

**A Conceptual Collaborative Engagement Framework for
Road Infrastructure Management in Nigeria**

by

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This thesis is submitted in partial fulfilment of the requirements for the award of the degree of

Doctor of Philosophy at the University of Central Lancashire, United Kingdom

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Student Declaration

I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the University or other academic or professional institution.

I declare that no material contained in this thesis has been used in any other submission for an academic award and is solely my own work.

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Type of Award : Doctor of Philosophy

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List of Abbreviations

Abbreviation	Description
AEC	Architecture, Engineering and Construction
ANOVA	Analysis of Variance
BCHS	Bi-Courtney Highway Services
BOO	Build Own Operate
BOOM	Build Own Operate Maintain
BOOT	Build Own Operate Transfer
BOT	Build Operate Transfer
BMU	Bridge Maintenance Unit
BSC	Balanced Scorecard
AVI	Automatic Vehicle Identification
CBN	Central Bank of Nigeria
CEFRIM	Collaborative Engagement Framework for Road Infrastructure Management
CMM	Capability Maturity Model
COREN	Council for the Regulation of Engineering in Nigeria
CPM	Critical Path Method
DBFO/M	Design Build Finance Operate/Maintain
DBOM	Design Build Operate Maintain
DFRRI	Directorate of Food, Roads and Rural Infrastructure
Dft	Department for Transport
DNIT	National Department for Transport Infrastructure
ETSC	European Transport Safety Council
EU	European Union
FM	Facility Management
FERMA	Federal Roads Maintenance Agency
FMW	Federal Ministry of Works

FRSC	Federal Road Safety Commission
GDP	Gross Domestic Product
GNP	Gross National Product
HM	Her Majesty
HMA	Hot Mix Asphalt
HOQ	House of Quality
ICRC	Infrastructure Concession Regulatory Commission
ICT	Information Communication Technology
IDEF	Integration Definition Function model
IFU	Infrastructure Finance Unit
ITS	Intelligent Transport System
LAMATA	Lagos Metropolitan Area Transport Authority
LCC	Lekki Concession Company
LCDA	Local Council Development Authority
LTNZ	Land Transportation New Zealand
MDA	Ministries, Departments and Agencies
MMU	Mobile Maintenance Unit
MOT	Ministry of Transport
MSTTD	Ministry of the Sea, Tourism, Transport and Development
MTPT	Ministry of Transport, Posts and Telecommunications
MTRSMMS	Medium Term Road Sector Maintenance Management Strategy
NARTO	National Association of Road Transport Operators
NHAI	National Highways Authority of India
NSW	New South Wales
NTHS	National Trunk Highway System
NURTW	National Union of Road Transport Workers
NZTA	New Zealand Transport Agency

OBC	Outline Business Case
OECD	Organisation for Economic Cooperation and Development
OGROMA	Ogun-State Road Maintenance Agency
PERT	Programme Evaluation and Review Technique
PFI	Private Finance Initiative
PPC	Public Private Collaboration
PPP	Public Private Partnerships
PSP	Private Sector Participation
PTD	Provincial Transport Department
QFD	Quality Function Deployment
RII	Relative Importance Index
RICS	Royal Institution of Chartered Surveyors
RSSC	Road Support Service Centres
SANRAL	South African National Roads Agency Limited
SIS	State Infrastructure Strategy
SPV	Special Purpose Vehicle
SPSS	Statistical Package for Social Sciences
SRSE	Systematic Road Strengthening and Enhancement Programme
STRMS	Short Term Road Maintenance Strategy
TNZ	Transit New Zealand
VOC	Voice of the Customer

CHAPTER 1: INTRODUCTION

1.1. BACKGROUND TO THE STUDY

The concept of infrastructure is most commonly discussed in terms of its characteristics such as longevity, scale, inflexibility and high investment costs (Jerome 2004). Infrastructure can be described as the basic physical and organisational structures needed for the operation of a society or enterprise, or the services and facilities necessary for an economy to function (Ahmed and Donovan 1992). It has been defined as the physical components of interrelated systems providing commodities and services essential to enable, sustain or enhance societal living conditions (Prud'homme, 2004). These include physical fixed assets such as roads, bridges, airports, sea ports, telecommunications systems, energy, water distribution systems and sanitation (public utilities), and information communication technology systems (Button, 2002). Thus, infrastructure facilitates the production of goods and services, the distribution of finished products to markets, and provides basic social services (Jerome 2004). In this respect, the World Bank landmark studies on infrastructure (World Bank, 1994, 1995, 2003, 2004) highlighted the critical role of infrastructure in the development of Countries' Gross Domestic Product. Hence, infrastructure appears to be an essential tool for sustainable economic growth and international competitiveness. Narayan and Petesch (2002) asserted that lack of basic infrastructure particularly roads, water, electricity, and health care are defining characteristics of poverty. The importance of delivering quality infrastructure has also been underlined by the United Nations declaration of the Millennium Development Goals (United Nations, 2006). Therefore, infrastructure management can play a pivotal role in the physical and socio-economic development of countries, be it developed or developing (Commission for Africa, 2005; Estache, 2006; Akintoye and Beck, 2009). However, the provision of 'adequate' basic structures and facilities necessary for the well-being of the ever-increasing urban population appears to be one of the major problems facing cities in developing countries (Mabogunje, 2002; National, Planning Commission, 2004; Nwaka, 2005; World Health Organisation 2005; United Nations Population Funds, 2007).

For many years, the public sector has traditionally financed and operated infrastructure projects using resources from taxes and various levies (e.g. fuel taxes, road user charges). Nevertheless, the rapid

increase in human population in recent times coupled with globalisation, changes in social and political environments, the challenges of economic growth, poverty and technological advancements seem to have gradually reduced the need for a single supplier of many infrastructure services, and have created conditions for collaboration (Hobday, 1990; World Bank, 2004). The genesis of private sector participation in public infrastructure provision is highlighted by Owen and Merna, (1997); Kumaraswamy and Morris, (2002); Li and Akintoye, (2003); Tang, Shen and Cheng, (2010). Jerome (2004) stated that since the late 1980s, there has been a shift towards private management (private sector participation) and private ownership (privatisation) of various industries, as well as the competitive provision of services within parts or all sectors (liberalisation), especially because of the rapid globalisation of world economies, which has brought into sharp focus the economic costs of inadequate infrastructure, and has prompted several developing countries to seek new initiatives in promoting competition, involving private and foreign interests in the provision of infrastructure. According to Kumaraswamy (1998), the paradigm shift which mobilised the private sector resulted from a combination of forces, such as the gross inadequacies of public funding capacities, particularly in comparison with the growing aspirations of ever-increasing populations; the inefficiencies of government monopolies; the conspicuous availability of surplus private resources (financial, technical and managerial); and the formulation of creative non-recourse financing mechanisms, whereby projects could be self-funding (i.e. without recourse to other assets of the stakeholders).

Different approaches have been adopted in an attempt to define the roles, responsibilities and conflicting objectives of infrastructure project participants. For example, Turnkey contracts have been pursued, where project design and construction are not separated, and the responsibility is with one principal party. Another approach often employed is partnering, where the owner and contractor undertake the project together, setting joint targets and objectives. This relationship exists from the beginning of the project in a formal structure. Build-Operate schemes such as Build-Own-Operate (BOO); and Build- Transfer schemes such as Build-Own-Operate-Transfer (BOOT) and Build-Operate-Transfer (BOT) often extend the paradigms of Turnkey and Partnering beyond the project implementation phase into the operation phase (Quartey, 1996; Egan, 1998; Hallmans and Stenberg,

1999). The physical infrastructure frequently procured through BOT type schemes in various countries include roads, bridges, ports, airports, and railways in the transportation sector; power, telecommunications, water supply, and waste disposal systems in the utilities sector; and hotels, hospitals, and prisons in the buildings sector (Kumaraswamy and Morris, 2002). BOO model has been deemed to be more cost effective (Love *et al*, 2000 and Tabarrok 2003) than the traditional procurement system (see Section 2.5.3.1 in Chapter 2). Furthermore, BOT models appear to be most commonly used to deliver road projects as this tends to bring additional resources to fill the fiscal gap, assist in the transfer of technical know-how, and imparts efficiency in project procurement and operation through the involvement of the private sector (Singh and Kalidindi, 2006).

The Federal Ministry of Works and Housing, Nigeria (2003) stated that all the road projects constructed by the Federal Government of Nigeria were procured by the traditional contracting system. In this respect, Akoni (2010) reported that over 55% of these roads were unpaved, poorly maintained, overused and impassable thereby cutting off many rural areas from larger settlements during the rainy season. Few studies have focused on the traditional methods of rural development (Udeh, 1989; Filani, 1993), air transportation development (Akpoghomeh, 1999), shipping industry (Damachi and Zhaosheng, 2005), vehicle speed control (Oke, *et al*, 2005; 2006), road traffic accidents (Osime, *et al*, 2006; Atubi and Onokala, 2009; Fadare and Ayantoyinbo, 2010) and port-hinterland trucking constraints (Ubogu, *et al*, 2011). However, there seems to be no record of any study that has investigated the relationship between the public and private stakeholders in road asset management in Nigeria. These are the circumstances that have given rise to this study. The advantages of public-private sectors collaboration are summarised by Li and Akintoye (2003) as: enhancing government's capacity to develop integrated solutions; facilitating creative and innovative approaches; reducing the cost to implement the project; reducing the time to implement the project; transferring certain risks to the private sector partner; attracting larger, potentially more sophisticated bidders to the project; and providing avenue to access skills, experience and technology.

The terms concessionaire, private investor, private sector and project operator are used interchangeably in this study. Similarly, public sector and government refer to the same entity just as

partnerships and collaboration are synonymous. Furthermore, the concept 'road' is used in its generic form throughout the study.

1.2. PROBLEM STATEMENT

The increased use of Public-Private Partnership (PPP) agreements in both the developed and developing countries are widely acknowledged (Kumaraswamy and Morris, 2002; Akintoye and Beck, 2009; Tang, *et al*, 2010), yet, the pervasiveness of these within Nigeria is somewhat limited, with only one major infrastructure project (see Section 2.7 in Chapter 2) being procured through this route (Babalakin, 2008). Notwithstanding this, there is an exigent need to evaluate new methods of managing infrastructure projects in Nigeria as viable alternative investment vehicles, specifically, to determine the gaps and priorities facing the pattern, along with contextual (Nigerian) constraints. These issues could be ameliorated through the development of a collaborative engagement framework for infrastructure management, the result of which would be able to 'map' patterns of opportunity from a multi-positioning stakeholder perspective. This is the gap which this study intends to fill.

1.3. RESEARCH AIM AND OBJECTIVES

The aim of this study is to develop a conceptual collaborative engagement framework for road transport infrastructure management in Nigeria. The research objectives are to:

1. Analyse and evaluate Public-Private Partnership studies on road transport infrastructure management.
2. Appraise road transport infrastructure management in Nigeria to identify the central issues which encourage the active involvement of both the public and private sectors in road infrastructure management.
3. Identify the drivers and priorities of collaborative road infrastructure management in Nigeria.
4. Evaluate existing tools/models to determine their appropriateness to road transport infrastructure management.

5. Develop a conceptual collaborative engagement framework for road transport infrastructure management in Nigeria.

6. Test and validate the developed conceptual collaborative engagement framework with domain experts for construct validity

1.3.1. Research Hypothesis

The research hypothesis formulated for this study is:

Null Hypothesis H_0 : There is no significant difference between the perception of the public, private and end-user stakeholders on the drivers of collaboration.

Alternative Hypothesis H_A : There is significant difference between the perception of the public, private and end-user stakeholders about the drivers of collaboration.

1.3.2. Research Programme Flow

The research programme flow is shown in Figure 1.1. This identifies the methods of gathering data, techniques of data analysis, findings and relationships between the research objectives.

1.4. SIGNIFICANCE OF THE STUDY

The backbone for the development of any nation is its physical infrastructure. These include roads and bridges, power generation plants, power transmission and distribution networks, water and sanitation networks, seaports, airports, and railways. However, these infrastructure projects are highly capital-intensive in nature and tend to exert a strain on public finances. Given this, the public sector authorities in developing countries are usually constrained with limited resources, and are therefore constantly on the lookout for alternative financial, managerial and technical resources to deliver essential public infrastructure (World Bank, 2004; National Planning Commission, 2004; Commission for Africa, 2005). One of such sources is investment by the private sector.

Public Private Collaboration (PPC) is now a vehicle often employed to accelerate economic growth, development, infrastructure delivery, and to achieve efficient quality service delivery and good governance (Estache, 2006; Akintoye and Beck, 2009). Given the changing economic, technological, social and political environment, coupled with globalisation and budgetary constraints, PPC has

become inevitable and desirable by countries. In this regard, many developing countries with limited financial resources adopt PPC as an alternative source for financing and managing much needed physical infrastructure such as roads and bridges (Adetola, *et al*, 2013a). However, many developed countries have transitioned to a new wave of collaboration that focuses heavily on achieving “value for money” by mobilising private sector efficiencies, innovations and flexibilities in delivering both public infrastructure and services to a more discerning general public.

Public private collaboration schemes are somewhat underutilised in Nigeria, even though the potential financing, managerial and technological gaps are significant and enormous for private sector investment/involvement in the country’s highway facility operation/management. The vision of the Federal Republic of Nigeria to become one of the largest 20 economies in the World by the year 2020 (Federal Government of Nigeria, 2010) demands accelerated national development and adequate infrastructure services in order to support the full mobilisation of all economic sectors. In order to achieve this vision, there is a need to rehabilitate and re-construct most of the roads in the Southern and Northern Nigeria which are in very poor conditions (Central Bank of Nigeria, 2003; Abiodun 2013). More specifically, the country requires additional 100,000 kilometres networks of road within the next five (2013-2018) years (Punch, 2013). This development requires a positive and dynamic collaboration between the public and private sectors, since government alone cannot muster sufficient resources to meet the country’s road asset requirement. Therefore, this study has significant implications for infrastructure policy makers, construction project managers, civil engineering contractors, civil/highway engineers, civil engineering consultants, quantity surveyors, urban/town and regional planners, road users/community stakeholders and the wider general public.

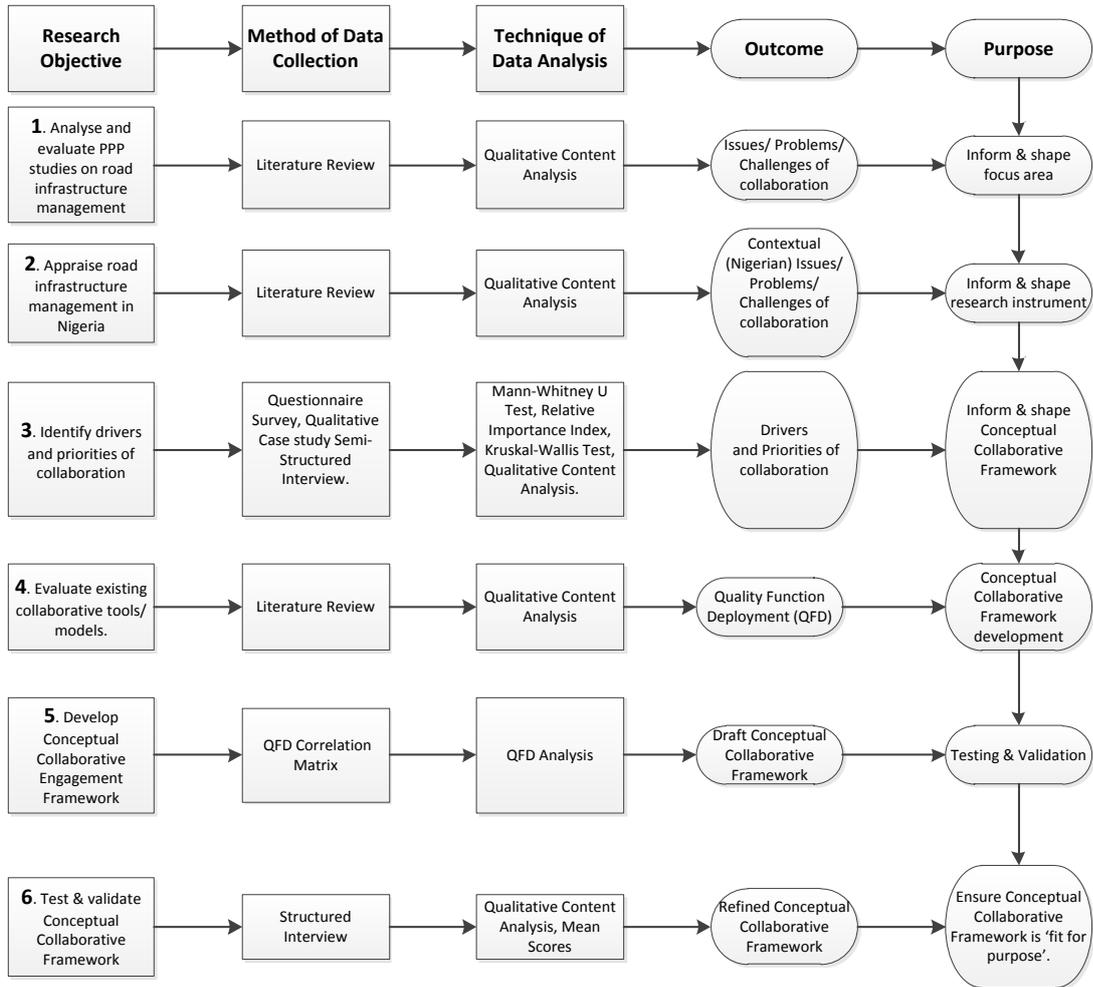


Figure 1.1: Research Programme Flow

1.5. SCOPE AND LIMITATION OF THE STUDY

This study focuses on collaborative road infrastructure management in Nigeria. Throughout the world, collaborative approaches have been adopted to manage viable urban highways/motorways infrastructure. Therefore, the conceptual collaborative engagement framework developed in this study targeted ‘Trunk A and B’ roads (Federal and State highways/expressways) in Nigeria that attract high volumes of vehicular traffic (see Sections 4.2.1.1- 4.2.1.2 in Chapter 4), and which if appropriately managed could generate revenues and be self-funding.

1.6. RESEARCH CONTRIBUTION TO KNOWLEDGE

The contribution of research to knowledge may be a new concept, a new theory, a new procedure, an importation of a strategy to a new setting, or the modification of an existing process to suit or satisfy contemporary needs/requirements (Krathwohl and Smith 2005).

This research is the first of its kind to specifically focus on the dynamic socio-political relationships of infrastructure management in Nigeria. In this respect, new relationships between the Public (Government), Private and User Sectors has been uncovered through the development of a conceptual collaborative engagement framework (CEFRIM). This investigation transcends conventional thinking by analysing issues through and across different stakeholders’ sets. This work falls into the remit of Management Science (organisational settings), Social Science (social rules) and Behavioural Science Theory (communication and decision science). More specifically, the investigation has helped to uncover new meaning and understanding on the diverged stakeholders’ positions on infrastructure project management. Findings from this research can help disentangle the positioning forces that often govern business models, the results of which can assist stakeholders’ appreciate the people-centric forces that often govern and drive relationships. Specific contribution to theory and practice can be seen in Section 10.5 in Chapter 10.

1.7 STRUCTURE OF THESIS

This thesis contains ten chapters. The contents of each chapter are summarised as follows:

Chapter 1 This chapter traces the genesis, background information and circumstances that have given rise to the study. It explains the problem statement and identifies the research/knowledge gap; states

the aim, objectives and research hypothesis; and the significance of the study. This chapter also describes the research programme flow; scope and limitation of the study; and presents the research contribution to knowledge. Furthermore, Chapter 1 gives an overview/ structure of the thesis.

Chapter 2 explains the concept, models/forms, and trends of public private sector collaboration. It identifies ten drivers of collaboration which provide a broad base for the study. Chapter 2 contributes to the first and third objectives of the study.

Chapter 3 analyses and evaluates public private partnerships studies on road transport infrastructure management. It identifies the institutional and financing arrangements for road transport management. Chapter 3 contributes to the first objective of the research.

Chapter 4 critically appraises road transport infrastructure management in Nigeria. It identifies central issues that would attract/encourage active public private sector collaboration in road transport infrastructure management in Nigeria. Chapter 4 contributes to the second research objective.

Chapter 5 evaluates existing tools/models. It identifies Quality Function Deployment as a tool for developing a conceptual collaborative engagement framework for road transport infrastructure management in Nigeria. Chapter 5 contributes to the fourth research objective.

Chapter 6 outlines the research methodology and research methods adopted in the study. It discusses the ontological, epistemological and methodological characteristics of the research area. The chapter describes the qualitative, quantitative and mixed methods research designs; methods of data collection; unit of analysis; and the techniques of data analysis. The chapter justifies the adopted research positioning/philosophical approach and explains how the conceptual collaborative framework is developed, tested and validated.

Chapter 7 presents the findings of the questionnaire survey. Results of the survey identified pivotal drivers, contextual (Nigerian) issues/challenges and service element requirements of collaborative road infrastructure management in Nigeria. It also identified the degree of correlation between the ‘pivotal drivers’ and the ‘voice of the customer’; and significant drivers and customer requirements

for sustainable collaborative road infrastructure management in Nigeria. Chapter 7 contributes to the second and third research objectives.

Chapter 8 presents the findings of the qualitative case study interviews. Results of the qualitative case study interviews further confirms the key issues, and identifies the challenges and priorities of the case study collaborative road infrastructure project in Nigeria. This chapter contributes to the second and third objectives of the research.

Chapter 9 presents the conceptual collaborative engagement framework for managing road transport infrastructure in Nigeria. This is the final output of this research. It also discusses the 12 priorities of collaboration and the results of the test undertaken to validate the developed framework. The chapter contributes to the fifth and sixth objectives of the study.

Chapter 10 summarises the research process and presents the key research findings. It presents the main conclusions derived from the overall findings of the study. Chapter 10 presents the contribution to knowledge (theory and practice) and also provides recommendations based on research findings and suggests areas for further investigation.

CHAPTER 2: COLLABORATIVE ENGAGEMENT APPROACHES

2.1. INTRODUCTION

The Architecture, Engineering and Construction (AEC) sector is extremely diverse in both scale and nature, ranging from traditional house buildings, through to complex structures. This plays an important role in the economy of most nations. The scope of activities in this sector also includes mechanical and electrical engineering works, roads, dams, airports, bridges, tunnels, petro-chemical, harbour, mining etc. (Adetola and Ogunsanmi, 2006).

Though AEC projects share common characteristics in terms of project phases (initial concept, detailed design, construct, commission and own/ maintain) and project structures (involving a range of organisations – architects, engineers, contractors, tradesmen and manufacturers), procurement route often depends on project size, scope, value, complexity and sophistication. Today, there is increased emphasis on collaborative engagement approach for delivering sustainable infrastructure projects.

Infrastructure as a concept has largely been absent from economic discourses for about two centuries (Prud'homme, 2004). Notwithstanding this, by the 1990's after many years of neglect, it featured prominently with renewed emphasis on the role of infrastructure in economic growth and poverty reduction (Estache, 2006). The world development report elaborated by the World Bank (1994) defined infrastructure as a long-life engineering structures, equipment and facilities, and also the services that are derived from and utilised in production and in final household consumption. Other authors like Ahmed and Donovan (1992), refuted this definition, indicating that the concept had evolved earlier, and included a wider range of public services that facilitate production and trade. Since infrastructure services tend to raise the productivity of other factors, it might be termed the “unpaid factor of production”.

Furthermore, the definition of infrastructure has been shifting from one focusing on physical fixed assets and ‘soft’ facilities (see Section 1.1 in Chapter 1). The recent disparity between the capacity to generate resources and the demand for new facilities seem to have forced governments worldwide to look for new funding methods and sources. Inadequate infrastructure has been reported to be holding

back the productivity of Sub-Saharan African entrepreneurs, and imposing major costs on business in terms of lost, output and additional costs incurred to compensate for inadequate public services (Brushett 2005). It has been widely acknowledged that infrastructure deficit is one of the key factors that prevent the Sub-Saharan Africa region from realising its full potential for economic growth, international trade and poverty reduction (World Bank, 2010; 2008; Organisation for Economic Cooperation and Development, 2006). Therefore, many countries are now contemplating Public-Private collaboration as an arrangement between public and private sectors to finance, design, build, operate and maintain public infrastructure, community facilities and related services (Tang *et al*, 2010; Akintoye and Beck, 2009).

Public-private sector collaboration is an evolving concept which takes many forms around the world. It is essentially an arrangement by which private entrepreneurs participate in, or provide support for the provision of public infrastructure. The private sector can be described as that part of an economy which is owned and run by individual persons, groups or business organisations usually as a means of enterprise for profit. The public sector on the other hand is the portion of the economy which is owned, controlled and run by the various levels of government (federal, state, region, local etc.) or its agencies. Collaboration is a partnering process through which individuals, groups and organisations have the opportunity to become actively involved in a project or programme of activity. Thus, public-private sectors collaboration can be described as a method of procuring public services and infrastructure by combining the best of the skills and assets of both the public and private sectors. According to Li and Akintoye (2003), the idea of allowing private firms to finance projects of public sector infrastructure resulted in the emergence of Public Private Partnership (PPP).

2.2. TRADITIONAL PROCUREMENT METHODS

2.2.1. The Design-Bid-Build

The Design-Bid-Build approach is a two-phase traditional method of project procurement where the design and construction of an asset is awarded separately to private sector engineering and contracting firms (Akintoye and Beck, 2009). In this regard, the project design can either be undertaken in-house by the public agency (government) or be contracted to a carefully selected competent engineering

design firm. On completion of the design phase, the project sponsor (public sector) enters into a separate contract with a private construction firm selected through a competitive bidding process for the construction phase of the project. The award of the construction contract is mostly based on the lowest bid price. In this arrangement, the project sponsor (government) is solely responsible for the financing, operation and maintenance of the infrastructure (see Table 2.1) and assumes the risk that the project drawings and specifications are complete and free from error (AECOM 2005, 2007). Since there is no increase in private sector responsibilities/risk, this method may not be considered as a PPC approach. Many road transport infrastructure projects still use the Design-Bid-Build method (Queiroz and Kerali 2010).

2.2.2. Design-Build

In the Design-Build system, the government contracts with a private partner to design and build a facility in accordance with the requirements set by the government. This model combines the design and construction phases of a project into one, fixed-fee contract. The overlap of the design and construction phases enables the design-build contractor (private partner) to assume the risk that the project drawings and specifications are free from error. Upon completion, the government assumes responsibility for operating and maintaining the facility (Deloitte 2009; Royal Institution of Chartered Surveyors, RICS 2011).

2.2.3. Build-Lease-Transfer

This model is similar to Design-Build, except that after the facility is completed it is leased to the public sector until the lease is fully paid, at which time the asset is transferred to the public sector at no additional cost. The public sector retains responsibility for operations during the lease period (Deloitte 2009).

2.2.4. Divestiture

In divestiture, the government transfers all or part of an asset to the private sector through an asset sale, public offering, or mass privatisation programme. Generally, the government includes certain conditions on the sale to require that the asset be improved and services be continued (RICS 2011).

Divestiture results in eroded authority whereby government loses full control of the daily operations, strategic planning and management of such assets or services (Okoroh *et al*, 2006).

2.2.5. Drawbacks of the Traditional Procurement Methods

Various studies have enumerated the drawbacks of the traditional procurement system. The studies agreed that the traditional procurement methods are characterised with inappropriate risk allocation, adversarial lose-lose relationships, inflated contract, cost and time overrun, trade dispute among project participants, use of inferior construction materials, abandoned projects, defects and failures in infrastructure (National Economic Development Office 1986; Latham 1994; Larson 1995; Egan 1998; Kagioglou *et al*, 2000).

2.3. CONCEPT OF PUBLIC-PRIVATE SECTOR COLLABORATION

The concept of public-private sectors collaboration may be difficult to define due to the persistent controversy concerning what “partnership” really means and the vast space which public private partnership fills between traditional procurement and full privatisation of production. Many authors have defined PPP slightly differently; acknowledging this, Boeuf (2003) noted that the only consensus is that there is no “one-size-fits-all” definition of PPP. Partnership have been a fashionable trend since the United Kingdom (UK) Government embarked on a large-scale privatisation programme beginning with the sale of British Telecom in 1984.

Savas (2000) described PPP as an elastic or easily controlled form of privatisation. Savas claimed that any act aimed at reducing the role of government or increasing the role of the private sector in satisfying people’s needs tends towards privatisation. In this regard, Savas (2000) opined that privatisation can involve delegation (i.e government may retain responsibility and oversight functions but uses the private sector for service delivery), divestment (i.e government relinquishes responsibility) and displacement (i.e private sector grows and displaces government activity). In a private sector participation arrangement, the public agencies may play the role of the ‘regulator’ (Leung and Hui, 2005); ‘enabler’ by providing the enabling environment for the private partner to operate; ‘moderator’ by balancing market incentives with community interests (Sengupta, 2005) and ‘facilitator’ by assisting in project completion and reducing the developer’s risks (Lynch *et al*, 1999).

Furthermore, in Hong Kong, the Efficiency Unit, (2008) saw public private participation as arrangements where the public and private sectors both bring their complementary skills to a project, with varying levels of involvement and responsibility, for the purpose of providing public services or projects.

2.4. MODELS/ FORMS OF PUBLIC PRIVATE COLLABORATION

An organisation may be described as a social unit of people that is structured and managed to meet a need or to pursue collective goals. All organisations have a management structure that determines relationships between the different activities and the members, and subdivides and assigns roles, responsibilities, and authority to carry out different tasks. Public-Private Collaboration may cover a wide range of business structures and partnership arrangements in the delivery of policies, services and infrastructure. The limited or constrained financial capacity of government to deliver infrastructure prompted the exploration of alternative forms of governance in order to provide and maintain essential services. The desire for collaborative engagement between the public and private sectors in order to procure and modernise public infrastructure services, rests on the belief that partnerships between the two sectors would deliver greater efficiency and offer better ‘value for money’ relative to traditional methods of public procurement (Hood *et al*, 2006; Shaw, 2004).

In this respect, governments around the world have adopted a wide variety of approaches in engaging the private sector in the delivery of infrastructure services. The methods seem to range from service contracts, in which relatively few responsibilities and risks are passed to the private sector, to concession contracts, in which the private sector takes full responsibility for operating and investing in infrastructure services and therefore takes on significant commercial risks (Jerome, 2004). Some of the most common forms of collaboration in infrastructure procurement, where risks are shared between the public and private sectors include:

2.4.1. Service Contracts

In a service contract arrangement, the public sector (government) hires a private entity to undertake one or more specified activities or services for a period usually ranging from one to three years. The government remains the major provider of the infrastructure service and contracts out only part of its

operation to the private partner. The private sector partner is expected to deliver the services at the agreed cost and also satisfy/meet the performance standards set by the government. In this arrangement, the public sector pays the private partner a fixed fee for the service. Most times, there may be some financial incentives in the contract to reduce operating costs and improve operating performance. The government is responsible for funding any capital investments required to expand or improve the system (Akintoye and Beck 2009; Deloitte 2009).

2.4.2. Management Contracts

The government pays a private operator to manage state-owned infrastructure for a fixed period. The state or public sector retains much of the operational risk, ownership and investment decisions on the facility (The World Bank and Public Private Infrastructure Advisory Facility, 2003).

2.4.3. Lease Contracts

A private operator typically pays a fee to the government for the right to manage the facility and takes on most of the operational risks which may include unpaid customers' debts. In this respect, the government grants a private entity a leasehold interest to operate and maintain an asset in accordance with the terms of the lease (Deloitte 2009; RICS 2011). Given the increased risk burden on the private sector, the duration of a lease contract is typically longer than a service or management contract (see Table 2.3).

2.5. CONCESSIONS

In a concession contract, the public sector (government) grants a private entity the exclusive rights to provide, operate and maintain an infrastructure over a long period in accordance with performance requirements set out by the government. The government retains ownership of the asset, but the private operator retains ownership over any improvements made during the concession period (RICS 2011). Concession for new infrastructure is often referred to as greenfield-concession. In this respect, a private agent or public-private joint venture builds and operates a new facility for the concession period specified in a contract, at the end of which the infrastructure generally returns to public sector control. In the same vein, the public and private sectors can also collaborate to reconstruct, rehabilitate, maintain, operate and manage existing services and facilities. This is often referred to as

brownfield concession, in which a private agent takes over the management of a state-owned undertaking for a given period, during which it also assumes significant investment risk. Concessions may include: rehabilitate, operate and transfer; rehabilitate, lease or rent, and transfer; build, rehabilitate, operate and transfer projects (Akintoye and Beck, 2009; Deloitte, 2009). The merits of concession (long term) contracts include transferring most project risks to the private sector (concessionaire); generating large up-front revenues for the public agency; transferring operations, maintenance and capital improvement responsibilities to the private sector; taking advantage of the private sector efficiencies in operations and maintenance activities; and transferring responsibility for increases in user fees to the private sector (AECOM, 2007).

Table 2.1: Characteristics of different Contracts

Nature of Contract	Asset Ownership	Design	Build	Operation and Maintenance	Financial Responsibility
Design-Bid-Build	Public	Private by fee contract	Private by fee contract	Public	Public
Design-Build	Public	Private by fee contract	Private by fee contract	Public	Public
Build-Operate-Transfer (BOT)	Public	Private by contract	Private by contract	Private by contract	Private/Public
Build-Own-Operate-Transfer (BOOT)	Private/ Public	Private by contract	Private by contract	Private by contract	Private/ Public
Design-Build-Finance-Operate (DBFO)	Public	Private by contract	Private by contract	Private by contract	Public, Public/Private or Private
Build-Own-Operate (BOO)	Private	Private by contract	Private by contract	Private by contract	Private by contract

2.5.1. Private Finance Initiative

The term Private Finance Initiative (PFI) has been defined as a subset of PPP (Quiggin 2004; Li *et al*, 2005; Singaravelloo 2010). The PFI model evolved to become one of the most commonly applied collaborative frameworks amongst national and regional governments around the world. The framework covers a wide spectrum of private sector participation, including management contracts, lease contracts, concessions, and divestiture/privatisation (Ball and Maginn, 2005; HM Treasury 2009). The UK is a leading and typical example of a developed country where the dominant PFI model has been extensively used to manage infrastructure since 1992. Other countries which have adopted this approach include Australia, Canada, Finland, France, Ireland, Japan, Malaysia, the Netherlands, Norway, Portugal, Spain, the United States and Singapore (RICS, 2011). The aim of the PFI collaborative model is to control public sector expenditure and encourage greater levels of private sector investment in large/ complex key infrastructural delivery (Terry, 1996). This is in addition to reducing pressure on government budget, accelerating project completion, ensuring effective operation of facility, and also delivering ‘value for money’ (HM Treasury, 2009).

In PFI procurement, the public sector establishes a project team, and produces a business case or proposal which clearly specifies both the functional and performance or output requirements for the scheme (Deloitte, 2006). The private sector then translates this proposal into a service or project design that conforms with the performance requirements specified by the public client, builds/ constructs, finances, owns, and/ or operates the facility for a specified time frame/ duration under a contract or franchise with the public sector client, and then transfers the infrastructure to the public agency at the expiration of the contract (Akintoye and Beck, 2009). A concessionaire is a consortium formed for a collaborative project, and is expected to operate, repair and maintain the asset throughout the contract period to an agreed quality standard, and ensure continuity and quality of service of the asset (Siemiatycki, 2010).

PFI is a legal framework for managing concession projects in the United Kingdom, in which the government (public sector) buys and regulates the services of the private sector in providing public infrastructure (Li and Akintoye 2003). The goal of this framework is to increase the use of private

sectors' money and management skills in procuring public projects at both central and local authority levels. In effect, the private sector earns more business profit on investment (Akintoye and Beck 2009). Under PFI arrangement, the government no longer constructs roads, rather it buys kilometres of maintained expressway/motorway; it no longer develops and renovates schools, it purchases the services to manage schools; it no longer builds prisons, but purchases custodial services. In this respect, public efficiency is increased through the use of private sectors' capital assets, managerial expertise and services (Akbiyikli and Eaton, 2006).

Being the most frequently used form of PPP in the UK, PFI has been criticised for not being particularly transparent, wasting resources, and also being inflexible (HM Treasury 2012). For example, there was widespread concern that the public sector had not achieved value for money and tax payers were not securing a fair deal. Similarly, there has been a lack of transparency of the financial performance of projects and the returns made by investors, and insufficient transparency of the future liabilities to the tax payer created by PFI projects (HM Treasury 2012). These are aside from the effects of recent global economic (financial markets) recession on PFI. These developments have led to an increasing tension in the relationship between PFI providers, the public sector and the wider public.

Consequently, the government recently initiated a fundamental reassessment of PFI. The Open Public Services White Paper sets out the government's new approach, PF2, for engaging private finance in the delivery of public infrastructure and services through long-term contractual arrangements. Under PF2, government seeks to become a minority co-investor in order to secure greater alignment; improve collaboration, provide more transparency and accountability; and improve value for money (HMT² 2013, Brown *et al*, 2013).

2.5.2. Build Transfer Schemes

2.5.2.1. Build Operate Transfer

Kumaraswamy and Zhang (2001) reported that TurgutOzal, a former Prime Minister of Turkey, first coined the term BOT and used the approach in Turkey in 1984 as a part of the Turkish privatization programme. The duo also described BOT as a project based on the granting of a concession by a

client (usually a public or governmental agency) to a consortium or concessionaire (usually in the private sector) who is required to ‘Build’ (including financing, design, managing project implementation, carrying out project procurement, as well as construction), ‘Operate’ (including managing and operating the facility or plant, carrying out maintenance etc., delivering product / service, and receiving payments to repay the financing and investment costs, and to make a margin of profit), and to ‘Transfer’ the facility or plant in operational condition and at no cost to the public client at the end of the concession period, when the public sector now assumes operating responsibility.

BOT type schemes have been used in power, water supply, transport, telecommunications and process plant sectors (Tam, 1999). Examples of projects which were procured through the BOT method include the Luba Port Terminal project in Equatorial Guinea executed in year 2000 at a cost of US\$23million, the Abidjan Port Terminal Expansion in Cote d’Ivoire executed in year 2000 at a cost of US\$140million, the Backwena Platinum Toll Highway at a cost of US\$450million and Mpumalanga Airport Runway and Terminal at a cost of US\$34million, all executed in year 2001 in South Africa and are currently operational (Jerome, 2004).

2.5.2.2. Build-Own-Operate-Transfer (BOOT)

Under BOOT, the government grants a private partner a franchise to design, build, finance and operate a facility for a specified period of time. Ownership of the facility goes back to the public sector at the end of that period (RICS 2011).

2.5.2.3. Design-Build-Finance-Operate/ Maintain

Under the Design-Build-Finance-Operate/ Maintain (DBFO, DBFOM), the private sector designs, builds, finances, operates and/ or maintains a new facility under a long-term lease. At the end of the lease term, the facility is transferred to the public sector. PPC in the UK have been predominantly Design-Build-Finance-Operate (DBFO) contracts financed by government-supported shadow tolls for highway projects and tolls for bridge/tunnel projects (AECOM, 2007). Table 2.2 below shows the collaborative highway projects procured through the DBFO/M model and financed through shadow tolls in England.

Table 2.2: Collaborative DBFO/M Highway Projects Financed through Shadow Tolls in England

Project	Model of Public-Private Partnership
Motorway A1 (M)	DBFO
Motorway M1 – A1 Link	DBOM
Motorway A13 Upgrade	DBFO
Motorway A130 Bypass	DBFO
Motorway A19 Widen and Upgrade	DBFO
Motorway A30/ A35 Lane Improvement	DBFO
Motorway A4048/ A472 Upgrade	DBFO
Motorway A419/ A417 Bypass	DBFO
Motorway A50 Bypass	DBFO
Motorway A55 Extension	DBFO
Motorway A69 Bypass	DBFO
Motorway 40 Widening	DBFO
Isle of Sheppey Bridge	DBFO
M6 Bypass	DBFO
Second Severn River Crossing Toll Bridge	DBFO
Dartford River Crossing Toll Bridge	DBFO
London Road Maintenance	PPP/PFI
National Roads Telecommunications Services	PPP/PFI
Downtown London Congestion Pricing Programme	DBO
Channel Tunnel	FBO (debt restructured in 2005)
Skye Toll Bridge in Scotland	BOT (concession terminated)
Motorway A2 and A282 Widening	DBFO
Motorway A249 Upgrade	DBFO
Mercy River Crossing Toll Bridge	DBFO
Thames Gateway Toll Bridge	DBFO
Tyne River Crossing Toll Tunnel	BOT
Motorway 25 Rehabilitation and Partial Widening (orbital highway around Metropolitan area London)	DBFO

(Source: AECOM, 2007)

2.5.3. Build Operate Schemes

Build Operate Schemes differ radically from the traditional way of financing, building and operating infrastructure facilities. Here, governments turn to the private sector to finance projects using the project's envisaged revenue as a guarantee for their investment and returns (non-recourse financing), rather than the need to provide sovereign guarantees (McCarthy and Tiong, 1991). The combined provision of construction, operation and maintenance enables BOT operators to design facilities with minimum life cycle costs and enhanced operational efficiency (Queiroz 2005). In other words, the

bundling/integration of design, construction, operation, and maintenance provides incentives for the private sector to optimise expenditure and maximise innovation to achieve the greatest level of cost efficiency over the life of the facility rather than minimising the cost of a specific part of the assets' lifecycle. Hence, the Build-Operate concession models have been the most extensively used collaborative engagement approaches in global road infrastructure project procurement (Federal Highway Administration 2009). In this respect, Europe, Asia, and North America (Canada, Mexico, United States) have delivered large and significant highway assets through public-private collaborative arrangements over the last two decades (AECOM, 2007).

2.5.3.1. Build Own Operate

In Build-Own-Operate (BOO) model, the private sector finances, builds, owns, operates and maintains a facility or service in perpetuity. In other words, the private sector retains ownership of the facility. This model has been used to procure prisons in Victoria, Australia, where it has been deemed by Love *et al.*, (2000) to be more cost effective. In New South Wales, through the use of the BOO method, the Australian government was able to procure a 600 bed medium security prison at Junee for US\$57million which was approximately half the cost that the State government itself would have expended. Operation costs in the Queensland correctional system were reported to be 9.3% more economical in the private sector compared to the public sector (Love *et al.*, 2000). Moreover, a purely private prison in Florida, United States (US), and a purely public prison in the US of the same specification and capacity were compared. The prison in Florida was constructed at a cost of US\$69.9million whilst, the publicly procured prison cost US\$85.7million. This highlights that the privately built facility was 23% more cost effective (Tabarrok, 2003) compared to the publicly built. This method of procurement is sometimes called Build-Operate-Own- Maintain (BOOM).

These collaborative approaches have been found to identify and transfer project risk to the partner best able to manage that risk, offer greater transparency, new forms of accountability, and evoke entrepreneurial government through the market-driven competition and performance contracting techniques of the private sector (Bloomfield, 2006; Shaoul, 2003; Mayo and Moore, 2001). This arrangement allows the public sector (government) to cultivate and imbibe the disciplines, incentives,

skills and expertise which the private sector have developed in the course of normal business activities. The private sector on the other hand would benefit from the release of the full potential of people, knowledge and assets within the public sector (McQuaid and Scherrer, 2010).

Table 2.3: Characteristics of Public Private Collaboration Models

Contract Type (Duration)	Asset Ownership	Capital Investment	Commercial Risk	Operation and Maintenance	Service and Payment to Private Sector Contractor
Service Contract (1-3 years)	Public	Public	Public	Public and Private	A definitive, often technical service fee paid by government to private sector for specific services.
Management Contract (3-8 years)	Public	Public	Public	Private	Private sector manages the operation of a government service and receives fees paid directly by government.
Lease Contract (5-10 years)	Public	Public	Private	Private	Private sector manages, operates, repairs and /or maintains a public service to specified standards and outputs. Fees are charged to consumers/users and the service provider pays the government rent for the use of the facility.
Concession, BOT, BOO, BOOT, DBFO.	Private and Public	Private	Private	Private	Private sector manages, operates, repairs, maintains and/or invests in infrastructure to specified standards and outputs. Fees are charged to consumers/users. The service provider may also pay a Concession fee to the government.

The choice of the form of collaboration to be adopted may be influenced by such issues as; the degree of control desired by the government; the government’s capacity to provide the desired services; risk

allocation between the public and private sector partners; the capacity of private partners to provide the required services; the legal and regulatory framework for monitoring and control; and the availability of financial resources from public and private sources (Gentry and Fernandez 1998). In this respect, project sponsors can match specific models of PPC to individual projects based on the nature/characteristics of each project, the capabilities, interest, needs, and risk tolerance of the public and private sector partners.

2.6. PUBLIC-PRIVATE SECTOR COLLABORATION IN INFRASTRUCTURE PROVISION

The rapid increase in human population in recent times coupled with globalization, technological advancements, changes in social and political environments and the challenges of economic growth and poverty might have led to unprecedented demand on government institutions to provide better and efficient services (Akintoye and Beck, 2009). Globalization has been seen as a new world order that provides a new business environment characterised by worldwide interdependence of resources, supplies, product markets and business competition (Mytelka, 2000) which often has to do with abundance of knowledge, unprecedented cross boarder transferability of information and the removal of trade barriers.

Technological change is a term often used to describe the overall process of invention, innovation and diffusion of technology (Freeman, 2007). Technological change happens to be one of the driving factors for increased private investment. The telecommunication sector, where mobile telephones have changed the way services are provided, is a typical example. But other sectors have been affected by technological change as well. For instance, sustainable forms of small and medium scale electricity generation are now possible with the proliferation of solar technology and more efficient wind generators (Estache *et al.*, 2005).

2.7. PUBLIC- PRIVATE SECTOR COLLABORATION TRENDS

Traditional forms of investment in infrastructure projects in developing countries are often leveraged through budgetary allocations, bilateral and/or multilateral donor funds. Thus, Olawore (2004) claimed that stakeholder's expectations and needs throughout the world are rising at a rate with which

government revenue alone can no longer cope, hence government revenue needs to be augmented in order to deliver public infrastructure. In this respect, many countries are now attempting to finance new infrastructure projects through private sector participation. For example, the Government of Sri Lanka decided in 1995 that future investments in new infrastructure projects would be with private sector participation taking the form of build, operate and transfer (BOT), or build, own and operate (BOO) arrangements. This decision was taken due to insufficient resources (on the part of the Sri Lankan Government) to undertake large investments required for infrastructure projects (Liddle, 1997).

Similarly, private participation in infrastructure development in China started with the power industry in the 1980's. The Shajiao B power plant in Shenzhen, which came to operation in year 1988 was the first BOT project in China. Thereafter, several state-approved pilot BOT projects such as Laibin B power project in Guangxi 1997 and Dachang water project were awarded in order to introduce BOT on a larger scale. Since then, the involvement of private investors in infrastructure development of public utilities such as transportation, water supply, gas supply, and waste disposal has improved greatly (Shen and Wu, 2005). Kumar (2010) reported that the Government of Maharashtra (India) had formulated policy to finance road development, metro rail, tourism, ports, civil aviation, power, urban development and agriculture projects through private sector participation. It was also reported that the Mumbai Metropolitan Region Department Authority planned a 146 kilometres long rail based mass rapid transit system for Mumbai.

The privatisation of prisons in Australia is also worth mentioning. For example, the Junee Correctional Centre, a prison in New South Wales, Australia, with a capacity of 750 inmates was procured through the BOO method in 1993. It was designed, financed and operated by GEO Group Australia (Department of Corrective services, 2006). The \$920 million New Southern Railway project, a 10 kilometre underground two-track railway designed to provide rail services between Sydney (Kingsford Smith) airport and Sydney Central Station, Australia was also procured (between June 1995 and May 2000) through a build, own, operate and transfer (BOOT) 30 year concession agreement between the State Government and the National Australia Bank (Loosemore, 2007).

Furthermore, the Eastern Harbour Crossing Tunnel in Hong Kong was procured through a BOT concession of 30 years. The construction of the project started in September 1986, and was completed half a year earlier than anticipated, and within budget. The success of the project was attributed to an established and equitable legal and regulatory system. Other successful BOT projects in Asia include the Hong Kong Cross-Harbour Tunnel, and the Western Harbour-Crossing Tunnel (Tam, 1999).

In a study on public private infrastructure projects in Africa, the World Bank (2010) reported that Telecommunications seem to be the leading sector in Sub-Saharan Africa, both in terms of capital investment and the number of projects, Energy ranked a distant second, Transport came third, while investment in Water and Sewerage projects lagged far behind other sectors. A strategy which seems to be gaining increasing popularity in public infrastructure development in Cameroon is citizen participation involving the community, local and international non-governmental organisations (Njoh, 2002; 2003; 2006). This people-centred method is also referred to as self-reliant development or local economic development (Binns and Nel, 1999). In this respect, Chambers (1995, 1997) argued that poverty reduction efforts in developing countries are likely to be more successful when members of the target populations are afforded the opportunity to analyse and articulate their own needs as well as participate in efforts to address these needs.

