance of infrastructure. It should be given an emphasis since it is also represent the critical success factor which need to be improved in order to be successful in carrying out maintenance work for local government.
- Preparation of documents needs to be improved to enhance the effectiveness of the maintenance work. The respective department should scrutinize the processes and procedures and make adjustment according to make it simple in order expedite to preparation of the documents.
- Regular inspection programmer and regular maintenance scheduling and planning should to be prepared for effective maintenance. This shall reduce the cost invoice besides maintenance the infrastructure facilities in good acceptable working conditions.

- The respective department who involved in maintenance work should prepare records of cost involved to do the maintenance and to justify with the complaints received in order to request for additional budget from the government.

5.5 Suggestions for Future Research

In this study, recommendations for future research would address the issues generated from this study. Based on these findings, future research may start from a relatively level of knowledge. Firstly, a replication of this study would be helpful in re-examining the validity of its findings for which the research was not able to investigate. Secondly, further empirical studies using larger sample sizes, greater geographical diversity and different region in Ghana would be helpful in validating specific parts of the theoretical models. Thirdly, the more structural interviews should be conducted in different local government in Ghana in order to improve infrastructure maintenance in the various perspective of design consultants in Ghana. Also. Local authorities should carry out study on their internal factors which includes strength and weakness of the organizations in order to be effective in carrying out maintenance job for local authorities. Finally, in-depth of this study, it should be conducted in Ghanaian local government on the challenges of effective maintenance of infrastructure in Ghana.

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APPENDIX

UNIVERSITY OF EDUCATION, WINEBA – GHANA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION

Examining critical factors that influences maintenance of buildings in Ghana: perspective of design consultants.

Dear Respondents

The questionnaire you are about to respond to is for academic purposes. You are however assured that information provided will be confidential. People tick (√) in the appropriate box with the responses that best reflect to the questions statement provided.

SECTION A: DEMOGRAPHICS OF RESPONDENTS

1. What is your age category?

   Under 30 years [ ] [ ] 31-40years

   41-50years [ ] [ ] 51-60 years

   61-70years [ ] [ ] above 70years

2. Please indicate do you belong to?

   [ ] Male [ ] Female

3. Which category do you belong to?

   [ ] Tender committee/review/evaluation member

   [ ] Entity procurement staff

   [ ] Engineer

   [ ] Consultants

   [ ] Other (please specify)

4. How long have you been engaged in public procurement of work?

   [ ] Under [ ] 2-5 years

   [ ] 6-8years [ ] 9-11years

   [ ] 12-14years [ ] above 14 years

5. What is your highest academic qualification?

   [ ] Master [ ] Advance Craft

   [ ] First Degree [ ] HND

   [ ] Other (specify

6. How long have you been working in the works department?

   [ ] Under 12 months [ ] 1-5years

   [ ] 6-10years [ ] Over 10years

SECTION B: PROCESS OF PROCUREMENT MANAGEMENT OF MAINTENANCE WORKS.

7. To what extend do you agree with the following process of procurement and management maintenance work? Please rate using a scale of 1 to 5: strongly disagree (1), disagree (2), uncertain (3), agree, (4) and strongly agree (5).

Procurement process	**Responses**				
	1	**2**	**3**	**4**	**5**
Required material/service, quantity and date is described to the supplier/service provider					
Requisition from user department is determined					
Possible sources of supply of materials/services is specified and determined					
Supplier are evaluated before selection					
Delivered materials/services at the right time on the right place is monitored					
Good receipt (GR) or services acceptance (SA) transaction is performed.					
Invoice information (such as price, terms of payment etc,) is cross check before payment is made.					

8. Which of the following maintenance practice is adopted?

[ ] Preventive [ ] Corrective [ ] Planned

[ ] Unplanned [ ] Emergency

[ ] Conditional Base [ ] Schedule

SECTION C: CHALLENGES OF MAINTENANCE OF PUBLIC INFRASTRUCTURE

9. To what extend do you agree on the following challenges faced by the perspective of design consultants in the maintenance of public infrastructure? Please rate using a scale of 1 to 5, where 1 present strongly disagree, 2 represents disagree, 3 uncertain, 4 represent agree and 5 represent strongly agree.

Challenges	**Responses**				
	1	**2**	**3**	**4**	**5**
Inadequate funds to carry out maintenance of infrastructure					
Adoption of inappropriate procurement methods/procedure					
Indiscipline resulting in abuse approved systems and procedures					
Poor maintenance culture of perspective of design consultants					
Wild spread corruption in the procurement process					
Diversion of approved maintenance of infrastructure funds for use					
Lack of planning of maintenance works					
Lack of skilled construction professionals to carry out maintenance of infrastructure					

Section d: strategies for effectively managing maintenance of public infrastructure

10. To what extend do you agree with the following ways in managing maintenance of public infrastructure in the local government sector?

Please rate using a scale of 1 to 5, where 1 present strongly disagree, 2 represents disagree, 3 uncertain, 4 represent agree and 5 represent strongly agree.

Strategies	**Responses**				
	1	**2**	**3**	**4**	**5**
Dealing effectively with condition information from observation					
Employing personnel with maintenance background					
Putting comprehensive maintenance plan in plan					
Using standard and quality materials in maintenance work					
Regular inspections of maintenance work					
Simplifying appropriate procedures or further improvement in maintenance work processes					
Effective implementation of public procurement act					
Keeping records and information					
Long term financial planning and fenced budgets for maintenance.					