The first major private sector participation infrastructure in Nigeria is the Murtala Muhammed International Airport Terminal project (Babalakin, 2008). The domestic wing of the Murtala Muhammed International Airport Terminal, Nigeria got burnt by fire in the year 2000. Government initially toyed with the idea of rebuilding it, but did not work out (Tell, 2007). In 2003, the then Minister of Aviation, fascinated with the idea of private sector getting involved in developing public infrastructure, got presidential approval for rebuilding the burnt terminal on a build, rehabilitate, operate and transfer 30 year concession contract to Bi-Courtney Consortium Limited at a cost of US\$250 million. The Lagos Bus Rapid Transit transport system is another facility introduced recently in Lagos, Nigeria. This roadway-based bus transport system operates on physically segregated lanes in order to guarantee fast and reliable bus travel devoid of any traffic congestion. Report has it that

between 1985 and 2004, there were a total of 2096 public private partnership projects worldwide with a total capital value of nearly US\$887 billion (AECOM, 2005).

2.8. COLLABORATIVE ENGAGEMENT APPROACHES FOR DELIVERING SUSTAINABLE INFRASTRUCTURE PROJECTS

Public Private Partnerships are widely acknowledged as an increasingly important vehicle to deliver public infrastructure development and public service (Kumaraswamy and Morris, 2002; Zhang, 2005; Akintoye and Beck, 2009; Tang *et al*, 2010). The United Kingdom has been recognised as the most active market in the World for this partnership which is widely known as PFI (see Section 2.5.1 in Chapter 2), and has also developed the most sophisticated institutional, legal, regulatory, and business structures to support the expansion of this strategy. Other developed countries which have embraced public private collaboration include the United States, Singapore, Hong Kong, Australia and Germany. With particular reference to transportation, many countries including Spain, South Korea, Canada, Ireland, France, China and Brazil seem to be moving up what the Deloitte research report described as the market maturity curve (Deloitte, 2006).

Since the introduction of public private collaboration in the United Kingdom in 1992, it has been recognised as an effective way of delivering value for money in public infrastructure services (Ke *et al*, 2009). In this respect, Banks (2005) claimed that the system accounts for about 15% and 8% of money spent on infrastructure in the UK and Australia (developed countries) respectively. Furthermore, public private collaboration also plays a significant role in the infrastructure development of developing countries (World Bank, 2008). Generally, the level of private sector participation ranges from simple service provisions without recourse to public facilities, to full private ownership and operation of public facilities and their associate services. In effect, increased private involvement in infrastructure management has often resulted into service contract, leasing, joint ventures, concession and privatisation (Li *et al*, 2005).

On the other hand, an extensive adoption of public private partnership by governments around the globe has generated problems and issues associated with implementation of projects. Such problems include high cost in tendering, complex negotiation, cost restraints on innovation, and conflicting

objectives among project stakeholders (Akintoye *et al.*, 2001). In this respect, Birgonul and Ozdogan (1998) stated that many urgent energy and transportation projects planned on a BOT basis in Turkey failed due to many reasons: These reasons include poor organisation of government agencies in packaging the projects; ineffective tendering and evaluation methods used by client organisations; insufficient legal arrangements; lack of coordination between private and public sectors; and unwillingness of the Turkish Government to provide guarantees against the risks originating from Turkey's unstable economic and political environments. This was reinforced by Canakci (2006) who reported that insufficient legal framework, administrative bottlenecks, and lack of methodical approach about risk allocation between the public and private sectors were the major factors which hindered the success of BOT projects in Turkey.

Furthermore, Zhang (2005¹) identified six categories of barriers for PPP/PFI projects. These include social, political, and legal risks; problems related to the public sector (e.g. inexperienced government and lack of understanding of public private partnerships); problems related to the private sector (e.g. preference for traditional procurement method); unfavourable economic and social conditions; lack of mature financial engineering techniques; and inefficient public procurement frameworks. In addition, Klijn and Teisman (2003) discovered that the inability to develop good partnerships lies in a combination of three factors: complexity of actor composition, institutional factors, and the strategic choices of public and private sectors. From the foregoing, the major problems and issues that appear to have been widely associated with the collaborative engagement approach for delivering sustainable infrastructure projects can be broadly classified as: risk allocation, globalisation/ collaboration, legal and regulatory framework, finance, technology, relationships, trust, market maturity, skills/ competence, and communication.

2.8.1. Drivers of Collaboration

2.8.1.1. Risk Allocation

Risk may be described as a probability or threat of damage, injury, liability, loss or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through pre-emptive action (Ward *et al.*, 1991; Li *et al.*, 2005). For example, financial risk may be the probability

that an actual return on an investment will be lower than the expected return. Therefore, the need for project participants to identify and understand all potential risks associated with a project cannot be over-emphasised. One critical factor to achieving successful implementation of a public private collaborative project is the optimal sharing of risks and responsibilities between the partners. The guiding principle often adopted in identifying and allocating responsibilities is that the party with the best financial and technical capabilities to manage a particular activity should be responsible for the risks associated with that activity and receive the associated rewards or losses (Ward *et al*, 1991; Edwards, 1995; Flanagan and Norman, 1993). For example, risks typically assigned to the private sector include the proper designing, construction, operation and maintenance of the assets and that financial returns are adequate to repay loans. On the other hand, the government (public sector) often assumes risks associated with inflation, environment, and land acquisition from the public and private owners.

In this regard, Woodward (1997); Charoenpornpattana and Minato (1997) studied risk allocation and sharing in respect of project financing and privatisation. They identified various risks such as social and political risks, environmental risks, technical risks, as well as economic risks which may emerge at different stages of a project life cycle. Social and political risks include instability of government, corruption / bribery, uncertainty of government policy, unfair process of selection of private investors, political influence, changes in laws and regulations, nationalisation, internal and labour resistance, inefficient legal process and legal barriers. On the other hand, economic risks include foreign exchange risk, devaluation risk, price escalation, inflation risk, inconvertibility of local currency, interest risk, general liability risk, management risk, too small number of interested investors, incapable investors, and small capital market demand and supply risk. The foreign exchange risk is a possibility that a business' operation or an investment value will be affected by changes in currency exchange rates. For example, if money must be converted into a different currency to make a certain investment, changes in the value of the currency relative to the American dollar will affect the total loss or gain on the investment when the money is converted back. This risk usually affects businesses, but it can also affect individual investors who make international investments.

Similarly, Merna and Smith (1996) classified the risks of partnership projects into two broad categories: global and elemental. Risk factors in the first group are generally those outside the control of the project participants, including political, legal, commercial, and environmental factors. The latter group contains mostly the project-level risks, such as construction, design, operation, finance, and revenue risks. In addition, Li *et al*, (2005) proposed an approach to classify partnership project risks into three levels: macro, meso, and micro. The macro-level risks are those risks external to the project itself; the meso-level risks are project-related risks; while the micro risks are partly –related risks.

2.8.1.2. Globalisation

Globalisation has to do with the creation of a ‘Global Village’, a process that brings the world closer through better international communication, transport and trade links. Globalisation has been defined as the multiplicity of linkages and interconnections that transcend the nation-states which make up the modern world system (McGrew 1992). It often describes a process through which events, decisions and activities in one part of the world can come to have significant consequences for individuals and communities in quite distant parts of the globe. In this regard nowadays, goods, capital, people, knowledge, images, communications, crime, culture, pollutants, drugs, fashions and beliefs all readily flow across territorial boundaries. Thus, transnational networks, social movements and relationships appear to be widespread in nearly all areas of human endeavour/ activities (McGrew, 1992).

The European Union’s (EU) internal market appears to have undergone a massive change in the past few years. Member states seem to be benefiting greatly from the world’s largest free market, and in particular, the liberalised transport market for both goods and passenger carriage in 1998 is apparently helping to promote the socio-economic cohesion of the Union (European Commission’s Directorate-General for Energy and Transport, 2006). Open markets may be a good engine that fits living standards and build shared prosperity. In this regard, countries that open up their economies to trade, capital movement and competition are likely to see significant increases in per capita income, social and economic progress. The benefits of globalisation may also include increased liquidity of capital allowing investors in developed nations to invest in developing countries, greater ease and speed of

transportation for goods and people, and the reduction of cultural barriers thereby expanding the global-village effect.

Ever before now, the public and private sectors had collaborated to deliver public infrastructure using a variety of methods which divided responsibility differently. Collaboration is often quite different from a situation where the government only seeks for the advice or solicits for the input of the organised private sector on policy issues/ decisions. It implies that there is some shared responsibility between the public sector and private sector for tangible deliverables (Collin, 1998). In this regard, Grantt, (1996) asserted that shared authority and responsibility, joint investment, shared risk/ liability, shared resources and rewards, and mutual benefit are the thrust of collaboration. Early collaborative engagement approaches for delivering infrastructure mostly employed the Design-Bid-Build (Traditional) model that assigns the public sector primary responsibility (Yakowenko, 2004). However the traditional forms of project procurement seem to have been characterised by abandoned projects, inflated contracts, trade dispute among players, unnecessary time and cost overrun, clients' inability to obtain 'value for money', delay in project completion and occupation, use of inferior quality materials which often lead to several defects in construction, and eventual building collapse (National Economic Development Office, 1986).

In the 1980's, governments around the world began to experiment with the privatisation of infrastructure delivery, using the Build-Own-Operate (BOO) model as a way to generate funds for new infrastructure projects and improve the efficiency of service provision. This attempt received strong political opposition (Gomez-Ibanez, 1996; Sclar, 2001). Thus, in the early 1990's, the UK led the way with projects that bundled facility design, construction, financing and operation into a single long-term concession. This approach seems to have become popular worldwide as a method of delivering large and complex public sector transportation projects. Furthermore, it probably has helped to align the interests, rewards and risks of both public and private partners through a long-term contractual relationship (Grimsey and Lewis, 2005). Public-Private Collaboration appears to have developed into extensively applied delivery vehicles for large and complex infrastructure projects, crossing international borders and diverse governmental structures to form an essential support for

global economic growth (Liu and Cheah, 2009). The likely obstacles to effective implementation of collaborative engagement approaches in developing countries may include an absence of efficient, transparent and participatory policies, mechanisms and institutions in such countries (Akintoye and Beck, 2009).

2.8.1.3. Legal and Regulatory Framework

The need for a comprehensive legal and regulatory framework which is clear, transparent and predictable for efficient, effective and fair bidding procedures has been emphasised (Asian Development Bank, 1996, 1997; Harris, 2003). The legal environment where projects operate often influences to a large extent the willingness of the private sector to collaborate in infrastructure project development. Therefore, in order to attract private sector participation, the government has to develop adequate legal and regulatory framework, as well as a financial environment, congenial to investment and attractive to foreign investors (Kumaraswamy and Zhang, 2001). It has been argued that the success of public private collaboration revolves around availing an adequate and enabling legal and regulatory framework that critically analyses services, partners and a 'value for money' procurement strategy (Zhang, 2005²; Bing *et al*, 2005). This is necessary, since disputes are likely to occur and service delivery delayed and / or impaired (Institute of Public Private Partnerships, 2000). The existence of a functioning legal and regulatory framework reduces opportunistic tendencies (Kuttner, 1997), aligns the interest of partners and also provides confidence to the private partners as it acts as a buffer against political interference from government agencies (Pongsiri, 2002). PPC requires a regulatory and institutional framework which clearly discourages criminal tendencies. The laws and regulations that govern all economic activities must empower appropriate government agencies/institutions to promptly detect and adequately penalise corrupt practices and illicit transactions (Zhang, 2005²).

Whether an investment is recouped through tolls, sales or other tariffs, it is always the end users/consumers who ultimately pay the cost of the project (Pahlman, 1996).

2.8.1.4. Finance

Infrastructure projects are often large, complex and capital-intensive in nature, hence, may require innovative financial strategies. Project financing, seems to be one such innovative financial engineering technique in which a project is considered as a distinct legal entity, and the financing of the project is repaid from the cash flows generated by that same project (Merna and Dubey, 1998). For example, the Hong Kong government adopted three sets of criteria to evaluate tenders for its BOT tunnel projects, and assigned weights to these criteria in their order of importance. The sets of criteria and their assigned weights are finance, 65%; engineering, 20%; and planning of operation and transport, 15%. The higher weight assigned to the financial criteria in this evaluation reflects the importance of a sound financial plan to the success of an infrastructure project (Zhang and Kumaraswamy, 2001). Similarly, Zhang (2005²) found that a concessionaire's financial capacity can be measured by four dimensions: strong financial engineering techniques; advantageous finance sources and low service costs; sound capital structure and requirement of low-level return to investments; and strong risk management capability. Partnership projects are often funded with both equity (e.g. common stock) and debt (e.g. loans). A common practice is to utilise as much debt as the project cash flows permit to generate an attractive return for shareholders. In this regard, the capital structures in most partnership projects are highly leveraged, with equity financing covering 10-30% of total project costs and debt financing covering the remaining 70-90% (Levy, 1996). Although a higher debt may allow for higher rate of return to equity investors, too much can provide more risks to a project. Therefore, an appropriate mix of equity and debt may be necessary when financing a public private collaborative project (Zhang, 2005³).

2.8.1.5. Technology

Technology has been defined as the purposeful application of knowledge and information in the design, production and utilisation of goods and services, and in the organisation of human activities (Das and Van de Ven, 2000). As a key tool which can be used to improve the movement of people and goods in order to meet the evolving needs of modern economy and society, intelligent transport systems (ITS), a technology toolkit involving a systems approach to transport often facilitates effective infrastructure management encompassing road safety (European Transport Safety Council,

1999). The Organisation for Economic Cooperation and Development, OECD (2009) classified industries as high technology, medium technology and low technology, based on research integrity and the rate of use of technology. In this classification, the road construction industry falls into a low technology category.

Road infrastructure can be described as a large technical system consisting of physical components such as roads, bridges and traffic monitoring equipment which forms a network (Caerteling et al, 2011). It is a public space, used by all, and often controlled by the use of signs, regulations and dynamic route information which are organised to optimise traffic flow. Road infrastructure appears to be a major sector, a vital component for economic activity, and an important contributor to both Gross Domestic Product and employment (OECD, 2008; European Union Road Federation, 2007). Thus, a well-established road transport infrastructure is seen as an important precondition for economic growth (Demurger, 2001).

Roads are often grouped into natural surface roads, concrete roads, hot mix asphalt (HMA) roads and roads surfaced with component pavements, but the bulk of road works concerns concrete and HMA surfaced roads (Caerteling *et al*, 2008). Concrete and HMA are mixed in regional facilities and transported by trucks to the construction site, where they are laid down and finished to the final product. Roads typically have to be produced at the location of use, hence, the road construction industry is widely distributed and fragmented. Modern site equipment is well developed and uses high technology components, however, the operatives and site crew are mainly low educated, and often recruited per job (Caerteling *et al*, 2011; 2008). The majority of roads are owned by the public sector (federal/national, regional/state and local governments), hence, the entrepreneurial environment of the industry is shaped by the public sector procurement policy and practice (Caerteling *et al*, 2008).

2.8.1.6. Relationships

The issue of the relationship between public and private investment has been a focus of attention in the literature since the early 1980s, and it is still the subject of considerable controversy (Khan and Reinhart, 1990). Thus, the interaction between project participants is often a key factor in project management. Interactive processes include planning, communication, monitoring and control, and

project organisation in order to facilitate effective coordination throughout the project life. Trusting relationships are both inter-organisational and intra-organisational. An organisation which does not have confidence in its own people may find it difficult to build trusting relationships with other establishments (Khalfan *et al*, 2007). Inter-organisational conflicts in a construction project most often have adverse effect on project performance (Mohsini and Davidson, 1992). Therefore, the government plays pivotal roles and responsibilities in the development and management of partnership projects. The incapability of government to manage partnership projects may lead to project failure (Kwak, 2002). In this regard, many projects are worth mentioning. In a comparative study of three transportation projects delivered through public private partnership: the Croydon Tram-link in London, UK; the State Route 91 Express Toll lanes in Orange County CA, United States; and the Cross City Tunnel in Sydney, Australia; Siemiatycki (2010) observed that key planning documents were made secret and confidential, project construction costs escalated, and traffic volume was overestimated in all the three case studies. Consequently, lawsuits ensued as relationships between the parties deteriorated and all the three concessions were ultimately sold under duress. In this respect, Jacobson and Choi (2008) identified open communication and trust, willingness to compromise and collaborate, and respect as important factors for successful delivery of public private partnership projects. This is supported by Innes and Booher (2004) who emphasised the need for building trust between project stakeholders and resolving conflicts before they become intractable.

Similarly, Bangkok Elevated Transport System project, Thailand, was planned to construct a 60km elevated rail system and a road through the heart of the capital. Hopewell, the concessionaire, was granted the right to develop 900,000m² of land along the proposed route in addition to collecting tolls for a concession period of 30years under a BOT arrangement (Kumaraswamy and Zhang, 2001). It was reported that by the end of 1997, only a few piled foundations had been erected, whereas, the first stage of the project ought to have been completed by the end of 1995. This project was ultimately terminated by Thai Government. The problems leading to the non-realisation of the project include: a sudden request by the government to change from an elevated to an underground scheme following several changes of governments, lack of governmental assistance in resolving the conflicts with a

nearby competitive toll-way, and the inability of Thai Government to meet the financial demands of mass transportation (Tam and Leung, 1997). Similarly, Bangkok Second Expressway System and Bangkok Don Muang Tollway BOT projects in Thailand also failed as a result of immature legal and regulatory system, and changing foreign investment policy resulting from several changes of government (Tam, 1999).

Furthermore, the World Bank highlighted the reasons why many partnership projects were not delivered. These include: wide gaps between public and private sector expectations; lack of clear government objectives and commitment; complex decision making; poorly defined sector policies; inadequate legal/ regulatory frameworks; poor risk management; low credibility of government policies; inadequate domestic capital markets; lack of mechanisms to attract long-term finance from private sources at affordable rates; poor transparency; and lack of competition (Asian Business, 1996). In all these cases, the government and the end-users/ general public (not the private operators) have ultimately shouldered the cost of failure. Project success can be guaranteed if participants work together as a team with predetermined common goals, objectives and defined procedures for collaborative engagement (Larson, 1995). Both the public and private sector partners may need to share a common goal of reducing risk and increasing public procurement certainty, and have the capacity to execute their roles. The roles include the ability to assess costs and needs, the skills to manage and negotiate a public private partnership, and the capacity to monitor and enforce contracts (Zhang, 2005³). Lack of private participants with the capacity to do business also seems to be a significant barrier to the success of public private collaboration (Henderson and McGloin 2004).

2.8.1.7. Trust

Trust can be described as a firm belief, confidence and hope in the reliability, truth, ability or strength of someone or something. In other words, it is often a firm reliance on the integrity or character of a person or thing (Bies *et al*, 1995). Rousseau *et al*, (1998) defined trust as a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another. In practice, trust could be both an emotional and logical act. Trust could be emotional where an individual exposes his/her vulnerabilities to other people, but believing that such

people would not take advantage of his/her openness. It could be logical in a situation where an individual assesses the probabilities of gain and loss, calculates expected utility based on hard performance data, and concludes that the other person would behave in a predictable manner. Trust can be felt hence its associated emotional feelings often include companionship, friendship, love, agreement, relaxation, and comfort (Hosmer, 1995). The predictability of trust allows man to spot and prepare for threats and also make plans to achieve long-term goals. Trust may have to do with being able to predict what other people will do, and what situations will occur. Therefore, relationships and business transactions in most cases revolve around trust in value-exchange, hence, the principle of reciprocity often binds societies together (Kramer and Tyler, 1996).

It has been widely acknowledged that trust is an important hall-mark of effective organisations, and has a number of important benefits for organisations and their members (Bies *et al*, 1995; Hosmer, 1995; Kramer and Tyler, 1996; Rousseau *et al*, 1998). Trust often results in more positive attitudes, higher levels of cooperation (and other forms of workplace behaviour), and superior levels of performance (Mayer *et al*, 1995; Jones and George, 1998). Mayer *et al*, (1995) claimed that individuals' beliefs about another's ability, benevolence and integrity often lead to a willingness to take risk in a relationship. In other words, a higher level of trust in a work partner increases the likelihood that one will take a risk with a partner, and/or increases the amount of risk that is assumed. Therefore, risk-taking behaviour is often expected to lead to provide outcomes and higher unit performance in social units such as work groups, collaboration, negotiation, communication and information sharing (Dirks and Ferrin, 2001). Individuals tend to transmit more information with higher fidelity, to a trusted superior or work partner, hence, trust is often a necessary condition for cooperation (Hwang and Burgers, 1997). In this respect, an individual who considers another to be dependable will find it relatively easy to collaborate with that partner, and directs resources towards the group goal without been anxious about the partner's potential behaviour (Dirks and Ferrin, 2001).

Trust theory emphasises three important antecedents of interpersonal trust, these include ability, benevolence and integrity (Mayer *et al*, 1995). Ability refers to skills, competencies and characteristics relevant to a specific situation, while benevolence encompasses loyalty, receptivity and

care. Integrity involves adherence to acceptable set of principles such as consistency, fairness, reliability, openness and general value congruence. In complex construction projects, there may be several specialist trades which may not be understood by everyone, hence, the need to rely on other person's expertise and experience. Trust emerges where information is reliable; promises are fulfilled; and the outcomes match or exceed people's expectations, while suspicion sets in when trust breaks down and people's expectations are dashed. The methods through which trust could be built include shared goals, problem solving, experience, reasonable behaviour and reciprocity (Khalfan *et al*, 2007). Through the all-encompassing bundling of tasks into a single concession, PPP is expected to align the long-term interests of the public and private sector partners, create trusting relationships, and nurture reciprocal inter-organisational reliance that transfer the risks of a project to the partner that is best able to manage them (Siemiatycki, 2011). Thus, there is a real issue to avoid the "blame culture" (Khalfan *et al*, 2007), as the impact of trust can have a positive impact on project outcomes (Laan *et al*, 2011).

2.8.1.8. Market Maturity

Market is often described as an actual or nominal place where forces of demand and supply operate, and where buyers and sellers interact (directly or through intermediaries) to trade goods, services or contracts/instruments, for money or better (RICS, 2011). Markets include mechanisms/means for determining price of the traded item, communicating the price information, facilitating deals and transactions, and effecting distribution. The market for a particular item is made up of existing and potential customers who need it and have the ability and willingness to pay for it. Since year 1992 to date, it appears there has been an increased and significant use of public-private collaboration to procure infrastructure services in both the developed and developing countries. The maturity and sophistication within international markets also seem to be at different stages of development (see Figure 3.1). Today, the UK has been recognised as the most active market in the world for public-private collaboration which is popularly known as PFI and has also developed the most sophisticated institutional, legal, regulatory and business structure to support the expansion of the strategy (Deloitte, 2006). Additionally, the UK is also considered to have the most expansive project portfolio in terms of both the diversity of infrastructural provision as well as innovative application of the collaborative

model. This is closely followed by Australia with vast experience, substantial institutions and record of numerous road transport infrastructure projects being delivered in New South Wales through the design-build-finance-operate (DBFO) collaborative approach (Siemiatycki, 2010). Partnerships UK (2007) claimed that the diversity of PFI/ PPP application across government departments has created an intellectual family within the UK in respect of partnership based procurement, encompassing a market of experienced suppliers and advisors as well as a robust contractual framework. The range of contractors and service providers appear diverse and includes construction contractors, hard facility management (FM) contractors and soft FM contractors. Hard FM contractors typically provide utilities management and asset maintenance, while soft FM contractors deliver services such as security, cleaning, catering and help desk operations (RICS, 2011).

Similarly, other countries such as Ireland, Spain, Canada, France, USA and China seem to be well placed on what Deloitte (2009) referred to as the 'market development curve' (see Figure 3.1). The UK, Australia and Canada are often considered amongst the most mature and transparent collaborative global markets, even though they differ considerably in terms of regulatory frameworks, scope and volume of collaborative projects, infrastructural-target and duration of the tender process. Furthermore, since India and the USA seem to have witnessed substantive growth in the application of PPPs as a method of infrastructure procurement over the last five years (2006-2010), both countries are rated as 'emerging' markets in the context of collaboration (Deloitte 2009). The partnership markets in the USA and India seem to represent a wholesome learning environment in terms of the challenges that must be overcome in order to facilitate continued growth as well as enhancing market maturity and sophistication. Also the markets in both countries appear to offer the opportunity to transfer knowledge in terms of innovative application and risk-shift mechanisms (RICS, 2011).

For a country to move up the market maturity curve (see Figure 3.1), it may be required that she expands and develops her market capacity, involving the execution and management of innovative partnership models and financial structures. However, public sector institutions in developing countries have been reported to be weak, have poor economic resource base, and inadequate regulatory framework (Charles 2006). In similar vein, the private sector has been described as young,

inexperienced and probably lacks the resources (financial, technical, managerial capabilities and innovative competencies) to effectively collaborate (Charles, 2006). The money-market fund (e.g. treasury bills, bonds) seems to be for a short term while the capital-market-fund (stock/ shares) are medium and long term in nature. The inability of the private sector to secure fund to finance essential infrastructural provision due to current global financial crisis attracted national government interventions. For example, Canada created the Canada Fund, the UK government established the Infrastructure Finance Unit (IFU) while the French and Australian governments launched federal guarantees on partnership projects. These interventions are expected to stimulate the partnership market, generate construction sector employment, contribute to wider economic growth and instil greater confidence in collaborative model, most especially within the banking sector (Deloitte 2009; RICS, 2011).

2.8.1.9. Skills / Competence

Projects are often managed by people who probably have to make decisions and enforce procedures that might affect other people. Managing even a small project may require careful attention to details and the ability to anticipate possible problems. Therefore, management skills, principles and competencies may be necessary in order to keep track of all the activities and issues associated with infrastructure project implementation and execution. These skills and principles may include planning, organising, controlling, coordinating, motivating, communicating, procuring, leading, delegating and negotiating (Fayol, 1949). Project management tends to apply these skills and techniques to the organisation and control of all aspects of every project in order to optimise the use of resources to produce a well-designed, soundly constructed, functional and financially viable facility that will satisfy the clients' requirements of quality, purpose, safety, cost and time budget, and future maintenance (Chartered Institute of Building, 2010).

2.8.1.10. Communication

Project communication management has been described as the knowledge area that employs the process required to ensure timely and appropriate generation, collection, distribution, storage, retrieval and ultimate disposition of project information (Project Management Institute, 2002). Communication

is a collaborative process which often involves more than one person. Effective communication may help to coordinate work activities, manage information/knowledge and make decision. Management often relies on clear communications, and the ability to pass thoughts, ideas, information and instructions quickly and effectively between people with different technical skills and interest. Effective communications may occur in two ways: informal and formal. Informal telephone conversations, oral or face to face communications may be necessary for establishing personal relationships, for the speedy and effective resolution of problems, and for deciding upon courses of action. Yet, formal communications might be required to ratify the decisions made informally, to record the main reasons for a decision, and to communicate relevant information to people who probably were not involved in decision- making (Cleland and Gareis, 2006). In this respect, many of the reports and procedures such as application for funds, certification and payments, periodic reports and financial accounts of a project are prepared in a well-established standard way in order to avoid ambiguity and reduce the risk of dishonest manipulations. Similarly, project drawings, specifications, bill of quantities, schedules, articles of agreement and other contract documents may be regarded as forms of formal communications (Project Management Institute, 2010).

The 'role ambiguity' usually associated with construction projects, coupled with the fragmented and uncoordinated nature of construction processes have resulted in poor communication between the parties involved in construction projects (Kagioglou *et al*, 2000). Many construction projects comprise a project team formed specifically to facilitate the development of a single project, with little or no opportunity to work together again on other projects. Furthermore, many key specialist experts are identified and involved too late in the process. This development, Sommerville and Stocks (1996) observed may have effect on the project team's interaction and performance. In this regard, the continual formation and break-up of project teams might not allow participants to learn from project experience or benefit from shared best practice. Project success relies on the right people having the right information at the right time. Thus, the active involvement of all participants in the early phases of a project may help to foster a team environment and encourage appropriate and timely communication and decision-making (Kagioglou *et al*, 2000).

2.9. STRATEGIES FOR DELIVERING SUSTAINABLE INFRASTRUCTURE PROJECTS

The World Commission on Environment and Development (1987) defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The complex and evolving nature of risks involved in partnerships and the large numbers of project stakeholders make it both necessary and expedient to adopt relational contract approaches in order to secure a sustainable product and service (Kumaraswamy and Zhang, 2003). Thompson and Sanders (1998) observed that the benefits of relational approaches increase with a progression of teamwork attitudes from competition, through cooperation to collaboration and finally coalescence. Under coalescence, the project team members work as a virtually seamless team. In effect, value for money is often realised because costs are shared, economies of scale and synergies are achieved while decision making is shortened due to cooperation between partners (Klijn and Teisman, 2000; Ke *et al*, 2009). In this respect, MacNeil (1974) traced the development of contracts from traditional ‘classical’ through ‘neoclassical’ to ‘relational’. Classical contracting approaches are often characterised by segregated teams, adversarial contracts, a blame culture and short-term focus; while relational contracting approaches on the other hand, are characterised by integrated teams, joint risk management, sustainable relationships and a longer-term focus.

Furthermore, relational contract principles seem to provide a sound basis for harmonising relationships between the contracting parties, thereby reducing areas of disagreements and lubricating the transactional friction. This is made possible by focussing on common objectives, adopting cooperative and collaborative approaches, and introducing compatible and useful processes over and above classical contracting practices and principles (MacNeil 1978). Relational contract approaches often engender proactive project delivery modalities by fostering cooperation between project team members with a longer-term mind-set, and focussing team efforts on whole-lifecycle performance and sustainable infrastructure. Thus, ‘tension’ is reduced between the public and private sector participants, thereby facilitating integrated team-work with a long time horizon (Rahman and Kumaraswamy, 2002).

2.10. DISCUSSION AND KEY FINDINGS

The long-term nature of public private collaboration might allow trust to grow and consolidate among project team members, just as an effective partnership seems to be a way of integrating the public and private sectors which often bring the benefit of private sector expertise and experience to bear on public sector management. A good interaction between project participants might be paramount in project management. In this regard, Kummaraswamy and Zhang, (2003) suggested the need to identify the degree of trust and mutual credibility of the parties in relationships. Moreover, high levels of trust often enable relationships to be built up faster and better, while the tendencies of one party to default on agreements, exploit loopholes or let down another party would be minimal. For example, performance specifications which clearly state the desired end results of projects are increasingly used in all infrastructure construction works. However, since the specifications are always silent on construction methods, disputes could arise as a result of different interpretations of end results which would require sound and a long-term 'relational understanding' solution.

Furthermore, relational approaches appear to be useful in pooling the resources of project stakeholders towards win-win scenarios, that can extend beyond a single project (e.g. in framework agreements and term contracts), and also benefit from a longer-term view (e.g. by focussing on sustainable infrastructure). While contractual arrangements attempt to cover all foreseeable eventualities, relational approaches are also crucial for developing relationally integrated teams that can respond rapidly and efficiently to unforeseen risks as well as technological and socio-economic developments during the life span of the infrastructure.

The need for appropriate identification, classification and allocation of risk is also espoused in the extant literature. Joint risk management, according to Rahman and Kumaraswamy, (2002) often ensures clear and equitable allocation of all foreseeable risks, along with relational contract based adjustment mechanisms for addressing any unforeseen events and changes during contract execution.

Furthermore, the seminal literature also emphasised the invaluable role of an equitable legal and regulatory framework. The framework clearly explains the changed roles, that is, redefine the role of government from providing and delivering services directly to facilitating and regulating private

sector service provision. The framework is necessary to protect public interest, check abuses, enhance capacity and promote public private collaboration. The private sector will only invest in a project where there is an assurance that it would certainly make an adequate profit. It was a consensus of opinion by all the scholars that the private sector has the technical, financial, managerial and entrepreneurial capacity to invest in, and turn-around the public infrastructure. For simplicity, ten core themes have been identified, these being the most commonly cited issues in this area.

Table 2.4: Seminal Literature on Public-Private Sector Collaboration

Core Drivers	Authors
Relationships	Khan and Reinhart 1990; Mohsini and Davidson 1992; Kwak 2002; Siemiatycki 2010; Jacobson and Choi 2008; Innes and Booher 2004; Tam and Leung 1997; Larson 1995; Ke <i>et al</i> , 2009; Klijn 2000; Erridge & Greer 2002; Ysa 2007; Zhang and Kumaraswamy 2001; Zhang <i>et al</i> , 2002, 1998; Zhang 2004, 2005 ³ ; Henderson and McGloin 2004; Abdul-Aziz 2001; Chan <i>et al</i> , 2003; Wang <i>et al</i> , 1998, 1999, 2000; Wang and Tiong 1999, 2000; Ling 2004; Khan and Reinhart 1990; Asian Business 1996
Trust	Bies <i>et al</i> , 1995; Rousseau <i>et al</i> , 1998; Hosmer 1995; Kramer and Tyler 1996; Mayer <i>et al</i> , 1995; Khalfan <i>et al</i> , 2007; Laan <i>et al</i> , 2011; Jones and George 1998; Dirks and Ferrin 2001; Hwang and Burgers 1997; Banks 2005; Rhaman and Kumaraswamy 2002; Kumaraswamy and Zhang 2003; MacNeil 1974; 1978; Thompson and Sandars 1998; World Commission on Environment and Development 1987; Spackman 2002; World Bank 2008; Mohsini and Davidson 1992; Siemiatycki 2009; Larson 1995; Tang <i>et al</i> , 2010
Risk Allocation	Ward <i>et al</i> , 1991; Edwards 1995; Flanagan and Norman 1993; Woodward 1997; Charoenpornpattana and Minato 1997; Merna and Smith 1996; Li <i>et al</i> , 2005; Abednego and Ogunlana 2006; Li <i>et al</i> , 2005, 1999; Shen <i>et al</i> , 2006; Akintoye <i>et al</i> , 2000, 1998; Sheu and Akintoye 2010, 2009; Li and Tong 1999; Schaufelberger and Wipadapisut 2003; Mustafa 1999; Zayed and Chang 2002; Lam and Chow 1999; Bing 2005; Dixon 2005; Regan 2005; Canakci 2006; Asian Business 1996; Tam 1999; Macdonald 2000; Grimsey 2002; Henderson 2004; Tang <i>et al</i> , 2010; Rahman and Kumaraswamy 2002; Zhang 2005 ¹
Legal and Regulatory Framework	Asian Development Bank 1996; 1997; Harris 2003; Birgonul and Ozdogan 1998; Canakci 2006; Asian Business 1996; Tam and Leung 1997; Larson 1995; Kumaraswamy and Zhang 2001; Zhang 2005 ² ; Bing <i>et al</i> 2005; Institute of Public Private Partnership 2000; Kuttner 1997; Pongsiri 2002; Tam 1999; Kanter 1994; Shalakany 1996; Tang <i>et al</i> 2010; Pahlma 1996
Communication	Project Management Institute 2002, 2010; Cleland and Gareis 2006; Jacobson and Choi 2008; Innes and Booher 2004; Siemiatycki 2009; Tam and Leung 1997; Asian Business 1996; Tam 1999; Kumaraswamy and Zhang 2003; Samii <i>et al</i> , 2002; Regan 2005; Tang <i>et al</i> , 2010; Asian Business 1996; Jamali 2004
Technology	Das and Van de Ven 2000; European Transport Safety Council 1999; Organisation for Economic Cooperation and Development 2008, 2009; Caerteling <i>et al</i> , 2008, 2011; European Union Road Federation 2007; Demurger 2001; Freeman 2007; Estache <i>et al</i> , 2005; Kumaraswamy 1998; Chen 2002; Li 1998; Tang <i>et al</i> , 2010; Akintoye <i>et al</i> , 2001
Skills / Competence	Chartered Institute of Building 2010; Fayol 1949; Kumaraswamy 1998; Birgonul and Ozdogan 1998; Tam 1999; Tang <i>et al</i> , 2010; World Bank 2008
Finance	Merna and Dubey 1998; Zhang and Kumaraswamy 2001; Zhang 2005 ² ; Zhang 2005 ³ ; Levy 1996; Akintoye <i>et al</i> , 2003 ^{1, 2} ; Norwood and Mansfield 1999; Huang and Chou 2006; Saunders 1998; Kumaraswamy 1998; Tam and Leung 1997; Asian Business 1996; Rondeinelli 2004; Asian Development Bank Report 1996; Tang <i>et al</i> , 2010; Liddle 1997; Pongsiri 2002; Pahlma 1996;
Globalisation	McGrew 1992; European Commission's Directorate-General for Energy and Transportation 2006; Collin 1998; Grant 1996; Yakowenko 2004; National Economic Development Office 1986; Gomez-Ibanez 1996; Sclar 2001; Grimsey and Lewis 2005; Liu and Cheah 2009; Tam 1999; Kumaraswamy 1998; Kumaraswamy and Morris 2002; Akintoye and Beck 2009; Myteka 2000
Market Maturity	Deloitte 2006, 2009; Siemiatycki 2010; Partnerships UK 2007; Royal Institute of Chartered Surveyors 2011; Charles 2006; Asian Business 1996; Henderson and McGloin 2004; Rondeinelli 2004; Woodward 1997; Charoenpornpattana and Minato 1997

Source: Adetola *et al*, (2011a)

The severity of the current global financial crisis is underscored by the collapse of large financial institutions which constitute the pillars of the global economy. Other consequences of the global economic meltdown are negative economic growth, growing unemployment, rising inflation and crashing stock markets. Collaborative engagement approaches for delivering sustainable infrastructure might be alternative strategies for cushioning the effects of the global recession. This approach may re-define the role of government in infrastructure provisioning, transforming its status from a provider to that of an enabler and regulator. This shift in the method of infrastructure delivery underscores the realisation that the traditional approach probably is no longer sustainable in the face of the dwindling resources of the state and inefficiency in the public sector. A new and increasingly popular strategy of social service delivery with global endorsement, brings to the fore the need for private sector participation in the management of infrastructure both in terms of providing the needed huge capital, and injecting greater efficiency into the operation of public utilities. The attributes, motive, interest and operational strategies of the private sector often differ from that of the public sector. For example, the goal of the public sector is to provide equal social welfare services to the citizens, while the private sector on the other hand aims at maximising profit on investment. These conflicting objectives may create push-pull forces between the two sectors as shown in Figure 2.1.

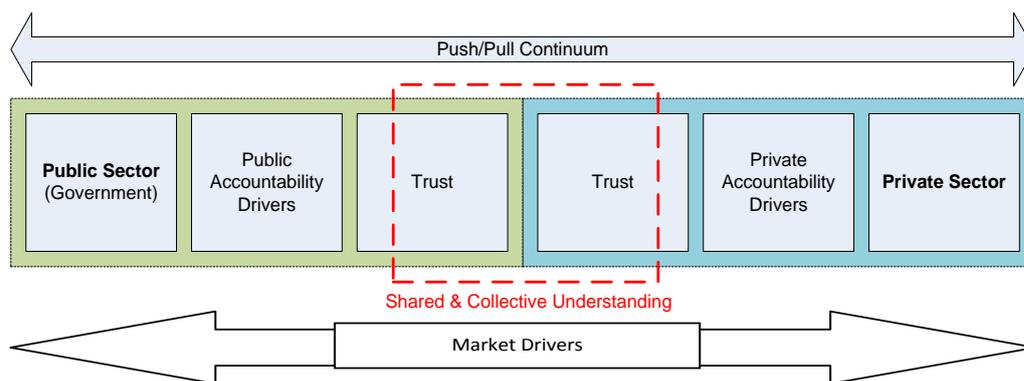


Figure 2.1: Equilibrium of Push-Pull forces between Public and Private Sectors. Source: Adetola *et al*, (2011a)

This model would allow stakeholders (Public and Private sectors) to partner/ work together and share risks, responsibilities, resources, rewards, skills and assets in order to deliver sustainable

infrastructure for the general public. The framework is a mechanism that would lower divergences in interests and foster cooperation.

2.11. SUMMARY

The provision of infrastructure services is a critical factor for economic growth and contribution to GDP. For example infrastructure, is the capital stock that provides public goods and services, the provision of which acts as a formal conduit for leveraging economic and market drivers. Through traditional procurement systems, the government / public sector builds or purchases a physical asset, retains ownership; and operationalises these (along with the associated risks) to deliver the required service. In this respect, extant literature is now highlighting the importance of embracing new collaborative engagement approaches to effectively share and manage risks and rewards.

Given these developments, private investment through an array of models is increasingly playing an important role in public infrastructure services development in particular. Moreover, private sector on the other hand seems to be well placed in providing bespoke skills and services to deliver infrastructure needs. Notwithstanding this, it is advocated that an important “ingredient” in collaborative arrangements is that of trust; as building and developing this through effective communication between project participants is often cited as being crucial to project success. Given this, Public-Private sector Collaboration can be used to leverage a unique ‘esprit de corps’ to deliver customer satisfaction, ‘value for money’ and win-win positions.

This chapter identified Relationships, Trust, Risk Allocation, Legal and Regulatory Framework, Communication, Technology, Finance, Skills/ Competence, Globalisation and Market Maturity as ten vital areas that impinge upon collaborative arrangements. These areas need to be appropriately captured, managed and aligned to existing business models to successfully deliver sustainable infrastructure projects. Research findings underpin the need to support these ten core drivers through some formal model/ framework. Thus, the implications from this research advocate the need to capture and prioritise both cognate and non-cognate drivers in order to assess the magnitude of the “push-pull” continuum identified in Figure 2.1.

The public sector has traditionally financed and operated infrastructure projects using resources from taxes and various levies (e.g. fuel taxes, road user charges). However, the rapid increase in human population growth coupled with extended globalisation complexities and associated social / political / economic challenges have placed new demands on the purveyors and operators of infrastructure projects. The importance of delivering quality infrastructure has been underlined by the United Nations declaration of the Millennium Development Goals; as has the provision of 'adequate' basic structures and facilities necessary for the well-being of urban populations in developing countries. Thus, in an effort to finance developing countries' infrastructure needs, most countries have adopted some form of public-private collaboration strategy. This chapter critically reviews these collaborative-engagement approaches, identifies and highlights 10 critical themes that need to be appropriately captured and aligned to existing business models in order to successfully deliver sustainable infrastructure projects. Research findings show that infrastructure services can be delivered in many ways, and through various routes. For example, a purely public approach can cause problems such as slow and ineffective decision-making, inefficient organisational and institutional augmentation, and lack of competition and inefficiency (collectively known as government failure). On the other hand, adopting a purely private approach can cause problems such as inequalities in the distribution of infrastructure services (known as market failure). Thus, to overcome both government and market failures, collaborative approach is advocated which incorporates the strengths of both these polarised positions.

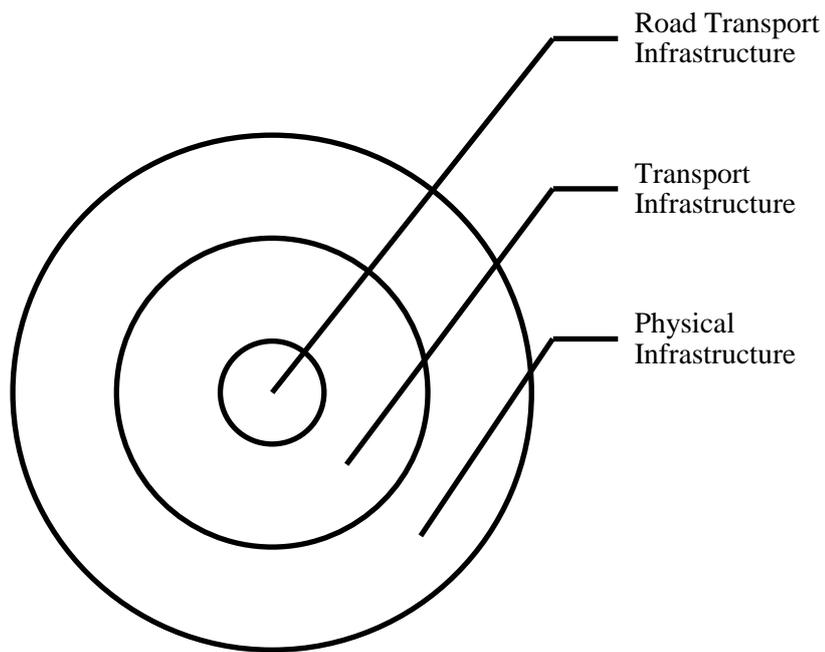


Figure 2.2: Focus of the study

This study centres on road transport infrastructure management (see Figure 2.2). Therefore, the next chapter presents a discussion on road transport infrastructure management.

CHAPTER 3: ROAD TRANSPORT INFRASTRUCTURE MANAGEMENT

3.1. INTRODUCTION

This chapter articulates the economic importance of road transport infrastructure and presents road infrastructure management in various countries. The chapter also highlights the procedure for launching a collaborative road infrastructure management.

Transport is a means of conveying people, goods and services from one place to another, and across several communities through road, rail, air, water, tunnel and pipeline. The term is derived from the Latin 'trans' (across) and 'portare' (to carry) (Brockenbrough and Boedecker 2007). Transportation plays a crucial role in shaping the destiny of many nations because modern industry and commercial activities seem to rest on appropriate, well developed and efficient transport systems. It performs a critical role by allowing raw materials to be moved from farm to factory, and finished goods from factory to market, thereby enabling products to be made available at locations desired by the consumers (Potter and Lalwani, 2008). Other activities which require the movement of people include farming, agriculture, education, recreation and social contacts, employment opportunities, health services, economic activities, general development of the community, and maintenance of law and order. Emergency services rendered by most agencies also depend on street and highway systems for optimal efficiency (Brockenbrough and Boedecker, 2007). Thus, the extent to which a nation's land mass is covered by road networks is often an index of the degree of mobility of people, goods and services within the country, and the quality of the network measures the ease and cost of that mobility (Adesanya, 1998).

A road can be described as an identifiable thoroughfare, route, or way between two places, which typically has been improved to allow travel by some conveyance, including a horse, cart or motorised vehicle. Traditional roads were simply recognisable routes/ paths without any formal construction or maintenance while modern roads are normally smoothed, paved, or otherwise prepared to allow easy travel on land via carriageway. Road transport seems to consist of two distinct segments: road transport services and road transport infrastructure. Road transport services often serve the public or

commercial customers directly, and are in most cases privately owned and operated (e.g. commercial vehicles, buses, cabs/ taxis, and tricycles). On the other hand, road transport infrastructure consists of the fixed installations used by the road transport service providers (i.e. road network). Road transport has trip origin and destination through terminals where passengers can embark, or where goods and services can be loaded or off-loaded in urban areas (Kendrick *et al*, 2004).

3.2. ECONOMIC IMPORTANCE OF ROAD TRANSPORT INFRASTRUCTURE

Transport plays a key role in the economic and social development of every nation. In this respect, Heggie and Vickers (1998) described public road network as the largest public infrastructure asset. The predominance of road transport as the means of passenger and freight movements in Sub-Saharan Africa underlines the economic importance of roads (Brushett 2005). The value of road asset and cost implications of delayed maintenance to a nation's economy and the road user underscore the invaluable role of maintenance. For example, in Sub-Saharan African countries, the costs of degraded road network to road users are often very high and consequently hinder national economic development potential. In other words, poor road condition often translates into higher vehicle operating costs and lengthier travel times (Brushett, 2005). In this regard, road networks may be considered as an asset which needs to be maintained and improved in order to ensure the best performance, value-for-money and the maximum service-life. Effective management enables the road network to withstand the damage caused by wear and tear, prevents substandard conditions from developing, and ensures the flow of traffic in a safe, efficient and reliable manner with little or no damage to the environment. Thus, well maintained road networks that provide the level of service needed by road users are critical and important elements of development (Transport Research Laboratory, 1998).

The users of effective highway facilities tend to benefit from enhanced ease of travel, safety and economy of time. The owners of abutting property also benefit from better access and increased property values. A good highway system often makes for effective emergency service and better street parking. Concentration of people in urban areas might be greatly reduced, as an efficient transportation system encourages the people to live in places away from their work centres. Thus, it

may help in decreasing the growth of slums in urban areas. Highway systems may also have an impact on the overall economy by lowering the cost of producing and distributing goods and services which make up the economy and directly feeds the Gross National Product (GNP). Furthermore, it tends to generate employment since a considerable number of jobs may be highway-related and expenditure on highways seems to form a big portion of the GNP (Queiroz and Gautam, 1992). The provision of highways probably makes easier the defence of a territory against aggression and the task of guarding the borders.

In the traditional procurement system, the public sector (government) assumes all the responsibility for developing a road project and bears most of the risks associated with its operation and maintenance. Such risks include problems with the quality of road design and construction, delays in the construction schedules, cost overruns, and shortfalls in estimated/projected traffic volume and road revenue (tolls). However, public private collaboration (PPC) has been widely acknowledged to provide the required fund and deliver road projects more quickly at a lower cost than is possible through the traditional method. This arrangement can secure financing for a project through private sources that may require more accountability and assign greater responsibility to private organisations for carrying out the work (Tang *et al*, 2010).

Public-Private Collaboration has developed into widely applied delivery vehicle for complex infrastructure projects, rising above international borders and diverse governmental structures to form an essential pillar for universal economic growth (Liu and Cheah, 2009). In this respect, Deloitte (2009) constructed a global 'market development curve' for countries delivering infrastructure through public private collaboration. The curve classified international markets at different stages of maturity cycle. The development stages include 'low', 'sophistication', and 'high'; while countries with insignificant or no performance were unclassified. The curve ranked the UK and Australia as 'highly matured' in delivering transport infrastructure through PPC, and postulated that Portugal has the potential to leapfrog from the 'sophistication' stage to 'highly matured' class. Consequently, the choice of countries in this review was influenced by Deloitte's classification. The UK and Australia were selected from the 'highly matured' category; Spain, New Zealand and Portugal were selected

from the ‘sophistication’ stage; and South Africa, China, Brazil, India, Slovakia and Croatia were selected from the ‘low’ group (see Figure 3.1). Furthermore, the countries of South Korea, Slovenia, Ghana and Morocco were selected from the unclassified markets.

The aim of this chapter is to compare different institutional and financing arrangements for road infrastructure management in various countries and highlight salient lessons. In order to achieve this, the next section of this chapter presents a review of the institutional and financing arrangements in different countries. This is followed by discussion and reflection, and conclusion. In this chapter, the terms public private collaboration and public private partnerships are used interchangeably.

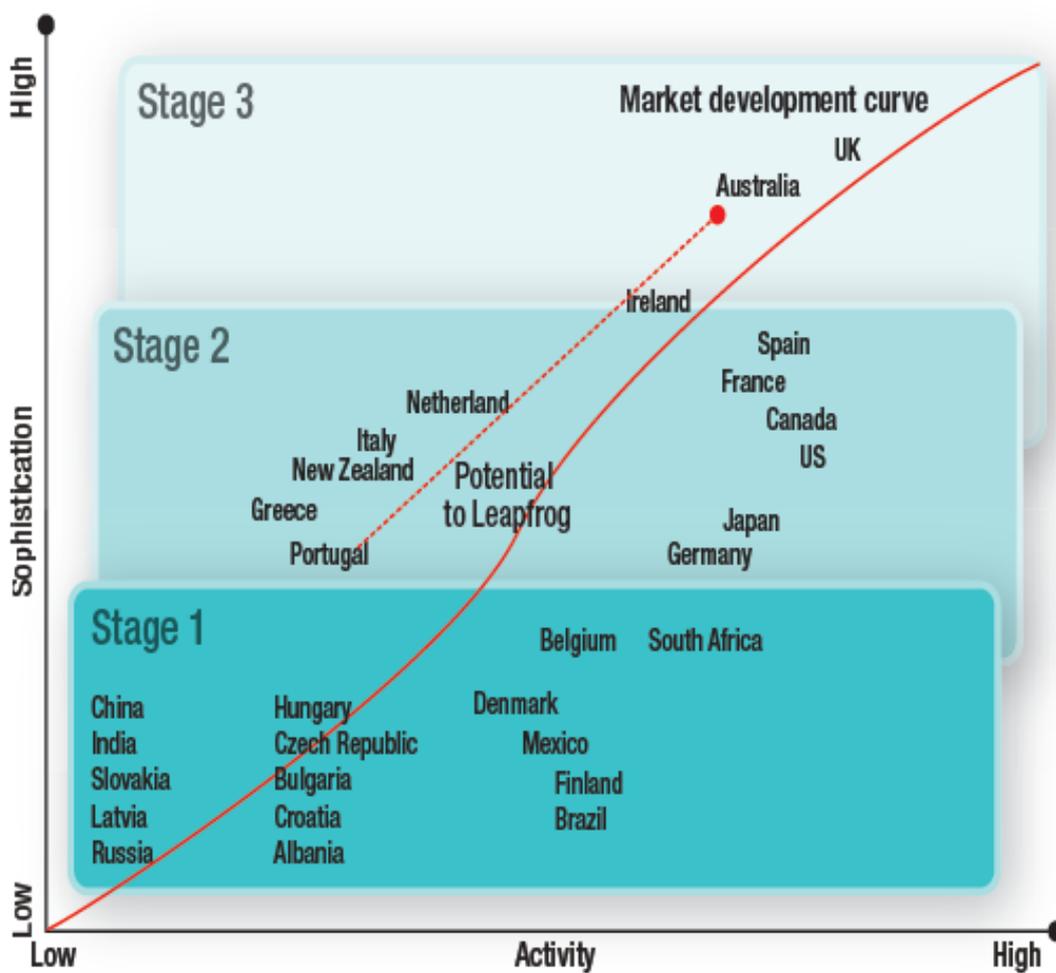


Figure 3.1: Public-Private Collaboration Market Maturity Curve. Source: Deloitte, (2009).

Throughout the world between 1985 and 2009, more than 950 transportation facilities worth over US\$550 billion were newly built, upgraded, or operated through PPP (Public Works Financing 2009). The UK has been widely recognised as the pioneer and leading nation in delivering transportation through PPP, alongside such countries as Australia, Spain, South Korea, Canada, Ireland, France, China and Brazil (Deloitte 2009; Smyth and Edkins 2007). The various forms of Public-Private Collaboration include Private Finance Initiative (PFI), Build-Operate-Transfer, Build-Own-Operate-Transfer, Build-Own-Operate, and Design-Build-Finance-Operate/ Maintain (see Sections 2.5.1; 2.5.2.1; 2.5.2.2; 2.5.2.3; and 2.5.3.1 in Chapter 2).

3.3. ROAD TRANSPORT INFRASTRUCTURE MANAGEMENT

This chapter presents a review of different institutional and financing arrangements adopted for road infrastructure management in selected ‘highly matured’, ‘sophisticated’, ‘low’ and unclassified PPC markets. By implication, these markets also represent the developed and developing countries. A developed country can be described as a nation which has achieved (currently or historically) a high degree of industrialisation, high per capita Gross Domestic Product (GDP), high human development index, and enjoys higher standard of living which wealth and technology make possible (World Bank 2011). These countries are financially independent and self-sufficient hence, their citizens enjoy a free and healthy life in a safe environment. In common practice, Japan in Asia, Canada and the United States in northern America, Australia and New Zealand in Oceania, and Western Europe are considered ‘developed’ regions. In addition, the Southern Africa Customs Union is also regarded as a developed area in international trade statistics. On the other hand, a ‘developing’ country can be described as a nation which has not achieved a significant degree of industrialisation relative to her population, has a low level of material well-being, and low per capita income. The citizens of a developing country endure low/poor standard of living. According to the World Bank (2011), Sub-Saharan African countries are typical examples of developing countries.

3.4. ROAD INFRASTRUCTURE MANAGEMENT IN HIGHLY MATURED PPC MARKETS

3.4.1. Road Infrastructure Management in the United Kingdom

Road transport may have a central role to play in the continued growth of Europe's economy, since goods are expected to be delivered door-to-door to all corners of the continent, quickly and on time (European Commission Directorate-General for Energy and Transport, 2006). The demand for this kind of high level of mobility and flexibility apparently can only be met through road transport. The existing policies and regulations in the European Union (EU) road transport sector aims at providing a single harmonised regulatory framework in order to ensure the free movement of people, goods, services and capital within the continent. The road transport sector has been reported to have continuously contributed immensely to the European economy. In this respect, it conveys about 73% of goods on land, provides about 4.5 million jobs, and generates a turnover of about 1.6% of EU 'Gross Domestic Product'. Road transport is also expected to carry the greatest percentage of the estimated increase of goods between EU Member States. This is projected to increase by 50% between now and the year 2020 (European Commission Directorate-General for Energy and Transport, 2006). Furthermore, other modes of transport appear to depend largely on an efficient, safe, cost effective and vibrant road transport system, since most freight and passenger journeys often start and end with a trip on the road. This implies that road transport therefore plays a vital role in the development of Europe's integrated transport networks and intermodal transport solutions.

In the United Kingdom, the Department for Transport (DfT) was established in order to deliver the government's transport scheme. The Department formulates policy and strategy, establishes and manages relationships with the organisations responsible for transport delivery. The DfT has seven executive agencies that are central to delivering the government's transport policies, priorities and services. These include: Driving Standards Agency, Driver and Vehicle Licensing Agency, Vehicle Certification Agency, Vehicle and Operator Services Agency, The Highways Agency, Government Car and Dispatch Agency, and Maritime and Coastguard Agency (Queiroz and Kerali, 2010). The Highways Agency UK (established in 1994) is responsible for operating, maintaining and improving

the strategic road network in England on behalf of the Secretary of State for Transport. The strategic road network consists of motorways and major trunk roads, while other roads are managed by Local Authorities. The primary functions of the Highways Agency UK are to manage traffic, handle congestion, make traffic information available to road users, ensure safety and journey time reliability, while respecting and minimising any negative effect on the environment.

For effective management of England's strategic network, the Highway Agency has divided the country into fourteen areas, each of which is assigned an Area team and a general engineering contractor known as a Managing Agent. Each Area team and corresponding Managing Agent is responsible for the maintenance of the Agency's roads in their area. The Managing Agents serve as general engineering consultants who support the Area teams in developing preliminary designs and overseeing the works of project design and construction contractors (AECOM, 2007). In other words, the Agency seems to have bundled portions of the motorway system into commissions and then requests tenders from consultants to take over the maintenance of all road infrastructure within the commission to a specified quality. The successful consultant then arranges a viable term contract between the client (Department of Transport) and the contractor who then undertakes all works based on the advice of the consultant. For example, in West Yorkshire, one of the leading commissions with 330km lane, 420km drains, 305 bridges, 950 road signs and 3,400 lighting columns, there was a cost reduction of about 15% based on the new scheme (Kerali, 2008).

Private sector participation in infrastructure provision and management began in the United Kingdom in the 1980's. This paved the way for the Private Finance Initiative (PFI) which was introduced by the national government in 1992. PFI is a specific UK policy to increase private sector participation in infrastructure financing and provision. The motive behind the PFI policy include: dissatisfaction with the results of the conventional construction contracts which were characterised with schedule slippage, cost overruns, and high asset life-cycle costs; infrastructure deficit; limited public funds; desire to transfer more risk to the private sector; and the desire to get better value for public sector expenditures (Akintoye and Beck 2009). Since 1992, over 67 transportation projects costing more than US\$42 billion have been delivered through PFIs, and an additional 12 projects are in the

planning pipeline in UK (Her Majesty Treasury 2009). The first three highway infrastructure procured through PPP/ PFI concession arrangements were Queen Elizabeth 11 Bridge, Second Seven Crossing, and M6 Toll which employed real tolls to secure private financing. Since 1996, new PPP agreements abolished real tolls and made road use free at the point of use to drivers. Most of the PPP highways in England are delivered through the DBFO contract arrangement using shadow tolls (see Table 2.2), in which the concessionaire finances the project and is reimbursed directly by the Government through road availability payment, vehicle-based payment, or active management payment over the term of the concession agreement. This method of payment eliminates the installation of tolling equipment, collection of tolls directly from the road users, and encourages the concessionaire to operate and preserve the motorway at high performance standards. Report has it that the total cost of PFI projects in UK is about £60 billion (Federal Highway Administration, 2009).

The United Kingdom has about 394,428 kilometres of road network. Of these, the National Motorway System has a network of 7,100km (see Table 3.1), and carries 33% of all traffic and 62% of freight. The percentage of the national motorway managed under PPP/PFI arrangements is expected to increase from 10% to 17% when the M25 project is procured. The M25, the orbital 400km motorway that encircles London has been described as the largest PPP project to date in UK. It is a DBFO concession model project, using a direct payment mechanism for a contract period of 30 years starting from 2009 (Queiroz and Kerali 2010). The Department of Transport and Local Authorities have also been executing projects under PPP contracts. With the exception of the M6 Toll, the national motorways under PPP arrangements use either shadow tolls or direct payment mechanisms exclusively. While early PPP contracts employed shadow tolls based only on traffic volumes, more recent PPP agreements have adopted a payment mechanism based on such factors as safety performance, lane availability, congestion, and minimum performance criteria. However, funding challenges seem to suggest the use of real tolls on future highway PPP projects (Federal Highway Administration, 2009).

3.4.2. Road Infrastructure Management in Australia

There are three levels of government in Australia. These are the Commonwealth/ National, State and Local governments. At each level of government, there are also a number of agencies responsible for road infrastructure management. Road network in Australia can be broadly classified as arterial and local roads. Arterial roads are roads that mainly connect one region to another, thereby forming major avenues of travel for traffic movements. On the other hand, local roads are streets or roads primarily used for access to adjoining properties. Both arterial and local roads are usually further subdivided into urban and rural roads. In addition to arterial and local roads, some roads of ‘national significance’ otherwise referred to as the National Land Transport Network comprising important national and inter-regional land transport passageways are funded by both the Commonwealth and state governments (Austroads 1998; Hodge 2004).

Arterial roads are owned, funded, operated and maintained by State Governments while the local roads fall within the ownership, management and jurisdiction of the Local Governments. However, both State and Local Governments receive financial assistance from the Commonwealth Government for managing road networks. The agencies responsible for managing the 818,356 kilometres of road network at different levels of government in Australia include the Commonwealth/National Level Agencies; State Level Agencies; Local Level Agencies; The Australian Transport Council; The National Transport Commission; The Department of Infrastructure, Transport, Regional Development and Local Government; Infrastructure Australia; Road Traffic Authorities; Local Government Grants Commissions; Local Government Associations; and Local Governing Bodies (Austroads 1998; Federal Highway Administration 2009).

The Australian Transport Council is a national body/ forum comprising Commonwealth, State, Territory and New Zealand transport ministers in charge of roads, marine and port issues. It offers advice to governments on the co-ordination and integration of all transport policy issues and also considers and approves recommendations made by the National Transport Commission. The National Transport Commission is an independent statutory body responsible for advising and making recommendations for reform on the land transport system (road, rail and inter-modal connections) to

the Australian Transport Council. The body also helps to co-ordinate and implement the approved reforms in order to improve efficiency and ensure that national uniformity and consistency is maintained. This agency derives its fund from contributions by the States and Commonwealth Governments in the ratio of 65% and 35% respectively (Hodge 2004).

The Department of Infrastructure, Transport, Regional Development and Local Government assists the Commonwealth government to promote, evaluate, plan and invest in infrastructure (including roads). The body offers advice on planning and investment in infrastructure, regulation, policy development and administration of funding programmes. Infrastructure Australia is a body that is responsible for co-ordinating Australia's economic infrastructure and reports to the Federal Minister for Infrastructure, Transport, Regional Development and Local Government. The agency also offers advice on the policy, regulations, access, implementation and financing mechanisms for infrastructure (Austroads 1998).

Road Traffic Authorities exist in all States in Australia. The body is generally responsible for managing the arterial road network, road safety administration, drivers' licence and vehicle registration. The agency may also help to coordinate local government planning and provide technical and financial assistance to local governments. Local Government Grants Commissions is responsible for making recommendations to State governments about modalities for the allocation of identified road grants to local governments. Local Government Associations are the peak representative bodies for local governments. The Associations may be involved in road infrastructure policy development, operations and management (Hodge 2004).

There are about 565 local governing bodies in Australia owning, operating, maintaining and managing about 660,000 kilometres of local road network. In this respect, the agency receives grants from the Commonwealth Government. Similarly, local governments may also receive fund from state governments in order to provide and maintain arterial (State) roads (New South Wales, 2006).

Unlike Portugal, Spain and the United Kingdom where PPP policies and programmes are controlled at the national level, PPP activity in Australia is prominent in three States to make easy the development

of major segments of highway infrastructure in their urban areas. The States are New South Wales (NSW), Victoria, and Queensland while the urban centres are Sydney, Melbourne and Brisbane respectively (Hodge 2004).

The desire for direct pricing of road usage, the intention to transfer major risks to the private sector, the potential to implement congestion pricing, the notion that market risks and rewards provide incentives for prompt delivery of projects by the private sector, and public sector budgetary constraints prompted the adoption of PPP in New South Wales in the early 1990s (Austroads, 1998). The General Government Debt Elimination Act of 1995 and the Fiscal Responsibility Act of 2005 enacted by the NSW state established principles of financial management and specified that the state should maintain debt levels at certain thresholds. This debt stabilisation policy influenced financing decisions on the Cross City Tunnel project (New South Wales, 2006).

The Office of Infrastructure Management develops and updates a rolling 10 year plan for all infrastructure systems in NSW. This plan, otherwise referred to as the State Infrastructure Strategy (SIS) draws greatly from the agencies Asset Strategies, Capital Investment Strategic Plans, and other strategies at municipal/ regional levels. NSW has a total network of over 20,000km state roadways, regional and local roads. The first collaborative highway project in the State was the Sydney Harbour Tunnel which became operational in August 1992. The State has also delivered seven additional PPP contracts in order to complete the ring road around Sydney. Similarly, about three other facilities were recently procured within a five year period. These include the Cross City Tunnel, the M7 Motorway, and the Lane Cove Tunnel. The NSW currently has about 108km of state highway under PPP arrangements (Austroads 1998; Hodge 2004).

The general believe that private sector participation could drive growth and efficiency, coupled with the desire to limit public debt burdens, led to collaborative infrastructure procurement in Victoria. In this regard, the Melbourne City Link Act permitting PPP contracts was passed in Victoria in 1995. The State has a total network of about 22,000km of metropolitan and rural arterial roads, and two highway PPP agreements. These agreements include a 22km City Link highway commissioned in

2000 to provide a north-south connection to Melbourne's Central Business District and airport; and a 40km East Link highway opened in 2008 to provide another north-south connection on the eastern border of Melbourne (Federal Highway Administration, 2009).

Public-Private Collaboration started in Queensland with the 6.8km North-South Bypass Tunnel initiated by the Brisbane City Council in 2005, and the Airport Link / Northern Busway project initiated by the State Government in 2006. The Airport Link/ Northern Busway project was a multifaceted \$4.6 billion connection between Brisbane and the Airport. Queensland has a total network of about 33,500km State-controlled roads with two PPP agreements. The State Main Roads rolling five year Roads Implementation Plan outlines projects totalling \$16.2 billion. Furthermore, the Brisbane City Council has set up a Brisbane Transport Plan Update 2006-2026, and the TransApex Study of 2004 focused on an inner-city orbital motorway system to create three new high capacity river crossings (Hodge 2004; Federal Highway Administration, 2009).

These three states in Australia seemed to have used somewhat similar contract administration and management methods. The Roads and Traffic Authority has an oversight function of the highway system and PPP programme in NSW. In Victoria, temporary public authorities were created to manage the delivery of its highway projects pending the time the state's highway agency, 'VicRoads' would take over the administration and management of the state contract. Similarly, Queensland established an autonomous public agency to acquire the AirportLink, pending the time the state's Department of Main Roads would take over the management of state contract. Furthermore, real tolls are used for highway PPP contracts by all these states. Report has it that collaborative highway management seem to have improved commuter and freight travel in densely populated cities of Sydney, Melbourne, and Brisbane in Australia (Austroads 1998; Hodge 2004).

3.5. ROAD INFRASTRUCTURE MANAGEMENT IN SOPHISTICATED PPC MARKETS

3.5.1. Road Infrastructure Management in Spain

Private sector participation in highway infrastructure management in Spain began in 1960 with the approval of the concession for the Guadarrama Tunnel project. At that time, the Spanish government

realised that the nation's infrastructure requirements exceeded its public funding capacity. An earlier (1953) legislation had allowed private organisations to develop and manage toll-ways for a maximum period of 75 years. However, a new legislation came into law in 1960 to make the public sector more flexible in concession arrangements and attract the private sector. This gave birth to the Cadiz Bay Bridge concession (which has been toll-free since 1982), and the Cadi Tunnel concession which is now managed by the Autonomous Community of Catalonia (Spanish Institute of Foreign Trade, 2006). Furthermore, by 1964, a blueprint for Spanish National Expressway System was made, which estimated/proposed the development of about 3,000 kilometres of expressways by 1980. A general legal and regulatory framework which served as the bedrock for concession arrangements (till 2003) was established and passed through Law 8/1972. Similarly, Law 13/2003 was enacted to reinforce private financing of public infrastructure and improve the legal framework (through a new risk-sharing method). Federal Highway Administration (2009) reported that this law was also superseded by Law 30/2007 which was recently promulgated to regulate all public sector contracts including public works concessions.

Spain has no national highways agency hence, highway infrastructure is managed by the Director-General of roads who also has an oversight function of the national PPP programme. The Director-General reports to the Secretary-General for Department of Development. Similarly, the government team representing the Ministry of Public Works play a prominent role in the administration and management of PPP contracts at the Autonomous Communities which also have their own roadway agencies. Spain has a total road network of about 681,298km, highway of about 30,000km, out of which about 16,000km constitutes the National Highway System. About 4,300km of the national highway is under PPP procurement (see Table 3.1). Presently, about 1,500km of highways network enhancements and upgrades are also being delivered through PPP. This is expected to increase the national highway infrastructure under PPP to 5,800km. About 3,800km of the national highways under PPP attract real tolls, while 500km use shadow tolls. Furthermore, the Autonomous Communities also initiate PPP road projects and receive funding and management assistance from the national government. Since year 2000, a vast majority of transport concession contracts have been on

road projects. Spain has a 15 year national plan spanning 2005-2020 for different transportation modes, during which about 25% of the required fund for managing national highways and roadways is expected to be sourced from non-budgetary concession arrangement sources (Federal Highway Administration, 2009; Vassallo and Gallego, 2005).

Since 1960, Spain has pioneered the procurement of infrastructure through the concession model and has continuously sought for better ways to improve the effectiveness and efficiency of the approach. Spain currently depends heavily on real tolls, and therefore may need to construct toll-free connector roads as part of its concession contracts.

3.5.2. Road Infrastructure Management in Portugal

For the past four decades, the Portuguese Government has adopted PPP extensively to develop and manage its National Motorways System. This decision was mostly driven by her compliance with the European Union convergence criteria of adopting euro, and reducing public debt and budget deficits. The first concession for a tolled motorway was approved in 1972 with the establishment of Brisa (a private company). However, the ‘Carnation Revolution’ in 1974 made the Portuguese Government to acquire major shares in and assumed ownership of Brisa as a State-owned enterprise. By the 1990s, the government privatised Brisa and increased the number of private companies taking part in highway infrastructure concessions in order to promote competition and development in the industry (Transportation Research Board, 2009). This arrangement helps to increase private sector capacity, facilitates the execution of the National Road Plan, improves public safety, and allows public funds to be invested in other areas. Similarly, in an attempt to move government debts off the national balance sheet, three public agencies (Instituto das Estradas de Portugal, Instituto para a Construcao Rodoviaria, and Instituto para a Conservacao e Exploracao da Rede Rodoviaria) were converted into a State-owned enterprise, Estradas de Portugal, S.A. (EP). EP was charged with the responsibility for oversight and development of the Portuguese National Highway network. The company holds a 75 year concession with the national government to develop and manage the national highway system, execute future PPP agreements on behalf of the Portuguese Government, and by implication acquire

all assets under existing PPP agreements at the expiration of such contracts (Federal Highway Administration, 2009).

Portugal has a total road network of 82,900km, and roadway/highway of about 16,500km. About 2,500km of the current 2,660km motorway system is operated under a PPP arrangement (see Table 3.1). This represents only 15% of Portugal's current total highways/roadways. Portugal employs direct real tolls and shadow tolls in order to generate the revenues required to support collaborative projects. In this regard, EP assesses the viability of the proposed projects, and makes recommendations on funding mechanisms to the national government which eventually decides the appropriate toll system. About 1,400km (55%) network of the PPP motorways presently attract real toll, 900km (37%) operate shadow toll, while 200km (8%) is toll-free. Toll-free motorway is achieved when a private partner constructs a connector road that does not attract toll as a part of an overall highway concession contract. In situations where traffic volumes are high and real tolls are sufficient to meet project financial requirements, shadow tolls become unnecessary (Federal Highway Administration, 2009).

3.5.3. Road Infrastructure Management in New Zealand

On August 1, 2008, the New Zealand Transport Agency (NZTA) was created. This agency incorporated all the activities of two former entities, Land Transport New Zealand (LTNZ) and Transit New Zealand (TNZ) in order to have an all-inclusive transport scheme encompassing planning, funding and procurement. It was discovered that the division of the functions of the two former agencies did not augur well for enduring planning, hence the merger of the agencies into NZTA. The activities of the NZTA are expected to contribute to an integrated, responsive, safe, viable (value-for-money) and sustainable land transport system, thereby supporting the updated New Zealand Transport Policy (Queiroz and Kerali, 2010). Before this development, TNZ had existed as a highway authority responsible for planning, designing, and development of annual national road programmes, construction, rehabilitation and maintenance of state highways. The TNZ also used to draw-up a long-term (10 year) development plan which was always submitted to LTNZ for consideration and approval. Furthermore, the agency had formulated standards, rendered support and

offered suggestions and collaborated with the LTNZ, the New Zealand Police and the National Road Safety Committee. On the other hand, the LTNZ had been responsible for specifying construction and maintenance standards, review and audit of highway management authorities, offered suggestions to local authorities, and formulated financial guidelines and assessed projects and determine viable pricing techniques (New Zealand State Services Commission, 2007).

The major tasks of the NZTA include managing the state highway system; land transport planning; allocation of government funding for land transport; regulating access to, and participation in the land transport network; and promotion of land transport safety and sustainability, including driver licensing, road signs, and ‘drive safe’ advertising campaigns. The NZTA appears to manage about 10,894 km of state highways, which represent about 12% of New Zealand’s roads, and about 50% of the 36 billion vehicle kilometres travelled each year in the country. The agency which seems to have about 4,000 representatives tend to process an average of 5 million vehicle registrations, 1 million vehicle ownership changes, 2 million road user licences, and 5.3 million warrants of fitness annually. Moreover, it seems to offer an important link between government policy formulation and the management of road transport infrastructure (Queiroz and Kerali, 2010).

3.6. ROAD INFRASTRUCTURE MANAGEMENT IN LOW PPC MARKETS

3.6.1. Road Infrastructure Management in South Africa

Since 1994, South Africa has adopted PPC in the provision of road infrastructure. The N4 Maputo corridor concession project was jointly awarded by the governments of South Africa and Mozambique on 5th May 1997 to Trans Africa Concessions Limited at a cost of USD 430 millions for a period of 30 years (Perez 2004). The tolled-highway has caused an increased traffic growth of 5 – 7 percent for passenger vehicles and 10 percent freight per annum (Haule 2009; Bhandari, 2011). South Africa has a total road network of about 754,000 kilometres, of which about 70,00km (9%) are paved. The Department of Transport is responsible for formulating road policy; while the South African National Roads Agency Limited (SANRAL), the nine provinces, and local governments undertake road construction and maintenance. In addition, SANRAL also manages the country’s 20,000km network of national roads. About 3,000km of the national roads attract tolls, of which 1,800km are controlled

by SANRAL, while the remaining 1,200km are under concession to private sector investors to develop, operate and maintain (Farlam, 2005; South African National Treasury, 2004).

3.6.2. Road Infrastructure Management in China

In China, the Ministry of Transport (MOT) is charged with the responsibility for policy formulation, monitoring, control and enforcement of standards, and regulation of all transport modes, except railways. The 27 Provincial Transport Departments (PTD) and the transport bureaus for the four mega cities namely Beijing, Chongqing, Shanghai, and Tianjin (which also have the status of a province) are responsible for detailed planning, engineering design, and construction of expressways and other selected roads in China (Queiroz and Kerali, 2010) . Since there is no national (central) road authority in China, the provinces finance about 66-90% of the capital cost of expressways through budgetary allocation and debt financing, while the private sector makes finance available on a limited scale through various types of concession schemes. However, as soon as the expressways are commissioned, their operations and maintenance are undertaken by the PTDs through a private company or other authorised organisations. This collaborative engagement strategy has resulted in the rapid expansion of the Chinese expressway network over the past 15 years (Queiroz and Kerali, 2010).

As at 1990, there were only 522 km of expressway in China. In 2005, the number increased to 41,000km, and by the time all links of the planned on-going National Trunk Highway System (NTHS) is completed in year 2020, the government of China looks forward to having a national expressway network of 85,000km (Wood, 2006). The system which was launched in 1990 is expected to produce expressways that would link all the major cities with each other as well as the ports. The NTHS, (also known as the 7918 network) links all provincial capitals as well as cities with a population above 200,000 and incorporates the 7 highways from Beijing, 9 North to South vertical expressways, and 18 East to West horizontal expressways. Furthermore, for greater integration of rural areas in the economic development process, the government of China plans to build and modernise about 270,000 kilometres of rural roads (World Bank, 2007). This development by China national government and the provincial governments appear to have created a 65,000 kilometres network of high capacity

expressway which now forms the basis for the on-going economic development in all sectors of the Chinese economy.

In an attempt to expand its NTHS, the government of China adopted a toll-based road network, using debt financing as a key vehicle for development. While management and finance of most of the expressway network rests in the public sector (government), China has adopted a public-private collaborative financing for a partial number of expressway projects (World Bank 2007). In this respect, the provincial governments construct a toll expressway, sets up an expressway corporation as a public limited company that is listed on the stock exchange to manage the facility, while the government sells shares in the toll expressway corporation to the general public. The money accruing from the sale of shares is used to construct new toll roads. The dividend earned by the shareholders is often determined by the profit generated primarily on the growth of traffic, inflation and approved toll increases. The toll revenue is used to offset the principal and interest of loans, while the remainder is used to pay the costs of maintenance, staff salaries and operating expenses. Consequently, between 2005 and 2010, annual investment on expressway financing in China stood at about US\$17 billion, out of which private investments accounted for about 7% (Heggie, 2008).

Several expressways in China were constructed through the 'one road- one company' model. This method allowed for debt control, proper examination of the feasibility of each major road segment, time structuring of the investments, targeted management of the capital formation, and contracting and supervision of construction, and in most cases provided a smooth transfer to operations (World Bank 2007). Furthermore, the model seem to accommodate most forms of collaboration, secured ownership, direct private sector investment, and various forms of leasing and concessions (Asian Development Bank, 2006). The BOT form of concession appears to have become popular in China, having been used to procure the 137km Lesham-Yibin expressway in 2005. In a comparative study of road transport infrastructure development in China and India, Postigo (2008) reported that China devoted priority attention to the construction of high standard highways and expressways with an investment of about 3.5% of the country's GDP, while India initially concentrated investment on

lower level district and rural roads. Furthermore, while China government plays an instrumental role in road infrastructure development, India has encouraged and relied more on the private sector.

Most provinces in China appear to have started charging tolls on goods vehicles in order to discourage overloading, and recover investment costs arising from the damage caused by overloaded vehicles. For instance in Hubei, the standard truck toll is set at RMB 0.08 per ton-km (about US\$0.01/ton-km) in a situation where a vehicle is overloaded up to 30% above its normal capacity. Similarly, an excess load ranging between 31-60% attracts a toll of RMB 0.16/ton-km, 61-80% overloading attracts RMB 0.24/ton-km, 81-100% excess load attracts RMB 0.32/ton-km, while 100% and above excess load attracts RMB 0.4/ton-km (Queiroz and Kerali, 2010).

3.6.3. Road Infrastructure Management in India

Historically, road projects in India were undertaken by the public sector (Government) and financed through budgetary allocation. However, the inadequacies of public funding have resulted in the use of alternative procurement models for road infrastructure provisioning. In this regard, the National Highways Act of 1956 was amended in June 1995 in order to attract private sector participation in road construction, operation and maintenance. The amended Act facilitated private investment in the national highway projects; empowers the private sector to levy, collect and retain user-fee; and regulate traffic on highways in accordance with the provisions of the Motor Vehicle Act of 1988 (Government of India, 2005).

The Ministry of Road Transport and Highway is responsible for the development and maintenance of national highways. The National Highways Authority of India (NHAI), an agency under the Ministry is responsible for constructing, upgrading and maintaining most of the national highway networks. The National Highways Development Project (NHDP) launched in 2001 and administered by the NHAI, forms the backbone of India's road network with a length of 66,590 kilometres carrying about 40% of the total road traffic. The NHDP is a major effort to expand and upgrade the highway network, and connect the four metropolitan cities of New Delhi, Mumbai, Chennai and Kolkata (the Golden Quadrilateral). This project is spread over seven phases and is expected to be completed by the year 2015. The BOT model of PPC which is in vogue in India assigns a leading role to the private

sector while the public sector (government) plays the role of a facilitator (Bahadur, 2006; Farrel, 2006).

India has a total road network of about 3,320,410 kilometres, of which 200km are expressways and 2,623,123km (79%) are rural roads. Road transportation carries nearly 65% of freight and 85% of passenger traffic in India (Government of India, 2007).

3.6.4. Road Infrastructure Management in the Slovak Republic

Road transport seems to be the most important mode of transportation in the Slovak Republic. It appears to be progressively gaining ground and has effectively relegated rail transport for short distance, high value, and time responsive consignment. In 2006, the road market share for passenger transport in terms of passenger-km was about 85%, while for freight in terms of ton-km was about 70%. The major objectives of the Slovak transport policy as enumerated by the Ministry of Transport, Posts and Telecommunications -MTPT (2005) are to improve the parameters of transport infrastructure in order to meet EU standards; develop transport infrastructure in order to enhance efficiency and quality of the transport system; improve the quality and safety of the infrastructure in order to reduce negative effects of transport on the environment; and improve accessibility of the regions to the trunk transport infrastructure (TEN-T Trans-European Transport Network). In an attempt to achieve these objectives, a suggestive financial arrangement was made by MTPT amounting to EUR 7,311 million for 2007-2013 periods. The sources of fund to sustain the 2007-2013 transport infrastructure programmes include state budget, EUR 3,158 million; EU funds, EUR 630 million; infrastructure charges, EUR 2,887 million; and public-private partnerships (PPP) in motorways and expressways, EUR 636 million (AECOM, 2007).

The Slovak Republic has a total road network of 43761km, about 337 km of motorways, 105 km of expressway and 17,840 km of Class 1, 11 and 11 roads. Motorways and expressways are under the jurisdiction of the National Motorway Company. The public road network includes about 3,080 km of national roads (Class 1) which is directly managed by the Slovak Road Agency, as well as 14,760 km of Class 11 and 111 roads managed by the country's eight regions. The Slovak Republic presently has a vignette system that charges heavy-goods-vehicles for road infrastructure use, although plans are

underway for its replacement by an electronic toll collection system. The annual income of the system is estimated at EUR 273 million in 2013 from vehicles having more than 3.5 tons weight (Ministry of Transport, Posts and Telecommunications, 2005).

3.6.5. Road Infrastructure Management in Brazil

The transport system in Brazil was restructured through Law 10.233 of 5th June 2001 which recognised and proscribed some agencies under the Ministry of Transport. The agencies which were set up by the law include the Brazilian National Agency for Land transport (Agencia Nacional de Transportes Terrestres, ANTT); the National Board for Integration of Transport Policies; the National Department for Transport Infrastructure; and the Brazilian National Agency for Ports and Waterways. The agencies which were proscribed by the law include: the Brazilian Transport Planning Agency; and the Brazilian National Highway Department (Amoreli, 2009). The National Department for Transport Infrastructure (DNIT) which derives its fund from the federal budgetary allocation is charged with the responsibility to plan/design, finance, construct, maintain and operate the federal highways, railways, waterways and ports in Brazil. The agency carries out the government's transport programme directly or through contracts and entrustments to other public agencies or the private sector. The activities of the agency include upgrading, expanding and maintaining the federal highway network; planning and construction of new railways; and dredging, expanding, modernising and maintaining ports and waterways (Queiroz and Kerali, 2010).

Brazil has over 1.7 million kilometres of roads, of which 172,897km are paved. The federal government manages a network of 57,211km (33%), the states control 94,753km (55%) while the municipal authorities look after the remaining 20,914km (12%) road network. Road transport service in Brazil consists of about 17.9 million cars, 3.087 million light commercial vehicles, 1.17 million trucks, and 258,000 buses. More than 60% of freight transport is conducted through the national highways. The ANTT manages the tolled 13,781km federal highway and the concession contracts awarded by the federal and other state governments. The tolled expressway concession contracts under the jurisdiction of the ANTT were given in two phases. The first phase, which was made up of 12 concession contracts covering 4,083km road was given to private concessionaires between 1994

and 1998 for 25 years. The second phase comprised seven concession contracts with a length of 2,601km road given to three different private concessionaires in 2008 for 20 years. The ANTT intends to invite tender for an additional 3,675km road from six states for the next phase of award. The states include Federal District, Minas Gerais, Bahia, Goias, Santa Catarina and Espirito Santo (Perrupato, 2009).

3.6.6. Road Infrastructure Management in Croatia

In recognition of the need for a new road infrastructure for economic, social, political and strategic development, the government of Croatia opted for a supply-driven investment policy for motorway infrastructure development in the late 1990s. This approach resulted in an increased and improved length of the national road network (800km) with about 3.5% of the country's GDP being expended on the development and operation of road network between 2001 and 2004 (Talvitie 2006). The Public Roads Act which was enacted in 2001 reorganised the Croatian Road Authority into two separate organisations: Hrvatske Autoceste (HAC), and Hrvatske Ceste (HC). HAC happens to be a joint-stock establishment wholly owned by the state, and responsible for the building and administration of the national motorway network, apart from the roads which are built or maintained by concessionaires. Similarly, the HC is also a joint-stock corporation which builds and operates all other state roads (about 7,000 km) that form the bulk of the road network, just as the county roads are operated and maintained by the County Roads Administration. The users and beneficiaries of road facility often pay user fees and taxes, and this seems to have had an impact on the economic viability of industries and services (Kerali, 2008; Talvitie, 1996).

The reorganisation demanded a new form of funding for the management of road facilities. The Public Roads Act allows for the right to grant the construction and operation of road to a private sector organisation, with the contract being administered by the Ministry of the Sea, Tourism, Transport and Development (MSTTD). In this respect, three road concession contracts were awarded between 1995 and 2004. The MSTTD oversees and monitors the activities of HAC, HC and the Counties and authorises their strategic plans through the road development planning and regular administrative processes. Road infrastructure development plan involves three stages; the method for

developing public roads is recommended by the MSTTD and approved by the legislative body. Based on the accepted approach, the Ministry draws up a four-year plan; after which the HAC, HC and the Country Roads Administration make one-year execution plan for the production and upkeep of public roads (Kerali, 2008).

The sources of fund for managing road infrastructure in Croatia seem to include long-term loan, fuel levy and tolls on motorways. The fuel levy appears to have been a regular source of fund to HAC and HC. Moreover, two toll methods seem to be in operation on the road-networks in Croatia: the open and the closed toll systems. The open toll method tends to apply at tolled road structures (i.e. bridges, tunnels) and on shorter road sections, where the toll is collected at either the entry or exit point. On the other hand, the closed toll system is often used on roads with many entrances and exits, hence, the road user collects a toll card at the entry point, and pays the toll commensurate with the distance travelled (as might be indicated by the toll card) at the exit point of the motorway (Queiroz and Izaguirre, 2008).

3.7. ROAD INFRASTRUCTURE MANAGEMENT IN UNCLASSIFIED PPC MARKETS

3.7.1. Road Infrastructure Management in South Korea

South Korea has a total road network of about 86,990 kilometres, of which 3,000km are expressways, 12,447km are national roads, 64,808km are paved while 22,182km are unpaved. The Korea Expressway Corporation is responsible for constructing, operating and maintaining most of the expressways in South Korea. Almost all freeways/highways/expressways/motorways attract tolls. Privately financed BOT concession roads include Nonsan-Cheonan Expressway, Daegu-Busan Expressway, Incheon International Airport Expressway, Seoul-Chuncheon Expressway and parts of the Seoul Ring Expressway (Amos, 2004).

3.7.2. Road Infrastructure Management in Slovenia

The Motorway Company of the Republic of Slovenia otherwise known as DARS, a joint-stock concern was created in December 1993 with a mandate to plan, organise, finance, render engineering services, construct and maintain the entire motorway network in Slovenia. Thus, in January 1994, the

management of all existing motorways including the 198.8 km of two-lane and four-lane motorways, expressways and 67.5 km of access roads; plant; and associated facilities were transferred to DARS (Kerali 2008). The organisation was authorised to collect tolls on the motorway in order to generate fund for the maintenance, management and construction of new roads. As at 2008, about 265 km of four-lane and two-lane motorways have been constructed and commissioned. Similarly, about 486.7 km of four-lane motorways and expressways with 130 km of access roads appear to have been managed by DARS. The sources of fund for this programme seem to include earmarked fuel tax, tolls, EU funds and loans. Furthermore, it appears it is now mandatory for all vehicles with allowable overall weight of up to 3,500 kg on motorways and expressways in Slovenia to use vignettes. The rationale behind the toll and vignettes which started in July 2008 is to make traffic flow better and trim down emissions to the environment, since it reduces congestion on toll stations. At toll plazas, cars with vignettes seem to use designated lanes that can be plied at speeds of up to 40 km/h (Queiroz and Kerali, 2010).

3.7.3. Road Infrastructure Management in Morocco

Morocco has a total road network of about 60,000 kilometres, of which about 36,000km (60%) are paved, and 600km are motorways/expressways that link places like Fez and Meknes and coastal cities of Asilah, Rabat and Casablanca. The Ministry of Equipment and Transport formulates policy for road facility in Morocco. The Mediterranean by-pass project, about 550km road network designed to link the cities of Tangier and Saidia is presently under construction. Road transport carries about 75% of goods traffic and 95% of passenger traffic in Morocco. Report has it that many roads are closed for a period of about 30 to 60 days a year due to severe weather (Brushett, 2005).

3.7.4. Road Infrastructure Management in Ghana

Road transport seems to be the predominant mode of land transportation in Ghana. It accounts for over 95% of passenger and freight travel. The cost of road construction and maintenance is borne by the government. In this regard, the Ministry of Roads and Highways formulates policy and oversees the activities of four other agencies. These agencies include the Ghana Highways Authority, Ghana Road Fund, department of urban roads, and the department of feeder roads. Ghana has a total road

network of about 62,221km, of which 9,955km (16%) are paved and 52,266km (84%) are unpaved. The Ghana Highways Authority, established under the National Redemption Council decree 298 of December 1974 is responsible for planning, constructing, operating, maintaining, and managing the country's 13,367km trunk road network and related facilities. A Trunk Road Network Stabilisation Programme comprises the Mobile Maintenance Unit (MMU) and Bridge Maintenance Unit (BMU). The MMU undertakes periodic and emergency maintenance of trunk roads while the BMU maintains bridges across the country. The Ghana Road Fund was established in 1996 to finance routine periodic maintenance and rehabilitation of public roads (Brushet, 2005; Benmaamar, 2006).

3.8. PROCEDURE FOR LAUNCHING PUBLIC PRIVATE COLLABORATIVE ROAD INFRASTRUCTURE MANAGEMENT

Construction project procurement is quite different from acquiring goods that can be purchased 'off the shelf' where an instant choice can be made in terms of quality and cost. The user-need/requirements of the client needs to be identified and clearly defined, while various procurement methods have to be considered in order to arrive at an appropriate/suitable procurement approach. A construction project often involves many stakeholders, long project duration and complex contractual relationships (Oyegoke et al 2009). Love *et al*, (2002) perceived procurement as an organisational system that assigns specific responsibilities and rights/authorities to people and organisations, and defines the relationships between the different elements of construction in a project. Therefore, construction project procurement establishes the contractual framework that determines the relationships between the project team members, different elements of a construction project, and the way in which works are placed in the market (Oyegoke *et al*, 2009). The Office of Government Commerce (2008) reported that PFI design and build, and prime contracting represent the majority of the procurement methods adopted by UK government clients.

Given the capital-intensive nature of collaborative infrastructure projects and the risks associated with them, the private investor/sponsor of a concession project often forms a separate independent company or legal entity under a special purpose vehicle (SPV) arrangement. The justification for SPVs is that the risks associated with a project are unique to that project and therefore should be

limited to that project. Furthermore, when a public sector (government) tender goes to market, interested private sector partners often pool skills and finances together in a consortium that will form the basis of the SPV, so the implementing partners are also unique to that project. The SPV also allows the private sector consortium to raise limited recourse funding restricted to the SPV, thus protecting the parent companies from the risks of the project failure. In this regard, the risks in-built in the design, construction, operation and maintenance of the asset are transferred to the private sector (Oyegoke *et al*, 2009). Queiroz (2005) identified the steps involved in launching a collaborative highway infrastructure management. These steps include defining the priority highway projects where the government requires private investors financing of either the whole or partial cost of the project, enacting the relevant regulatory laws/legislation, and carrying out a full scale feasibility and viability study of priority projects. Other steps which he identified include carrying out a comprehensive environmental impact and social assessment of the project in order to develop mitigation plan and strategy for acquiring land and securing the right of way, defining the required service/operation performance standard of the asset, and establishing the willingness of the road user to pay tolls. The experience with motorway development in the Czech Republic, Hungary, Poland, Croatia, Slovenia, Romania, and Serbia revealed that strong government support/engagement and an enduring political will are pre-requisites for a successful public-private collaborative arrangement (Queiroz, 2005).

3.8.1. Selection of a Private Investor/Concessionaire

The tendering process in PPP/PFI procurement might be more complicated and expensive than the traditional approaches. Thus, it may require negotiation rather than competitive tendering, or a well-structured tendering process that can minimise tendering costs and still encourage competition. When compared with other procurement methods, the time from commencement of the project to attaining a start on site may also be considerably longer. In this respect, many governments now develop systematic guidelines, standardised tendering documents and contracts to facilitate the tendering procedure, and adopt a multi-stage tendering process. These stages include inviting expression of interest, prequalifying tenders, evaluating tenders, and negotiating with the preferred tender(s) to select the most appropriate concessionaire (Birnie 1997; Kwak *et al*, 2009). The government

advertises the project in at least one international newspaper and one of national circulation in order to invite/elicit expression of interest from potential private investors to prequalify. The prequalification stage helps to shortlist only reputable, experienced and competent bidders for the project. In this regard, weaker tenders do not incur unnecessary tendering costs for the project. At the tenders' evaluation stage, only shortlisted tenders are allowed to submit detailed proposals which are examined in accordance with the pre-determined transparent assessment/selection criteria. Tender evaluation often focuses on technical and financial feasibilities of project proposals. A preferred tender is expected to satisfy certain criteria. These include confirmation of access to finance, acceptance of major contract terms and risk-allocation requirements, ability to meet project output specifications, whole life value for money, and a cohesive consortium. The best evaluated/preferred bidder is recommended for contract award. A contract award notice will be published immediately the agreement is signed, and the contract is implemented (Queiroz, 2005).

3.8.2. Essential Considerations When Adopting PPC

An extensive use of PPC by the developed countries such as Australia, the United Kingdom, and the United States have revealed the advantages and feasibility of such arrangements and re-defined the meaning of public service delivery. Granted that PPC has opened a door of opportunity for delivering essential public services, the experiences of these nations have also generated issues that need to be considered by developing nations when adopting PPC. The suitability of a project for PPC seems to depend largely on its ability to pay for itself and the benefit it offers to the public. In this respect, Anvuur and kumaraswamy (2006) identified the essential factors that may enhance the use of PPC in developing economies. These include adequate and regulatory frameworks, governmental support, a stable economic environment, fiscal and budgetary constraints, assurance of sound project cash-flow, and potential for improved services to the community. Though the non-existence of any of these factors may challenge PPC projects, the fatal factors which can endanger or 'kill' PPC projects include the lack of understanding of the concept of PPC, political instability, issues over transaction and tendering costs, and lack of a credible PPC market (Anvuur and Kumaraswamy, 2006).

3.9. DISCUSSION/ REFLECTION AND KEY FINDINGS

The importance of road transport to the economy and social development of a country cannot be over-emphasised. Traditionally, road infrastructure has been managed as a social service for the good of the public. However, managing road network today appears to have become increasingly challenging for all governments as demands increase and resources are limited (Adetola *et al*, 2013a). This review focussed on different institutional and financial arrangements used for road infrastructure management in the United Kingdom, Spain, China, Brazil, Portugal, New Zealand, Croatia, Australia, India, South Korea, and South Africa.

Early attempts at PPC contract began in the late 1970s with highway concessions in France and the mid-to-late 1980s in Spain and the United Kingdom. The economic reforms in the United Kingdom strongly encouraged efforts to privatise major elements of the nation's most developed transportation systems such as roads, transport service, rail, and aviation. The strongest impetus for infrastructure PPC occurred in UK in 1992 when the PFI legislative and regulatory reforms were established. This also made other countries in the British Commonwealth of nations such as Australia, New Zealand, Scotland and Canada to establish their own PPC initiatives. The emergence of PPC in Portugal and Spain was driven by European Union's convergence criteria. Since the United Kingdom is not part of the Eurozone, it is not bound to comply with EU convergence criteria. In this regard, the pressure to move liabilities off the public sector balance sheet appears not to be an urgent issue in UK. While collaborative arrangement is controlled at the national level in UK, Portugal and Spain, it is used primarily in three states (New South Wales, Victoria, and Queensland) in Australia to address mobility issues in their major urban centres. In addition, the UK has implemented a variety of changes overtime which has given birth to a standard PFI contract that is now in use. The Highway Agency (UK) has also realised the need to revisit contracts more frequently in order to evaluate potential changes, rather than allow changes to accumulate and attempt to negotiate a major contract modification. PPC in the UK have been predominantly Design-Build-Finance-Operate (DBFO) contracts financed by government-supported shadow tolls for highway projects and tolls for

bridge/tunnel projects (AECOM, 2007). PPC in Australia and New Zealand have been primarily used for private toll road projects, most of which seem to have been successful.

A project has been likened to a living organism that passes through the stages of conception, birth, growth and end product hence it is often structured in such a way that tangible deliverables are accomplished and visible from its beginning to its end. In this regard, construction projects are usually divided into project inception, design, tendering, construction, completion/handover, operation/maintenance phases. Each of these project phases is marked by the completion of one or more verifiable work product (Adetola, 2007). Similarly, each project phase has its associated risks, thus potential risks in PPC projects have to be identified, analysed and allocated to the partner best capable to manage them. The primary risks often associated with road projects include development risks, construction risks, and operation/maintenance risks. Development risks that may emerge during the life cycle of a road project may relate to land acquisition, design, sourcing for project fund, environmental clearance, credit-worthiness issues, change of government/political instability, inflation, foreign exchange rate, interest rate, force majeure, and market/demand. Construction risks arise during the course of constructing a project and may include such things as difficult site conditions, engineering and technical difficulties, poor performance of suppliers and contractors. Operation and maintenance risks are post-construction threats which may include wrongly estimated traffic volume/demand, toll levels, and the toll collection technology.

Risk allocation often requires a sound knowledge of the market and project finance principles for a balanced/equitable appropriation between the public and private sectors. For example, the public sector (government) might be capable of managing some developmental risks, while the private sector might as well absorb the construction and operation/maintenance risks. Furthermore, risk mitigation instruments can be employed to mobilise private capital to finance PPC infrastructure projects in which financing requirements significantly exceed budgetary/internal resources. These are financial mechanisms that transfer definite risks from project financiers (lenders and equity investors) to creditworthy third parties (guarantors and insurers) that have a better capacity to bear such risks. Risk

mitigation instruments are mostly useful when the public sector partner is not sufficiently creditworthy/has little or no partnership experience (Queiroz and Kerali, 2010).

In all the countries reviewed, there is a designated Ministry for Transport that formulates the overall transport policy and also responsible for establishing checks and balances for good governance and management of fiscal risk. In addition, some nations also have a separate agency to manage each transport subsector such as roads, railway, airports and seaports. In particular, China and India have a full-fledged autonomous Ministry of Railways managing that subsector. The review showed that countries have adopted different collaborative engagement approaches that are suitable to their needs and circumstances to manage their road networks. The need to improve the efficiency of managing and financing road infrastructure underscores the establishment of various institutional structures. In this regard, Queiroz and Kerali (2010) identified the factors affecting the efficiency of road transport management agencies. These include outdated management structures, lack of clear responsibilities, human resource constraints, weak management information systems, inadequate financing, and perception of roads as a public good.

This review observes that ‘large’ countries appear to decentralise, while ‘small’ countries centralise management authority. For example, the management of all tolled expressway network in China is delegated to the provinces, whereas, it is centrally controlled by the national governments in Portugal, New Zealand, Croatia, and South Korea. In addition, while China borrows money to finance highway/expressway construction and repays such loan with toll revenues, Brazil awards highway/expressway contracts to private concessionaires. All the countries reviewed finance road projects through budgetary allocations and toll revenues. In 2001, Brazil created an agency to manage highway and railway concessions, and another agency to manage non-concession roads, railways, waterways and ports. In contrast, Portugal, China and South Africa have single mode management entities. Furthermore, while most of the highway/expressway networks in Brazil are under concession contracts to private concessionaires, China manages her expressway networks through public corporation. Similarly, in several countries in Eastern Europe, road administration adopts a decentralised organisational structure which separates works implementation from project

management. In this regard, many units are established with specific functions such as planning, inspection/supervision, works implementation, and management. The Ministry of Transport defines the mission, goals, and annual budget of road administration, and delegates responsibilities. In addition, many regional/state implementation organisations are set up to carry out road works in accordance with agreements issued by the road administration or its regional/state offices. This is a clear departure from the traditional Public Works Department that employs thousands of people in many developing countries to manage public infrastructure in which road administration is centralised and its overseeing Ministry micro-manages the resource allocation and project prioritisation with political objectives (Queiroz and Kerali, 2010).

Private sector investment and involvement in infrastructure provisioning may encourage the development of new, innovative and creative strategies to financing, economies of scale, development, operation and maintenance of facilities. Similarly, the private sector can also offer expertise in project, operational and risk management (AECOM, 2007).

Though PPC arrangements seem to have been used on a small-to-modest portion of the total roadway network in most countries (see Table 3.1), it has played a pivotal role in the development and management of critical highway corridors.

Table 3.1 Road Network in Selected Countries

Country	Total Road Network (Kilometres)	National Highway/ Expressway/Motorway Network (Kilometres)	PPC Motorway/ Expressway Network (Kilometres)	Percentage of PPC network to Total network
United kingdom	394,428	7,100	710	0.18
Australia	818,356	12,730	170	0.02
Spain	681,298	16,000	4,310	0.63
South Korea	103,029	12,447	3,000	2.9
India	3,320,410	300	300	0.009
United States	6,506,204	90,000	250	0.003
South Africa	754,000	20,000	3,000	0.39
Brazil	1,751,868	57,211	13,781	0.78
Canada	1,042,300	231,000	32,000	3
Portugal	82,900	2,660	2,500	3
China	4,008,200	65,000	45,000	1
France	951,200	30,500	12,000	1.2
Slovak Republic	43,761	337	None	None
Slovenia	38,562	300	None	None
Morocco	60,000	600	None	None
Turkey	352,046	19,775	None	None
Ghana	62,221	13,367	None	None
New Zealand	130,728	10,894	None	None
Croatia	28,788	800	10	0.035

Key: PPC = Public-Private Collaboration

Source: Adetola *et al* (2013b)

Total road network (see Table 3.1) includes motorways/expressways, highways/national roads, secondary/regional roads, and all other roads in a country. A motorway/expressway is a road designed and built to separate motor traffic flowing in opposite directions. A dual carriageway is a class of highway with two carriageways for traffic travelling in opposite directions separated by a central reservation/barrier/median. Roads with two or more carriageways with controlled access are also generally referred to as motorways/freeways/expressways (see Table 3.1). Dual carriageways seem to have improved road traffic safety and speed limit over single carriageways. A road without a central reservation is a single carriageway regardless of the number of lanes.

Public Private Collaboration contracts require revenue in order to support capital, operating, financing, and transaction expenses, and provide a return on equity investments. In this regard, some countries adopt such mechanisms as real tolls, shadow tolls, and direct payment. In real tolls, users

pay a fee for the use of an asset, while the government (public) pays shadow tolls to a contractor based on traffic volume and the availability of service. Direct payment refers to the fee that the public (government) pays the contractor. Ancillary revenues might also be derived from commercial development such as restaurants, service stations or utility corridors along a highway.

3.10. SUMMARY

This chapter critically appraised the institutional and financing arrangements adopted for road transport infrastructure management in selected developed and developing countries through an evaluation of extant literature. Public-Private Collaboration is a procurement method that delivers assets or provides services through joint public and private cooperation. The arrangement allows the private sector to help reduce the overall cost of delivering public facilities and services through increased efficiency and better management of some risks (design, construction, operation and maintenance). Many countries have used PPC to help develop, operate and maintain their road networks. The public agencies that manage PPC are structured differently in various countries. These organisations range from traditional highway agencies to state-owned enterprises. However, despite the observed differences in institutional structures, all the countries appear to share common views about road administration. These common notions include emphasis on increased participation of the private sector in constructing, operating, maintaining, and managing road infrastructure; and the need to devise strategies to communicate with road users in order to incorporate their needs and concerns into road infrastructure provision. Though there seems to be no global regulation regarding whether a country's highway/motorway/expressway should attract fee, road transport infrastructure ultimately has to be paid for either by the government or users. While roads with low traffic volume may operate as a social (free) service, user charges on roads with high volume of (congested) traffic can become an essential source of generating revenues. In this regard, toll might be a useful pricing tool for rationing limited road space to those users who recognise/value its worth.

The review revealed that no public agency has sufficient funds to expand, restore and preserve its highway facilities indefinitely. Hence, public-private collaboration seems to have become an effective strategy for managing highway assets both in terms of service delivery and financial arrangements. In

this regard, a moderate percentage of each country's overall road and highway/motorway networks are under PPC arrangements (see Table 3.1) using various sources of financial arrangements. The policies and practices in these countries clearly show that potential collaborative projects need to be analysed, selected, structured and procured thoughtfully in order to preserve public interests. Furthermore, public sector institutional capacity may require continuous strengthening and improvements for effective collaborative agreements. The ability to manage the partnership throughout the life of the contract might also be critical to providing the expected services and sustaining the public-private relationship.

In this respect, the willingness of the public sector (government) to provide the enabling environment that will attract and support the private sector is critical to the successful implementation of the programme. In addition, good governance will also enable the general public to reap the full/maximum benefits of the involvement and investment of the private sector. Good governance is synonymous with due process or competitive selection of concessionaire, full/proper disclosure of relevant project information to the public, and the establishment of a regulatory body to oversee the contractual agreements throughout the life of the concession. This process will help to engender accountability of both the concessionaire and the regulatory authority.

This appraisal has not been able to cover all the countries of the world. Therefore, there is need for nations to actively embrace the lessons learned from other countries, align interests, share resources, maximise processes, and engage 'win-win' scenario for sustainable road transport infrastructure management.

Road infrastructure is a major catalyst for the physical and socio-economic development of a country's Gross Domestic Product; as the movement of people, labour, goods and services depend mainly on it. In the traditional procurement system, the public sector (government) assumes all the responsibility for developing a road project, and bears most of the risks associated with its operation and maintenance. Hence, road infrastructure has been managed as a social service for the good of the public. However, managing road network today appears to have become increasingly challenging for

all governments as demands increase and resources are limited. In this respect, many countries around the world are now exploring a wide variety of approaches in engaging the private sector in the delivery of road infrastructure. This chapter highlights the different institutional and financial arrangements adopted for road facility management in selected developed and developing countries. The chapter discovers that the public agencies that manage road assets are structured differently in the various countries. In addition, it observes that ‘large’ countries appear to decentralise, while ‘small’ countries centralise management authority. The chapter identifies through an evaluation of extant literature that no public agencies or single-point governmental body have sufficient funds to expand, restore, or preserve its highway facilities indefinitely. Despite all the observed differences, all the countries seem to share a common notion of increased participation of the private sector in financing, constructing, operating, maintaining and managing road infrastructure. Given this, it is advocated that good governance and the willingness of the public sector (government) to provide the enabling environment that attracts and supports the private sector is critical to the successful implementation of public-private collaboration in road infrastructure management.

A cursory look at this chapter shows that very limited studies align to Africa, while there is conspicuously no literature on collaborative road infrastructure management in Nigeria. Therefore, the next chapter focuses on road transport infrastructure management in Nigeria.

CHAPTER 4: ROAD TRANSPORT INFRASTRUCTURE MANAGEMENT IN NIGERIA

4.1. INTRODUCTION

This chapter articulates the historical development of road infrastructure and the roles of various agencies responsible for road infrastructure management in Nigeria. The chapter also identifies the challenges of road infrastructure management in Nigeria and presents current efforts/initiatives towards PPC.

Road transportation has been the most popular means of movement in Nigeria, a country with an area of 923,768.64 km², a population of over 150 million comprising 11 cities with population above one million and 23 cities with populations of over 200,000 (Federal Government of Nigeria, FGN 2010). It accounts for about 90% of all inter and intra city movements of persons, farm produce, merchandise, animals and mobile services such as clinics, libraries and banks across the country (Akpogomeh, 2002). The optional use of motor cars for pleasure tend to contribute tremendously to the importance of road transport in Nigeria given the deteriorated state of alternative modes of transportation (rail system, inland waterways) and also the psychological satisfaction offered by the possession of a car (Adesanya, 1998). The major cities, including the 36 state capitals and the Federal capital are connected to each other by a network of highways. The road network in the South-Western and South-Eastern Nigeria seem to be much denser than others in the rest of the country due to higher population densities (Ubogu *et al*, 2011).

Nigeria appears to have the largest road network in West Africa and the second largest South of Sahara (Abiodun 2013). The current national network of roads is estimated at about 196,000 kilometres (including 1,194km of expressways) with the Federal roads network carrying about 70% of freight in Nigeria (Oni and Okanlawon, 2006). Details of the distribution are given in Table 4.1. The present condition of some of these roads requires urgent attention in most parts of the country. According to Abiodun (2013), Ubogu *et al*, (2011), Oni (2008), Oni and Okanlawon (2006) this is impacting negatively on the cost of production and representing a major trigger of cost-push inflation in Nigeria. Transport appears critical to economic development, both in low volume/ rural roads and

major arterials, since there seems to be a direct relationship between a country's economic prosperity and the length (kilometres) of paved roads (Queiroz and Gautam, 1992).

4.2. ROAD INFRASTRUCTURE DEVELOPMENT IN NIGERIA

The colonial period marked the evolution of modern transport system in Nigeria with the development of networks of road, rail and water geared essentially to meet the exportation of cash crops such as cocoa, cotton, groundnuts and palm products; and the importation of cheap, mass produced consumption goods (Federal Government of Nigeria, 2010). The road transport system in Nigeria began in the early 1900s essentially as feeder road networks, complementary to the railways which then formed the main travel routes. The first road for motorised vehicles in Nigeria was built in 1906 from Ibadan to Oyo (Odeleye, 2000). The early road network development resulted from the Post-First World War effort. Thus, the history of road infrastructure development in Nigeria dates back to 1925, when the Road Board was established by the then colonial administration. The mandate of the Board was to evolve blueprints for trunk road network, connecting major administrative centres in the colonial time (Federal Government of Nigeria, 2010). These early transport systems were planned in the most economical way possible, as characterised in sub-standard road and rail alignments and a sub base, which later proved inadequate to accommodate heavy vehicles. Furthermore, with the re-orientation of goals after independence in 1960, road transport became one of the instruments of unification of Nigeria and an important tool for social and economic development. The development of petroleum resources from the 1950's also had significant impact on the nation's social and economic growth, exerting increasing demands on the road transport system (Federal Ministry of Works and Housing 2003).

As at 1951, about 1800km out of the total 44,414km of roads built in Nigeria was surfaced. Granted that these roads served to open up Nigeria, they were in a single lane, lacking in standard designs, had sharp curves, poor drainage systems, and were constructed on weak sub-grades (Campbell, 2009; Oni and Okanlawon, 2006; Central Bank of Nigeria, 2003). The growth of economic activities due to population growth might have placed increasing demands for road network to make food and other essentials available for livelihood. As a result, the quality of road construction was improved as the

length and network increased such that by 1952, about 15,785km of bituminous surface and 75,200km of earth/ gravel surface roads were in place in Nigeria (Federal Government of Nigeria, 2010). Furthermore, the discovery of crude oil in 1958 probably necessitated improved road infrastructure in order to gain access to and extract oil.

In 1978, the first expressway in Nigeria was constructed from Lagos to Ibadan, and a branch of this route was later extended east to Benin City. Another expressway also connected Port Harcourt with Enugu. In the 1980s, a massive rural road construction programme (Directorate of Food, Roads, and Rural Infrastructure, DFRRI) resulted in increased feeder roads in rural areas in many states (Akinyemi, 1983). As at 1990, Nigeria had 108,000km of roads of which 30,000km were paved, 25,000km were gravel and the rest were unimproved earth. Of the current 196,000kilometres road network in Nigeria, 34,341km (17%) are Federal roads, linking the state capitals and other major towns; 30,500km (16%) are state roads linking towns and major settlements; and the remaining 130,600km (67%) are Local Government/ Local Council Development Authority (LCDA) roads (see Table 4.1), linking local government headquarters and smaller communities to one another (Abiodun 2013; Campbell, 2009; Oni and Okanlawon, 2006; Central Bank of Nigeria, 2003).

Table 4.1 Distribution of the Nigerian Road Network

Type of Pavement	Federal (km)	State (km)	Local Government (km)	Total (km)	Percentage
Paved Trunk Roads	28,741	10,400	-	39,141	20%
Unpaved Trunk Roads	05,600	20,100	-	25,700	13%
Urban Roads	-	-	21,900	21,900	11%
Main Rural Roads	-	-	72,800	72,800	37%
Village Access Roads	-	-	35,900	35,900	19%
Total (km)	34,341	30,500	130,600	195,441	100%
Percentage	17%	16%	67%	100%	

(Source: Oni and Okanlawon, 2006)

4.2.1. Road Classification in Nigeria

The important factors often considered in classification of roads seem to be the authority responsible for the roads, accessibility to the abutting property, location and functions of the road. In this respect, the Nigerian road system is classified into three broad categories.

4.2.1.1. Trunk 'A' Road

The trunk 'A' roads form the major network around which other categories of roads are built. They run through the length and breadth of the country, connect ports, capitals of various States and also provide international links with neighbouring countries. Notable examples are Lagos-Ibadan Expressway, Sagamu-Ijebu Ode-Benin Expressway, Abuja-Kaduna Expressway, Akure-Ilesa road, Katsina-Jibia road and Lagos-Badagry-Republic of Benin road. This category of roads are constructed, managed and owned by the Federal Government. The distribution and length of the federal highway network in the six geo-political zones of Nigeria is shown in Table 4.2.

4.2.1.2. Trunk 'B' Road

The trunk 'B' roads are the highways within the States which connect important towns and cities of the states, connect the cities of the states to federal highways and serve as the main arteries of traffic to and fro the district roads. This category of roads are developed, maintained and owned by the component states. Examples are Etiosa-Lekki-Epe expressway, Ahmadu Bello way, Nnamdi Azikiwe road, Nsukka road, Abubakar Tafawa Balewa road and Obafemi Awolowo road.

4.2.1.3. Trunk 'C' Road

The trunk 'C' roads serve the interior rural population of the district and connect areas of production and market with state highways, major district roads and railways. This category of roads are under the ownership and management of the local government, hence they are commonly referred to as local government roads. Examples are Agbede road, Isawo road, Nwachukwu road, Okorie road, Gingiyun road and Gaskiya road.

Table 4.2 Federal Highway Network in the Six Geo-Political Zones of Nigeria

Zone	States	Road Network (Km)
South-East	Anambra, Enugu, Imo, Ebonyi, Abia.	3,121.70km
South-West	Lagos, Oyo, Osun, Ondo, Ekiti, Ogun	4,161.06km
South-South	Akwabom, Delta, Cross River, Bayelsa, Rivers, Edo	4,150.89km
North-East	Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe	6,787.90km
North-West	Kaduna, Jigawa, Kano, Katsina, Kebbi, Sokoto, Zamfara	6,363.40km
North-Central	Niger, Kwara, Plateau, Benue, Nasarawa, Kogi, Federal Capital Territory Abuja	9,756.00km
Total		34,340.95km

Source: Adetola *et al.*, (2011b)

Each tier of government has the responsibility for planning, designing, constructing, rehabilitating, operating and maintaining the network of roads under its jurisdiction (Ubogu *et al*, 2011). In other words, federal roads are managed by the Federal Ministry of Works, state roads are managed by the State Ministries of Works, while the local roads are managed by the Works Department of the 774 local government authorities in Nigeria.

4.3. ROAD INFRASTRUCTURE MANAGEMENT AGENCIES IN NIGERIA

Road infrastructure management covers the use, operation, maintenance, development or construction of new roads. It has been described as the process of maintaining, improving and optimising the overall performance of the road network and all its elements (pavement, bridges, street lights, signs, drains, lines, street furniture, verges etc.) over time (Transport Research Laboratory, 1998). A highway is a general term which defines a conduit or public way provided for use of vehicular traffic including the entire area within the strip of land reserved by mutual consent or acquired by statutory regulations. A typical highway is constructed in such a way that will enable the operators of vehicles to have a clear view ahead of lines, curves, horizontal and vertical alignments that merge (O'Flaherty, 2007). Well-maintained roads are expected to be well lit especially to aid night travel; hence, road lighting is put in place on roads to ensure the safe movements of both vehicles and pedestrians at all times (Slinn *et al*, 2005). Similarly, the road surface often affects the stability of vehicles by the nature of the contact between the wheels and surface, and it further affects the driver in controlling his vehicle by the amount of irregularities present. Sudden bumps are known to cause loss of control if speeds are not adjusted to the road conditions (Kendrick *et al*, 2004). The quality of any work is often a factor of materials, the methodology used and the competence of personnel or the supervisor. In this regard, Arumala (1987) and Akpododje (1986) discovered little or no adherence to highway design standards, poor supervision by government officials, and lowering of the design specifications during construction as major factors responsible for road failure in Nigeria. Similarly, Ibrahim (1980) and Ola (1978) attributed road failure mainly to overloading, use of sub-standard construction materials, and inadequate knowledge of the geotechnical properties of the soils over which roads are built.

The administration of highways in Nigeria does not differ considerably from the standard practice. The Federal Ministry of Works, an agency designated to administer the highway programme of the Federal Government of Nigeria, is responsible for managing all the road systems that form the core of the national grid.

4.3.1. Federal Ministry of Works

The Federal Ministry of Works is responsible for the procurement and management of federal highways in Nigeria. Before April 2010, this agency was known as the Federal Ministry of Works, Housing and Urban Development. The Ministry is headed by the Minister of Works who is assisted by the Permanent Secretary and the Directors of the various departments under its jurisdiction. The Federal Ministry of Works, (FMW) is charged with several statutory responsibilities among which are federal highways and bridges (planning, design, construction and rehabilitation); supervision of the monitoring and maintenance of federal roads nationwide; provision of engineering infrastructure on federal highways; and surveying and mapping of Nigeria's internal and international boundaries (Federal Ministry of Works and Housing 2003).

The Ministry has undergone some structural changes in recent times aimed at ensuring the effective discharge of its mandate. The agency is presently structured into 15 professional departments, four service departments and five units. The professional departments include Highways Planning and Development; Highways Design - Roads; Highways Design - Bridges; Highways Material Geotechnics and Quality Control; Highways Public Private Partnerships; Highways Road Sector Development Team; Highways South – West Zone; Highways South –East Zone; Highways South - South Zone; Highways North –West Zone; Highways North – East Zone; Highways North – Central Zone; Electrical / Street Lighting Services; Central Workshop; and Engineering Management Services. The four service departments are Planning, Research and Statistics; Finance and Accounts; Public Procurement; and Human Resource Management. The five units include Legal Services; Press and Public Relations/ Protocol; Audit; Reforms, Servicom and Anti- Corruption Unit; and Office of the Permanent Secretary.

The Zonal Directors of Highway in the six geopolitical zones of Nigeria (see Table 4.2) are saddled with the supervision of all road projects in their domain. This is with a view to improve the turnaround time, and enhance the effective and efficient delivery of road projects nationwide. Furthermore, the Materials, Geo-technics and Quality Control department has a duty to enforce compliance with standard of all materials for road development. The Ministry also supervises the activities of a parastatal, the Federal Roads Maintenance Agency (FERMA); an extra-ministerial department, the Office of the Surveyor-General of the Federation; the Federal School of Surveys, Oyo; and the Regional Centre for Training in Aerospace Surveys, Ile-Ife. The Ministry operates through its Zonal headquarters which oversees its field offices located in the 36 States of Nigeria and the Federal Capital Territory, Abuja. The vision of the ministry is to elevate Nigerian roads to a standard where they become national economic and socio-political assets, contributing to her rapid growth and development. The agency intends to make federal roads functional, pleasurable and an avenue of re-inventing Nigerians' trust and confidence in government. The Federal Government of Nigeria also relates with multilateral agencies such as the World Bank, African Development Bank and several other development agencies regarding infrastructure development.

4.3.2. Federal Roads Maintenance Agency

In 1995, civil engineering experts and concerned stakeholders including the Nigerian Society of Engineers (NSE), Council for the Regulation of Engineering in Nigeria (COREN), the organised private sector, experts from the Central Bank of Nigeria (CBN), experts from the World Bank and the International Road Federation, Nigerian Association of Road Transport Owners (NARTO) and the National Union of Road Transport Workers (NURTW), after hectic brainstorming sessions, came up with what is now known as the Road Vision 2020 (Federal Ministry of Works and Housing 2003). The Vision advised the government to de-link road maintenance from planning, design, construction and rehabilitation, which are the traditional Federal Highways Department's role domiciled in the Federal Ministry of Works. Thus, the Federal Roads Maintenance Agency, (FERMA) was established on 20th November 2002, with the enactment of the Establishment Act 2002 to monitor and maintain all federal roads in Nigeria. FERMA is an agency under the Federal Ministry of Transport, Nigeria,

whose principal role is to carry out regular routine maintenance on the federal road network (Federal Roads Maintenance Agency, 2008). The agency came into being as a 10 year stop gap pending the time a full-fledged reform is put in place to incorporate the Nigerian roads with a comprehensive road infrastructure management system. In this regard, the Federal Government of Nigeria is proposing a Federal Road Authority which will be responsible for the design, construction, rehabilitation and maintenance of national road assets (Punch, 2013). Similar to FERMA, a few State governments have created agencies for the maintenance of roads within their jurisdiction. These agencies include the Lagos Metropolitan Area Transport Authority and Ogun State Road Maintenance Agency.

According to the Establishment Act 2002, FERMA has the mandate to:

- Plan and manage the development and implementation of road safety standards.
- Plan and develop strategies towards ensuring efficient and effective movement of traffic on the federal trunk roads and ensure their implementation.
- Make policy recommendations to the Federal Government of Nigeria on matters relating to the maintenance of federal trunk roads.
- Establish Road Support Service Centres (RSSC) at toll plaza locations nationwide.
- Establish observation camps along federal highways.
- Establish Zonal Direct Labour Maintenance Bases (ZODILAMBS).
- Maintain all bridges on federal roads across Nigeria.
- Maintain all street lights on all major bridges and highways nationwide.
- Carry out such other activities as appear to it necessary or expedient for the full and efficient discharge of its functions under this act.
- Provide all other services relating to the efficient and smooth operation of the agency such as registration of contractors, staff welfare, training of staff, staff discipline, payment of contractors / consultants etc.

FERMA, along with the Highways Department of the Federal Ministry of Works are responsible for looking after the federal roads network. The Highway Department is charged with the construction of new highways, and the reconstruction and rehabilitation of badly damaged highways (Federal Ministry of Works and Housing 2003), while FERMA is responsible for maintaining the highways at acceptable levels of usability. FERMA outlines a short, medium and long-term strategy to carry out its work.

The Short Term Road Maintenance Strategy (STRMS) focuses on making the roads accessible for the movement of people and goods. Under this strategy, the agency adopts the direct labour, retainership contract and regular contract type of methods to carry out its activities.

The Medium Term Road Sector Maintenance Management Strategy (MTRSMMS) is a form of output and performance-based road contracts. Under the scheme, contractors who undertake road maintenance works are paid based on agreed service levels at which the contractor has to maintain the road over a long period of time.

The Systematic Road Strengthening and Enhancement (SRSE) Programme is the same with MTRSMMS with the scope of works expanded to include periodic maintenance. The strategy helps to recover any road network that requires overlay and strengthening over a period of 8 to 10 years.

4.3.2.1. Road Traffic Administration and Safety Management

The World Health Organisation (2005) projected that over 1.3 million people are killed in road accidents, 50 million suffer different injuries annually, while 80 percent of these cases happen in developing countries with African countries recording the highest number of deaths (National Mirror, 2013). A ravaging disease that is fast killing people in Nigeria is road traffic accidents. This is as a result of the scars, craters, cracks, ruts and potholes on Nigerian roads which appear to be emblematic of a war-torn country (see Appendix 6). This culminates in the gridlocks on the highways, with commuters spending several hours, sometimes a whole day on a journey that should ordinarily not take longer than one hour. In 1976, there were 53,897 road traffic accidents resulting in 7,717 deaths in Nigeria. In the year 1981, the number of accident reduced to 35,114, but the fatality increased to

10,236. On the average, there were 96 accidents and 28 deaths every day of that year. The situation in subsequent years was not significantly different, although fatality rate reduced to 9,707 in the year 1993 and 6,521 in the year 2000 (Federal Government of Nigeria 2010). Recently, the Corps Marshal of the FRSC reported that 4,266 persons died from road accidents in year 2012 (Punch, 2013).

Road safety engineering according to Akinyemi, (1986), is a set of activities designed to reduce the number and/ or severity of accidents on specific road sections by exchanging or modifying some road environment characteristics. Such activities generally consist of planning (identification of safety problems, road locations and feasible road counter measures); implementation (installation or construction of the counter measures); and evaluation (the determination of the degree of effectiveness of the counter measures). In this respect, Odeleye, (2000) reported that the road traffic environment in Nigeria is characterised by over-speeding, blocked drains, narrow pedestrian walkways, bushy road environment, rough and undulating surfaces, black spots (accident prone locations), unfit road intersections, narrow bridges, defaced signs, non-functional traffic lights, irregular road marking, road median not crash worthy (concrete), poor guard railing arrangement, high disregard for traffic law and regulations, and flooded road surfaces. This description suggests a system that is devoid of modern technology.

4.3.3. The Federal Road Safety Commission

The Federal Road Safety Commission (FRSC), a government agency with statutory responsibilities for policy making, organisation and administration of road safety in Nigeria was established in February 1988, through Decree No. 45 of 1988 as amended by Decree 35 of 1992 referred to in the statute books as the FRSC Act cap 141 Laws of the Federation of Nigeria, passed by the National Assembly as Federal Road Safety Commission (Establishment) Act 2007 (Federal Government of Nigeria 2010).

The functions of the Commission generally relate to making the highway safe for motorists and other road users; recommending works and devices designed to eliminate or minimise accidents on the highways, and advising the Federal and State Governments including the Federal Capital Territory Administration and relevant governmental agencies on the localities where such works and devices

are required; and educating motorists and members of the public on the importance of discipline on the highway.

In particular, the Commission is charged with responsibilities for:

- Preventing or minimising accidents on the highways
- Clearing obstructions on any part of the highways
- Educating drivers, motorists and other members of the public generally on the proper use of the highways
- Designing and producing the driver's licence to be used by various categories of vehicle operators
- Determining, from time to time, the requirements to be satisfied by an applicant for a driver's licence
- Designing and producing vehicle number plates
- The standardisation of highway traffic codes
- Giving prompt attention and care to accident victims
- Conducting researches into causes of motor accidents and methods of preventing them and putting into use the result of such researches
- Determining and enforcing speed limits for all categories of road users and vehicles, and controlling the use of speed limiting devices
- Cooperating with bodies or agencies or groups in road safety activities or in prevention of accidents on the highways
- Making regulations in pursuance of any of the functions assigned to the Corps by or under this Act
- Regulating the use of sirens, flashers and beacon lights on vehicles other than ambulances and vehicles belonging to the Armed Forces, Nigeria Police, Fire Service and other Para-military agencies
- Providing roadside and mobile clinics for the treatment of accident victims free of charge

- Regulating the use of mobile phones by motorists
- Regulating the use of motorcycles on the highway
- Regulating the use of seat belts and other safety devices
- Maintaining the validity period of drivers' licences which shall be three years subject to renewal at the expiration of the validity period
- Arresting and prosecuting persons reasonably suspected of having committed any traffic offence

Recently, the FRSC reported that Nigeria lost three percent of her GDP which translated to 17 percent of current national reserves through road traffic crashes in 2009 (Punch 2013).

4.4. CHALLENGES OF ROAD INFRASTRUCTURE MANAGEMENT IN NIGERIA

From the foregoing, the key issues that would encourage active public private collaboration in road transport infrastructure management in Nigeria may include the challenges of funding, maintenance, concerns about the use of roads, matters of inter-modal transport system, and institutional problems.

4.4.1. Funding of Road Infrastructure

The highways and streets on which motor vehicles travel are often provided, maintained and operated by the government as one of its primary function. Highway financing may have to do with the sourcing and the usage of capital for the construction and improvement of highways. According to Mabogunje (1998), there are few available avenues in most African countries for raising sufficient revenue to fund urban infrastructure. Moreover, these countries are often restricted by their national governments to a narrow range of revenue. This may be the true state of road development funding in Nigeria, where government solely finances all road development projects. The different sources of finance for a road scheme may include private financing, public financing, credit facility and joint venture/collaboration (Heggie 1995; Haule 2009).

Private financing could be by savings, reinvested income, stocks and bonds. Sourcing funds through capital market appears to be a viable way of raising funds for highway. This is done by private firm floating bonds in order to generate funds rather than depending on the traditional source of funds such

as statutory budgetary allocations and internally generated revenue. This tends to ease the problems of loans and interest payment and thus releases more funds for road maintenance (Haule 2009).

Public finance is often based on general credit and taxing power of the government. It could also come in form of grants from government and international donors. The taxes include import duty on motor vehicles, parts and accessories; exercise duty on vehicle tyres and tubes; and excise duty from motor fuel. All these are paid into federation account and the budget for the road derives from budgeting provision for this purpose (Heggie 1995).

Credit facility has to do with borrowing in order to finance the development of a highway scheme. Joint Venture is a partnership between the government and the private sector to achieve the needed efficiency and effectiveness in the sector. This is often achieved by involving the private sector in the provision of services such as consultancy and procurement; undertaking maintenance and rehabilitation works; and financing new works, rehabilitation and equipment (Haule 2009).

The methods of generating revenue from road schemes often include highway tolls (toll gate collection), vehicle taxes, truck weight bridges, parking fees, motor fuel tax, passengers and goods tax, licence fee for drivers and property tax.

Project financing can be described as a business plan for a profitable investment, with a long-term view, and the combination of time and money put together in a dynamic contract with a delegation of responsibility over time (Heather, 2000). In this regard, The Central Bank of Nigeria (2003) reported that since the economic reform in 1999, less than 10% of the funding request made by the Federal Ministry of Works was appropriated, while only about 54% of the appropriation was released. This suggests the fact that funding of road infrastructure projects in Nigeria might have been grossly inadequate. For example, FERMA has an enormous task of maintaining nearly 35,000 kilometres of road network (see table 4.2), with about 60% of the roads in very serious state of disrepair. In this regard, Queiroz and Kerali (2010) asserted that budget allocations for investments in road are often less than what is required to keep the infrastructure in a sustainable operating condition. Therefore,

there seems to be an urgent need for alternative source(s) of finance other than government for road improvement programmes, so as to make the national gridlock more safe, vibrant and viable.

4.4.2. Maintenance Issues

Highway maintenance often has to do with preserving and keeping road structures as near as possible in their original state. It consists of correcting deficiencies that have developed as a result of age, use and the effects of the elements, and taking steps to prevent or delay the development of other deficiencies. Road maintenance is vital in order to prolong its life, just as well-maintained roads often reduce the cost of operating vehicles by providing good running surface. Proper maintenance also keeps the roads open and ensures greater regularity, punctuality and safety of transport services (Central Bank of Nigeria, 2003; Federal Ministry of Works and Housing 2003).

Road maintenance is often classified into four categories. These are routine Maintenance, recurrent Maintenance, periodic Maintenance and emergency / special repair (Central Bank of Nigeria, 2003; Federal Ministry of Works and Housing 2003).

Routine Maintenance is expected to be carried out continually on every road, irrespective of its engineering features or volume of vehicular traffic. It includes lane marking, drainage clearing, bridges and culvert maintenance, grass cutting and so on. Routine maintenance expenses are often treated as fixed-cost items in the maintenance budget (Central Bank of Nigeria 2003).

Recurrent Maintenance is often required at intervals during the year. The frequency of this maintenance depends on the topographic and climatic characteristics of the area, and the volume of traffic on the road. It involves maintenance of pavements for paved roads, repairing of potholes and grading of unpaved roads (Federal Ministry of Works and Housing 2003).

Periodic Maintenance involves major repairs or rehabilitation of those parts of the highway that have deteriorated over the years. The frequency involves intervals of some years. The activities include surface dressing or resealing and re-gravelling of shoulders for paved roads and re-gravelling of unpaved roads (Central Bank of Nigeria 2003).

Emergency / Special Repair is carried out beyond routine, recurrent and periodic maintenance. It is often caused mainly by unexpected substantial landslide, when a road is abruptly cut or a bridge washout occurs. It could also be due to some seismic or unstable factors such as earthquake or earth vibration (Federal Ministry of Works and Housing 2003).

According to Queiroz and Kerali (2010), it takes several years for road infrastructure to deteriorate to a level that would generate public pressure for more financing, and yet it costs three to four times more to rehabilitate road infrastructure than if timely maintenance had been adequately financed. For example, in 1985, about 23% of national roads were in a bad state in Nigeria. This situation rose to 30% in 1991, 50% in 2001 and about 60% in 2010 (Federal Government of Nigeria 2010). The findings of a survey conducted by the Central Bank of Nigeria (2003) revealed that some roads which were constructed over 30 years ago have not had any rehabilitation interventions, thereby resulting in major longitudinal and transverse cracking, depressions, broken bridges and numerous potholes that make road transport both very slow, costly and unsafe. The survey reported that most of the roads in the Southern and Northern Nigeria were in very poor conditions, and therefore require complete/ total rehabilitation and asphalt overlay, re-installment of the shoulders, filling of potholes and re-building of collapsed bridges (see Appendix 6). This implies that road infrastructure in Nigeria probably suffers from inadequate routine maintenance, neglect of periodic maintenance and the absence of emergency maintenance in areas affected by flood, storms and other natural calamities.

Recently, the Minister of Works, Federal Republic of Nigeria reported that a major problem facing the road sector in Nigeria is the lack of adequate and timely maintenance strategy. The Minister claimed that huge resources are spent on the construction of new roads while no provision is made for the maintenance of existing networks. In this regard, the only maintenance programme in the FMW seems to be the mandatory one year maintenance undertaken by the contractor during the defects liability period of a road construction project. The Minister emphasised that for Nigeria to be among the 20 largest economies in the world by year 2020, the country must grow its road infrastructure from about 200,000 kilometres to 300,000 kilometres in the next five (2013-2018) years (Punch,

2013) . This would generate new road alignments required to serve as feeder roads to mine fields, agricultural centres, industries and other major theatres of economic activities around the country.

Absence of adequate road maintenance often reduces the useful life of roads, and contributes to high social costs of atmospheric pollution. The multiplier effect results in premature and costly road reconstruction, whilst poor road surface increases the operating cost of vehicles and has significant effects on road safety (Campbell, 2009). The deteriorating state of Nigerian roads seems to have resulted into avoidable loss of lives, psychological trauma on road users, and reduction of productive man-hours. Furthermore, decisions regarding which roads to improve may depend more upon political factors rather than the economic potential of the proposed route (Porter, 2007).

4.4.3. Road Concerns

Nigerian roads are heavily motorised. Goods that ought to have passed through the railways and waterways are moved through the road network. Thus, the capacity of Nigerian roads has been overstretched by the movement of 95 percent of the nation's passenger and freight on road transportation (Punch 2013). The Nigerian road traffic environment is apparently composed of heavy-duty trucks, lorries, trailers, tankers, cars, motorcycles/ tricycles, pedestrians, and cart pushers. Though almost all roads in the federal road network were designed to carry a maximum axle load of about 30 tonnes, many trucks carry up to about 50 tonnes axle loading (Akpokodje 1986). The results of this excess axle loading (overloading) of articulated vehicles are the visible ruts and cracks that cause failures and damage to Nigerian roads. Furthermore, the federal roads in Nigeria appear to lack adequate transit park and rest areas, hence, heavy-duty trucks are often parked on highways (see Appendix 6 Plate 17). Excessively-high axle loads on paved and gravel roads especially during the raining season often contribute substantially to reducing the life expectancy of roads. Thus, a major cause of the declining roads infrastructure might be the misuse of roads due to overloaded trucks (Arumala and Akpokodje 1987).

The dependence on roads in Nigeria presently is almost total simply because the Nigerian railway is almost grounded and air traffic appears low in the country. It is estimated that between 90-95% of the total transport movements is on the road network. Thus, the transport of goods seems not optimised

towards the most appropriate mode as the railway and inland waterways modes appear neglected. In this respect, freight and bulk goods are carried over long distances by heavy-duty trucks and tractor-trailers, whose activities are probably responsible for some of the fatal accidents on Nigerian roads. For example, they are known for overloading, over-speeding and flagrant disregard for traffic laws (Odeleye, 2000).

4.4.4. Matters of Inter-Modal Transport System

An integrated transport system often has to do with effective connectivity between ports, rail, road, inland waterways and air, thereby making use of the advantages of different modes to ensure seamless movement of goods and people and better utilisation of resources. For instance, goods arriving by sea appear best transported from the port by rail or inland waterways. However, Nigerian ports (Calabar, Onne, Tin Can Island, Warri), except Port Harcourt and Apapa are not connected by rail and the waterways (Federal Government of Nigeria 2010). This implies that a comprehensive transportation system which interconnects the various transport modes to make the most use of their individual advantages does not seem to exist at present in Nigeria. Hence, freight transports are probably not carried by the most appropriate transport mode. Bulk cargoes/ goods are carried over long distances by trucks and tractor-trailers.

4.4.5. Institutional Problems

Road transport infrastructure management appears to be a complex issue in Nigeria. This is because the supply of road facilities cuts across various categories of public agencies. For example, the Federal Ministry of Works constructs and rehabilitates the federal road (see Section 4.2.1.1 in Chapter 4), the state ministries of works build and maintain state road (see Section 4.2.1.2), while the remaining roads are under the jurisdiction of the local government authorities (see Section 4.2.1.3). FERMA is expected to undertake regular routine maintenance (see Section 4.3.2), while the FRSC is responsible for road traffic administration and safety management (see Section 4.3.3). Furthermore, the Vehicle Inspection Officers ascertain the roadworthiness of vehicles, the Traffic Police/ Warden controls road traffic, while the Traffic Department of the Nigerian Police Force prosecutes erring road users. Some State Governments also have their own state transport maintenance agencies. Aside from

the problem of overlapping objectives and responsibility, there seems to be no attempt to coordinate the activities/ effort of these agencies. In this respect, Malmberg-Calvo (1998) emphasised the need to develop an institutional framework for managing and financing road infrastructure.

4.5. INFRASTRUCTURE CONCESSION REGULATORY COMMISSION

In an attempt to attract massive investments beyond the means available to government and close the wide infrastructure gap, the Federal Government of Nigeria has recognised the significant role of the private sector in providing public infrastructure through public private collaboration. In this regard, the Federal Government of Nigeria enacted the Infrastructure Concession Regulatory Commission (Establishment) Act, (ICRC) 2005 (Federal Government of Nigeria, 2012). The Act provides for the participation of private sector in financing the concession, development, operation and maintenance of infrastructure or development projects of the Federal Government through concession or contractual arrangements (Federal Government of Nigeria, 2012). The projects covered by the Act include power plants, highways, seaports, airports, canals, dams, hydroelectric power projects, water supply, irrigation, telecommunications, railways, interstate transport systems, land reclamation projects, environmental remediation and clean-up projects, industrial estates or township development, housing, government buildings, tourism development projects, trade fair complexes, warehouses, solid wastes management, satellite and ground receiving stations, information technology networks and database infrastructure, education and health facilities, sewerage, drainage, dredging, and other infrastructure and development projects as may be approved , from time to time by the Federal Executive Council of Nigeria (Federal Government of Nigeria, 2012). The ICRC Board was inaugurated on 27th November 2008. The Board has the mandate to develop and issue guidelines on PPP policies, processes and procedures; and regulate, monitor and supervise the concession contracts on public infrastructure development projects. In this respect, the Board developed the Nigerian National Policy on Public Private Partnership in year 2009 (Federal Government of Nigeria, 2009).

The ICRC is also expected to collaborate and work closely with State Governments that want to develop their own PPP policies in order to ensure consistency, best practice, and a co-ordinated approach to the private sector supplier market. This effort is also expected to promote an orderly and

harmonised framework for development of infrastructure, and accelerate market development for PPP projects (Federal Government of Nigeria 2012).

4.5.1. Lagos State Public Private Partnership Law 2011

The need to upgrade, refurbish and expand public infrastructural services appears to be paramount in the economic and infrastructural development agenda of Lagos State Government. The ten-point development-agenda of the present administration which prioritises an accelerated infrastructure roll-out plan to stimulate economic growth include roads, transportation, power and water supply, environmental or physical planning, health, education, employment, food security, shelter, and revenue enhancement (Lagos State Government, 2012).

The Lagos State Roads, Bridges and Highway Infrastructure (Private Sector Participation, PSP) Bill was passed into Law on November 25th 2004. The Law provided for the establishment of the State Roads, Bridges, and Highway Infrastructure (PSP) Development Board. The concession agreement between the Government of Lagos State represented by the State Roads, Bridges and Highway Infrastructure (PSP) Development Board and Lekki Concession Company Limited for Etiosa-Lekki-Epe expressway project was signed on the 24th April 2006. However, the Lagos State Roads (PSP) Authority Law number 7 enacted in 2007 superseded the 2004 Law. Furthermore, a bill to provide for Public Private Partnerships, establish the Office of PPP, and enhance infrastructure service development in Lagos State was signed into Law on the 24th June 2011. This Law repealed the Lagos State Roads (PSP) Law number 7 of 2007.

4.5.2. Policy Documents

A very few policy documents have been developed to offer guidelines for providing public assets and implementing public private collaboration in public infrastructure management in Nigeria. These policy documents include the National Policy on Public Private Partnerships developed in 2009, and the Draft National Transport Policy developed in August 2010. These documents originate from the Federal Government of Nigeria, address public private partnerships, relate to road transport infrastructure, and are freely available to the general public.

4.5.2.1 The National Policy on Public Private Partnerships

The National Policy on Public Private Partnerships bemoaned the infrastructural deficit militating against the economic growth and development of Nigeria. In this respect, the document asserted that:

“The demand for basic public infrastructure services such as transport, power and water has rapidly outstripped the supply capacity in Nigeria. Many years of underinvestment and poor maintenance have left Nigeria with a significant infrastructure deficit which is holding back the country’s development and economic growth” (Federal Government of Nigeria 2009). This assertion is in line with the findings in Sections 4.4.1 and 4.4.2 in Chapter 4.

In order to address this situation and achieve the Government’s vision of being one of the top 20 global economies by the year 2020, the policy promised that:

“Government will develop regulatory and monitoring institutions so that the private sector can play a greater role in the provision of infrastructure, whilst ministries and other public authorities will focus on planning and structuring projects” (Federal Government of Nigeria 2009). This assertion confirmed the findings in Section 4.4.5 in Chapter 4.

The policy further stated that:

“The Federal Government believes that the private sector can play an important role in providing new investments through public private partnerships which is expected to enhance efficiency, broaden access, and improve the quality of public services” (Federal Government of Nigeria 2009).

The National Policy on Public Private Partnerships emphasised that:

“There is a need for massive investments beyond the means available to government in order to close/bridge the yawning infrastructure gap” (Federal Government of Nigeria 2009). This assertion confirmed the findings in Section 4.4.1 in Chapter 4.

4.5.2.2 The Draft National Transport Policy

The Draft National Transport Policy provides the guidelines for planning, development, coordination, management, supervision and regulation of the transport sector. This document described road transport as *‘an instrument of unification and an important tool for social and economic development’*. According to the policy:

“Goods and passenger movements in Nigeria are performed mainly by road, with the railway and inland waterways playing less important roles” (Federal Government of Nigeria 2010). This assertion resonates with the findings in Sections 4.4.3 and 4.4.4 in Chapter 4.

However the policy affirmed that inadequate public funding constitutes a major constraint to road infrastructure development and maintenance.

“Due to competing needs, government allocation to the road network sub-sector over the years has been dwindling and is now grossly inadequate. This inadequacy has consistently been reflected in inadequate/ lack of road maintenance which often necessitates subsequent reconstruction, results in high operating costs of vehicles, and contributes to high social costs of atmospheric pollution” (Federal Government of Nigeria 2010). This assertion is consistent with the findings in Sections 4.4.1 and 4.4.2 in Chapter 4.

The document asserted that inadequate funding has consistently reflected in the neglect of periodic and routine maintenance of road network in Nigeria. Furthermore, the policy identified the institutional problems plaqueing road infrastructure. In this regard, the document stated that:

“Road transport activities in Nigeria are characterised by the proliferation of management bodies which has resulted in overlapping objectives and responsibilities” (Federal Government of Nigeria 2010). This assertion supports the findings in Section 4.4.5 in Chapter 4.

The policy further stated that the Nigerian road transport system is in a very difficult situation that needs urgent remedies.

“At present, the Nigerian road transport system functions in a crisis situation, partly due to major imbalance between the needs of Nigerian society and economy for adequate road transport sector to meet such demands” (Federal Government of Nigeria 2010).

The Draft National Transport Policy acknowledges the need for innovative approaches to the management and financing of road network. In this regard, the policy emphasises that:

“There is a need for institutional reform to advance the efficiency of road transport infrastructure and services’ operations and management. This can be achieved by promoting private sector investment in the upgrade, maintenance and management of road infrastructure through public private collaboration” (Federal Government of Nigeria 2010).

The document specifically mentioned that:

“One of the objectives of this policy is to encourage and remove all barriers towards the private sector participation in the development, provision, maintenance, operation, and upgrading of road transport infrastructure and services” (Federal Government of Nigeria 2010).

The goal of the Draft National Transport Policy is to provide guidelines for the development of an adequate, safe, environmentally sound, efficient and affordable integrated transport system.

The common objectives of both the National Policy on Public Private Partnerships and the Draft National Transport Policy concerning road infrastructure are threefold: economic, social and environmental.

The economic objectives include accelerating investment in new road infrastructure, upgrading existing road asset to a satisfactory standard that meets the needs and aspirations of the general public, and ensuring that investment projects provide ‘value for money’. The policies intend to increase the capacity and diversity of the private sector by providing opportunities for local and international investors and contractors in the provision of road transport infrastructure, thereby encouraging efficiency, innovation, and flexibility.

The social objectives include ensuring balanced regional development, increasing access to quality road facility for all members of the society, ensuring that user-charges for new or improved road infrastructure are affordable and provide ‘value for money’, and enhancing the health, safety and well-being of the general public. The environmental objectives include protecting and enhancing the natural environment, and minimising greenhouse gas emissions and other pollutants.

Table 4.3: Correlation between seminal literature and policy documents

S/N	Challenges of Road Infrastructure Management	Seminal literature	National Policy on PPP	Draft National Transport Policy
1	Challenges of funding	✓	✓	✓
2	Maintenance issues	✓	✓	✓
3	Matters of inter-modal transport system	✓		✓
4	Institutional problems	✓	✓	✓
5	Concerns about the use of road	✓		✓
6	Competing needs	✓	✓	✓

Results from Table 4.3 above indicate a strong correlation between the seminal literature and policy documents about the challenges of road infrastructure management in Nigeria.

4.6. DISCUSSION

An effective network of roads and highways often fosters safe and efficient movement of people, goods and services, and contributes to economic growth. Roads and highways directly connect to other transportation modes and hence, are vital to moving raw materials to factories and finished products to markets.

The road networks in Nigeria appear to have been plagued by a number of problems, the major ones being faulty designs, poor drainage system; excess axle loading of articulated vehicles; dumping of refuse on the shoulders, drains and manholes; wrong and harmful parking on the highways; and poor maintenance. Given the long years of neglect of maintenance and severe pressures being exerted on them, many of these roads seem to have deteriorated beyond maintenance and consequently require complete rehabilitation and reconstruction. These problems might have significantly reduced the utility of the roads, negatively impacted on the cost of production and caused a major trigger of cost-push inflation which often leads to loss of man-hours. A road study conducted in 1998 revealed that

NGN300 billion was required between 1998 and 2008 to recover the national road network into a fairly good condition. The investigation also projected that an average of NGN24 billion would be required each year for subsequent maintenance and NGN32 billion per year for road rehabilitation (Federal Ministry of Works and Housing, 2003). An annual loss due to bad roads is estimated at NGN80 billion, while additional vehicle operating cost resulting from bad roads is valued at NGN53.8 billion, bringing the total loss per annum to NGN133.8 billion (Central Bank of Nigeria, 2003). These figures might be currently higher due to the progressive deterioration of road network, but presently, there is no updated figure available in the public domain. This loss is aside from the productive man-hour losses in traffic due to bad roads and other emotional, physical and psychological trauma people go through while plying roads and the consequent loss in productivity.

In the past, the government had concentrated efforts on road construction, but probably much has not been done in the areas of establishing a regulatory framework and introducing measures that would promote effective road transport infrastructure management in Nigeria. The Federal Government had set up some Commissions in the past to address the problem of road maintenance. For instance, The Wey Commission of 1971 examined the organisational structure of highway development and management in five selected countries, and therefore recommended the formation of a Federal Highway Authority for the administration of all federal roads in Nigeria. The 1979 Panel also recommended the setting-up of an agency (The Federal Highway Authority) under the then Federal Minister of Works and Housing, for planning, designing, constructing, maintenance and surveillance of federal highways. Similarly, the 1996 workshop launched the 'Road Vision' 2000 and recommended the establishment of an autonomous road agency that would be responsible for road maintenance. Furthermore, the 1999 Presidential Policy Advisory Committee recommended the establishment of a central body to ensure high standards in highways development and maintenance. This Committee also recommended that funding of highways maintenance should be improved by establishing a 'Road Fund', which would derive its funds from highway tolls, vehicle taxes, petroleum taxes, weight bridges and parking fees.

In recognition of the challenges of infrastructure development, the Federal Government of Nigeria set up the Infrastructure Concession Regulatory Commission (ICRC, Establishment) Act, 2005. This Act provides for the participation of the private sector in financing, constructing, developing, operating or maintaining of public infrastructure or development projects of the Federal Government through concessions or other contractual arrangements. The scope of the Act covers every sector of Nigerian economy (see Section 4.5 in Chapter 4). The ICRC 2005 is expected to regulate, monitor and supervise the contracts on infrastructure or development projects. The Board of the ICRC was inaugurated in November 2008. However, since its establishment and inauguration, it appears not much has been done to implement the policies contained in the Act.

The problems associated with poor road maintenance policies may therefore have to do with weak or unstable institutional arrangements for managing and financing roads. Funds for road infrastructure projects have been from the Federal Government allocation to the FMW, as well as state and local government allocations for maintenance purposes. Given the limited financial resources coupled with budgetary constraints of the Nigerian government, fund for road infrastructure management has been grossly inadequate. Similarly, the proliferation of agencies appears to have created problems of overlapping objectives, responsibility, conflicts in the provision and management of road transport infrastructure and services, and in the enforcement of traffic laws and regulations. Considering the impact of effective road transport infrastructure services on the economy/ welfare of the society, and the huge amount of money required for its development, it behoves on Nigerian Government to partner with the private sector in order to achieve the desired efficiency and effectiveness in road transport infrastructure services. This is supported by Akintoye and Beck (2009) who identified transportation as one of the major physical infrastructure mainly needed by developing countries to support economic activities, but noted that many developing countries cannot afford this facility without affecting other economic activities because of the cost considerations (initial capital outlay and cost of operation/ maintenance) and lack of appropriate technology.

4.7. SUMMARY

The movement of passengers' and freight has been an integral part of everyday activities, an engine of economic growth, and an important component of the well-being of the society. Over the years, investment in public infrastructure has been the exclusive responsibility of government. But now, there is an increased trend world-wide, where government collaborates with the private sector in order to bridge the country's infrastructure gap. For example, since the completion of the internal market in 1992, road transport in Europe seems to have improved tremendously. The intra-EU transport market has been opened up, a single 'Community licence' has been created, and accompanying documents have been harmonised in order to ensure that borders or national administrative practices do not act as barriers to the growing prosperity generated by the road transport sector. Thus, a single European market appears to have spurred competition and made road transport one of the most dynamic and efficient sectors of the economy.

Nigeria has become increasingly dependent on the road system to meet virtually all its inland transport needs as the rail, pipeline and inland waterway systems have deteriorated. At the same time, the road network itself has suffered from continuing lack of maintenance and investment by the three levels of government, federal, state and local. Given that the Federal Government of Nigeria has superior professional, technical and financial capacity to justify extending its jurisdiction over some state and local roads, the need arises for the Federal Government to consider a fair distribution of the road network to reflect the capability of the different tiers of government. Thus, this study carefully identifies inadequate maintenance, misuse of roads, over dependence on roads, poor inter-modal transport systems, institutional problems, and inadequate funding as key issues that may actually encourage the active involvement of the private sector in road transport infrastructure delivery in Nigeria.

The need for high quality, cost-effective, all-weather, safe, reliable and environmentally sensitive road infrastructure of world-class status that guarantees 'value for money' benefit to all road users cannot be over-emphasised. Therefore, this study strongly recognises the need for an adequate, enforceable and enabling legal/ regulatory/ collaborative engagement framework for road transport infrastructure

management in Nigeria. The framework would encourage and remove all barriers towards the private sector participation in the development, provision, maintenance, operation, and upgrading of road transport infrastructure and services. This would guarantee regular attention as well as adequate finances for the construction, rehabilitation, routine repairs, and integration through which the road traffic environment will enjoy the benefits of modern technology like Intelligent Transport System/telematics component installation on the Nigerian road network. Furthermore, it would also integrate modes of transport infrastructure services for convenient travel, using modern systems like electronic ticketing and payment. An integrated transport system would guarantee effective connectivity between airports, seaports, rail, road, and inland waterways in order to ensure seamless movement of goods, people and better utilisation of resources.

In contemporary human society, transportation is crucial to the economic life of every nation. Road transport happens to be the most common mode of transportation in Nigeria, and accounts for about 90% of the movement of persons, farm produce, merchandise, animals and mobile services such as clinics, libraries and banks. Most of the federal highways in Nigeria were procured decades ago by the traditional contracting system. A good number of the road networks in many Nigerian cities are unpaved, poorly maintained, overused and impassable thereby cutting off many rural areas from larger settlements during the rainy season, which has a corresponding negative impact on the cost of production. This chapter critically reviews the management of road transport infrastructure in Nigeria. It identifies five key issues that would encourage the active involvement of the private sector in road transport infrastructure delivery. These issues include: inadequate maintenance, road concerns (misuse and over dependence), poor inter-modal transport systems, institutional problems, and inadequate funding. It is therefore positioned that, in order to provide high quality, cost-effective, all-weather, safe, reliable and environmentally sensitive road transport infrastructure of world-class status (underpinned by ‘value for money’ drivers), there is a strong need for an adequate, enforceable and enabling legal/ regulatory collaborative engagement framework for road transport infrastructure management in Nigeria.

In order to be able to develop an appropriate and functional collaborative engagement framework, there is a need to be acquainted with existing tools. Therefore the next chapter captures existing models and frameworks.

CHAPTER 5: EXISTING TOOLS AND MODELS

5.1. INTRODUCTION

The growing complexity of construction projects, coupled with the fragmented and uncoordinated nature of processes in the construction industry have prompted the need for integrated processes, teams, improved quality and efficiency in the construction sector (Nadim and Goulding 2011; Morton 2002; Egan 1998; Latham 1994). In this regard, Kagioglou *et al*, (2000) argued that the pre-construction activities of most projects have been accelerated to reach the construction stage, just as the post-construction activities are often side-lined in order to move on to the ‘new job’. This might be responsible for the poor client requirements identification and inadequate review/performance feedback information on construction projects. Therefore, in order to improve the quality and efficiency of the construction industry, there is need to learn, transfer and adapt knowledge, established practices and processes at the strategic, managerial and operational levels from the manufacturing sector to suit the construction industry (Kagioglou *et al*, 2000; Cooper *et al*, 1998). Furthermore, since construction activities are interdependent, attention needs to be paid to the identification, definition, and evaluation of client requirements in order to proffer enduring solutions. This assertion was corroborated by Goulding *et al*, (2012) who emphasised the need for a paradigm shift from the ‘traditional’ approach in order to help improve the construction industry’s performance as well as meet market demands through the provision of improved, adaptable and sustainable infrastructure. A major stakeholder in a construction project is the client who could be an individual, a family or an organisation. In this Chapter, the terms client, customer and end user are used interchangeably. Furthermore the words requirements, needs, demands and expectations are used interchangeably to express the features considered important by the customer. More importantly, in order to develop an appropriate collaborative engagement framework, all issues concerning a project need to be considered from both the business and technical/engineering perspective. In this respect, an attempt is made to critically assess relevant existing tools and models.

The increased need to collaborate in many different project tasks in the modern society underscores the importance of existing management tools and models that can facilitate collaboration. These

include the Integration Definition Function Models, the Generic Design and Construction Process Protocol, Quality Function Deployment, Balanced Scorecard, and Capability Maturity Model.

5.2. INTEGRATION DEFINITION FUNCTION MODEL

The Integration Definition Function modelling (IDEF) is a product of the Integrated Computer-Aided Manufacturing initiative of the United States Air Force. It is a family of 14 modelling techniques in systems and software engineering whose methods and applications include IDEF0 (function modelling), IDEF1 (information modelling), IDEF1X (data modelling), IDEF2 (simulation model design), IDEF3 (process description capture), IDEF4 (object-oriented design), IDEF5 (ontology description capture), IDEF6 (design rationale capture), IDEF7 (information system auditing), IDEF8 (user interface modelling), IDEF9 (business constraint discovery), IDEF10 (implementation architecture modelling), IDEF11 (information artefact modelling), IDEF12 (organisation modelling), IDEF13 (three schema mapping design), and IDEF14 (network design) (Savage, 1996). Lingzhi *et al* (1996) argued that each of these models focuses on a relatively narrow set of relationships and system characteristics comprising a particular viewpoint of the same system; describes different information and knowledge of the same system; and that each model cannot be converted or generated from another model directly and automatically.

The IDEF0 method includes a graphical language that enables a user to describe the activities being modelled in a hierarchical manner. The fundamental concepts of IDEF0 are shown in Figure 5.1. A box depicts an activity or function while the arrows (data) are constraints/parameters (input, output, control and mechanism) that define the box.

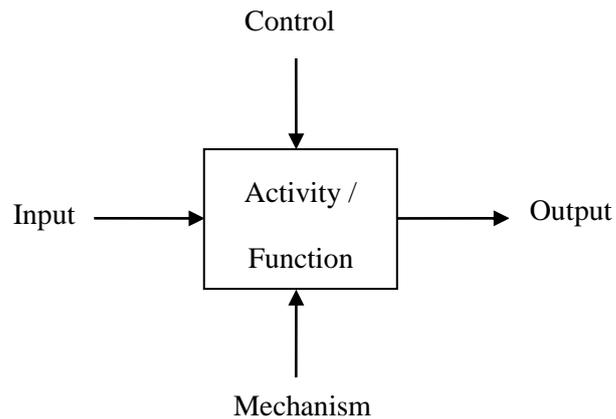


Figure 5.1: IDEF0 Basic Functions

IDEF0, a graphical functional modelling method is designed to model the decisions, actions, and activities of an organisation/system. This technique has been effective when modelling ‘as is’ processes, but has short-comings in modelling ‘will be’ processes. For example, the method was used to represent Sanvido’s Integrated Building Process Model (Sanvido 1990). Granted that IDEF0 model is good for mapping details, it is however complicated and does not facilitate communication or accommodate different viewpoints (Kagioglou *et al*, 2000).

5.3. THE GENERIC DESIGN AND CONSTRUCTION PROCESS PROTOCOL

The Generic Design and Construction Process Protocol was developed at the University of Salford, UK. The concept of the process protocol was informed by issues, drawbacks and deficiencies of practices in the construction industry when compared with established practices in the manufacturing sector (Egan 1998; Latham 1994). In this regard, constructed facilities are perceived as new products developed to satisfy customer/client requirements or felt needs of the market. The modelling approach captures the whole lifecycle of a construction project whilst integrating its participants under a common framework. The process protocol model is capable of representing the diverse interests of all the parties involved in the construction process and change management. The aim/goal of the process protocol was to fashion out processes and procedures for the various stakeholders in a construction project to collaborate. In this regard, the framework replaced such titles as ‘designer’ and ‘contractor’ with ‘design management’ and ‘production management’ respectively (Lee *et al*, 2000). It is a mechanism by which the systematic and consistent interfacing of existing practices, professional

practice and information technology practice support tools can be facilitated. The process protocol model breaks down the design and construction process into 10 distinct phases which are grouped into four major stages known as pre-project, pre-construction, construction and post-construction. The principles underlying the process protocol include its ability to capture views and opinions, and clarity which enhances the standardisation of deliverables and roles associated with achieving, managing and reviewing the process and product (Kagioglou *et al*, 2000). The model was developed to create a collective and shared understanding of production processes.

This 'Stage Gate' modelling technique applies a consistent planning and review procedure throughout any manufacturing process, thereby progressively fixing and/or approving information throughout the process. This in no small measure has helped to improve the conventional chaotic, ad hoc approach of manufacturing (Cooper 1994).

5.4. THE BALANCED SCORECARD

Contemporary business organisations often have Vision and Mission statements. A Mission statement defines the company's business, its objectives and its approach to accomplish those objectives; while a Vision statement describes the desired future position of the company. Elements of Mission and Vision statements are often combined to provide a statement of the company's purposes, goals and values (Rigby 2013). Wall *et al*, (1999) asserted that it is a good practice for objectives to be measurable, approach to be actionable and vision to be achievable. The idea of balanced scorecard (BSC) was conceived and promoted by Kaplan and Norton in the 1990s. A BSC defines an organisation's performance and measures whether management is achieving desired results. It is a management system which often translates an organisation's mission and strategy into a comprehensive set of objectives and performance measures that can be quantified and appraised (Kaplan and Norton 1992). It enables an organisation to set, track, and achieve key business strategies and objectives. The tool which focuses its searchlight on a company's vision and mission helps to frequently control, monitor, keep tract of activities and measure performance. The BSC is ultimately about choosing measures and targets (Kaplan and Norton 1993). Kaplan and Norton (1993) explained that the design process of BSC includes:

1. Translating a given vision into operational goals.
2. Communicating the vision and linking it to individual performance
3. Business planning
4. Feedback and learning, and adjusting the strategy accordingly.

Business strategies today are often developed, deployed and pursued through four distinct perspectives. These perspectives include customer knowledge, financial measures, internal business process, and education/learning and growth (Kaplan and Norton 1996). The customer knowledge measures customers' satisfaction and performance requirements about the products and services of an organisation. The financial measures track the financial requirements and performance of an organisation. The internal business process measures steps critical-to-customer process requirements, while education/learning and growth focuses on how employees are trained, how knowledge is captured, and used to maintain a competitive edge within markets. These viewpoints are necessary for planning, implementation and achievement of business strategies (Maisel 1992). The perspectives also need to be analysed, aligned together and continuously improved as a single thread for a business to flourish. Thus, the BSC effectively articulates the links between leading human and physical inputs, processes, and lagging outcomes and focuses on the importance of these components to achieve the strategic priorities of an organisation (Kaplan and Norton 1996). In this regard, the design of the BSC attempts to identify small number of financial and non-financial measures and attach targets to them, in order that when reviewed, it would be possible to determine whether current performance 'meets' expectations. This implies a 'strategic linkage model' in which the requirements for a given design process is made to fit within broader thinking and integrate with the wider business management process (Kaplan and Norton 2004). A situation where alert is created in areas where performance deviates from expectations may require focused attention in those areas and consequently triggers improved performance. This enables companies to track financial results while simultaneously monitoring progress in building the capabilities and acquiring the intangible assets required for future growth and development (Kaplan and Norton 2004).

A strategy map has been defined as a communication tool used to describe how value is created for an organisation. It shows a logical, sequential step-by-step connection between strategic objectives (Rigby 2013). To develop a strategy map, Kaplan and Norton (1996) explained that a few strategic objectives within each of the perspectives are selected and cause-effect chain among these critical objectives is defined by drawing links between them. This allows a BSC of strategic performance measure to be directly derived from the strategic objectives. The BSC appears to be a tool for assessing public private projects and programmes. It provides feedback around both the internal business processes and external outcomes in order to continuously improve strategic performance and results (Niven 2006). In this regard, Loppolo *et al*, (2012) employed BSC to procure environmental management projects and new public governance actions. BSC have been implemented by government ministries, departments and agencies; corporate organisations and business units; non-profit organisations; and educational institutions. It transforms strategic planning from an academic exercise into the nerve centre of an enterprise (Rigby 2013).

5.5. THE CAPABILITY MATURITY MODEL

The Capability Maturity Model (CMM) has been defined as a framework that describes the key elements or an evolutionary improvement path from an ad hoc, immature process to a mature, disciplined process (Paulk *et al*, 1993). The scope of CMM covers such areas as planning, engineering, and managing software development and maintenance in order to improve the ability of organisations to meet goals for cost, schedule, functionality and product quality (Paulk *et al*, 1993). Thus, it establishes a benchmark for assessing the maturity of an organisation's software process and compares it to the state of the practice of industry.

The structure of the CMM comprises five maturity levels. These include the initial, repeatable, defined, managed, and optimising levels. Aside from the initial level, each maturity level is made up of several key process areas. Furthermore, each key process area is organised into five sections referred to as common features which collectively accomplish the goals of the key process areas (Paulk *et al*, 1993). A maturity level seems to be a clearly defined evolutionary platform which contains a coherent, integrated set of software engineering and management process. The software

process capability of an organisation describes the range of expected results. The key process areas identify a cluster of related tasks whose collective performance would accomplish important goals for establishing process capability at maturity (Weber *et al*, 1991). The goals define the scope, boundaries, intent and practices of each key process area. The key practices include commitment to perform, ability to perform, activities performed, measurement analysis, and verifying implementation (Paulk *et al*, 1991). Commitment to perform includes establishing policies and management system; while ability to perform comprises organisational structure, resources and training. Activities performed include programme of works, schedules and methods/procedures. Measurement and analysis is synonymous with job valuation and certification; while verifying implementation confirms that project tasks/activities are performed in accordance with established procedures. The common features tend to be characteristics that signify whether the implementation and institutionalisation of a key area is effective, repeatable and enduring (Paulk *et al*, 1993). CMM was originally designed to evaluate the ability of government contractors to perform a software project. However, it is argued that process maturity might not be a necessary/mandatory condition for successful software development. For example, Apple, Lotus and Microsoft companies successfully developed their software without observing the third (defined) level of CMM (Weber *et al*, 1991).

5.6. QUALITY FUNCTION DEPLOYMENT

The term “Quality Function Deployment” is a literal translation of the Japanese phrase “*HinShitsu KiNo TenKai*”. The word *HinShitsu* can be translated as qualities, features, characteristics, or attributes; *KiNo* denotes function, method, or procedure; while *TenKai* means deployment, allocation, flow-down, or distribution (Bahill and Chapman 1993). Quality Function Deployment (QFD) has been described as a synthesis of numerous methodologies that originated from the United States of America but perfected, integrated and first used in Japan in the 1960s by Yoji Akao (Govers 1996; Cohen 1995; Akao 1990). The rationale behind the use of QFD in Japan were to improve ‘the quality of design’ and ‘provide manufacturing and field staff with the planned quality control chart prior to the initial production run’ (Chan and Wu 2002). This is what Neff (1991) described as the struggle by product designers under the total quality control movement to improve their work. QFD has been

extensively used in the design and production of automobiles, construction equipment, agriculture systems, home appliances, consumer electronics, software systems etc. in many Japanese industries (Chan and Wu 2002; Kim and Moskowitz 1997). In the last four decades, many establishments in many countries have made use of QFD and acknowledged its significant advantages in customer requirements analysis, design, planning, decision-making, engineering, product development, quality management etc. (Chan and Wu 2002; Griffin and Hauser 1993).

Govers (1996) argued that QFD is more a process than just a tool for product and production process development, since it helps companies to make the key trade-offs between what the customer wants and what the company can afford to build/produce. Its essential characteristics include customer orientation, team approach, structured communications and information network; while the product development process from customer requirements to manufacturing process operations can be outlined through a systematic (step-by-step) approach. The approach includes:

Product concept → Product design → Process design → Manufacturing operations. The strength of QFD is the deployment of the “voice of the customer” to the most detailed level of manufacturing operations (Govers, 1996). For example, Park *et al*, (2012) employed QFD process as an improvement tool to translate customer needs into activities for the development of products and services. However, its application seems to be characterised with many challenges. These include interpreting the customer voice, defining the correlations between the quality characteristics and quality demanded (Chan and Wu 2005), defining the estimated quality as a result of the variance between the quality characteristics and quality demanded (Ramasamy and Selladurai, 2004).

QFD is a total quality management process in which the voice of the customer is considered throughout the engineering design and manufacturing stages of product development (Aguwa *et al*, 2012). In this case, customer requirements, needs and desires are integrated into the product design thereby combining marketing and engineering parameters/strategies. QFD uses matrices to ascertain interrelationships between customer demands, product characteristics, and manufacturing processes. Temponi *et al*, (1999) described the ‘house of quality’ as one of the matrices of QFD which is often used to translate customer needs into the voice of the engineer. The voice of the customer has to be

appropriately captured and analysed in order to provide key information required by marketing experts and design engineers for the product development process (Yang, 2007). This can be achieved through research on customer's recognition, customer survey and customer feedback (Bradlow, 2010). Furthermore, voice of the customer data need to be transformed into engineering input in order to improve product features and satisfy customer requirements (Aguwa *et al*, 2012). According to Chan and Wu (2002), the primary functions of QFD include customer needs analysis; planning; product design; decision-making; product development; engineering; management; teamwork, timing and costing; and quality management.

The QFD model has six major sections. These are the customer needs and benefits, otherwise known as the voice of the customer; the planning matrix; the technical response/design requirements; the relationships section; the technical correlation; and the technical matrix sections. These sections contain the central elements that make up the 'house of quality' (HOQ) (see Figure 5.2). The voice of the customer (Section A) describes 'what' the customer requires from a specific product or service. The planning matrix (Section B) involves a qualitative market research and strategic planning that defines or shows the comparative evaluation of competing alternatives. This section specifies the relative importance of the customer needs and satisfaction with the organisation, and what can be obtained from competitor organisations in the same industry. The technical response or service elements (Section C) explains 'how' the customer's necessities/ needs can be met or fulfilled with regards to the organisation's competence and quantifiable product design requirements. The relationships matrix (Section D) determines the strength of relationship between the customer necessities/ need (A) and the specific product design requirements (C). This section relates each customer need with each service element of the organisation's technical response or product design requirements. The technical correlation (Section E) 'the roof' consists of the positive and negative association, support and interrelationships between the elements of the organisation's technical response. Lastly, the technical matrix (Section F) consists of the prioritised product design requirements based on what can be done to satisfy most of the customer needs. This section contains

the important measurements and target values of each of the design requirements, hence, it answers the question ‘how much?’.

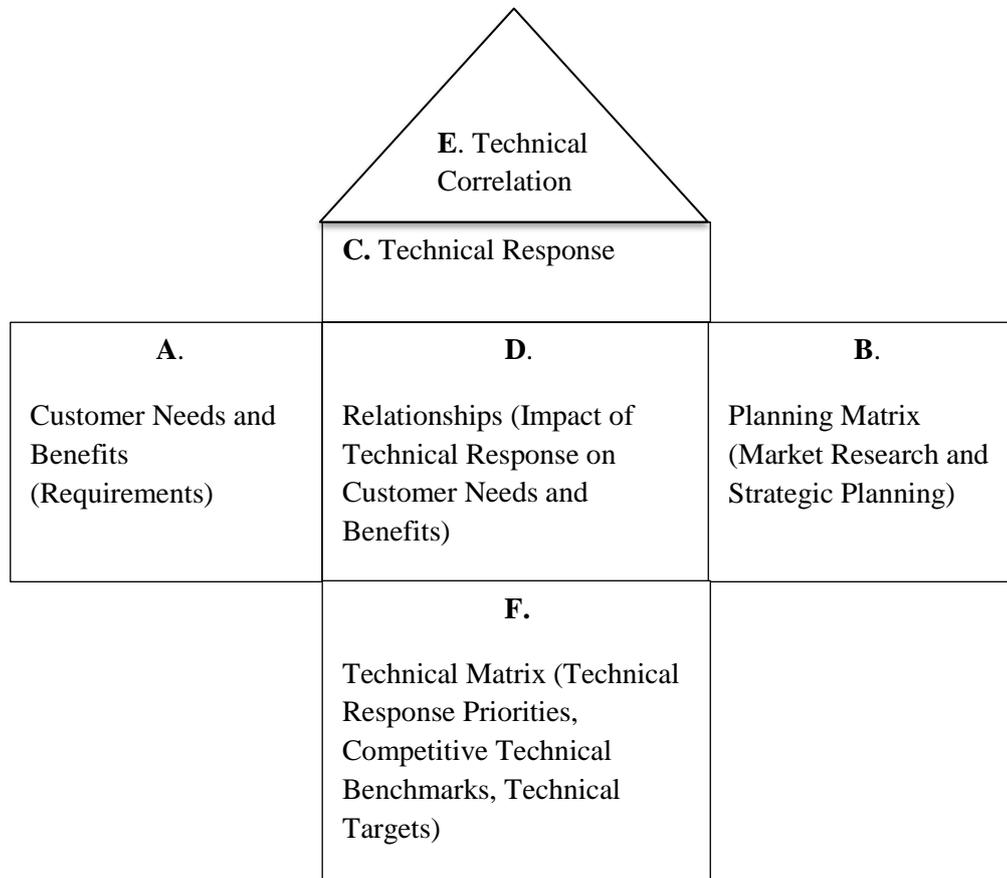


Figure 5.2: House of Quality, Source: (Cohen 1995)

The HOQ consists of the most important information required by a development team concerning the company’s relationship with customers and its position in the competitive market (Costa *et al*, 2001). The four important elements of the HOQ are ‘what’ (customer attributes, needs or requirements), ‘how’ (company characteristics, technical requirements or engineering parameters), relationship (between ‘what’ and ‘how’), and ‘how much’ (target value). The ‘how’ of one phase becomes the ‘what’ of the next phase in the ‘Four-phase model of QFD (see Figure 5.3), thus, the HOQ offers a direct link from one phase to another (Park *et al*, 2012; Quinn 2002). In this regard, Kumar *et al* (2006) posited that the generic methodology for constructing the ‘house of quality’ can be employed in many situations.

The activities/processes of industry respond more rapidly to technological development, social change and market demands. This may require different skills, abilities and competencies. The design phase of construction projects often focuses on satisfying the client's requirements and meeting quality standards through drawings and technical specifications. However, the construction industry in most developing countries is arguably yet to identify, capture and transform client's requirements into technical objectives and targets through the use of QFD. In this regard, Dikmen *et al*, (2005) observed that though the clients' needs are often collected prior to the project design, they seem to be ignored and finally disappear at the construction stage. This is due to lack of integration and co-ordination between the design and construction phases and teams. Thus, the issues of incomplete designs, buildability, misinterpretation of client expectations, rework and delays arise.

QFD is a method for the development/deployment of functions, attributes and features that offer a product/service high quality. It is a system for designing a service or product based on customer needs and involving all members of the organisation (Sahney *et al*, 2003). QFD is a customer-oriented strategy of product/service improvement that aligns customer needs to company activities. It is a systematic approach for collecting, tracking and translating 'what' customers require from the product, to 'what' the company can offer to best fit the customer requirements through the integrated process of research, product development, engineering, manufacturing, marketing/sales and distribution (Park *et al*, 2012).

The QFD identifies and ranks the relative importance of the customer needs; identifies the design parameters that satisfy those customer needs; estimates the relationship between the customer needs and the design characteristics; determine the relationship among the design features; and identify the set of design attributes that best satisfy the customer needs (Sahney *et al*, 2003; Cohen 1995). The ultimate goal of QFD is to translate the frequently subjective quality criteria into objective ones that can be quantified and measured, and which can then be used to design and manufacture a product that will satisfy both customer and company simultaneously (Hauser and Clausing, 1988).

The literature identified two major methods of implementing QFD. These are the ‘Akao matrix of matrices’ and the ‘Four-Phase model’ otherwise known as the focused approach (Chan and Wu 2002; Cohen 1995; Akao 1990). The former method is based on a scheme of 30 matrices or quality tables in which each matrix details a specific aspect of the development process, while the latter approach describes the basic product development steps and the numerous component parts brought together to form the tangible physical final deliverable or product (Cohen 1995). Given these, the Four-Phase model which comprises four steps is more widely used (Park *et al*, 2012). The phases of the model include Phase 1- House of Quality (Product Planning), Phase 2- Design Development (Part Development), Phase 3- Manufacturing Planning (Process Planning), and Phase 4- Production Planning (Production Operations Planning) (Benner et al 2003; Cristiano et al 2000; Cohen 1995) (see Figure 5.3).

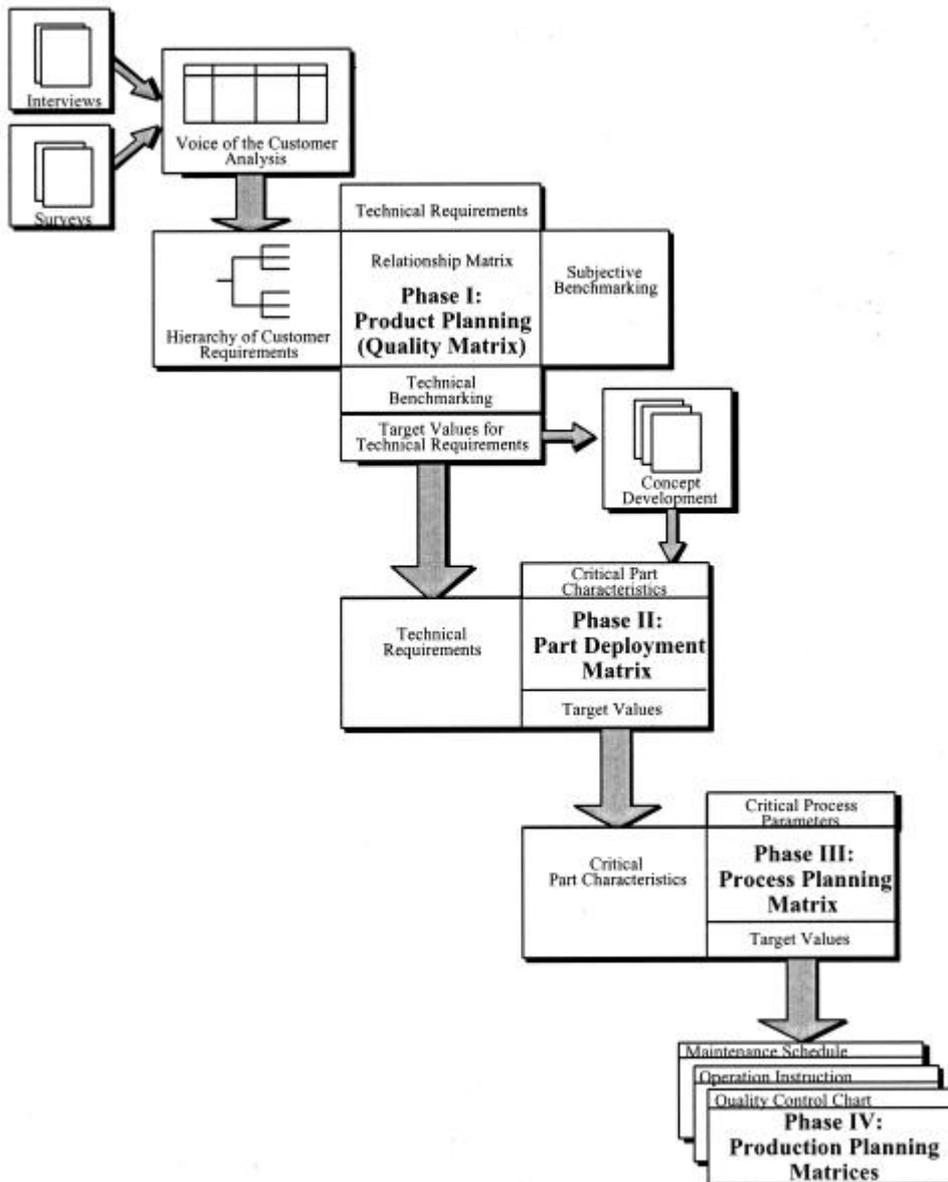


Figure 5.3: Four-Phase Model of QFD. Source: (Cristiano *et al*, 2000)

The production planning phase (1) translates qualitative customer needs into design independent, measurable, quality characteristics of the product. The quality characteristics are prioritised on the basis of the customer’s views, opinions and target values; while the desired level of performance is a function of competitive benchmarking. These influence the choice of a design concept or quality development (Hauser and Clausing 1988). The part deployment phase (2) scrutinizes the connection between the quality characteristics and the different component parts of the product design. The outcome of the design/part deployment phase is a prioritisation of the component parts of the design

with regards to their ability to meet the desired quality specific performance level. The essential few component parts are deployed to the next phase that determines the association between the part and the production process employed in manufacturing the part (Kim *et al*, 1998). The objective of the manufacturing/process planning phase (3) is to ascertain the manufacturing operations that regulate or control the component target value and variation, and correlate component specifications with process target values and specifications (Cristiano *et al*, 2000). The outcome is a prioritisation of production process and specifications for critical process characteristics that are deployed to the final phase. In the production/operations planning phase (4), the core manufacturing process and related factors are translated into work instructions, quality control and feedback mechanisms, and pedagogical requirements necessary to ensure that the quality of critical parts and processes is sustained. The Four-phase model of QFD provides an appreciable/noticeable link from the shop floor back to customer needs that provides employees awareness into how their job function influences customer satisfaction (Cristiano *et al*, 2000).

QFD identifies customer needs, converts them into quality indicators and facilitates competitive benchmarking in a logical way (Dikmen *et al*, 2005). The QFD process translates the customer requirements into measurable goals in the light of competitive market environment, and fosters functional teamwork of all company employees towards satisfying the customer needs. In this respect, QFD alleviates the problems associated with the quality of product/services through effective communication, interaction, integration, co-ordination, reduction in time-to-market, and collaboration of all stakeholders (Park *et al*, 2012). However, Cohen (1995) argued that the drawbacks of QFD model include its inability to capture and incorporate production cost, tools, technology and assign resources. Furthermore, its implementation process seems to be somewhat time consuming. Given these developments, attempts to overcome the shortcomings of QFD model resulted into fuzzy set theory, computerised QFD tool, expert systems, analytic network process, artificial neural works, fuzzy analytical hierarchy process, fuzzy logic, and the Taguchi method for benchmarking competitors and determining precise target values (Park *et al*, 2012, Ertay *et al*, 2011; Dikmen *et al*, 2005; Bouchereau and Rowlands 2000; Bode and Fung 1998; Verma *et al*, 1998).

Table 5.1: Comparative Evaluation of Tools/Models

Assessment Criteria	Integrated Definition Function	Quality Function Deployment	Balanced Scorecard	Generic Design & Construction Process Protocol	Capability Maturity Model
Product planning	✓	✓		✓	✓
Product design	✓	✓		✓	
Process planning	✓	✓		✓	
Product control	✓	✓	✓	✓	
Flexibility to capture views and opinions		✓		✓	
Understanding customer needs		✓		✓	
Analytic prioritisation of customer needs		✓			
Documentation of system requirements	✓			✓	
Ability to represent complex data		✓		✓	
Documentation of product specifications		✓			
Increased customer commitment towards product design		✓			
Reduced product development time				✓	
Consensus-building within the company		✓			
Informed balance between quality and cost					
Effective task assignment/scheduling	✓	✓		✓	✓
Reduced engineering bottlenecks		✓			
Elimination of waste					
Enhanced communication between design and manufacturing		✓			
Reduced manufacturing problems		✓			
Reduced design changes during product development/production		✓			
Reduced rework					
Increased sale		✓			
Increased market share					
Increased customer feedback		✓			
Improved human relations between divisions		✓			
Improved employee job satisfaction		✓			
Improved company organisation		✓			
Total quality management		✓			
Quality systems thinking (psychology + epistemology)		✓			
Systematic approach		✓		✓	
Creating value for money		✓			
Continuous tracking of client expectations from start to end of project		✓			
Team building/ cross functional team integration		✓			
Effective decision making		✓	✓	✓	✓
Translation of subjective quality criteria into objective criteria		✓			
Transfer client expectations into design solutions		✓			
Win-win scenario for customer and manufacturer					
Strategic planning/management		✓	✓	✓	
Strong support from the research community		✓		✓	
Performance measurement			✓		

5.7. SUMMARY

The ultimate objective of every business is to satisfy and increase the appetite/demand of the consumer/customer for its product. The existing management tools and models were derived through seminal literature. The assessment criteria/metrics are essential needs or requirements of an effective collaborative engagement framework. Given this, Table 5.1 above shows that the QFD satisfied the assessment criteria/metrics and consequently has more advantages over other tools and models. One main merit of QFD is that it helps policy formulators and planners to focus on the characteristics of a new or existing product or service from the viewpoints of market segments, business, or technology-development needs. The ultimate goal of QFD model is to satisfy the needs/requirements/desires/expectations of and create value for the customer. Bahill and Chapman (1993) described QFD as the jewel of the collection of tools being called total quality management. QFD is a proven technique for product development, has strong support from the research community, flexible to capture views and opinions, and represent complex data dependencies and relationships. Given these attributes, QFD was considered an appropriate tool for the development of the collaborative engagement framework for road infrastructure management in Nigeria.

This chapter has evaluated a few existing models. The next chapter focuses on research methodology.

CHAPTER 6: RESEARCH METHODOLOGY

6.1. INTRODUCTION

Scientific research involves the collection of relevant data and appropriate methodologies aligned to the research problem at hand. In this regard, this chapter discusses the various approaches to data collection, and explains the philosophical orientation of the study with due cognisance of the ontological, epistemological and methodological positioning. It describes the differences between ‘quantitative’, ‘qualitative’ and ‘mixed methods’ research. It also discusses in detail the chosen strategies of enquiry including data collection and analysis techniques for each stage of this study. Research needs to be systematic, structured, planned, organised, transparent, robust and dependable. Thus, this research design comprised four main stages. The first stage was the literature review. The second stage focused on questionnaire survey. The third stage used explorative case study interview with the basic qualitative content analysis. The fourth and final stage of the investigation focused on the development, refinement and validation of a conceptual collaborative engagement framework for road transport infrastructure management in Nigeria (see Figure 6.2).

6.2. RESEARCH DESIGN

The term research consists of two syllables ‘re’ and ‘search’. The former (a prefix) means again, anew or over again while the latter (a verb) translates to examine carefully, closely, probe, test or try. Together, they form a noun describing a careful, organised, patient study and investigation in some field of knowledge, undertaken to establish facts or principles (Grinnel, 1993). This is what Fellows and Liu (2008) described as ‘a voyage of discovery’, a careful investigation, and a learning process. Kumar (2011) identified the characteristics and requirements of a research process. According to him, a research process must be controlled, rigorous, systematic, empirical, critical, valid and verifiable. These features distinguish scientific research from the day-to-day traditional methods of solving problems. The traditional methods such as intuition, personal experience, trial and error, authority and expert opinion have limitations. For example, they are not verifiable, not empirical, and cannot be replicated, hence such results cannot be generalised. Given these, Grinnell (1993) defined research as structured inquiry that utilises acceptable scientific methodology to solve problems and creates new

knowledge that is generally acceptable. According to Naoum (2007), research is a systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions. Similarly, Kerlinger (1986) perceived scientific research as a systematic, controlled, empirical and critical investigation of propositions about the presumed relationships about various phenomena. Simply put, research is a logical way of finding solutions to a problem, with a view to extending/advancing the frontiers of knowledge. Research attempts to answer such pertinent questions as ‘what,’ ‘where,’ ‘who,’ ‘when,’ ‘how,’ ‘whom,’ ‘how much,’ and ‘why’? (Fellows and Liu 2008; Creswell 2009; and Yin 2009). From the foregoing, a problem could be an issue that needs to be investigated, a question that has persisted over time, a missing link in a system which has adversely affected the system, a vacuum or gap that needs to be filled. Nevertheless, not all problems are researchable. A researchable problem could be an issue that allows an investigator to collect and process/analyse data, interpret results, and draw inferences from findings.

However, there is need to differentiate between the concepts of research methodology and research methods. Yin (2009) perceived research design as a logical sequence that connects empirical data to the aims and objectives of a study, and ultimately to its inferred conclusions. Furthermore, Creswell (2009) described research methodology as a plan and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis, involving a mixture of philosophy, approaches, and specific methods of investigating a problem. Similarly, Dainty (2008) defined research methodology as the rationale and the philosophical assumptions that trigger a particular study. For the purpose of this investigation, research methodology denotes the unequivocal philosophies, approaches, principles, and procedures upon which enquiry is based and against which knowledge is assessed. On the other hand, research methods basically refer to the specific techniques/ways of collecting/gathering and processing/analysing data. The choice of a research design/methodology may be influenced by the nature of a research problem, thus, an appropriate research methodology will determine the research methods to be adopted for a study.

Extant literature has revealed that no public agencies or single-point governmental body has sufficient funds to expand, restore or preserve its highway facilities. Therefore, this study focuses on

collaborative road infrastructure management between the public and private sector organisations. Transport is one of the most important sectors in every society. It involves many stakeholders ranging from government ministries, departments and agencies; the organised private sector; and the general public. In particular, road infrastructure is a major catalyst for the physical and socio-economic development of a country's Gross Domestic Product; as the movement of people, labour, goods and services largely depend on it (Queiroz and Kerali 2010; Adetola *et al*, 2013a). Yet demand for this basic facility has grown over the years rapidly outstripping the supply capacity of road asset. Therefore, research on road transport infrastructure has become well established and increasingly important, due to its pivotal role in the development of all other sectors and industries. In order to determine the appropriate methodology for this research, it is necessary to look at previous studies in similar areas.

The Federal Highway Administration (2009), Campbell (2009), Umoren *et al* (2009) and Benmaamar (2006) chose a combination of qualitative and quantitative methods comprising literature review, questionnaire survey and case study interviews to investigate road/highway transport infrastructure management. Siemiatycki (2011) adopted an evaluation of extant literature approach to explore business-government relationships in UK transportation projects. Queiroz and Kerali (2010) also employed qualitative research to review institutional arrangements for road asset management. Similarly, Ke *et al*, (2009) and Tang *et al*, (2010) have carried out extensive review of studies on public private partnership projects in the construction industry through content analysis of seminal literature. Furthermore, Aska and Gab-Allah (2002) and Carrillo *et al*, (2008) used quantitative research techniques to identify problems facing parties involved in BOT transport projects; and participation barriers and opportunities in PFI respectively. In addition, Abednego and Ogunlana (2006), Charles (2006) and Abiodun (2013) also utilised mixed methods research design to examine good PPP project governance; PPP modes of procuring public infrastructure and services; and decision models and frameworks respectively. The differences, features and characteristics of these methodologies and methods are discussed in Section 6.3 in Chapter 6.

6.3. RESEARCH PHILOSOPHIES

The human view of the World is usually described as a basic set of beliefs that guide action (Lincoln and Guba 2000). Other authors have referred to beliefs as paradigms. A paradigm may be described as an intellectual perception accepted by an individual or a society as a clear example, model or pattern of how things work in the world (Lincoln and Guba, 2000; Mertens, 1998). Yet, other scholars view belief as epistemologies and ontologies (Crotty, 1998); or broadly conceived research methodologies (Neuman, 2000). Research methodology has been defined as a design, plan or procedure for a study which include such elements as philosophical assumptions, strategies of enquiry, and specific research methods of data collection, analysis and interpretation taking due cognisance of the nature of a research problem (Creswell, 2009). Although Slife and Williams (1995) argued that philosophical ideas tend to remain largely hidden in research, Creswell (2008) asserted that they still influence the practice of research and consequently need to be identified. Philosophically, researchers make claims/assumptions about what knowledge is (ontology), how it is known (epistemology), what values go into it (axiology), how it is written (rhetoric), and the process for studying it (methodology) (see Figure 6.1). Therefore, the basic paradigms of research include ontology, epistemology, methodology, and methods. Ontology is concerned with what exists, what is out there to know, or what is being investigated. Epistemology addresses how what exists can be studied or known, hence, Symon and Cassell (2012) described epistemology as the study of the criteria by which the content of knowledge can be known. Methodology explains how knowledge can be acquired, while methods describe the precise procedures or processes that can be adopted to carry out a study. This is consistent with the assertion of Bryman (1988) that a paradigm is a cluster of belief and dictates, which influence what should be studied, how research should be done, and how research results should be interpreted.

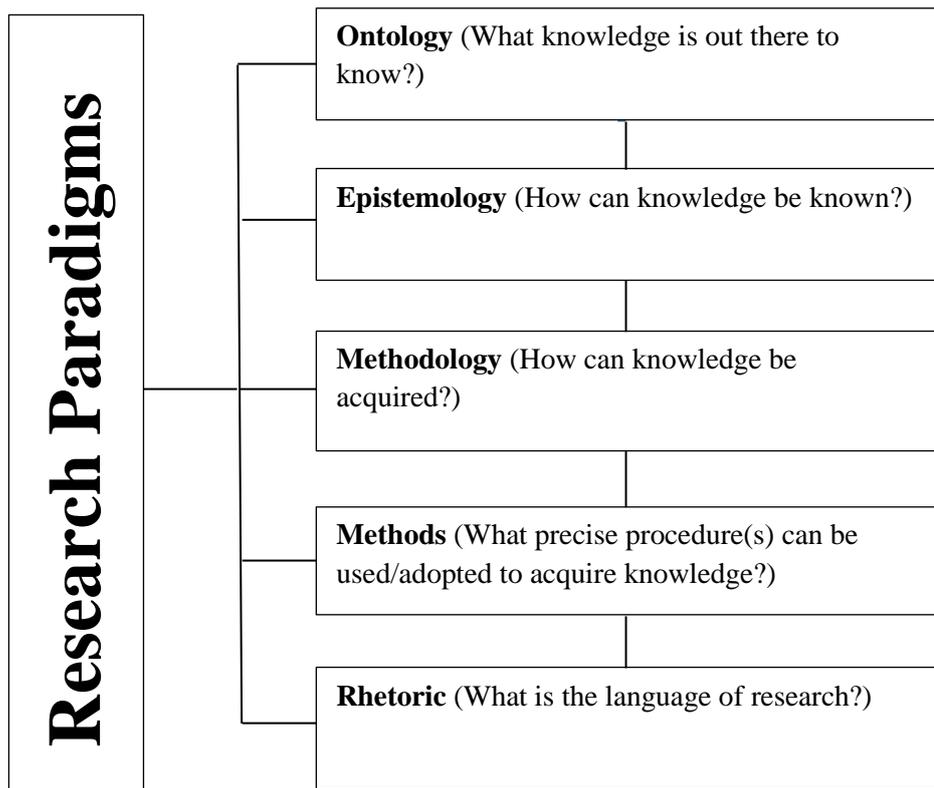


Figure 6.1: Typical Research Paradigms. Source: Bryman (2012)

Furthermore, Hitchcock and Hughes (1995) postulated that ontological assumptions (beliefs about the nature of reality and things) gave rise to epistemological assumptions (ways of researching and enquiring into the nature of reality and things); which in turn gave rise to methodological considerations, research instruments and data collection. Thus, ontological, epistemological and axiological assumptions enable research to focus or be concerned with the understanding of the World.

6.3.1. INTERPRETIVISM

Interpretivism is an epistemological position that requires the social scientist to grasp the subjective meaning of social action (Bryman and Bell 2007). Interpretivism has been widely acknowledged as an appropriate approach for qualitative research, and often looks for culturally derived and historically situated interpretations of the social world. In this regard, Cohen *et al*, (2011) observed that the

interpretive approach hinges on humanistic and existential ontologies and epistemologies. Interpretivism is concerned with how human beings interpret and make sense of reality, granted that human beings are able to critically assess and change society and become emancipated (Creswell 2009). Social constructivists often hold the assumptions that individuals seek understanding of the World in which they live and work, develop subjective meanings of their experiences (meanings directed towards certain objects or things), and that these varied and multiple meanings lead the researcher to look for the complexity of views rather than narrowing meanings into categories or ideas (Creswell 2009). In this context, qualitative research tends to use open-ended questions in order to enable the participants to share their views. This largely inductive process allows the inquirer to generate meaning from the data collected in the field (Crotty 1998). The constructivist researcher often addresses the process of interaction among individuals and focuses on the specific contexts in which people live and work in order to understand the historical and cultural settings of the participants (Creswell 2009).

6.3.2. POSITIVISM

Positivism is an epistemological position that advocates the application of the methods of the natural sciences to the study of social reality and beyond (Bryman and Bell 2007). Positivism as an approach has been acknowledged to be more appropriate for quantitative research. It asserts that there are observable facts which can be seen and measured by an observer, who remains detached, unbiased and uninfluenced by the observation and measurement (Fellows and Liu 2008). In other words, facts are independent of the observer. In this respect, total, objective and accurate observation would yield consistent perception, same outputs/results, given the same inputs under the same circumstances. Positivism positioning engenders reliability, consistency, objectivity, validity, replicability and generalisability. The knowledge that develops through a positivist approach is based on careful observation and measurement of the objective reality that exists in the world (Creswell 2009).

While Fellows and Liu (2008) broadly grouped research into pure and applied research categories, Kumar (2011) classified research based on three different perspectives. He proclaimed that a research project may be classified as pure or applied research (from the perspective of application); as

descriptive, correlational, explanatory or exploratory (from the perspective of objectives); and as qualitative or quantitative (from the perspective of the enquiry mode employed). Pure research is an academic study undertaken in order to acquire cognitive, psychomotor or affective knowledge about phenomena and develop new techniques and procedures. The findings of an applied research (mostly Social Science studies) are used to understand an issue or bring about a change in a programme/situation). While a descriptive research simply describes a situation, phenomena or issue; a correlational research establishes or explores a relationship between two or more variables. Kumar (2011) also identified two broad categories of research enquiry. These are the structured and the unstructured approaches. In the former, the research objectives, design, sample and questions are predetermined, whereas, the latter category allows flexibility in all the aspects of the research process. The structured approach to enquiry is often referred to as ‘quantitative’ research, while the unstructured approach is classified as ‘qualitative’ research. Creswell (1994) saw the quantitative approach as a traditional, positivist, experimental or empiricist paradigm, and the qualitative approach as a constructivist, naturalistic, interpretivist, post positivist or postmodern paradigm.

Considering the widespread nature of the raw facts to be collected in this study, it is imperative to examine the existing research methodologies. In this respect, Creswell (2009) identified three types of research designs: qualitative, quantitative and mixed methods.

6.4. QUALITATIVE RESEARCH

Qualitative research is a form of explanatory examination in which an investigator makes an interpretation of what he/she sees, hears and understands. It involves the collection, analysis and interpretation of verbal and textual data in order to portray the specificity, uniqueness, complexity and interpersonal dynamics of a problem (Cohen *et al* 2011). Thus, it often seeks to gain insights, explore and understand people’s perception, beliefs, understandings, opinions and views of a problem, and the ‘world’ either as individuals or groups through systematic investigation (Fellows and Liu 2008). Sometimes, a qualitative study may focus its searchlight on identifying the social, political or historical context of the problem being investigated.

Qualitative research is suitable for exploring the nature of a research problem, and describing an observed situation in order to give a vivid account of the different opinions about an issue or problem (Kumar 2011). A qualitative research investigator constructs his/her own research instrument(s) and validates same with experts, collects data personally by interviewing participants, examining documents, and/or observing the respondents' behaviour. The researcher may also modify existing instruments developed by other scholars to suit his/her study. He/she gathers multiple forms of data (from interviews, observation, documents etc.) without relying on a single source of data (Yin 2009). A qualitative investigator reviews all data, focuses on learning the meaning that the research subjects hold about the research problem, and organises such into themes or categories that cut across all data sources. This may involve close interaction with the research participants in order for them to help shape the themes emerging from the process. This face-to-face interaction/discussion allows for genuine understanding of the respondents' behaviour, values, beliefs, and non-verbal communications or body language in their natural settings and in the context in which research is conducted. Qualitative research is not rigid, hence, the phases of the process may change in the course of field-data collection. For example, the initial research plan may be altered, the research questions may change, while the individuals studied and the places visited may be modified. This flexibility allows for the qualitative research process to emerge (Cohen *et al*, 2011; Kumar 2011; Creswell 2009).

Therefore, qualitative research process involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data (Creswell 2009). The reliability and validity of qualitative research may seem difficult since it is impossible to 'freeze' a social setting and the circumstances of an initial study to make it replicable in the sense in which the term is usually employed (Bryman and Bell 2011). In this respect, Lincoln and Guba (2000) proposed two primary criteria for assessing a qualitative study. These are trustworthiness and authenticity. Trustworthiness is made up of credibility (internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity) (see Table 6.4).

Qualitative strategies include narrative research (Clandinin and Connelly, 2000); phenomenology (Moustakas, 1994); grounded theory (Strauss and Corbin 1990, 1998); ethnographies (observation and interview) (Wolcott, 1999); and case study (Stake, 1995).

6.4.1. PHENOMENOLOGY

Phenomenology is the empirical study of the qualitative variation in the ways that a group of people experience a phenomenon. It is a theoretical point of view that advocates the study of direct experience taken at the face value; and one which sees behaviour as determined by the phenomena of experience rather than by external, objective and physically described reality (Akerlind 2005). The mapping of this variation is generally motivated by a desire to improve people's learning in some way. In phenomenological inquiry, the investigator identifies the essence of human experiences about a phenomenon as described by the participants. This makes phenomenology a philosophy as well as a method, and the procedure involves studying a few subjects through extensive and prolonged engagement to develop patterns and relationships of meaning (Moustakas 1994). The phenomenological interview focuses on specific experience of a phenomenon for an individual. Within this, interviews are fairly open-ended attempting to elicit the meaning of that instance of the phenomena to the individual.

6.4.2. ETHNOGRAPHY

Ethnography is a written description of a particular culture (customs, beliefs and behaviour) based on information collected through fieldwork. It involves participant observation in which the investigator is immersed in the everyday life of the research setting, and the researcher enters the informants' world and through close interaction, seeks the informants' perspectives and meanings (Cohen *et al*, 2011). In this regard, it captures other people's realities (the participants's point of view) by paying attention to language and rhetoric (Hariss and Johnson 2000). Crang and Cook (2007) defined ethnography as a traditional method of sociology and cultural anthropology which involves the study of people performing activities and interacting in complex social settings, in order to obtain a qualitative understanding of these interactions. Ethnography offers a useful tool to analyse organisational culture and signs, given that the researcher studies an intact cultural group in a natural

setting over a prolonged period of time. Organisations are socially constructed entities in which participants create meaning not only from functionally-defined symbolic objects, but also through the contextualisation of semiotic strategies (Tierney 1987). Individuals often make sense of situations not only from the organisation in which they work, but from the multiplicity of organisations in which they live. Ethnography aims at identifying routine practices, problems and possibilities for development within a given activity or setting.

6.4.3. ETHNOMETHODOLOGY

Ethnomethodology has to do with everyday life activities. According to Garfinkel (1967), ethnomethodology focuses on practical circumstances, real-world activities and practical sociological understanding of realistic study, and by paying to everyday events the attention often given to extraordinary happenings, in order to know about them as occurrences in their own right. Ethnomethodology focuses on how people interpret their everyday world. It is focused at the strategies by which people accomplish and sustain interaction in a social milieu, the rules they make, the conventions they employ, and the practices they adopt. Thus, ethnomethodology seeks to understand social achievements in their own terms (Burrell and Morgan 1979).

6.4.4. GROUNDED THEORY

According to Greckhamer and Koro-Ljungberg (2005), grounded theory is a method or set of procedures for the generation of theory or for the production of a certain kind of knowledge. The theory is derived inductively from the analysis, study and reflection on the phenomena under examination. Thus, theory generation is a consequence of, and partner to systematic data collection and analysis. Similarly, Glaser (1996) described grounded theory as the systematic generation of a theory from data; it is an inductive process in which everything is integrated and in which data pattern themselves rather than having the researcher pattern them, as actions are integrated and interrelated with other actions. In grounded theory, data collection, analysis and theory are closely intertwined. A researcher does not begin with a pre-conceived theory in mind, rather the researcher begins with an area of study and allows the theory to emerge from the data. Grounded theory requires highly formalised coding and categorisation, and involves constant comparison and iterative development

(Cohen *et al*, 2011). Grounded theory is more suitable or appropriate when deriving a theory of a process, action or interaction grounded in the views of participants in a study.

6.5. QUANTITATIVE RESEARCH

Quantitative research often tests objective theories by examining the relationship among variables which in most cases are measured on instruments in order to analyse numbered or coded data using statistical procedures (Creswell, 2008). It is generally concerned with measurement, causality, generalisability and repeatability, and more appropriate to determine or quantify the extent of variation in a problem, issue, phenomenon or situation (Bryman and Bell 2011; Kumar 2005). Quantitative strategies include experimental, quasi-experimental and correlational studies (Campbell and Stanley, 1963) and non- experimental designs, such as surveys. Survey research often provides a quantitative or numeric description of trends, attitudes or opinions of a population by studying a sample of that population. It includes cross-sectional and longitudinal studies using questionnaires or structured interviews for data collection, with the intent of generalising from a sample to a population (Babbie, 1990). Quantitative approaches tend to relate to positivism and seek to gather factual data, to study relationships between facts, and how such facts and relationships agree with theories and the findings of any previously executed research/ literature (Fellows and Liu 2008).

Table 6.1: Features of Qualitative and Quantitative Research

Features	Qualitative	Quantitative
Meaning	A means of exploring and understanding the meaning individuals/groups give to a social/human phenomenon.	A means of testing objective theories by examining the relationship among variables.
Philosophical approach	Interpretivism/Social Constructivism, Advocacy/participatory	Positivism/Empirical Science
Focus	Seeks to find out ‘how’ and ‘why’ things happen?	Addresses such questions as ‘what’, ‘how much/many’?
Nature of data	Rich, deep and subjective	Hard, objective and reliable
Role	Attitude measurement based on opinions, views and perceptions	Fact-finding based on evidence or records
Relationship between researcher and subject	Close (researcher may bring personal values into study)	Distant (researcher uses unbiased approaches)
Scope of findings	Idiographic (explanation and understanding of the unique and particular case)	Nomothetic (characterised by procedures and methods designed to discover general laws)
Relationship between theory/concepts and research	Emerging/ developing	Testing/Confirmation/Verification
Nature of problem	Exploratory, context important, attitudinal	Explanatory, Context-free, Body of literature exists
Type of reasoning	Inductive –builds theory, Developing process	Deductive –tests theory, Confirmation process
Method of enquiry	Narrative research, Phenomenology, Grounded theory, Ethnography, Case study	Experimental, Surveys/(Non-experimental), Quasi-experimental, Correlational studies
Type of instrument used for gathering data	Open-ended/Unstructured Interviews, Observations, Emerging approaches, Image data/ Textual, Documents	Close ended/Structured, Predetermined approaches, Standard instrument, Numeric data
Data Analysis	Inductive/ Interactive	Recursive/ Deductive
Communication of findings	Words, Individual quotes, Personal voice, Literary style	Aggregated data, Statistics Numbers, Scientific style
Sampling	Information rich-centric	Data-centric
Merits	Insightful, Descriptive, Flexible guidelines, Validates the accuracy of findings, Detailed, in-depth/extensive, Change/Reform oriented, Focuses on a single phenomenon/concept, Search for themes, patterns/categories, Wholistic	Impersonal, Economical, Reliable, Uses systematic procedures, Replicable, Easily generalised, Uses standards of validity and reliability, Identifies variables to study, Statistical interpretation, Focused, Predictive

(Source: Naoum, 2007; Fellows and Liu, 2008; Creswell, 2009; Yin, 2009; Leedy and Ormrod, 2010)

From the foregoing, qualitative and quantitative research differ in philosophical approach, focus, nature of data, relationships between the researcher and the subject, scope of findings, method of enquiry, data collection methods, data analysis technique, and communication of research findings. For example, qualitative research often requires close interaction/relationship between the researcher and the subject of research, and involves the use of interviews, observations or discourse analysis. Whereas, a quantitative investigator may never see his/her subjects/respondents since the quantitative approach requires the use of standardised instrument/measures (see Table 6.1).

6.6. MIXED METHODS RESEARCH

Mixed -methods is a combination of methods, a multi-method research involving pragmatic epistemological approach and seeking convergence across qualitative and quantitative methods. Mixed methods research design arises out of actions, situations, and consequences rather than antecedent conditions. It is concerned with applications, answers to questions, and solutions to problems (Creswell, 2009). The pragmatist approach focuses on the use of all available techniques in order to have the best understanding of a research problem (Rossman and Wilson, 1985). In this regard, mixed methods research integrates the elements of both qualitative and quantitative designs, opens the door to multiple methods, different worldviews, different assumptions, as well as different forms of data collection and analysis (Tashakkori and Teddlie, 1998; Morgan, 2007; Creswell, 2009). Since every method has its limitations, the biases inherent in any single method could neutralise or cancel the biases of other methods. Otherwise known as triangulated studies, mixed methods research can help a researcher to gain insight, assist in making inferences and drawing conclusions (Fellows and Liu 2003; Creswell 2009).

In mixed-methods research design, both probability and non-probability sampling might be required. In this regard, Cohen *et al*, (2011) classified mixed methods sampling techniques. These include parallel mixed methods sampling, sequential mixed methods sampling, multilevel mixed methods sampling, stratified purposive sampling, purposeful random sampling, and nested sampling technique. The sequential mixed-methods sampling may involve two different sampling techniques (probability and non-probability) in which one sample precedes another and impacts or influences the

proceeding sample. For example, numerical data may set the stage for in-depth interview in critical, extreme or unique cases. On the other hand, qualitative data from case studies may tease out or identify salient issues for exploration in numerical survey (Teddlie and Tashakkori 2009).

6.7. RESEARCH POSITIONING / PHILOSOPHICAL APPROACH

Taking due cognisance of the philosophical considerations, and the wide range of data to be collected, the use of a mixed –methods approach to research was considered appropriate for this study. The use of mixed methods is not just about the balance of qualitative and quantitative data per se, it is about understanding the complex social and political contexts of the public private sectors collaboration in highway infrastructure management. Recent studies on road transport infrastructure development support the use of mixed-methods research design for research such as this (see Section 6.2).

Since 1992 to date, Public-Private Partnerships appear to have become increasingly popular worldwide as a vehicle for delivering large public infrastructure, especially transportation projects such as roads, bridges, tunnels, railways, seaports and airports. However, this approach seems to have generated problems and issues associated with implementation and operationalisation. This research attempts to uncover new relationships between the stakeholders in infrastructure management through the development of a collaborative engagement framework. In this respect, it is arguable that some facets of human actions especially behaviour phenomena might not be easily captured or measured quantitatively. Therefore, in order to study those social phenomena, especially in the context of relationship between distinct entities with different objectives, interests and strategies may require the use of an exploratory method. Therefore, this study adopts an interpretivist positioning approach (see Section 6.3.1), as it seeks to uncover new meanings and constructs relating to new methods of public infrastructure project management in Nigeria as viable alternative investment vehicles.

Granted that quantitative measure may be suitable for this study, it was only able to yield comparatively superficial information about the sector stakeholders' relationships. Therefore, in order to probe beneath the surface and examine the less overt aspects of the interaction between the public, private and end-user infrastructure stakeholders', it became important to combine quantitative and qualitative methodologies for data collection. In this respect, a mixed methodology research was used

for the empirical data collection, using numerical and verbal data, in order to gather rounded and reliable data. A survey approach was initially employed to gain an overall picture of the study, while a more fine-grained analysis was later achieved through individual interview (see Chapters 7 and 8). The use of mixed-methods in this study is an attempt to gain some benefits from the different methods across the spectra, and get the best of all available approaches. The overall strength of mixed methods study is often greater than any other research (Fellows and Liu, 2008; Creswell 2009).

The mixed-methods research design adopted in this study include a critical evaluation of extant literature, questionnaire survey and case study to collect pertinent data for ‘developing a conceptual collaborative engagement framework for road infrastructure management in Nigeria’. Initially, the causal problems and key issues that impinge upon the effective delivery of collaborative infrastructure projects were identified through extensive seminal/extant literature spanning over two decades (see Table 2.4). The temporal timeframe reflects relevance and propinquity, and the research lens adopted was ‘open-bounded’, thereby not constrained by context/regional/geographic issues. Secondary data were gathered through a systematic, critical review, appraisal and synthesis of relevant literature such as scholarly publications, refereed conference papers, government policies and guidelines, and expert panel reports (see Chapters 2, 3, 4, and 5).

This was followed by questionnaire survey conducted to collect primary data in respect of ten (10) key issues mostly cited in literature (see Chapter 7). As a result of its emerging status in Nigeria, there is presently no database of organisations involved in PPC, hence the ‘purposive sampling’ technique was used for primary data collection from relevant professionals and stakeholders in both the public, private and end-user sectors. The unit of analysis consisted of highway directors, construction project managers and promoters, procurement managers, highway engineers, civil engineering consultants and contractors in both the public and private sectors of Nigeria. Responses to the instrument were measured on a five point Likert scale, where all the subjects were allowed to place themselves on an attitude continuum for each question item. The research instrument generated ordinal data. This informed the use of the non-parametric statistics adopted for data analysis (refer to Sections 6.12.2 and 6.12.5). Quantitative data were analysed using the ‘SPSS version 19’ along with Mann-Whitney

U test and Relative Importance Index to determine the core drivers and priorities that need to be aligned to existing business models for the successful implementation/ delivery of sustainable road infrastructure projects in Nigeria.

Furthermore, an exploratory case study interview (qualitative) was conducted in order to explore, probe and explain in-depth the gaps, needs, significant drivers, challenges and priorities facing collaborative road infrastructure projects along with contextual (Nigerian) constraints. In this respect, a semi-structured interview approach was adopted since it often generates as much as possible primary data about specific issues related to a study (Naoum 2013). In this respect, a comprehensive set of amplifying questions were designed to elicit data and acquire relevant information. The questions were made general enough to capture unanticipated data the respondents might provide (see Appendix 2). Semi structured interviews were conducted with 15 top/senior management level professionals across the public, private and user/community stakeholders of the case road being investigated in order to obtain wholistic view of the issues and challenges associated with the project (see Table 8.4). The interviewees ranged from Permanent Secretaries, Directors-General, Managing Directors/Chief Executive Officers, General Managers, Directors, and users / relevant community stakeholders in the case project (see Table 8.4). This was supported with data from public qualitative documents such as policy guidelines, reports, and newspapers. Data were recorded by hand written notes and audio devices, and analysed with the generic qualitative content analysis.

A QFD correlation matrix between the ‘pivotal drivers’ of collaboration and the ‘voice of the customer’ was also developed and used to allow the case-study interviewees to elaborate more on the questions (see Appendix 3a). The matrix provided a framework for the interview, made it possible to triangulate data, and infuse internal consistency to the interview. The matrix also helped to identify main issues pertaining to each question discussed with the case study participants.

Processed data (results of quantitative and qualitative analysis) were used to develop a conceptual collaborative engagement framework adopting the QFD systematic integration approach. The QFD design, popularly referred to as the ‘voice of the customer’ was adopted because it often translates

subjective quality criteria into objective ones that can be quantified, measured and evaluated. The approach also helps to determine how and where priorities are to be assigned in product development. The developed framework was tested and validated with domain experts (see Section 9.4 in Chapter 9). The process adopted for this scientific study is shown in Figure 6.2.

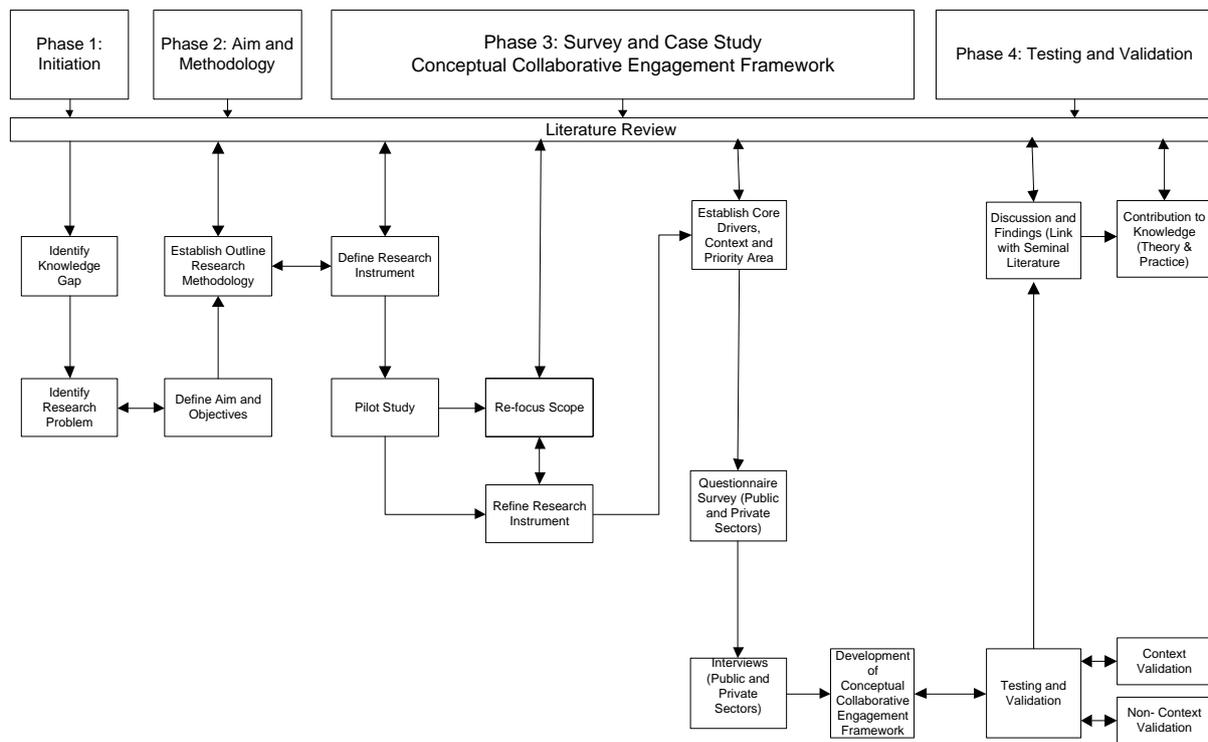


Figure 6.2: Research Process

6.7.1. Justification for the Mixed-Methods Research Option

A set of paramount philosophical assumptions influenced the choice of mixed methods for this investigation (see Sections 6.3; 6.3.1; 6.3.2; 6.4; 6.5; and 6.6). The issue of ontology (nature of reality) embraces the concept of multiple realities. According to Patton (2002), the differences between quantitative and qualitative research involve trade-offs between breadth and depth. Patton explained that qualitative research allows in-depth inquiry into selected issues with careful detail, context and nuance; such that data collection is guided by predetermined analytical groups which contribute to the potential breadth of qualitative investigation. On the other hand, he claimed that quantitative research probes standardised questions that limit responses to predetermined categories

(less breadth and depth). Similarly, the issue of axiology identifies the values that go into research undertakings. In this regard, a researcher and the subjects of a study have their own personal values and prejudices aside from the information actually gathered. Given this, the use of mixed methods (qualitative and quantitative) in this study helped to counteract and minimise any error which might have been caused through personal sentiments/biases. The research methods employed for data collection in this study are principally literature review, questionnaires survey and qualitative case study interview.

Creswell and Clark (2007) identified four options of mixed method approach. These include the ‘sequential study’ option in which quantitative data is first collected and analysed, upon which qualitative data is later based. Another ‘sequential study’ option is a situation in which quantitative data builds on qualitative data. In the ‘concurrent study’ option, both quantitative and qualitative data are collected at the same time and brought together in data analysis. The ‘transformative study’ option is also based on concurrent design.

In this study, the sequential quantitative first option was adopted. This option enables statistical, quantitative results to be obtained from a sample, and then followed up with a case study interview of key few individuals in order to help explain those results in more depth (O’Cathian *et al*, 2007).

The intent of this two-phased, sequential mixed methods study is to determine the key/ core drivers, gaps, priorities and contextual (Nigerian) constraints that could be ameliorated through the development of a collaborative engagement framework for road infrastructure management in Nigeria. In the first phase, two survey questionnaires (quantitative research) compared the perception of both the public and the private sectors about the drivers of collaboration in infrastructure management in Nigeria. Information from this first phase was explored further in another phase. In the second phase, qualitative case study interview was used to probe significant core drivers by exploring the gaps and priorities of collaborative infrastructure management with a few professionals and stakeholders from the public, private and end-user/community. The reason for following up with

qualitative research in the second phase is to better-understand and explain the contextual (Nigerian) constraints.

6.8. STUDY AREA

Nigeria is a federal constitutional republic comprising 36 States, a Federal Capital Territory Abuja, and 774 Local Government Authorities (Federal Government of Nigeria, 2010). The country is located in West Africa and shares land borders with the Republic of Benin in the West, Chad and Cameroon in the east, and Niger in the north. Its coast in the south lies on the gulf of Guinea on the Atlantic Ocean. Nigeria has well over 300 ethnic groups, each of which has its own language or dialect. Because of its language-diverse nature, English is the only common and unifying language to most people. Though the dominant indigenous languages of Yoruba, Hausa and Igbo are widely used, they are not universally understood. Therefore, English language is the official language of Nigeria. In terms of religion, Nigeria is roughly split half between Muslims and Christians with a very small minority who practice traditional religion. The name Nigeria was taken from the Niger river running through the country and was coined by the British journalist Flora Shaw in the 1890s.

Nigeria is the seventh most populous country in the World, and the most populous country in which the majority of the population is black. It is listed among the 'Next Eleven' economies, and is a member of the Commonwealth of Nations (Central Intelligence Agency, 2011). The World Bank (2012) Development Indicators database put Nigeria at the lower middle income category. The case road project for this study is situated in Lagos State.

Lagos State was created on the 27th May, 1967 in the South-Western region of Nigeria. In topography, it is flat and the ground elevation varies from sea level to about 45 metres above. The low relief and soil type have resulted in a high water table over most of the state, and the geology consists of quaternary deposits that are the youngest of the rocks. The mean annual temperature of the state is 27⁰C, with an average rainfall of 183mm. The vegetation of the State falls between high forest and fresh water swamp belt (Kadiri 2000). Lagos State is well known for its aquatic splendour, with 22% of its total area made up of lagoons, rivers and creeks. The State was the capital city of Nigeria immediately after the country gained its independence from the British in 1960, and maintained this

role until 12th December, 1991, when the seat of government moved to Abuja. The city however remains the corporate, commercial and industrial nerve centre of Nigeria.

For administrative convenience, Lagos State is divided into five divisions namely Lagos, Ikeja, Badagry, Ikorodu, and Epe. There are 20 Local Governments and 37 Local Council Development Areas in the state. In aerial extent, it covers 3577 square kilometres and occupies comparatively 0.4 percent of Nigeria's land space. The Federal Republic of Nigeria (2007) put her population at 9,013,534 inhabitants representing 6.4 percent of Nigeria's population and harbouring about 40 percent of the nation's skilled labour force. Given this, there seems to be increasing pressure on the need for expansion of existing facilities and provision of new physical infrastructure. The Central Intelligence Agency (2011) projected that by the year 2025, the population of Lagos State will be about 25 million. Lagos State seems to be the most industrialized state in Nigeria and accounts for the highest number of educational institutions in the country (Adetola 2010).

6.9. TYPES OF DATA

Data are raw or unprocessed facts. These may include alphabets, words, numbers, dates, symbols, codes, images, sounds, attributes or characteristics that refer to or represent conditions, ideas or objects (Checkland and Holwell 1998). Data items may need to be part of a structure in order to be meaningful. Similarly, data is processed in order to obtain information which can be used to make decision. Data can be either primary or secondary.

6.9.1 Primary Data

Primary data are original data collected by a researcher through the administration of research instrument(s) to the research population/sample of a study. Primary data are often processed and analysed by the researcher, hence the investigator is familiar with the research design, data collection, data set, response categories, and data analysis procedure (Cohen *et al*, 2011). In this regard, primary data are expected to be current and up-to-date.

It is widely acknowledged that there are four scales of measurement which define the nature of statistical data. These are Nominal, Ordinal, Interval and Ratio scales.

6.9.1.1. Nominal Data

The word nominal comes from a Latin word which means ‘name’, hence, some data can be measured by assigning names to them. Numbers can also be used to identify different categories of people, objects and other entities. However, the numbers do not reflect any particular quantity or degree (Creswell, 2009). For example, a researcher might code the ‘public sector’ as 1 and the ‘private sector’ as 2; or ‘engineering consultants’ as 1 and ‘engineering contractors’ as 2. Nominal data are often referred to as categorical data. The data classify, but have no order, hence, the categories are mutually exclusive and have no numerical meaning (Cohen *et al*, 2011).

6.9.1.2. Ordinal Data

Ordinal scale of measurement allows a researcher to classify or compare various pieces of data in terms of being greater or higher than another. Here, the assigned numbers reflect an order or sequence. The numbers tell the degree to which people, objects or other entities have a certain quality, attribute or characteristic. However, the numbers do not tell how great the differences are between the people, objects etc. (Leedy and Ormrod, 2010). For example, respondents may be requested to rank their views/ opinions on a certain issue using a 5 point Likert Scale: 0 = No opinion, 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree. In this respect, the numbers indicate the relative position of the respondents but not the magnitude of differences between them (Fellows and Liu, 2008).

A Likert Scale is a special form of multiple-choice rating instrument commonly used for measuring intensity questions. It allows the respondents to choose one of several degrees of agreement or disagreement about a statement. Given that respondents have the opportunity to express a variety of views when several alternative answers are provided, Batchelor *et al*, (1994) argued that Likert Scale can generate more valid data than single measures. In this respect, a five point Likert Scale was considered appropriate and employed in this study, because it allows sufficient discrimination between statements/responses. The use of a six point Likert Scale was not adopted because it might set statements/responses too far apart from one another, cause confusion for respondents, and make the study lose potential information.

6.9.1.3. Interval Data

Aside from having the attributes of classification and order, the interval scale is characterised by two key features. In the first instance, it has equal units of measurement; and secondly, its zero point is arbitrarily fixed (Naoum 2007). For example, the Fahrenheit (F) and Celsius (C) scales for measuring temperature use interval scale. The interval between any two successive numbers or degrees reflects equal changes in temperature, but the zero point is not equivalent to a total absence of heat. In other words, the interval data has no meaningful or absolute zero. The interval scale shows precisely how far apart are the objects, events, people or entities that form the focus of enquiry (Cohen *et al*, 2011).

6.9.1.4. Ratio Data

Ratio data have all the features of classification, order and equal interval metric (nominal, ordinal and interval data), but are distinguished by an additional property of having a true zero point (Leedy and Ormrod, 2010). The numbers in a ratio scale have equal intervals between values for the characteristic being measured. This enables researchers to determine proportions easily. The zero value indicates that there is a complete absence of the characteristic being measured. The absolute zero property allows all the arithmetical operations of addition, subtraction, multiplication and division to be performed on ratio data (Naoum 2013).

6.9.2 Secondary Data

Secondary data are data collected by someone else for some other purpose(s). Typical examples of such data are from literature, published texts, statistics, reports, policy documents and unpublished thesis. Other sources of secondary data include refereed conference papers, journal articles, conference proceedings, internet, libraries, museums and newspapers (Checkland and Holwell 1998). The accuracy of secondary data may not be known to the researcher.

6.9.2.1. Literature

Literature can be described as a body of existing knowledge. Therefore, a review of relevant literature in research is important because it is often a critical, analytical, synthesis, and in-depth evaluation of previous studies on a given problem (Naoum 2013). In addition, it establishes the problem leading to a study, and identifies the gaps that need to be filled in a particular problem area (Creswell 2009). It

may also assist in determining appropriate research methods for a study when sufficiently available, thereby setting a study within the context of other related studies. In this regard, Cohen *et al*, (2011) claimed that literature serves many purpose in research. The authors asserted that it gives credibility and legitimacy to the research by reporting up-to-date information and issues, and the theoretical, conceptual and methodological framework to a problem. Literature may also set the context for an investigation and establishes the key issues to be addressed in a study. Thus, literature is crucial to research.

At the beginning of this study, an initial review of literature was carried out covering infrastructure management. This helped to provide the background for the study and identify the gaps in knowledge. In actual fact, a review of relevant literature spans through the entire duration of this research (see Figure 6.2). The pertinent questions that informed literature search include:

- What is infrastructure?
- What is road transport infrastructure?
- How is road infrastructure managed?
- What is public private collaboration?
- Why the global paradigm-shift towards public private collaboration in road infrastructure management?
- How do organisations collaborate with one another in order to provide joint assets and services?
- What are the issues and problems associated with the global implementation and operation of collaborative road infrastructure management in the last two decades?
- What are the drivers of collaboration?
- How can an enduring relationship be developed and sustained between persons/teams/organisations?

More in-depth and focused review of literature was conducted once the findings started to emerge from data analysis. This was useful in strengthening the researcher's arguments, as well as increasing the credibility of the research findings (Charmaz 2006).

Literature materials were searched, accessed and gathered from different sources for examination. These include peer-reviewed journal articles, refereed conference proceedings, technical reports, theses and dissertations, and text-books. Internet sources such as Google Scholar, Science Direct, Academic Search Complete, EBSCO Databases, Scopus, Web of Knowledge, Emerald, Elsevier, etc. were also searched and accessed for the aforementioned materials using key words, subject headings and controlled languages. Technical reports include the 'World Bank Group Transport' papers and 'European Transport Safety' papers.

6.10. RESEARCH POPULATION

A research population may be described as a collection of physical objects, items or people possessing certain/specific characteristics which a researcher intends to study or understand. In other words, it is a well-defined group/collection of individuals or objects known to have/possess similar, common and binding characteristics/traits required/questioned in a study. A research population constitutes the focus of a scientific research hence the ideal scenario is to test all the individuals/objects in a study in order to obtain reliable, valid and accurate results (Kumar, 2005). However, aside from accessibility; time, money and effort/workforce might be inadequate to test every single individual/object in a given population. Therefore, researchers often rely on a smaller group or sample which is a subset of subjects that is representative of the entire population having sufficient size to warrant statistical and non-statistical analysis. The sample allows a researcher to conduct a study to individuals drawn from a given population in order that the results of such study can be used to derive conclusions that will apply (be generalised) to the entire population. In this regard, the population "gives" the sample, and then "takes" conclusions from the results obtained from the sample (Bryman and Bell, 2007). The sample size of a study may be influenced by the purpose of the study, the nature of the population under scrutiny, the level of accuracy required, the anticipated response rate, and whether the research is quantitative or qualitative (Cohen *et al*, 2011).

6.10.1 Sampling Techniques

Population sampling techniques include non-probability sampling and probability sampling. In non-probability sampling technique, members of the population do not have equal chance of being selected for a study hence the sample may not fully represent the target population. This method may be employed in studies which are not interested in the parameters of the entire population. Examples of non-probability sampling techniques include convenience sampling, quota sampling, purposive sampling, dimensional sampling, volunteer sampling, and snowball sampling. Each type of non-probability sampling technique seeks only to represent itself (Cohen *et al*, 2011; Bryman and Bell, 2011). On the other hand, every individual in a given population have equal chance of being chosen/selected as a subject in probability sampling technique. This method guarantees that the selection process is completely randomised and free from researchers' prejudices, bias and sentiments. This method can be used to estimate the population parameters since it is often reliable and representative of the entire research population (Kumar, 2011). Examples of probability sampling techniques include simple random sampling, systematic sampling, random stratified sampling, cluster sampling, stage sampling, and multi-phase sampling. Results of probability samples can be generalised because they all have a measure of randomness built into them, have less risk of bias, and they seek representativeness of the wider population (Kumar, 2011; Cohen *et al*, 2011).

6.10.2 Population Sample Set

The population of this study is made up of experts who are directly involved in policy formulation, design, planning, construction, rehabilitation, operation, maintenance and management of highways in Nigeria. These include the public, private sectors and end-user. The public sector comprises the professionals working in government establishments/agencies such as the Federal Ministry of Works, Federal Road Maintenance Agency, and State Ministries of Works and Infrastructure. On the other hand, the private sector consists of professionals working in private organisations such as consulting and contracting Civil Engineering companies. The end-user comprises the road transport owners, operators and community stakeholders. Therefore, the public sector respondents were officials of the FMW, FERMA and State Ministries of Works and Infrastructure drawn from the six geo-political zones of Nigeria (see Table 4.2). The private sector respondents were registered Civil Engineering

consultants and contractors drawn from the Council for the Regulation of Engineering in Nigeria and the Nigerian Society of Engineers. The end-user respondents were road transport owners and operators registered with the National Association of Road Transport Owners and settled community residents.

Given the homogenous characteristics of each sector and their relevance to the study, this population sample was considered appropriate for this investigation. Therefore, a ‘purposive sampling’ technique was adopted in collecting quantitative and qualitative data for the questionnaire survey and case study interview respectively. These professionals include highway directors, construction project managers and promoters, procurement managers, highway engineers, Civil Engineering (highway) consultants and contractors, legal practitioners, community leaders, transport operators, accountants, and business administrators (see Tables 7.1 and 7.7).

6.10.3 Sampling Strategy

Purposive sampling, otherwise known as selective, judgemental or subjective sampling could be described as a non-probability homogenous sampling technique which focuses on particular characteristics that are pertinent to a study (Patton, 1990). This is supported by Ball (1990) who asserted that purposive sampling is used in many cases in order to access ‘knowledgable people’ who have in-depth understanding about particular issues by virtue of their professional role, power, access to networks, expertise or experience. In other words, purposive sampling might be undertaken to focus on specific, unique issues or cases as it provides greater depth to the study than probability sampling (Teddlie and Yu 2007).

The ‘purposive sampling’ technique was employed in this study because the entire population in each sector from which the sample was taken is homogeneous (experts in the same field/discipline/industry). Furthermore, the study focuses on new relationships between distinct groups (public, private and end-user sectors) hence, there is a need to acquire rich and in-depth information from those who are in a position to give it.

Therefore, purposive sampling method was considered appropriate and adopted particularly in the case study in order to acquire in-depth information from the principal stakeholders (public, private and end-user) directly involved in the case road policy formulation; highway planning and design; highway construction and rehabilitation; highway project procurement; usage; operation and maintenance in Nigeria. These key stakeholders were chosen because they have in-depth knowledge about the case study by virtue of their roles, positions and professional expertise.

6.11. Questionnaire Survey

Cohen *et al*, (2011) defined survey as a study that gathers data at a particular point in time about individuals, groups, institutions, processes, methods, phenomenon or materials. The intent might be to describe the nature of existing conditions, identify standards against which such conditions can be compared or contrasted, or determine the relationships between specific events. In this respect, a survey may classify, analyse and interpret entities and events.

The questionnaire is an extensively used and useful research instrument for collecting data from research respondents. It can be administered by field enumerators in the absence of the researcher. A questionnaire can either be structured/close-ended or unstructured/open-ended. Closed or structured questionnaires prescribe the range of response from which the respondents may choose (Naoum 2013; Creswell 2009). Though it may be difficult to construct, it is useful in generating response or frequencies amenable to statistical processing and analysis (Oppenheim 1992). Structured questionnaires are focused, quick to complete, straightforward to code and analyse, and also allow comparisons to be made across groups in the sample. On the other hand, open-ended or unstructured questionnaires are easy to construct, allow the respondents to freely express their views/opinions in their own words hence, they capture the specificity of a particular situation (Naoum 2013). Where measurement is sought, a quantitative (structured) approach is required; where rich and personal data are sought, then, a qualitative (unstructured) approach might be more appropriate. Open-ended questionnaires are suitable for investigating complex issues, to which simple answers cannot be provided. However, they can lead to irrelevant and redundant information, just as the data are not easily classified and compared across participants (Cohen *et al*, 2011).

Adequate attention needs to be paid to the construction and administration of questionnaire, the explanations that are given to the respondents, the data presentation, analysis and interpretation (Fellows and Liu 2008). Similarly, the confidentiality, anonymity and non-traceability of the respondents to a questionnaire is of utmost importance (Creswell 2009). A valid questionnaire is an instrument that measures what it is designed to measure. Its content must cover the scope of the investigation and it must be administered to the appropriate research population. A reliable questionnaire would yield consistent results when administered to the same or similar population under the same condition (Naoum 2013). Cohen *et al*, (2011) observed that the questionnaire appears to be more reliable by virtue of its anonymity, encourages greater honesty, more economical than the interview in terms of time and money, and can be administered electronically and by post. The use of online/web based survey solutions such as 'survey monkey', 'bristol online survey' and 'zoho survey' to administer questionnaire and process survey data appears to be in vogue. In this regard, short, simple and easy to answer question items accompanied with a covering letter are posted electronically to respondents' e-mails for online completion. This arrangement may save time, save cost, enhance follow up, and probably help to reach out to a large number of research subjects who manage e-mail accounts. However, Kumar (2005) noted that the response rate to questionnaires is often low while its application is limited to a study population that can read and write.

In this study, a critical review of literature identified the main drivers, causal problems and key issues that directly impinge upon effective delivery of collaborative infrastructure projects. These issues were captured, synthesised and embedded into two structured questionnaires adopted as one of the research instruments for the study. The first questionnaire had a total of 72 questions made up of 12 sections, while the second questionnaire comprised 58 questions also covering 12 sections. These sections were informed by the aim, objective and scope of the study. Each question item on this instrument was carefully considered and specifically worded to elicit and provide valuable feedback on the particular area it addresses. The questionnaires translate the research objectives into specific questions. However, opportunity was given to respondents at the end of the questionnaires to express

other views of interest pertinent to the study but not covered in the questionnaire (see Appendix 1a and 1b).

The first segment of the structured questionnaire solicited for information about the respondents' sector, main work remit, work designation, academic and professional qualifications, work experience and the operational experience of their organisations. The justification for the survey population sample set and sampling strategy are explained in Sections 6.10.2 and 6.10.3 respectively. The respondents placed themselves on an attitude continuum and rated 64 variables on the drivers of collaboration using a five point Likert scale. The respondents were also requested to express in their own words other variables which were not listed in the instrument. The refined survey questionnaires were manually distributed and administered equally to purposively selected research respondents in the six geo-political zones of Nigeria, in order to collect primary data from the research participants (see Appendix 1a, 1b and 3a). In the first instance, 45 survey questionnaires were administered to relevant professionals and stakeholders in both the public and private sectors of Nigeria, out of which 34 completed useable questionnaires (representing 75% response rate) were retrieved. In the second instance, 50 survey questionnaires were administered to public, private and end-user respondents out of which 36 completed and useable questionnaires were retrieved, representing 72% response rate. The response rates in the two questionnaires survey are higher than what would have normally been expected through traditional distribution methods. This was achieved mostly by follow-up of respondents through e-mails and telephone calls. The general statistical practice assumes that sampling distribution can be approximated by a normal distribution whenever the sample size is 30 or more (Anderson *et al*, 2009), and central limit theorem holds true (Ott and Longnecker, 2010).

6.11.1 Pilot Study

Pilot study is a small scale preliminary study conducted before the main research in order to check the feasibility or to improve the design of a research. It is a small scale or mini version run in preparation for a full-scale or major study. It involves testing the wording of the questions, checking for consistency of comprehension, establishing the length of the questionnaire, avoiding ambiguous questions, eliciting suggestions for analysing the data, as well as testing the technique(s) selected for

collecting the data (Naoum, 2007, Naoum 2013). In other words, a pilot study provides a trial run for the main investigation by testing the difficulty level of the questions, identifying ambiguous words, testing the data collection technique and measuring the effectiveness of the research instrument. Pilot study is a test of the validity and reliability of a research instrument (Cohen *et al*, 2011).

In this study, a trial-run/pilot-test of the draft questions for the survey was carried out with four experts and scholars from the industry (public and private), academia and end-user stakeholders to invite comments and suggestions. The pilot test addressed a number of logistical issues. For example, it helped to ascertain that instructions given to respondent were comprehensible and that the wordings of the surveys were not confusing. The test helped to check the reliability and validity of the research instruments and by implications the research results. Similarly, the trial run assisted to ascertain the appropriateness of the statistical tools and analytical processes of the study. The test run helped to avoid misleading, inappropriate and redundant questions. In this regard, the inability of respondents to answer a particular question and several answers given to another specific question informed the need for the revision of those questions. Thus, the pilot study helped to identify potential weaknesses in the research instruments. Furthermore, the trial run generated constructive comments about the relevance of each question to the expressed intent of the study. These comments and responses assisted to refine the research instruments before they were administered to the survey questionnaire respondents for the main study. These in no small measure helped to tremendously improve the study.

6.12. TECHNIQUES OF DATA ANALYSIS

Generally, statistical analyses serve two related purposes of description and inference. In other words, statistics, a tool of research often describe, compare, investigate, measure associations and relationships between variables, and make informed interpretations about an association or relationship between variables (Naoum 2007; Fellows and Liu 2008; Creswell 2009; Leedy and Ormrod 2010). The choice of statistical techniques to analyse data depends to some extent on the nature of data and the degree to which they reflect a normal distribution. On this basis, inferential statistics are classified into 'parametric' and 'non-parametric' statistics (Fellows and Liu 2008).

6.12.1 Parametric Statistics

Parametric statistics are based on two main assumptions about the nature of the population from which data are drawn. The assumptions include the fact that the data is an interval or ratio scale, and that the data fall in a normal distribution (e.g. the distribution has a central high point, and it is not seriously skewed). Examples of parametric inferential statistics include the ‘t’ test, Analysis of Variance (ANOVA), Regression Analysis etc. (Leedy and Ormrod 2010).

The ‘t’ test is used to determine whether a statistically significant difference exists between two means, while ‘Analysis of Variance’ (ANOVA) looks for differences among three or more means by comparing the variance (S^2) both within and across groups. Regression Analysis examines how effectively one or more (independent-variables) allow the value of another (dependent- variable) to be predicted (Naoum 2007).

6.12.2 Non-Parametric Statistics

Non-parametric statistics are based on two main assumptions. These include the fact that the data is ordinal in nature rather than interval or ratio, and that the data is highly skewed. Examples of non-parametric statistics are Chi-square test, Mann-Whitney U test, and Kruskal-Wallis test (Naoum 2013).

6.12.2.1. Chi-Square Test

Chi-Square test has about three versions. ‘Goodness-of-fit test’ version is used on a single categorical variable from a single population to determine whether sample data is consistent with population distribution. ‘Test for independence’ version is applied to determine whether there is a significant association between two categorical variables from a single population; while the ‘test for homogeneity’ version is applied to determine whether frequency counts are distributed identically across two different populations (Fellows and Liu 2008).

6.12.2.2. Mann-Whitney U Test

Mann-Whitney U test compares whether one of two samples of independent observations between two groups have larger values than the other. It is used when the data are ordinal rather than interval. Mann-Whitney U test is the non-parametric equivalent of ‘t’ test (Cohen *et al*, 2011) (see Table 7.4).

6.12.2.3. Kruskal-Wallis Test

Kruskal-Wallis test compares three or more groups when the data are ordinal. It is the non-parametric equivalent of ANOVA (Bryman 2012). The test compares ‘Means’ and ‘Median’ within and across groups (see Table 7.9).

6.12.3 Descriptive Statistics

6.12.3.1. Relative Importance Index

Relative Importance Index is a descriptive statistical tool which is often employed to analyse and interpret nominal and ordinal data (see Tables 7.5; 7.11 and 7.12).

6.12.3.2. Mean

Mean is the average value in a data set (Naoum 2013). The comparison of the ‘Mean’ scores of independent samples from the public, private and end-user sectors in this study was performed in the quantitative data analysis in order to identify the differences between those samples and sector (see Tables 7.14 and 9.1).

6.12.4 Correlation Matrix

The Correlation Matrix is a product of the QFD ‘House of Quality’ (see Section 5.6). In general, the left hand side of the QFD chart/matrix contains the list of ‘What’ variables while the top contains the ‘How’ variables. The ‘How’ elements are matched by or measured against the ‘What’ elements. Thus, each element of ‘What’ is compared with each element of ‘How’ in order to determine the strength of relationships or the degree of correlation between the ‘Whats’ and ‘Hows’. Strong relationships are represented with a value of 9 in the appropriate cell, moderate relationships are given a value of 3, while weak relationships are denoted with a value of 1. No relationship is given a value of 0 or the cell is left blank (see Appendix 3a). The logarithmic 9-3-1 weighting was created by the Japanese and has been adopted by most QFD users. The correlations may also be represented with symbols. Sometimes, both symbols and numbers are used in a chart (Bahill and Chapman 1993; Chan and Wu 2002).

In this study, the pivotal drivers of collaboration constitute the ‘what’ while the key collaborative service elements constitute the ‘How’. The pivotal drivers were identified through critical evaluation

of seminal literature and empirical survey (Adetola *et al* 2011a; 2013a), while the key collaborative service elements were the expressed requirements/needs of the study participants (see Section 7.5). The relative importance or weight of the pivotal drivers of collaboration was determined through the Kruskal-Wallis analysis (see Table 7.10). The assigned weight ranges between 1 and 10, with 10 being the most important. The QFD Correlation Matrix was used in this study to determine the strength of relationships or the degree of correlation between the ‘pivotal drivers’ and the ‘voice of the customer’ in the House of Quality.

6.12.5 Statistical Tools and Significance Employed in the Study

It has been widely acknowledged that the nature of data determines the appropriate statistical technique/procedure for data analysis (Naoum 2007; Fellows and Liu 2008; Creswell, 2009; Leedy and Ormrod 2010). In this respect, the ordinal data generated by the research instruments for this study informed the choice of the non-parametric inferential statistics employed. These include the Mann-Whitney U test and the Kruskal-Wallis test. The Mann-Whitney U test was used to assess whether the samples of independent observations from the public (government) sector have larger values than the samples of independent observations obtained from the private sector. Similarly, the Kruskal-Wallis test was used to compare the ‘Means’ of independent observations from the public, private and end-user sectors. Furthermore, the Relative Importance Index was employed to rank the means of all the dependent variables in order to determine their comparative importance in the survey (quantitative) study.

The level of statistical significance is the level of risk that a researcher or an analyst is prepared to take, to infer that there is a relationship between two variables in the population from which the research sample was drawn, when in fact no such relationships exist (Bryman 2012). In this study, the maximum level of risk that is conventionally taken in Social research is adopted (see chapter 7.4.1 and 7.6.1). This claims that there are up to five chances in 100 that might exhibit a relationship when there is not one in the population. This is denoted by $p \leq 0.05$ (p means probability). This level of confidence allows the results/findings of this study to be generalised to the population from which the

sample was taken. Given that this risk is fairly small, Bryman (2012) warns that it might be prone to Type 1 error (i.e. rejecting the null hypothesis when it should in fact be confirmed).

6.13. VALIDITY AND RELIABILITY OF QUANTITATIVE RESEARCH

Validity is a concept and process of determining the appropriateness, quality and accuracy of the procedures adopted in a study. The concept of validity and reliability differs significantly between quantitative and qualitative research. This is due to the standardised and structured methods of collecting and analysing data in quantitative research as against the flexible, free and spontaneous approach employed in qualitative research (Cohen *et al*, 2011). Babbie (1990) defined validity as the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. It is the degree to which an investigator has measured what he has set out to measure (Smith 1991). Kumar (2011) identified two methods of establishing the validity of a research instrument in the social sciences. These methods hinge on the logic that reinforces the construction of the research tool and the statistical proof that is gathered through the research instrument. While logic rationalises every research question in relation to the research objectives, statistics generate hard evidence to determine the coefficient of correlations between the questions and the outcome variables. These, Kumar (2011) asserted may be difficult in qualitative research that explores feelings, experiences, attitudes and perceptions.

Establishing a logical link between research questions and objectives ensures **face validity**, while the ability of the items, questions or statements in a research instrument to cover the full range of issues or attitude being measured guarantees **content validity** (Kumar 2005). **Predictive validity** is determined by the degree to which a research instrument can conjecture or guess an outcome, while **concurrent validity** is assessed by how well an instrument matches with a second assessment done simultaneously (Kumar 2005, 2011). **Construct validity** is centred upon statistical technique and established by determining the contribution of each factor or construct to the total variance observed in a situation (Kumar 2005). Face and content validity; concurrent and predictive validity; and construct validity are applicable in qualitative research.

The concept of reliability in research is concerned with the consistency, stability, predictability and accuracy of a research tool or instrument. A measuring scale or test is reliable to the extent that repeat measurements made by it under constant or similar conditions will yield or produce the same or similar results (Moser and Kalton 1989). Thus, reliability has to do with the degree of accuracy, precision and comparability in the measurements made by a research tool or instrument. The lower the degree of 'error' (inconsistency) in a research instrument the higher its reliability. The factors which may affect the reliability of a research instrument include: ambiguity in the wording of questions or statements, a change in the physical setting of the instrument, a respondent's mood when providing information, an interviewer's mood on the field, the nature of interaction between interviewer and interviewee, and the regressive effect of a research instrument (Kumar 2011).

The reliability of an instrument in quantitative research can be determined through external consistency and internal consistency procedures. **External consistency** procedures match or equate results from two independent processes of data collection such as test/retest or parallel forms of the same test. In the **test/retest** or repeatability test method, an instrument is administered and then re-administered to the same respondents under the same or similar conditions. The proportion or ratio between the results/scores of the test and retest indicates the reliability of the research instrument. The merit of test/retest method is that it allows an instrument to be compared with itself. However, test/retest reliability may be marred by the ability of a respondent to recall his/her responses during the first test, and the maturation of respondents during the time span between the two tests (Kumar 2005; Bryman and Bell 2007). In the **parallel forms of the same test**, two instruments that are intended to measure the same phenomenon are constructed and administered to two similar populations. The results from the first instrument are matched with the results from the second instrument. If similar results are obtained, then it is presumed that the instrument is reliable. Granted that this method is free from the problem of recall associated with test/retest system, it might be pretty difficult to construct two instruments that are comparable or measure a phenomenon with the same standard. Similarly, it might not be easy to have two similar population groups and two similar conditions required for the tests (Cohen *et al*, 2011; Kumar 2011)

The **internal consistency** system uses the split-half method considered appropriate for instruments that are designed to measure attitudes towards an issue or phenomenon. In this respect, the questions/statements in the instruments are divided into two halves, administered and the result of one half is correlated with the result of the other half (Kumar 2011).

6.14. CASE STUDY DESIGN

Case Study is a qualitative research strategy that involves detailed and intensive analysis of one or more cases. It is employed when a study requires an extensive and ‘in-depth’ description of some contemporary social phenomenon with real-life context (Yin 1984). In case study enquiries, the researcher explores in-depth, a programme, an event, an organisation, an activity, a project, a process, a group or an individual. A case study provides a unique example of real people in real situations, enabling readers to understand ideas more clearly, and how ideas and abstract principles can fit together (Yin 2009). Case studies acknowledge the fact that there are many variables operating in a single case, and that many sources of evidence are required to capture the implications of these variables. The sources of evidence in case study may include direct observation of the events being studied, and interview of the person(s) involved in the project, activity or event. Its unique strength appears to be its ability to deal with a full variety of evidence beyond what might be available in other research methods (Yin, 2009). This is an opportunity to use many complimentary different sources of evidence chief of which include documentation, archival records, interviews, direct observations, participant-observation, and physical artefacts. In this respect, Cohen *et al*, (2011) described case study as a prototypical instance of mixed methods research. Other sources of evidence include films, photographs and videotapes; projective techniques and psychological testing; proxemics; kinesics; ‘street’ ethnography; and life histories (Marshall and Rossman, 2006). The comparative strengths and weaknesses of the major sources of case study evidence are outlined in Table 6.2.

Case Study might be appropriate for exploratory investigation, when no control of behavioural events is required, and when ‘why and how’ questions deal with operational links which may need to be traced over time, rather than mere frequencies or incidence. Rich descriptions and details are often a feature of a case study, given its ability to vividly explain, describe, illustrate and enlighten (Yin

2009). Thus, it can be used in studies that are not prone to numerical analysis. An important advantage of case study is that it observes effects in real contexts, recognising that context is a powerful determinant of both causes and effects. Furthermore, contexts are unique and dynamic, thus, case studies investigate and report the real-life, complex dynamic and unfolding interactions of events, human relationships and other factors in a unique instance (Cohen *et al*, 2011). Additionally, Sturman (1999) argued that a distinguishing feature of case studies is that the human systems have a wholeness or integrity to them rather than being a loose connection of traits, requiring in-depth investigation. This is supported by the assertion of Nisbet and Watt (1984) that ‘the whole is more than the sum of its parts’.

Hitchcock and Hughes (1995) identified the hallmarks of case studies. These include the fact that case study provides a chronological narrative of events relevant to a case, and blends the description of events with their analysis. Yin (1984) identified three types of case studies. These are exploratory (as a pilot to other studies/research questions), descriptive (providing narrative accounts) and explanatory (testing theories). This classification is supported by Merriam (1998) who also identified three types of case studies. These are descriptive (narrative accounts), interpretive (developing conceptual categories inductively in order to examine initial assumptions), and evaluative (explaining and judging).

Furthermore, Yin (2009) identified and described four major case study designs. These include the *single-case design*, the *embedded single-case design*, the *multiple-case design* and the *embedded multiple-case design*.

The *single case design* is similar to a single experiment and might be appropriate for a unique or an extreme case, a critical case, a revelatory case, a typical/representative case, and a longitudinal case. A single critical case study is justifiable when the single case meets all the necessary requirements/conditions to critically examine a significant or well formulated theory. A unique/extreme case might be appropriate where the single case represents a rare circumstance/occurrence. A typical/representative case is suitable when the single case captures a

significant commonplace everyday situation. A revelatory case is justified where a researcher has access to study a situation previously inaccessible. A longitudinal case might be appropriate where a specific single case is investigated at two or more different points in time (Cohen *et al*, 2011; Yin, 2009).

The *embedded single-case design* consists more than one unit of analysis, and each unit might require different research instruments such as observations, survey questionnaire or interviews for gathering data. A unit of analysis is a key issue that defines what constitutes a case. It can be an individual, a group, a community, an organisation, a project, a programme, or an industry (Cohen *et al*, 2011).

The *multiple-case design* involves comparative case studies within an overall piece of research or replication studies. It is synonymous with multiple experiments. Each case is expected to be carefully chosen in order that it either predicts similar results (a literal replication), or predicts contrasting results but for anticipatable reasons (a theoretical replication). Similarly, all replication procedures require the development of a rich, theoretical framework which would eventually become the vehicle for generalising to new cases. The framework needs to vividly explain the situations under which a literal replication is likely to be found as well as the circumstances when a theoretical replication is to be expected (Yin 2009). The essence of multiple-case design is to produce robust research findings. However, multiple case studies may require extensive resources and time beyond the means of an independent investigator (Yin 2009).

The *embedded multiple case design* may involve different sub-units in each of the different cases. Each sub-unit may require different research instruments such as observations, survey questionnaire, interviews or archival records distinct to each case (Cohen *et al*, 2011).

Given that a case represents itself, and that it might not necessarily be a sample of any population, case studies portray ‘logical/analytic’ rather than ‘statistical’ generalisation (Yin, 2009; Robson, 2002). Cases are often bounded by time and activity, and allow researchers to collect detailed information using a variety of data collection procedures over a sustained period of time (Stake, 1995).

Table 6.2: Sources and attributes of Case Study evidence

Source of Evidence	Strengths	Weaknesses
Documentation	Stable – can be reviewed repeatedly	Retrievability - can be difficult to find
	Unobtrusive – not created as a result of the case study	Biased selectivity, if collection is incomplete
	Exact – contains exact names, references, and details of an event	Reporting bias – reflects (unknown) bias of author. Access – may be deliberately withheld
	Broad coverage – long span of time, many events, and many settings	
Archival records	(Same as those for documentation)	(Same as those for documentation)
	Precise and usually quantitative	Accessibility due to privacy reasons
Interviews	Targeted – focuses directly on case study topics	Bias due to poorly articulated questions
	Insightful – provides perceived causal inferences and explanations	Response bias. Inaccuracies due to poor recall
		Reflexivity – interviewee gives what interviewer wants to hear
Direct observations	Reality – covers events in real time	Time-consuming.
	Contextual – covers context of “case”	Selectivity - broad coverage difficult without a team of observers
		Reflexivity – event may proceed differently because it is being observed
		Cost – hours needed by human observers
Participant-observation	(Same as those for direct observations)	(Same as those for direct observations)
	Insightful into interpersonal behaviour and motives	Bias due to participant-observer’s manipulation of events
Physical artefacts	Insightful into cultural features	Selectivity Availability
	Insightful into technical operations	

Source: Yin (2009)

The use of multiple sources of evidence in case studies allows a researcher to address a broad range of issues, develop converging lines of inquiry (a process of triangulation and corroboration), and produce convincing/accurate/reliable findings/conclusion (Yin, 2009). In this regard, Patton (2002) identified and discussed four types of triangulation. These include data triangulation, investigator triangulation, theory triangulation, and methodological triangulation. Data triangulation specifically addresses the potential problems of construct validity in research because multiple sources of evidence will essentially provide multiple measures of the same phenomenon (Yin, 2009).

Nisbet and Watt (1984) enumerated the advantages and disadvantages of case study. The duo claimed that a case study is strong on reality, speaks for itself, and captures the unique attributes critical to understanding a particular situation or phenomenon. These features they claimed may otherwise be lost in larger scale data such as 'survey'. Similarly, case studies can accommodate and build in unexpected events and uncontrolled variables, and provide insights into and help to interpret other similar situations and cases. Furthermore, case study findings are written in everyday language that makes it easily understood by a wide audience. However, case studies may not be easily open to cross-checking, hence may be subjective and liable to the problems of observer prejudice or bias. Above all, case studies' results may not be generalisable.

6.14.1 Interview

An interview is a flexible tool that allows multi-sensory channels to be employed for data collection. These include verbal, non-verbal, spoken and heard sensory channels (Cohen *et al*, 2011). Interviews are typically an exchange of views transaction between two or more people on a topic of common interest. In an interview process, the interviewer seeks information, while the interviewees supply information. Interviews are therefore a medium for appreciating the significance of human interaction for knowledge acquisition, and for highlighting the social situation (and significance) of research data (Kvale 1996). Interviews enable participants to discuss their interpretations of the world in which they live, and to express how they regard situations from their own point of view (Cohen *et al*, 2011). Cannel and Khan (1968) defined research interview as a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information, and focused by him

on content specified by research objectives of systematic description, prediction, or explanation. Woods (1986) identified the characteristics of ethnographers as interviewers. These include a trusting relationship between the interviewer and the interviewee that extends beyond an investigation, promotes a bond of friendship, a feeling of togetherness and joint pursuit of a common purpose or objective. Furthermore, a burning desire to know, learn about people's views and perceptions of facts, hear their stories and discover their feelings is required to drive researchers to overcome challenges and obstacles inherent in conducting successful interviews. According to Tuckman (1972), interview provides access to knowledge/information, values and preferences, and attitudes and beliefs. According to Naoum (2007), interviews are suitable when the interviewees are homogenous and share the same characteristics e.g. professionals in an industry. It is also appropriate when the interviewer knows enough about the interviewees, in which case only important questions are asked. Additionally, interview is useful when inter-personal contact is essential to explain and describe the questions; and when a case study needs to be investigated in detail asking such questions as 'how' and 'why' things happened the way they did.

In this regard, LeCompte and Presissle (1993) identified six types of interviews. These include standardised interview, in-depth interview, ethnographic interview, elite interview, life history interview and focus groups interview. Bogdan and Biklen (1992) also identified semi-structured and group interviews. Furthermore, Lincoln and Guba (1985) came up with structured interview, while Oppenheim (1992) identified exploratory interview. Similarly, Patton (1980) outlined informal conversational interview, interview guide approaches, standardised open-ended interview, and closed qualitative interview. Cohen *et al*, (2011) summed up interviews into four major kinds. These are the structured, unstructured, non-directive and focused interviews. In structured interview, the content, procedures, sequence, and wordings of the questions are organised in advance and monitored by an interview schedule/guide. Thus, the interviewer is allowed little or no freedom to make modifications. On the other hand, the unstructured interview is open, flexible and affords the interviewer the freedom to plan the content, procedure, sequence and wordings of the questions. Cohen *et al*, (2011) claimed that the non-directive interview stems from psychiatric interview, while the need to introduce more

interviewer control into the non-directive condition led to the development of the focused interview. In focused interviews, a carefully selected group of people are brought together in the same place to discuss a particular issue or topic relevant to them. Cohen *et al*, (2011) argued that open-ended questions are flexible, allow interviewers to probe in-depth, clear up any misunderstandings, enable the interviewer to assess the limits of the respondents' knowledge, encourage cooperation and help to establish rapport. Yet, ambiguous, leading, double-barrelled and sensitive questions may not augur well for interviews. Furthermore, it is a good practice to start an interview with simple, easy to answer, less threatening, non-controversial questions in order to put the interviewees at ease (Patton 1980). However, Kumar (2005) argued that the quality of data generated through interview may depend upon the experience, skills and commitment of the interviewer and his/her level of interaction with the interviewee. Oppenheim (1992) argued that the involvement and motivation of interviewees in the process make interviews to generate higher response rate than questionnaires. In this respect, interviews are often more appropriate for exploratory and open-ended questions. In addition, it also has to be acknowledged that interviews may also consume time, are sometimes open to interviewer bias, and can make the issue of confidentiality/anonymity challenging. The focus of structured and unstructured interviews is presented in Table 6.3.

Table 6.3: Focus of Structured and Unstructured interviews

Structured Interview	Unstructured Interview
Quantitative approach	Qualitative approach
Numbers	Words
Predetermined, given	Open-ended, responsive
Measuring	Capturing uniqueness
Short-term, intermittent	Long-term, continuous
Comparing	Capturing particularity
Correlating	Valuing quality
Frequencies	Individuality
Formality	Informality
Looking at	Looking for
Regularities	Uniqueness
Description	Explanation
Objective facts	Subjective facts
Describing	Interpreting
Looking in from the outside	Looking from the inside
Statistical	Ethnographic, illuminative

Source: Cohen *et al* (2011)

In the context of this study, an interview schedule was initially constructed and pilot tested with four experts from the public and private sectors, end-user stakeholders and the academia. Their comments, suggestions and contributions of the author's supervisory team helped to refine this instrument before it was administered to the case study interview participants. In this study, a semi-structured qualitative face to face interview approach was employed for the case study because it allows for prompts and probes (Morrison 1993). Prompts allowed the interviewer to clarify questions while probes enabled the interviewer to ask interviewees to clarify, elaborate, and provide details for their response, thus, increasing the richness, depth, comprehensiveness and honesty which serve as the hallmarks of successful interviews (Patton 1980). Face to face interviews, and open ended questions are preferred because they often capture the respondents' unbiased point of view (Naoum 2013). In this regard, 15 top level management stakeholders were purposively selected in the case study road project for interviews. This included five participants each from the public, private sectors and end-user. The interview process started with background information about the respondents and the case study project (see Appendix 2). The rationale for selection of these participants is explained in Sections 6.10.2 and 6.10.3.

6.14.2 Rationale for Case Study

Initially, two highway projects were selected for this case study. The first project is the first highway infrastructure in the case study area (Nigeria) while the second project is the only highway so far procured through public private collaboration in the study area (Nigeria). However, the concessional agreement for the first highway infrastructure was recently terminated on the ground of non-performance on the part of the concessionaire after three and a half years of award of contract. Therefore, Eti Osa-Lekki-Epe expressway happens to be the only highway infrastructure so far procured through public private collaboration in the study area, and the project is presently at the construction stage. This explains the justification for the choice of a watershed, unique, embedded single case design for this study (see Section 8.3 in Chapter 8 for Case Study Background).

6.14.3 Discourse Analysis

Discourse analysis has been defined as a method that examines how individuals actively use language to explain themselves, their relationships and the world in general (Cassell and Symon 2004). It often focuses on understanding why individuals construct themselves, their relationships and the world in particular ways, hence, it is underpinned by a social constructivist epistemology (Dick 2004). Fairclough (1992) asserted that discourse constitutes the identity of individuals, the relationships between individuals and the ideological systems that exist in society. This implies that it is concerned with how social actions, social practices, social relations, identity and bodies of knowledge are shaped by language. Discourse analysis seeks to identify how language constructs, reproduces, challenges and /or changes the ideological systems of belief that exist in society at large, thereby sharing the concerns of critical research (Dick 2004).

Discourse analysis seems to cover a broad range of approaches and disciplines such as anthropology, sociology, linguistics, psychology, and communication studies. Depending on the nature of research, structured, semi-structured and unstructured interviews can be used to generate data for discourse analysis (Cohen *et al*, 2011). It might be suitable for a small sample of interview participants, since it provides an in-depth analysis focused on explanation. Habermas (1970) argued that every discourse has a double structure. These are ‘what is being said’ and ‘what is being done or achieved through the discourse’. Every discourse is expected to satisfy the criteria of legitimacy, truth, rightness, sincerity and comprehensibility in order to empower (Habermas 1984). In discourse analysis, the researcher identifies patterns, broad areas and examines the utterance/speech to discover intentions, functions and consequences of the discourse (Cohen *et al*, 2011). This helps to determine whether the force of the discourse is to assert, impart, persuade, justify/defend, accuse, censure or encourage (Parker 1992). The major strength of discourse analysis appears to be the fact that it encourages researchers not to accept research data at face value. However, Coyle (1995) criticised discourse analysis for its emphasis on the linguistic construction of a social reality, and the risk of losing the independence of the discourse.

6.14.4 Qualitative Content Analysis

Content analysis is a procedure for collecting and organising unstructured information into a standardised format that allows inferences to be made about the characteristics and meanings of messages, written and coded materials (Richards 2009). It is a logical and replicable method of compressing many textual words into fewer content categories by objectively and systematically identifying specified characteristics of messages (Saldana 2009).

Richards (2009) described qualitative data as records of observation or interaction in complex social settings which are not easily reduced immediately (or, sometimes, ever) to numbers. Qualitative research data analysis has to do with breaking-up, disassembling or separation of research materials into parts, elements, pieces or units. In this regard, an investigator sorts and sifts raw facts, searches for classes, types, sequences, patterns or processes with a view to reconstructing the data in comprehensible and meaningful manner. This is what Saldana (2009) described as an exploratory problem-solving technique without specific formulas to follow; a short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based/ visual data. However, case study data analysis seems to be difficult and least developed (Yin, 2009). The raw facts generated from this case study interview were recorded by audio devices and hand written notes, coded, transcribed and analysed with the aid of the generic qualitative content analysis. Qualitative data were first arranged into categories, then into broader themes by counting the frequency and sequence of specific words, phrases and concepts. The word(s) that occurred most indicated common understanding, greatest interest and consensus of opinion.

6.14.5 Validity and Reliability of Qualitative Research

The concept of validity and reliability in qualitative research appear to be controversial. Gronlund (1981) posited that the subjectivity of respondents, their opinions, attitudes and perspectives contribute to a degree of bias in qualitative research; hence validity should be seen as a matter of degree rather than as an absolute state. In this respect, Lincoln and Guba (2000) proposed a framework of four criteria that can establish validity and reliability in qualitative research. These criteria are credibility, transferability, dependability and confirmability (Denzin and Lincoln (1994).

These criteria are considered to be closely related to the same construct in quantitative research hence Trochim and Donnelly (2007) matched them with the traditional concepts in qualitative research (see Table 6.4).

Table 6.4: Traditional and alternative criteria for establishing validity and reliability

Traditional criteria in quantitative research	Alternative criteria in qualitative research
Internal Validity	Credibility
External Validity	Transferability
Reliability	Dependability
Objectivity	Confirmability
Demonstrability	Trustworthiness
Replicability	Uniqueness
Predictability	Emergence
Context-freedom	Context-boundedness, Context-Specificity
Randomisation of samples	Purposive sampling
Inference	Thick description and detailed explanation of important aspects
Control/ manipulation of key variables	Fidelity to natural and real life situation
Generalisability	Uniqueness

Source: (Trochim and Donnelly 2007; Cohen *et al* 2011).

From the table above, the validity of a qualitative research can be measured through credibility and transferability while reliability can be established through dependability and confirmability. Credibility requires the investigator to present his results to the subjects of the study in order to confirm that the findings accurately reflect their views, opinions, beliefs and feelings. Transferability implies the degree to which the results of qualitative research can be generalised or applied to other settings or contexts. This may be achieved through an extensive and detailed description of the processes adopted. Dependability has to do with whether the same or similar results could be obtained if another investigator follows the steps adopted by an earlier researcher in a particular study. Given the motive, flexibility and freedom in qualitative research, this might be possible only to an extent. Confirmability explains the degree to which the findings of a qualitative research could be verified, upheld, compared, endorsed or supported by others.

Furthermore, Winter (2000) argued that the validity of qualitative data might be established through the honesty, depth, richness and scope of data collected, the participants approached, the extent of

triangulation and objectivity of the researcher. Triangulation in this context is concerned with the use of mixed-methods (quantitative and qualitative) in order to explain more explicitly the richness and complexity of human behaviour in a study. According to Cohen *et al*, (2011), triangulation bridges the issues of validity and reliability, and demonstrates concurrent validity in qualitative research. Winter (2000) also claimed that the overwhelming feature of qualitative research is to represent the situation or phenomenon being investigated fairly and fully and not to generalise.

6.14.5.1. Validity and Reliability of Case Study Findings

The validity of a content analysis study refers to the correspondence of the categories to the conclusions and the generalisability of results to a theory. The content analysis method adopted for the case study allowed a comprehensive case analysis to be carried out and robust results to be achieved in respect of the key issues, challenges and priorities of sector partners in collaborative road infrastructure management. In this regard a QFD correlation matrix between the ‘pivotal drivers’ of collaboration and the ‘voice of the customer’ was developed (see Appendix 3a and 3b). This allowed the case study interviewees to elaborate more on the questions. The matrix provided a framework for the interview, made it possible to triangulate data, and infused internal consistency to the interview. The matrix also helped to identify the main issues pertaining to each question discussed with the case study participants.

6.15. QUALITY FUNCTION DEPLOYMENT

QFD is a total quality management process for the development/deployment of functions, attributes and features that offer a product/service high quality. It is a system for designing a service or product based on customer needs and involving all members of the manufacturing organisation (Sahney *et al*, 2003). QFD is a customer-oriented strategy of product/service improvement that aligns customer needs to company activities. It is a systematic approach for collecting, tracking and translating ‘what’ customers require from a product, to ‘what’ the company can offer to best fit the customer requirements through the integrated process of research, product development, engineering, manufacturing, marketing/sales and distribution (Park *et al*, 2012). In this study, the QFD model was

employed in the development of the conceptual collaborative engagement framework for road infrastructure management (refer to Sections 5.6 and 7.6.3; Table 7.14).

6.16. DEVELOPMENT AND VALIDATION OF THE CONCEPTUAL COLLABORATIVE ENGAGEMENT FRAMEWORK

The findings of research objectives 1 to 4 (i.e. literature review, questionnaire survey and qualitative case study interview) informed and constituted the ingredients and component parts of the collaborative engagement framework developed for road infrastructure management in Nigeria. The framework was validated both internally and externally. In this respect the views, comments and contributions of the experts from the case study data set and external experts from the public, private and end-user sectors were sought about the logic flow/sequence/arrangement, relevance, comprehensiveness, relationships, and ease of understanding of the component parts of the proposed/draft framework (see Appendix 4). Data were captured through a structured interview, analysed through the ‘Mean Scores’ descriptive statistics and discussed (see Section 9.4, Table 9.1).

6.17. SUMMARY

This chapter presented the overall research design for this study. Given the aim and objectives of the study, the mixed methods research design was adopted. This pragmatic epistemological approach helped the study to seek convergence across qualitative and quantitative methods, and focus on the use of all available techniques in order to have the best understanding of the complex social and political contexts of public private collaboration in road infrastructure management. The triangulated method helped in no small measure to gain insight, make inferences, and draw conclusions from the findings of the study.

Overall, the research process consists of four key phases (i. e literature review; questionnaire survey; explorative case study interview; and development and validation of the conceptual framework). The strategies of inquiry employed during each phase along with the techniques adopted for data collection and analysis were also presented within this chapter. Furthermore, the justifications for selecting the research strategies have also been enumerated. The remaining chapters of this thesis present the research findings using the research approaches and methods discussed within this

chapter. In particular, the next chapter presents, analyses and discusses the implications of the findings of quantitative data.

CHAPTER 7: DATA PRESENTATION AND ANALYSIS: PUBLIC-PRIVATE PERCEPTION OF COLLABORATIVE INFRASTRUCTURE PROJECTS IN NIGERIA

7.1. INTRODUCTION

Historically, public infrastructure has traditionally been owned, constructed, financed, operated, maintained and provided by the public sector (government) for free use by the general public. This was made possible through budgetary allocations, levies, taxes, bilateral and/or multilateral donor funds. However, a number of forces have combined to inform the recent global paradigm shift towards Public-Private sector Collaboration (PPC) in infrastructure provision. These forces include gross inadequacies of public funding/budgetary constraints, inefficiencies of government monopolies, increase in human population, infrastructure deficit, rapid globalisation of world economies, social and political changes, challenges of economic growth, and technological advancements (RICS, 2011; World Bank, 2010; Akintoye and Beck, 2009). Consequently, many countries are now contemplating public-private collaborative engagement approaches through which the skills, assets and resources of each sector are shared in order to deliver infrastructure services for the use of the general public (Siemiatycki, 2010; Tang *et al*, 2010). The public sector can be described as that part of an economy which is established, managed and operated by the government. This includes government agencies, ministries, parastatals and extra-ministerial departments at federal, state/regional and local levels of authority. The private sector on the other hand is the portion of the economy that is owned and managed by individual persons, groups or business organisations as a break-even or profit-oriented venture. This includes manufacturing, production, consulting, contracting and services industries.

This chapter articulates the findings of an empirical study of the critical issues inherent in collaborative projects, and presents initiatives for effective and enduring public-private sector collaboration in infrastructure management in Nigeria. The sections of this chapter present the background for the survey, empirical results, discussion of findings, and summary. The sub-sections of this chapter include collaborative infrastructure projects and the issues associated with collaboration.

7.2. COLLABORATIVE INFRASTRUCTURE PROJECTS

Collaborative approaches have become increasingly popular as a vehicle to deliver large transportation facilities such as roads, bridges, tunnels, railways, seaports, and airports (Siemiatycki, 2010). Since 1992, over 67 transportation facilities worth over US\$42 billion have been procured through the Private Finance Initiative (PFI), and an additional 12 projects are scheduled for delivery between now and the year 2020 in UK. Report has it that the total cost of PFI projects in UK is about £60 billion (Federal Highway Administration 2009). Furthermore, in 2005, the length of expressways in China was increased from 522 kilometres (km) to 41,000km through the Build-Operate Transfer concessionaire model of PPC. By the time the on-going National Trunk Highway System is completed in the year 2020, China looks forward to having a national expressway network of 85,000km. In the same vein, the Republic of Turkey has a development plan to realise 5250km motorway network through PPC by the end of year 2023 (Wood, 2006). The benefits of Public-Private sector Collaboration are summarised by Li and Akintoye (2003) (see Section 1.1 in Chapter 1).

Road transport consists of two distinct segments: road transport services and road transport infrastructure. While road transport services serve the public or commercial customers directly, and are in most cases privately owned and operated (e.g. commercial vehicles, buses, cabs/taxis, and tricycles), road transport infrastructure consists of the fixed installations (road network) used by the transport service providers (Kendrick *et al*, 2004). Therefore, road infrastructure is a major catalyst for the physical and socio-economic development of a country's Gross Domestic Product (GDP), as the movement of people, labour, goods and services depend mainly on it. GDP is the value of a country's overall output of goods and services (typically during one fiscal year) at market prices, excluding net income from abroad. GDP can be estimated in three ways, which in theory should yield identical figures. For example, an estimate of GDP on expenditure basis reflects how much money was spent. An estimate of GDP on output basis shows how many goods and services were sold, while an estimate of GDP on income basis reveals how much income (profit) was earned. In this respect, road infrastructure performs a critical role by allowing raw materials to be moved from farm to

factory, and finished goods from factory to market, thereby enabling products to be made available at locations desired by the customers (Potter and Lalwani, 2008). In this regard, road transport may have a central role to play in the continued health and growth of Europe's economy, since goods are expected to be delivered door-to-door to all corners of the continent, quickly and on time (European Commission Directorate-General for Energy and Transport, 2006). Furthermore, other modes of transport depend largely on an efficient, safe, cost-effective and vibrant road transport system, since most freight and passenger journeys often start and end with a trip on the road.

The Federal Republic of Nigeria has a total road network of about 196,000km which are designed, constructed, financed, operated and maintained by the public sector (Government agencies). The Federal Government is responsible for managing about 34,000km which includes 1,194km of expressways (17%) of the entire road network, State Governments take care of about 31,000km (16%), while the remaining 131,000km (67%) fall within the jurisdiction of the Local Governments (Oni and Okanlawon, 2006). These roads seem to be characterised by faulty designs, longitudinal and transverse cracks, depressions, broken bridges, numerous potholes, narrow pedestrian walkways, narrow bridges, poor drainage system, bushy road environment, excess axle loading of articulated vehicles, rough and undulating surfaces, blocked drains, defaced signs, non-functional traffic lights, irregular road marks, wrong and harmful parking on the highways, poor guard railings, and flooded road surfaces (Campbell, 2009; Central Bank of Nigeria, 2003; Odeleye, 2000). These problems have significantly reduced the utility of Nigerian roads, had a corresponding negative impact on the cost of production, and caused a major trigger of cost-push inflation which often leads to loss of man-hours. An annual loss due to bad roads is estimated at NGN80 billion, while the additional vehicle operating cost is valued at NGN53.8 billion, bringing the total loss per annum to NGN133.8 billion (Central Bank of Nigeria, 2003). This is aside from the emotional and physical trauma experienced by the road users. Given these developments, Adetola *et al.* (2011b) recently identified some key issues which might attract or encourage Public-Private Collaboration in road infrastructure management in Nigeria. These include inadequate maintenance of roads, poor inter-modal transport systems, inadequate funding, and institutional problems.

7.3. COLLABORATION ISSUES

The extensive use of PPC over the last two decades seems to have generated problems and issues associated with implementation and operationalisation. These include weak or inadequate institutional framework, inefficient bureaucracy, inappropriate risk allocation, lack of transparency, poor communication, lack of mutual trust, ineffective contractual arrangements, adversarial relationships, lack of commitment, inadequate domestic capital markets, misunderstanding, lack of integrity, flagrant abuse/breach of contract, weak business structure, lack of capacity to collaborate, complex decision making process, poorly defined sector policies, poor project management skills, and blame culture (RICS, 2011; Project Management Institute, 2010; Chartered Institute of Building, 2010; Tang *et al*, 2010; Akintoye and Beck, 2009; Khalfan *et al*, 2007; Zhang 2005). Talking about collaboration, it is essential to understand the importance of supplier relationship management (Lintukangas, 2011), especially with the advances in modern technology e.g. the E-procurement system (Makinen *et al*, 2011). It is also important to understand ‘how best to achieve a mutually-beneficial arrangement between collaborating parties’ (Rod, 2011). More recently, ten causal problems/cogent issues that impinge upon the effective delivery of sustainable infrastructure were identified (see Sections 2.8.1.1-2.8.1.10 in Chapter 2; Adetola *et al*, 2011a).

The nature of respondents to the study is presented as follows:

Sector of Respondent

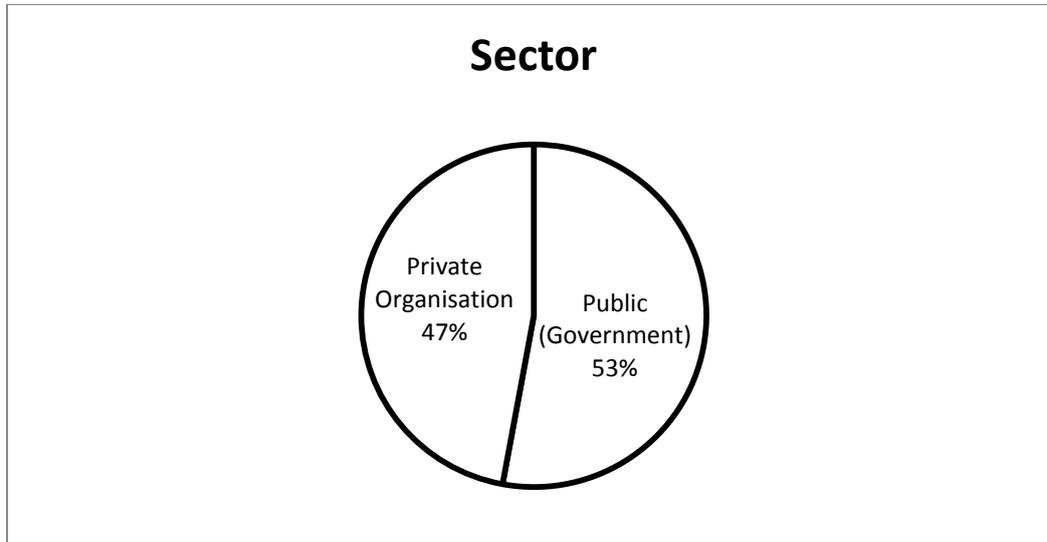


Figure 7.1 Sector of Respondent

Figure 7.1 above shows that about 53% of the respondents to this study are from the public sector (Government Agencies) while 47% are from the organised private sector. This represents a wide coverage of both sectors in the distribution of the research instrument for the study.

Table 7.1 Respondents main work remit

Work Remit	Frequency	Percentage
Federal Ministry of Works/ Similar Agencies	18	52.9
Civil Engineering Contractor	02	05.9
Civil Engineering Consultant	13	38.2
Project Promoter	01	02.9
Total	34	100

From Table 7.1 above, about 53% of the subjects to this study are officials of the Federal Ministry of Works and its agencies (Federal Road Maintenance Agency-FERMA, State Ministries of Works and Infrastructure); 38% are civil engineering consultants; 5.9% are civil engineering contractors and 2.9% are construction project promoters. This shows that the study captured the views of relevant and appropriate sector stakeholders

Table 7.2 Respondents work designation

Work designation	Frequency	Percentage
Director	10	29.4
Project Manager	10	29.4
Procurement Manager	1	2.9
Engineer	12	35.3
Technical Officer	1	2.9
Total	34	100

From Table 7.2 above, about 35% of the respondents are civil/ highway engineers; 29% are directors (policy makers) while 29% are construction project managers.

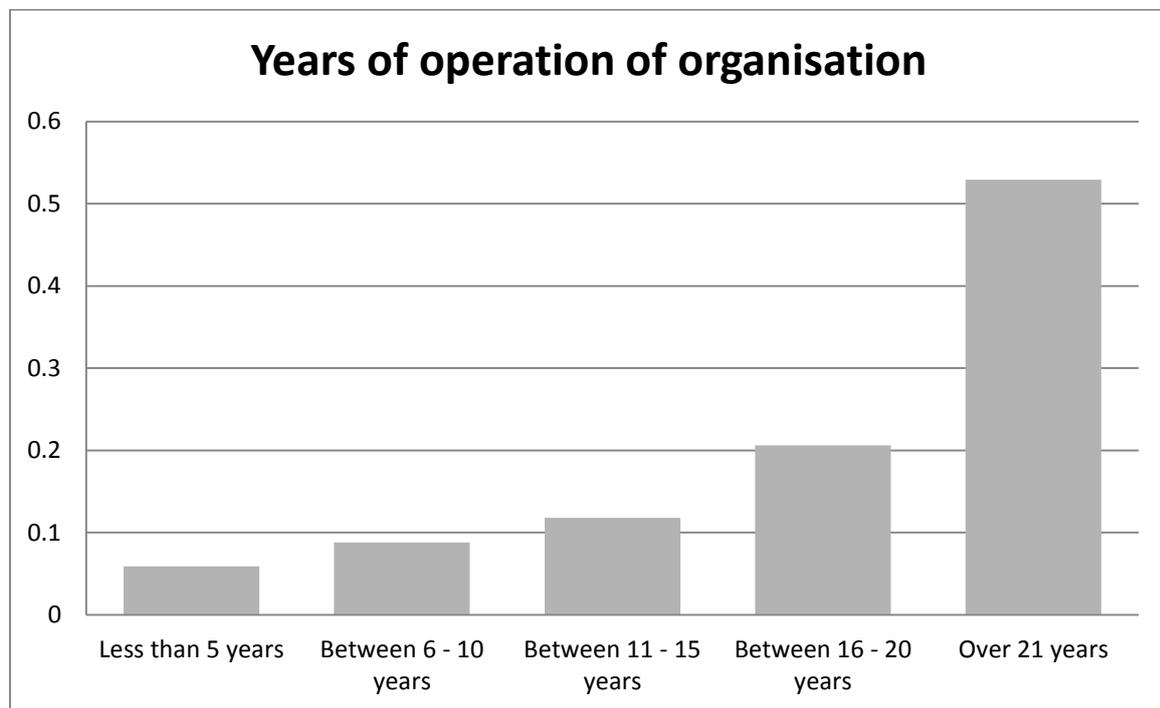


Figure 7.2 Years of operation of organisations

From Figure 7.2 above, about 53% of the organisations from which data were collected for this study have been in operation for over 21 years; about 21% were established over 15 years ago; about 12% have been in active business for over 10 years; while about 9% have operated for over 5 years.

Table 7.3 Academic qualification of respondent

Academic qualification	Frequency	Percentage
MPhil/ M.Sc/ M.Tech	19	55.9
B. Sc/ B. Tech/ B.A	13	38.2
HND	2	5.9
Total	34	100

From Table 7.3 above, all the respondents to this study have successfully completed the basic necessary training in their professions.

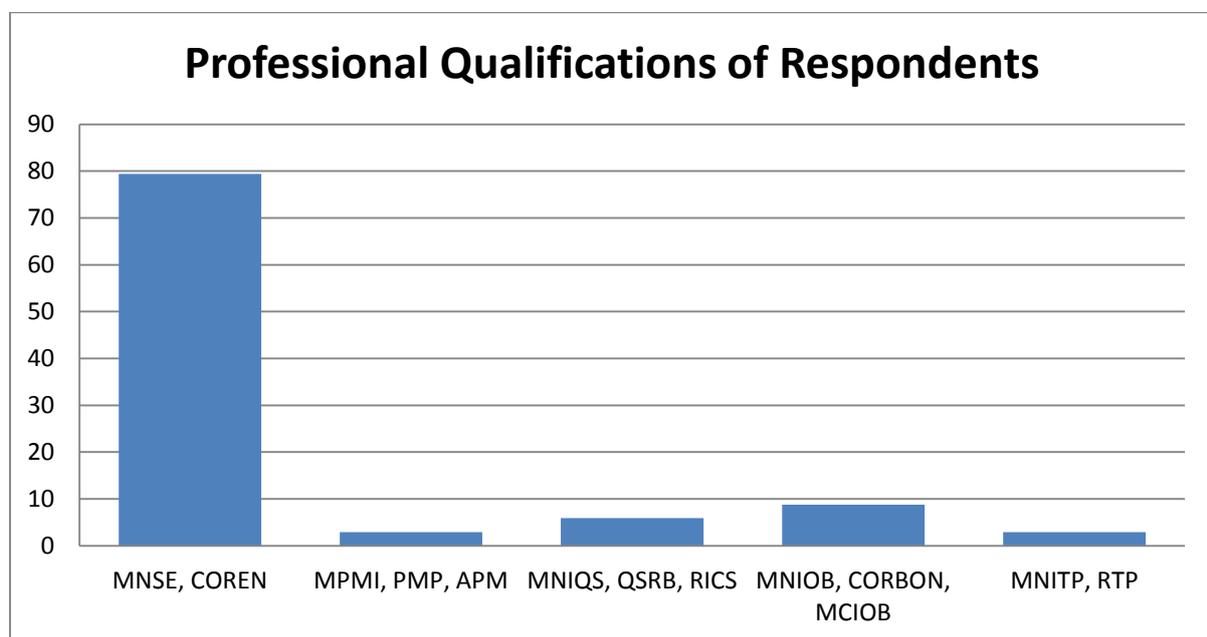


Figure 7.3 Professional qualifications of respondents

From Figure 7.3 above, about 79% of the respondents are registered members of the Nigerian Society of Engineers (MNSE), Council for the Regulation of Engineering in Nigeria (COREN) and Institute of Civil Engineers (MICE); about 9% are registered members of the Nigerian Institute of Building (MNIQB), Council of Registered Builders of Nigeria (CORBON) and the Chartered Institute of Building (CIOB); about 6% are registered members of the Nigerian Institute of Quantity Surveyors (MNIQS), Quantity Surveyors' Registration Board (QSRB) and the Royal Institution of Chartered Surveyors (RICS); about 3% are registered members of the Chartered Project Management Institute of Nigeria (CPMIN), Project Management Institute (MPMI), Project Management Professionals (PMP)

and Association of Project Managers (APM); while the remaining 3% are members of the Nigerian Institute of Town Planners (MNITP) and Registered Town Planners (RTP). This implies that all the respondents to this study have sound knowledge and abundant experience in construction project management.

Furthermore, the background information regarding the academic and professional qualifications of the respondents support the underlying assumption that respondents are competent, experienced and capable of exercising sound judgement. In this regard, the responses provided by them could be relied upon for this study.

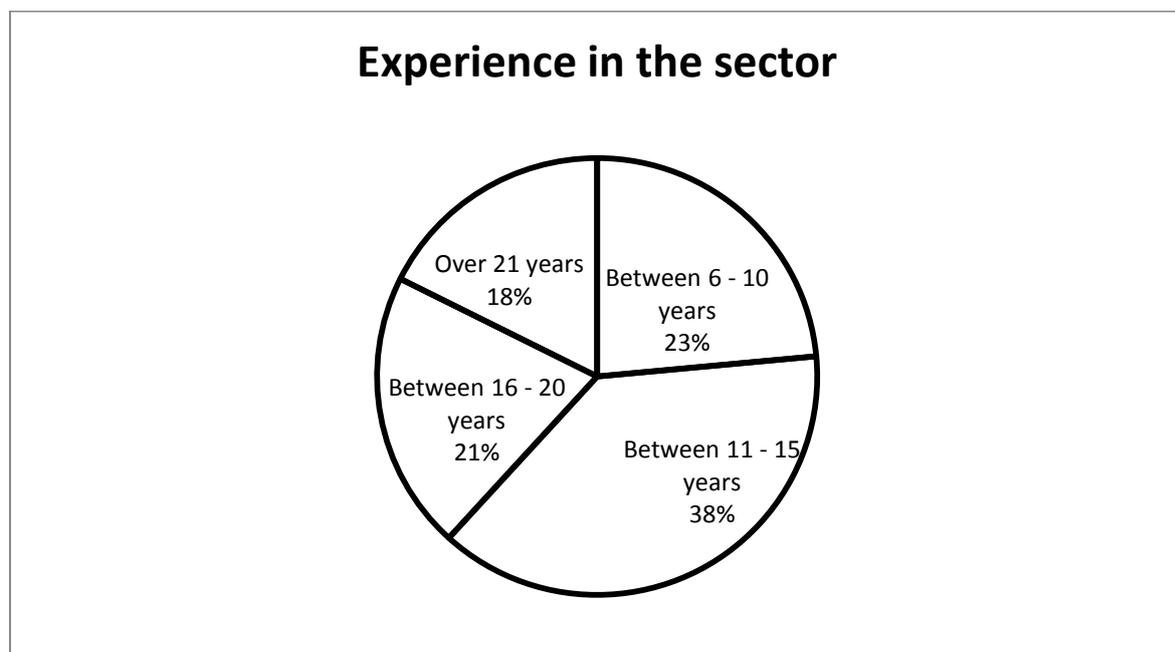


Figure 7.4 Experience of respondent in the sector

From Figure 7.4 above, about 18% of the respondents have been in the construction industry for over 21 years, 21% have had over 15 years post-qualification cognate experience, about 38% have worked for over 10 years while the remaining 23% joined the construction industry over 5 years ago. Overall, about 80% of the respondents have over 10 years post-qualification work experience in construction. This attests to their competence, proficiency and experience.

7.4. SURVEY RESULTS 1

The results of the first survey carried out in this study are presented as follows:

7.4.1. Test of Hypothesis

The null and alternative hypotheses postulated for this study are:

H₀: There is no significant difference between the perception of the public and the private sectors on the drivers of collaboration using a 5% level of significance ($p \leq 0.05$) (see chapter 6.12.5).

H_A: There is significant difference between the perception of the public and the private sectors on the drivers of collaboration

Table 7.4 Mann-Whitney-Wilcoxon test results for the drivers of collaboration

Drivers	MWW P value	Significance	Decision
Market Maturity			
All-weather, safe and reliable road reduces carbon emissions.	0.904	NS	Accept H ₀
High quality road can stimulate economic growth	0.240	NS	Accept H ₀
High quality road can promote social equity	0.009	S	Reject H ₀
The goal of the public sector is to provide social welfare services	0.061	NS	Accept H ₀
Privately procured facilities can lead to inequalities	0.562	NS	Accept H ₀
Inadequate domestic capital market is a barrier to collaboration.	0.313	NS	Accept H ₀
Technology			
There is no technology involved in road development	0.300	NS	Accept H ₀
Road can enhance the production of goods and services	0.521	NS	Accept H ₀
Commercial/industrial activities rest on effective and efficient road system.	0.096	NS	Accept H ₀
Skills and Competence			
Road projects should not be monitored	0.539	NS	Accept H ₀
Management involves organising resources in order to achieve goals.	0.803	NS	Accept H ₀
Effective management of resources always satisfies client's requirements.	0.254	NS	Accept H ₀
Skills are not required in road development	0.319	NS	Accept H ₀
Skills should be distributed equally between the public and private sector.	0.525	NS	Accept H ₀
Government can manage road better than private sector	0.025	S	Reject H ₀
Government can muster sufficient resources to meet road requirements.	0.783	NS	Accept H ₀
Finance			
Highway development has a long gestation period	0.209	NS	Accept H ₀
Capital market funds are short-term in nature	0.876	NS	Accept H ₀
Road projects are not capital intensive	0.086	NS	Accept H ₀
A sound financial plan is not important in road projects	0.176	NS	Accept H ₀
The private sector aims to maximise profit on all investments.	0.111	NS	Accept H ₀
Rewards should be distributed equally between sectors	0.564	NS	Accept H ₀
Government provides adequate financial support for road needs.	0.562	NS	Accept H ₀
Budgetary allocation should be aligned to physical infrastructure needs.	0.180	NS	Accept H ₀
Government revenue should be supported by private investment.	0.539	NS	Accept H ₀
Globalisation/Collaboration			
Collaborative effort can successfully deliver Road projects.	0.750	NS	Accept H ₀
Collaboration in road management can accelerate socio-economic growth.	0.436	NS	Accept H ₀
Collaboration can guarantee 'value for money' benefits to all road users.	0.211	NS	Accept H ₀
Collaboration can reduce failure of road projects.	0.275	NS	Accept H ₀

Drivers	MWW P value	Significance	Decision
Collaboration can encourage optimal and efficient use of resources.	0.860	NS	Accept H ₀
Collaboration can help to secure a sustainable, self-funding road.	0.764	NS	Accept H ₀
Relationships			
Relationships should not be managed	0.002	S	Reject H ₀
Stakeholders in collaboration have no different opinions.	0.623	NS	Accept H ₀
Harmonious interaction between project participants is paramount.	0.176	NS	Accept H ₀
Collaborating parties should instil confidence in one another.	0.686	NS	Accept H ₀
Intra-organisational conflict has no adverse effect on project performance.	0.641	NS	Accept H ₀
Both the public and private sectors should be willing to compromise.	0.381	NS	Accept H ₀
Both parties should have a collective understanding of project goals and risk.	0.319	NS	Accept H ₀
Effective working relationship is vital for collaborative management.	0.319	NS	Accept H ₀
Mutual respect can help foster good relationships.	0.086	NS	Accept H ₀
Communication			
All communication in collaborative projects should be open and transparent.	0.898	NS	Accept H ₀
Conflicts between project team should always be resolved.	0.935	NS	Accept H ₀
Project documents should always disclose information to all vested parties.	0.539	NS	Accept H ₀
Parties should agree to respond to all communication in a timely manner.	0.300	NS	Accept H ₀
Legal/Regulatory Framework			
Contracts should not be enforced.	0.186	NS	Accept H ₀
Poor road maintenance policies have no effect on the state of road.	0.968	NS	Accept H ₀
Weak institutional arrangements always result in poor road networks.	0.254	NS	Accept H ₀
A functional legal/regulatory framework aligns the interests of parties.	0.275	NS	Accept H ₀
Unstable foreign investment policies have no effect on collaboration.	0.310	NS	Accept H ₀
Enforceable legal/regulatory framework can attract the private sector.	0.176	NS	Accept H ₀
Measures for promoting effective road development are not always necessary	0.160	NS	Accept H ₀
Trust			
Trust is a hallmark of effective relationships	0.647	NS	Accept H ₀
Increased levels of trust result in more positive attitudes	0.750	NS	Accept H ₀
Increased levels of trust generate higher levels of cooperation	0.750	NS	Accept H ₀
Increased levels of trust generate superior levels of performance	0.623	NS	Accept H ₀
High levels of trust often enable relationships to be built up faster and better	0.319	NS	Accept H ₀
Increased levels of trust can reduce the occurrence of litigation	0.869	NS	Accept H ₀
Trust can facilitate group efficiency	0.720	NS	Accept H ₀
Risk			
Road project costs/needs should be assessed only in the short term	0.551	NS	Accept H ₀
Road infrastructure projects do not attract risk	0.275	NS	Accept H ₀
Risk should be distributed equally between the public and private sector	0.345	NS	Accept H ₀
Risk is often higher on projects before the contract is commenced	0.048	S	Reject H ₀
Partnerships do not attract risk	0.470	NS	Accept H ₀
There is no need to negotiate partnership terms of reference	0.275	NS	Accept H ₀

Key: MWW P value = Mann-Whitney-Wilcoxon probability value, NS = Not Significant, S=Significant

Results from Table 7.4 above show that the Mann-Whitney-Wilcoxon probability values for most of the variables tested for each driver exceed the null hypothesis declaration that $p \leq 0.05$. In general, there is certainly sufficient and satisfactory information to accept the null hypothesis and declare

categorically that there is no significant difference between the perception of the public and private sectors on market maturity, technology, skills/competence, finance, globalisation/collaboration, relationships, communications, legal/regulatory framework, trust, and risk as drivers of collaboration. Sections 2.8.1.1 – 2.8.1.10 in Chapter 2 discussed these drivers.

7.4.2. Descriptive Analysis of Data

Table 7.5 Relative Importance Index (RII) results for the perception of the public and private stakeholders about the drivers of collaboration

Dependent Variables	SA 4	A 3	D 2	SD 1	NO 0	RII	Rank
Market Maturity							
All-weather, safe and reliable road reduces carbon emissions.	13	20	1	0	0	0.838	29
High quality road can stimulate economic growth	30	4	0	0	0	0.970	1
High quality road can promote social equity	15	16	3	0	0	0.838	29
The goal of the public sector is to provide social welfare services	18	14	2	0	0	0.867	16
Privately procured facilities can lead to inequalities	5	24	4	1	0	0.742	40
Inadequate domestic capital market is a barrier to collaboration.	9	23	2	0	0	0.801	37
Technology							
There is no technology involved in road development	0	0	18	16	0	0.382	57
Road can enhance the production of goods and services	19	15	0	0	0	0.889	9
Commercial/ industrial activities rest on effective and efficient road system.	22	12	0	0	0	0.911	3
Skills and Competence							
Road projects should not be monitored	0	0	13	21	0	0.345	64
Management involves organising resources in order to achieve goals.	22	12	0	0	0	0.911	3
Effective management of resources always satisfies client's requirements.	13	19	2	0	0	0.830	32
Skills are not required in road development	0	0	16	18	0	0.367	61
Skills should be distributed equally between the public and private sector.	2	20	12	0	0	0.676	43
Government can manage road better than private sector	3	10	18	3	0	0.595	45
Government can muster sufficient resources to meet road requirements.	8	15	9	2	0	0.713	41
Finance							
Highway development has a long gestation period	8	24	2	0	0	0.794	39
Capital market funds are short-term in nature	3	12	19	0	0	0.632	44
Road projects are not capital intensive	0	0	18	16	0	0.382	57
A sound financial plan is not important in road projects	0	0	17	17	0	0.375	60
The private sector aims to maximise profit on all investments.	17	15	2	0	0	0.860	22
Rewards should be shared equally between sectors	4	18	12	0	0	0.691	42

Dependent Variables	SA 4	A 3	D 2	SD 1	NO 0	RII	Rank
Government provides adequate financial support for road needs.	1	4	24	5	0	0.507	48
Budgetary allocation should be aligned to physical infrastructure needs.	12	21	1	0	0	0.830	32
Government revenue should be supported by private investment.	13	21	0	0	0	0.845	27
Globalisation/ Collaboration							
Collaborative effort can successfully deliver Road projects.	16	18	0	0	0	0.867	16
Collaboration in road management can accelerate socio-economic growth.	21	13	0	0	0	0.904	6
Collaboration can guarantee 'value for money' benefits to all road users.	14	19	1	0	0	0.845	27
Collaboration can reduce failure of road projects.	14	20	0	0	0	0.852	24
Collaboration can encourage optimal and efficient use of resources.	16	17	1	0	0	0.860	22
Collaboration can help to secure a sustainable, self-funding road.	13	20	1	0	0	0.838	29
Relationships							
Relationships should not be managed	0	0	18	16	0	0.382	57
Stakeholders in collaboration have no different opinions.	0	0	31	3	0	0.477	50
Harmonious interaction between project participants is paramount.	17	17	0	0	0	0.875	15
Collaborating parties should instil confidence in one another.	14	20	0	0	0	0.852	24
Intra-organisational conflict has no adverse effect on project performance.	0	1	27	6	0	0.463	52
Both the public and private sectors should be willing to compromise.	8	25	1	0	0	0.801	37
Both parties should have a collective understanding of project goals and risk.	18	16	0	0	0	0.882	10
Effective working relationship is vital for collaborative management.	18	16	0	0	0	0.882	10
Mutual respect can help foster good relationships.	16	18	0	0	0	0.876	16
Communication							
All communication in collaborative projects should be open and transparent.	23	11	0	0	0	0.919	2
Conflicts between project team should always be resolved.	21	13	0	0	0	0.904	6
Project documents should always disclose information to all vested parties.	21	13	0	0	0	0.904	6
Parties should agree to respond to all communication in a timely manner.	16	18	0	0	0	0.867	16
Legal/ Regulatory Framework							
Contracts should not be enforced.	0	0	15	19	0	0.360	62
Poor road maintenance policies have no effect on the state of road.	0	0	15	19	0	0.360	62
Weak institutional arrangements always result in poor road networks.	13	19	1	1	0	0.823	34
A functional legal/ regulatory framework aligns the interests of parties.	14	20	0	0	0	0.852	24
Unstable foreign investment policies have no effect on collaboration.	0	1	28	5	0	0.470	51
Enforceable legal/ regulatory framework can attract the private sector.	9	25	0	0	0	0.816	35

Dependent Variables	SA 4	A 3	D 2	SD 1	NO 0	RII	Rank
Measures for promoting effective road development are not always necessary	0	0	19	15	0	0.389	55
Trust							
Trust is a hallmark of effective relationships	22	12	0	0	0	0.911	3
Increased levels of trust result in more positive attitudes	18	16	0	0	0	0.882	10
Increased levels of trust generate higher levels of cooperation	18	16	0	0	0	0.882	10
Increased levels of trust generate superior levels of performance	17	16	1	0	0	0.867	16
High levels of trust often enable relationships to be built up faster and better	18	16	0	0	0	0.882	10
Increased levels of trust can reduce the occurrence of litigation	10	22	2	0	0	0.808	36
Trust can facilitate group efficiency	16	18	0	0	0	0.867	16
Risk							
Road project costs/ needs should be assessed only in the short term	0	2	31	1	0	0.507	48
Road infrastructure projects do not attract risk	0	0	20	14	0	0.397	53
Risk should be distributed equally between the public and private sector	0	13	19	2	0	0.580	46
Risk is often higher on projects before the contract is commenced	0	6	24	4	0	0.514	47
Partnerships do not attract risk	0	0	19	15	0	0.389	55
There is no need to negotiate partnership terms of reference	0	0	20	14	0	0.397	53

Key: RII = Relative Importance Index, NO = No Opinion, SD = Strongly Disagree, D = Disagree, A = Agree, SA = Strongly Agree.

$$RII = \frac{1}{4n} \left[\sum_{i=0}^{i=4} W_i x f_i \right]$$

Where W_i is weight given to i^{th} rating; $i = 0, 1, 2, 3$ or 4 , f_i = response frequency of the i^{th} rating; and n = total number of responses.

From Table 7.5 above, both the public and the private sector stakeholders unanimously agree that high quality road infrastructure jointly managed by both sectors can stimulate and accelerate the socio-economic growth of a nation, since modern industry and commercial activities rest on well developed, effective and efficient road transportation system in order to enhance the production of goods and services. It is also a consensus of opinion that all communication in collaborative projects should be open and transparent, and that project documents should always disclose information to all vested

parties, while conflicts between project team should always be resolved before they become intractable. The role of trust as a hallmark of relationship is also emphasised since it can result in more positive attitudes, generate high levels of cooperation and enable relationships to be built up faster and better. The need to manage and organise resources in order to accomplish desired project goals and objectives is also stressed, just as both the public and private sectors should have a collective understanding of project goals and risk.

The government agencies appreciate the fact that harmonious interaction, mutual respect, and effective working relationships between project participants are vital for collaborative infrastructure project management. Aside from acknowledging her primary role of providing social welfare services to her citizens, the public sector also perceives that a functional legal/regulatory framework could align the interests of partners, and provide confidence to both the public and private sectors. Results of the study also show that collaborative effort can reduce the failure (risk) of road infrastructure projects, encourage optimal and efficient use of resources, successfully deliver road infrastructure projects, and guarantee 'value for money' benefits to all road users. The public sector sincerely believe that budgetary allocation at the various levels of government should be aligned to physical infrastructure needs; effective management of resources satisfies clients' requirements; weak institutional arrangements for managing and financing infrastructure projects results in poor road networks, while trust between the public and private sectors can facilitate group efficiency by allowing partners to focus resources towards a common goal, and also reduce the occurrence of litigation. The public sector also sees the need for both sectors to be willing to shift grounds when the need arises in order to secure win-win positions.

The private sector strongly believe that collaborative engagement approaches can encourage optimal and efficient use of resources; government revenue should be augmented with private sector investment especially in road infrastructure development; mutual respect between partners can help to foster good relationships; and that partners should respond promptly to all communication (or face the consequence of penalty clauses). The sector also perceives that a functional and enforceable

legal/regulatory framework can attract the private sector, and align the interests of partners. Furthermore, the role of effective relationship management, respect for partners' opinions, trust/confidence in one another, harmonious interaction between project participants, and the willingness to secure win-win positions are considered paramount in collaboration. The private sector is of the view that inadequate domestic capital markets might be a barrier to the success of collaborative projects in developing economies.

Table 7.6 Summary of the Relative Importance Index results for the perception of the public and private sectors about the drivers of collaboration

Drivers of collaboration	RII	Rank
Communication	0.898	1
Trust	0.871	2
Globalisation/ Collaboration	0.861	3
Market Maturity	0.842	4
Technology	0.727	5
Relationships	0.721	6
Finance	0.657	7
Skills / Competence	0.633	8
Legal and Regulatory Framework	0.581	9
Risk	0.464	10

7.5. DISCUSSION

From the Mann-Whitney-Wilcoxon test results for the 10 drivers of collaboration, there is certainly sufficient information to accept the null hypothesis and to declare that there is no significant difference between the perception of the public and private sectors about the drivers of collaboration (Table 7.4). This declaration is also supported by the Relative Importance Index results for the perception of the public and private stakeholders about the drivers of collaboration (Table 7.5). Furthermore, results from Table 7. 6 above show that communication has the highest ranking. This is closely followed by trust, globalisation/collaboration, market maturity, technology, relationships, finance, skills/competence, legal and regulatory framework, and risk. The overall ranking reflects the perception of the public and private sector stakeholders about the drivers of collaboration in infrastructure management in Nigeria. These are the key/core drivers that need to be aligned to

existing business models for the successful implementation or delivery of sustainable collaborative infrastructure projects. This is strongly supported by seminal literature though without ranking.

Collaboration provides an opportunity for the public and private sectors to partner/ work together and share risks, responsibilities, resources, skills, assets and rewards in order to deliver sustainable infrastructure for the use of the general public. In this respect, the need to appropriate or allocate risks to a partner with the best financial and technical capabilities to manage them has been widely acknowledged and supported by extant literature (Li and Akintoye, 2003; Li *et al*, 2005; Loosemore, 2007; Tang *et al*, 2010). Similarly, the role of an adequate, comprehensive, transparent, enabling, functional, and enforceable legal and regulatory framework for public–private sector collaboration has been stressed and supported by seminal literature (Pongsiri, 2002; Harris, 2003; Zhang, 2005; Bing *et al*, 2005). This would allow for effective contractual arrangements (contract type, contract award method and risk allocation) that are compatible with a country’s legal system to be put in place at the beginning of the project cycle. Moreover, it would also help to align the interests of partners, foster cooperation, and deliver customer satisfaction underpinned by ‘value for money’ and win-win positions to the public, private and user sectors.

Adetola (2007) identified the core activities inherent in the different stages/phases of a typical construction project. Effective management of these activities rely on clear communications and the ability to pass thoughts, ideas, information and instructions quickly and effectively between people with different goals, skills, interests, motives and operational strategies. In this respect, Consoli (2006) discovered that different expectations of stakeholders, contractual arrangements, and various philosophical standpoints often generate friction between project partners. Communication, being a process by which meaning is assigned and conveyed in an attempt to create shared-understanding, has been adjudged to be a key factor in the success of any collaborative arrangement (Smyth, 2008). This implies the need for the establishment of a clearly defined line/structure of project communication devoid of bureaucratic bottlenecks and procedures between the public and private sector participants, just as the parties would agree to respond to all communication in a timely manner or face the consequence of penalty clauses.

The role of trust in partnerships or collaborative engagement cannot be over-emphasised. Trust might be necessary for market functioning, and between organisations in order to preserve and develop quality in a project in the face of unforeseen events (Smyth, 2008). Trust can be viewed from two epistemological perspectives. The neoclassical traditions believe that trust is an important element in all relationships (Dirks and Ferrin, 2002; Bijlsma, 2003). However, the interpretative traditions tend to see trust as foundational in forming, maintaining and managing project relationships (Baier, 1994; Smyth, 2008). Edkins and Smyth (2006) defined trust as a disposition and attitude concerning the willingness to rely upon the actions of or be vulnerable towards another party, under circumstances of contractual and social obligations, with the potential for collaboration. The willingness to be vulnerable makes trust to look forward to uncertain or unknown outcomes that are yet to take place (Good, 1988; Gustafsson, 2004). In other words, trust may be required where there are uncertainties, while the belief on the other partner may be a sound basis on which to expect good or positive outcomes. In this regard, collaboration appears to reduce uncertainties and its attendant risks (Lagerspetz, 1998). The presence of a trusted partner tends to reduce perceived risk, renders organisational and project relationship more conducive to further risk reduction, and creates organisational and project opportunities to improve service and content quality (Smyth *et al*, 2010). In spite of the positive effects of trust in organisational/team management, Chow *et al*, (2012) argued that its application in construction project management has not been forthcoming as expected.

Results of this study show that high quality road infrastructure can enhance the production of goods and services. This is hinged on the premises that other modes of transportation, modern industry and commercial activities depend largely on well-developed, effective and efficient road transportation system. This is strongly supported by Brushett (2005) who argued that poor road condition often translates into higher vehicle operating costs and lengthier travel times. Furthermore, the current global economic meltdown has led to negative economic growth, growing unemployment, rising inflation, crashing stock markets, and the collapse of key corporate financial institutions which constitute the pillars of the global economy. These have resulted in revenue shortfall on infrastructure provisioning and management (RICS, 2011).

In project management, interpersonal interactions often permeate organisational and professional cultures hence, human and social relationships cannot be overlooked during project initiation, planning, design and execution. Similarly, project performance appears to depend largely on the capacity of specialised individuals to work together within multi-disciplinary teams, which might even exceed the boundaries of a project (Lizarralde, 2010). In this respect, Larson (1997) argued that the traditional win-lose adversarial relationships between project-participants often degenerate into a costly, lose-lose-situation for all the parties involved in a construction project. Therefore, collaborating sectors should be willing to make short-term sacrifices in order to sustain a long-term relationship. This underscores the importance of management skills/competences emphasised by the respondents to the study as tools or requirements to conduct infrastructure projects.

Collaboration involves genuine intent by partners to cooperate in order to create group synergy in pursuing shared vision and collective goals (Pryke and Smyth, 2006). It is a relationship built upon mutual trust, commitment to common goals, mutual respect, and an understanding of each partners' expectations and values in order to maximise the effectiveness of each participant's resources. The ability to maintain integrity, transparency and act consistently with established procedures often results in trust that increases partners' willingness to cooperate, collaborate, and actively engage in group tasks or activities (Druskat and Wolff, 2001). Public private collaboration initiative demands a transparent process which is necessary for confidence building among the participants, particularly with regards to risk sharing. Collaboration may require a considerable up-front investment in resources and energy to forge a team identity between project participants from different sectors, and the establishment of mechanisms designed to sustain and expand partnerships over the course of a project (Larson, 1997). In this respect, it might be necessary for principal/key participants from the different organisations to interact and engage in a shower-thought team-building session facilitated by consultants prior to project implementation/operationalisation. The session may focus on such areas as: ingredients of collaboration, importance of effective communication, relationship management, teamwork, conflict management, strategies of negotiation, qualities of good and bad project management, dispute resolution, and potential problem areas in the proposed project. This is

consistent with what Smyth and Edkins (2007) referred to as proactive management of relationship in order to foster collaboration between sectors. The merits of collaboration include improved efficiency, cost effectiveness, increased opportunity for innovations, and continuous improvement of quality products and services (Li *et al*, 2000).

The vision of the Federal Republic of Nigeria to become one of the largest 20 economies in the World by the year 2020 (Federal Government of Nigeria, 2010) demands accelerated national development and adequate infrastructure services in order to support the full mobilisation of all economic sectors. Specifically, the survey respondents identified and stated 28 service elements which they desire /require in a collaborative road infrastructure project. These include free flowing and sustainable road asset equipped with functional modern accessories and elements. The requirements also include intelligent road transport service, effective road drainage, traffic lights, street lights, transit park and rest area, bus shelter, visible road signs and lane marks, pedestrian bridges, crash-worthy road median, trash bin, pavement, pedestrian walk-way, guard railings, clear and visible road environment. The availability of these the respondents claimed would considerably reduce the rate of accidents on Nigerian roads, ensure predictable and fast journey times, reduce vehicle maintenance cost, and improve productivity through productive use of man-hour. Given this, the respondents acknowledged the need for new relationships, collective understanding, shared responsibility, innovative capacity, new methods, accountability, value for money, and knowledge transfer between relevant public and private stakeholders. The respondents also expressed desire for regular road maintenance, electronic ticketing/tolling system, electronic traffic control and management, up to date traffic information, breakdown assistance, armed police security patrol, and environmentally sensitive road asset.

The success of Vision 2020:20 requires a positive and dynamic collaboration between the public and private sectors, since government alone cannot muster sufficient resources to meet the basic amenities of life. The private sector may offer developing economies the prospects for rapid economic growth if allowed to operate in competitive market conditions. In this regard, the respondents expressed fears about the barriers that may undermine collaborative infrastructure projects in Nigeria. These include lack of appropriate legal framework, economic and political instability, high perception of risks, low

traffic volumes, inadequate security of life and property, poor payment regime, constantly changing government policy, prevalence of poverty, weak institutional structures, poor tax systems/(over-taxation), corruption, and lack of data.

7.6. SURVEY RESULTS 2

The results of the second survey conducted in this study are presented as follows:

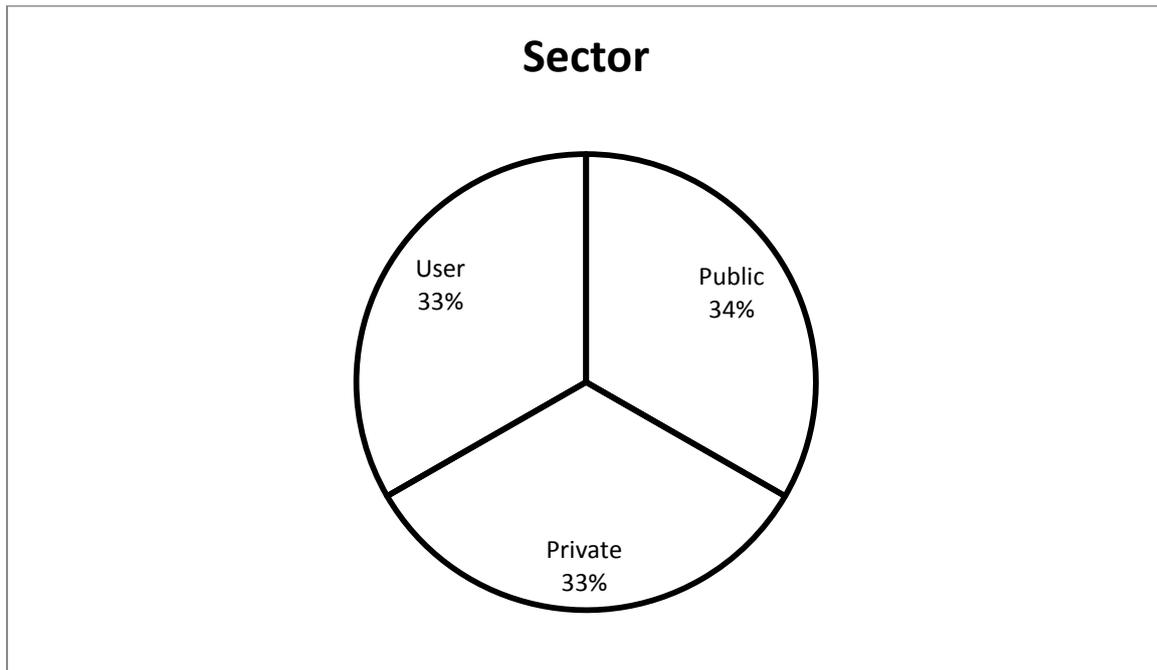


Figure 7.5: Sector of Respondent

Figure 7.5 above shows that the respondents include a balanced proportion of the public, private and user/ community stakeholders.

Table 7. 7: Respondents' work designation

Designation	Frequency	Percentage
Director	10	28
Civil Engineer (Highway)	7	20
Accountant	5	14
Legal Practitioner	5	14
Community Leader	3	8
Transport Operator	3	8
Business Administrator	3	8
Total	36	100

Results from Table 7.7 above show that the respondents cut across different fields of endeavour relevant to policy formulation, planning/design, construction/rehabilitation, operation and management of road facility.

Table 7.8: Academic qualification of respondents

Academic qualifications	Frequency	Percentage
MPhil/M.Sc/M.Tech/M.Eng/M.A/LLM/MBA/M.Ed	16	44
B.Sc/B.Tech/B.Eng./B.A/LLB/B.Ed	14	39
HND/HNC	3	8
ND/NCE	2	6
SSSCE/GCE/WASCE	1	3
Total	36	100

Results from Table 7.8 above indicate that 91% of the respondents have academic degrees and higher diploma in different fields, while the rest have basic diploma and certificates. This implies that most of the respondents have expert knowledge in management, legal, finance, project planning and design, and highway project construction and rehabilitation. They were selected because they are directly involved, have sufficient insight in highway projects and reflect a broad range of fields of expertise (see Table 7.7). This implies that balanced and reliable views/opinions are obtained from all relevant stakeholders of the facility under investigation.

7.6.1. Test of Hypothesis

The null and alternative hypotheses postulated for this investigation are:

H_0 : There is no significant difference between the perception of the public, private and user stakeholders on the drivers of collaboration using a 5% level of significance ($p \leq 0.05$) (see Section 6.12.5 in Chapter 6).

H_A : There is significant difference between the perception of the public, private and user stakeholders on the drivers of collaboration.

Table 7.9: Kruskal-Wallis test results for the drivers of collaboration

Drivers	Kruskal-Wallis P Value	Significance	Decision
Communication			
Project information must be made available to all stakeholders	0.761	NS	Accept H ₀
Alternative dispute resolution techniques enhance collaboration	0.468	NS	Accept H ₀
Concession agreement must be transparent, functional and enforceable	0.598	NS	Accept H ₀
Litigation encourages win-win position	0.723	NS	Accept H ₀
Stakeholders' consultation is paramount in a collaborative project	0.346	NS	Accept H ₀
Trust			
Trust is not a critical success factor in collaborative projects	0.717	NS	Accept H ₀
The alignment of words and actions determines a partner's reliability	0.761	NS	Accept H ₀
Trust is a hallmark of effective relationship	0.761	NS	Accept H ₀
Collaborating partners must act consistently with established procedures	0.346	NS	Accept H ₀
A transparent process is necessary for confidence building between project partners	0.598	NS	Accept H ₀
Globalisation			
Project stakeholders operate within a local network	0.346	NS	Accept H ₀
Activities in one part of the world have no consequences in distant parts of the globe	0.577	NS	Accept H ₀
Project stakeholders operate within a national network	0.595	NS	Accept H ₀
Road asset management requires no network	0.823	NS	Accept H ₀
Project stakeholders operate within an international network	0.482	NS	Accept H ₀
Market Maturity			
A market is a place where forces of demand and supply operate	0.842	NS	Accept H ₀
The money-market fund is appropriate for concession projects	0.648	NS	Accept H ₀
Countries are at different levels of market development	0.164	NS	Accept H ₀
The capital-market fund is suitable for road concession projects	0.626	NS	Accept H ₀
Local market capacity needs to be developed	0.164	NS	Accept H ₀
Technology			
Modern technology uses innovative materials	0.522	NS	Accept H ₀
Intelligent transport system does not improve mobility on road facility	0.527	NS	Accept H ₀
Modern technology applies innovative (new) methods	0.370	NS	Accept H ₀
Road infrastructure can be developed through indigenous technology	0.156	NS	Accept H ₀
Technology must be accessible	0.370	NS	Accept H ₀
Relationships			
Interpersonal interaction is a form of relationship	0.649	NS	Accept H ₀
Relationships need not to be managed	0.896	NS	Accept H ₀
The success of a collaborative project depends on the interaction between the organisations involved in the project	0.206	NS	Accept H ₀
Adversarial relationships are desirable in collaborative projects	0.874	NS	Accept H ₀
Project success requires team building spirit	0.346	NS	Accept H ₀
Finance			
Complex projects may require innovative financial strategies	0.042	S	Reject H ₀
Road projects do not require financial model	0.368	NS	Accept H ₀
User-charges (tools) are essential sources of generating revenues on highways	0.241	NS	Accept H ₀
A highway concessionaire needs no financial capacity to fulfil its contractual obligations	0.235	NS	Accept H ₀
The operation and maintenance of highways cost money	0.065	NS	Accept H ₀
Skills			
Technical know-how is essential in road construction	0.202	NS	Accept H ₀
Public agencies can manage road asset better than the private sector	0.385	NS	Accept H ₀
Entrepreneurial skills are essential in managing road infrastructure	0.118	NS	Accept H ₀
Road project resources include manpower, money, machines, materials and time	0.468	NS	Accept H ₀
Efficient management of resources is a key factor in project management	0.523	NS	Accept H ₀

Drivers	Kruskal-Wallis P Value	Significance	Decision
Legal and Regulatory Framework			
Institutional framework is required in road infrastructure management	0.557	NS	Accept H ₀
A comprehensive concession law is not required for collaborative road projects	0.456	NS	Accept H ₀
Extant financial model is fundamental in collaborative road infrastructure management	0.114	NS	Accept H ₀
Road infrastructure management needs no framework	0.896	NS	Accept H ₀
Regulatory framework aligns the interest of collaborating partners	0.880	NS	Accept H ₀
Risk			
Road infrastructure management has design risks	0.557	NS	Accept H ₀
Road facility is not prone to force majeure risk	0.827	NS	Accept H ₀
Road asset management has political risks	0.273	NS	Accept H ₀
Road facility management has construction risks	0.557	NS	Accept H ₀
Road infrastructure management has operation and maintenance risks	0.063	NS	Accept H ₀

Key: NS = Not Significant, S = Significant

Results from Table 7.9 above show that the Kruskal-Wallis probability values for most of all the variables tested for each driver exceeded the null hypothesis declaration that $p \leq 0.05$. Therefore, there is indeed sufficient and satisfactory information to accept the null hypothesis and declare categorically that there is no significant difference between the perception of the public, private and user/community stakeholders on communication, trust, globalisation, market maturity, technology, relationships, finance, skills, legal and regulatory framework, and risk as drivers of collaboration. These results are similar to the findings in Sections 2.8.1.1 – 2.8.1.10 in Chapter 2 and Table 2.4.

Table 7.10: Average Kruskal-Wallis p value results

Drivers	Total Wallis p value	Kruskal- Wallis	Average Kruskal-Wallis p value	Rank	Assigned Weight
Trust	3.183		0.636	1	10
Relationships	2.971		0.594	2	9
Legal and Regulatory Framework	2.903		0.580	3	8
Communication	2.896		0.579	4	7
Globalisation	2.823		0.564	5	6
Market Maturity	2.444		0.488	6	5
Risk	2.277		0.455	7	4
Technology	1.945		0.389	8	3
Skills	1.696		0.339	9	2
Finance	0.951		0.190	10	1

Furthermore, results from Table 7.10 above show that the average p value of all the variables under ‘trust’ is greater than the average p value of all the variables under any other driver. Therefore, the results identified ‘trust’ as the most important driver of collaboration. This is followed by ‘relationships’, ‘legal and regulatory framework’, and ‘communication’ as the second, third and fourth important drivers of collaboration respectively.

7.6.2. Descriptive Statistics

Table 7.11 Relative Importance Index (RII) results for the stakeholders' perception of the drivers of collaboration

Drivers	SA 4	A 3	D 2	SD 1	NO 0	RII	Rank
Communication							
Project information must be made available to all stakeholders	32	4	0	0	0	0.972	6
Alternative dispute resolution techniques enhance collaboration	17	19	0	0	0	0.868	11
Concession agreement must be transparent, functional and enforceable	34	2	0	0	0	0.986	1
Litigation encourages win-win position	0	1	17	18	0	0.381	47
Stakeholders' consultation is paramount in a collaborative project	33	3	0	0	0	0.979	3
Trust							
Trust is not a critical success factor in collaborative projects	0	0	21	15	0	0.395	43
The alignment of words and actions determines a partner's reliability	32	4	0	0	0	0.972	6
Trust is a hallmark of effective relationship	32	4	0	0	0	0.972	6
Collaborating partners must act consistently with established procedures	33	3	0	0	0	0.979	3
A transparent process is necessary for confidence building between project partners	34	2	0	0	0	0.986	1
Globalisation							
Project stakeholders operate within a local network	3	33	0	0	0	0.770	19
Activities in one part of the world have no consequences in distant parts of the globe	0	8	13	15	0	0.451	39
Project stakeholders operate within a national network	1	28	7	0	0	0.708	31
Road asset management requires no network	2	8	16	10	0	0.513	37
Project stakeholders operate within an international network	1	18	16	1	0	0.631	35
Market Maturity							
A market is a place where forces of demand and supply operate	7	29	0	0	0	0.798	17
The money-market fund is appropriate for concession projects	0	0	19	17	0	0.381	47
Countries are at different levels of market development	1	31	4	0	0	0.729	28
The capital-market fund is suitable for road concession projects	13	23	0	0	0	0.840	13
Local market capacity needs to be developed	3	29	4	0	0	0.743	23
Technology							
Modern technology uses innovative materials	1	30	5	0	0	0.722	29
Intelligent transport system does not improve mobility on road facility	7	4	15	10	0	0.555	36
Modern technology applies innovative (new) methods	1	25	8	2	0	0.812	15
Road infrastructure can be developed through indigenous technology	13	17	6	0	0	0.798	17
Technology must be accessible	0	25	10	1	0	0.666	33
Relationships							
Interpersonal interaction is a form of relationship	27	9	0	0	0	0.937	10
Relationships need not to be managed	0	0	20	16	0	0.388	46
The success of a collaborative project depends on the interaction between the organisations involved in the project	31	5	0	0	0	0.965	9
Adversarial relationships are desirable in collaborative projects	0	4	17	15	0	0.423	41
Project success requires team building spirit	33	3	0	0	0	0.979	3

Drivers	SA 4	A 3	D 2	SD 1	NO 0	RII	Rank
Finance							
Complex projects may require innovative financial strategies	3	33	0	0	0	0.770	19
Road projects do not require financial model	0	0	15	21	0	0.354	50
User-charges (tools) are essential sources of generating revenues on highways	0	20	16	0	0	0.638	34
A highway concessionaire needs no financial capacity to fulfil its contractual obligations	0	4	17	15	0	0.423	40
The operation and maintenance of highways cost money	1	29	6	0	0	0.715	30
Skills							
Technical know-how is essential in road construction	12	21	3	0	0	0.812	15
Public (Government agencies) can manage road asset better than the private sector	1	7	18	10	0	0.493	38
Entrepreneurial skills are essential in managing road infrastructure	2	30	4	0	0	0.736	25
Road project resources include manpower, money, machines, materials and time	17	19	0	0	0	0.868	12
Efficient management of resources is a key factor in project management	2	30	4	0	0	0.736	26
Legal and Regulatory Framework							
Institutional framework is required in road infrastructure management	4	31	1	0	0	0.770	19
A comprehensive concession law is not required for collaborative road projects	0	6	12	18	0	0.416	42
Extant financial model is fundamental in collaborative road infrastructure management	2	30	4	0	0	0.736	25
Road infrastructure management needs no framework	0	0	20	16	0	0.388	45
Regulatory framework aligns the interest of collaborating partners	11	25	0	0	0	0.826	14
Risk							
Road infrastructure management has design risks	4	31	1	0	0	0.770	19
Road facility is not prone to force majeure risk	0	1	19	16	0	0.395	43
Road asset management has political risks	1	33	2	0	0	0.743	24
Road facility management has construction risks	4	31	1	0	0	0.770	19
Road infrastructure management has operation and maintenance risks	1	25	10	0	0	0.687	32

Results from Table 7.11 above indicate that the public, private and user stakeholders strongly believe that project partners must develop and exhibit team building spirits ('esprit de corps') and liaise with relevant authorities in order to secure necessary approvals and support for the success of a project. Additionally, most of the variables under 'trust' rank higher than the variables under other drivers. This supports the results from Table 7.10 that 'trust' is the most important driver for collaboration (refer to Section 2.8.1.7 in Chapter 2).

Results from Tables 7.10 and 7.11 above clearly demonstrate a consensus of opinion by the public, private and user/community stakeholders about 'Trust' as the most important driver in collaborative road infrastructure management. This is closely followed by 'Relationships', 'Legal and Regulatory Framework', and 'Communication' in order of importance. The respondents unanimously agreed that

stakeholders' consultation is paramount in a collaborative project in order to secure necessary support and cooperation for successful implementation. They also strongly agreed that the concession agreement for a road construction must be transparent, functional and enforceable in order to build confidence and protect the interest of project partners. The need for project information to be made available to all project stakeholders at the appropriate time was also emphasised. Similarly, all the respondents expressed and upheld the view that project partners must match their words with actions, and act consistently with established procedures. The respondents emphasised the fact that a transparent process is essential for confidence building between partners. Furthermore, all the respondents affirmed that interpersonal, inter-organisational and team building spirit enhance the success of collaborative projects. The expressed opinions of the public, private and user stakeholders further confirm that 'Trust' is a very important/significant/fundamental/foundational ingredient for successful delivery of collaborative construction projects (refer to Figure 2.1). This result resonates with the findings of Mayer *et al* (1995), Hosmer (1995), Kramer and Tyler (1996), Rousseau *et al*, (1998), and Laan *et al*, (2011).

7.6.3. Quality Function Deployment Analysis

In general, the left hand side of the QFD chart/matrix contains the list of 'What' variables while the top contains the 'How' variables. In this study, the 'pivotal drivers of collaboration' constitute the 'what' while the 'voice of the customer' constitutes the 'How' (see Appendix 3a). The 'pivotal drivers' were identified through critical evaluation of seminal literature and empirical survey (see Sections 2.8.1.1- 2.8.1.10 in Chapter 2; Adetola *et al*, 2011a; 2013a), while the 'voice of the customer' were the expressed requirements/needs of the study participants (see Section 7.5).

The respondents to the survey are the customers in the QFD analysis. They include those who drive saloon cars, sports utility vehicles, minibuses and pick-up, commercial danfo minibuses, light trucks and two axle buses, heavy trucks and buses with two or more heavy axles. The 'How' elements are matched by or measured against the 'What' elements. Thus, each element of 'What' is compared with each element of 'How' in order to determine the strength of relationships or the degree of correlation between the 'Whats' and 'Hows'. Strong relationships are represented with a value of 9 in the

appropriate cell, moderate relationships are given a value of 3, while weak relationships are denoted with a value of 1. No relationship is given a value of 0 or the cell is left blank (see Appendix 3a). The logarithmic 9-3-1-0 weighting was created by the Japanese and has been adopted by most QFD users. The correlations may also be represented with symbols. Sometimes, both symbols and numbers are used in a chart (Bahill and Chapman 1993; Chan and Wu 2002). The relative importance or weight of the pivotal drivers of collaboration was determined through the Kruskal-Wallis analysis (see Table 7.10). The assigned weight ranges between 1 and 10, with 10 being the most important.

$$\text{QFD Formula: } \left[(W_j) = \sum_{i=0}^{i=9} d(i) * r(ij) \right]$$

Where (W_j) = score, $d(i)$ = degree of importance of pivotal driver, r = relationship between the pivotal driver (i) and VOC (j)

The total score for each column of the ‘voice of the customer’ in Appendix 3b indicates the importance of that characteristic in measuring the customer’s satisfaction. Naturally, measures with low scores receive little consideration. Though, this does not necessarily mean that such measures will not be used in the product design, they may still be required for contractual or other reasons. Therefore, in order to satisfy the customer, strict attention is focused on measures with the highest scores. This attention to the customer is the main purpose of the QFD chart (Bahill and Chapman 1993; Chan and Wu 2002).

For reasons of anonymity, the letters G, P and U are used to represent Government/public sector stakeholder, private sector stakeholder and user/community stakeholder respondents respectively (see Tables 7.12 and 7.13).

Table 7.12: Relative Importance Index (RII) results for the Voice of the Customer

Variables	Strong Relationship: 9			Moderate Relationship: 3			Weak Relationship: 1			No Relationship: 0			Relative Importance Index			Rank		
	G	P	U	G	P	U	G	P	U	G	P	U	G	P	U	G	P	U
Voice of the Customer																		
Sustainable road asset	3	0	2	7	7	5	1	3	2	1	2	3	0.453	0.222	0.324	6	13	12
Effective road drainage	0	0	0	4	4	4	2	2	3	6	6	5	0.129	0.129	0.138	28	26	23
Functional traffic lights	0	0	0	5	4	5	1	3	3	6	5	4	0.148	0.138	0.166	23	21	20
Free flowing traffic	0	4	0	6	3	7	5	2	3	1	3	2	0.212	0.435	0.222	15	4	16
Shared responsibility	4	5	5	5	3	4	2	2	1	1	2	2	0.490	0.518	0.537	5	3	2
Innovative capacity	4	3	2	6	4	6	1	3	2	1	2	2	0.509	0.388	0.351	3	5	7
Knowledge transfer	3	0	0	4	3	7	4	6	1	1	3	4	0.398	0.138	0.203	10	21	17
Collective understanding	7	5	4	4	4	4	1	1	2	0	2	2	0.703	0.537	0.462	2	2	3
New methods	3	0	2	6	8	6	3	2	2	0	2	2	0.444	0.240	0.351	7	11	7
Relationships	8	5	6	4	4	3	0	2	2	0	1	1	0.777	0.546	0.601	1	1	1
Transit park & rest area	0	0	2	6	3	6	5	7	2	1	2	2	0.212	0.148	0.351	15	20	7
Accountability	4	3	2	6	4	6	1	3	3	1	2	1	0.509	0.388	0.361	3	5	6
Productive use of man-hour	0	0	3	7	6	5	3	4	2	2	2	2	0.222	0.203	0.407	14	14	4
Value for money	0	2	2	8	5	6	3	3	2	1	2	2	0.250	0.333	0.351	12	8	7
Low vehicle maintenance cost	0	0	0	6	9	8	4	1	2	2	2	2	0.203	0.259	0.240	17	10	15
Reduced vehicular wear & tear	0	0	0	3	4	9	7	5	2	2	3	1	0.148	0.157	0.268	23	18	14
Safe & functional road elements	0	0	0	8	8	5	3	2	5	1	2	2	0.250	0.240	0.185	12	11	19
Regular maintenance	3	2	2	6	4	5	2	4	3	1	2	2	0.435	0.314	0.333	8	9	11
Electronic ticketing/tolling	0	0	0	4	4	6	6	6	4	2	2	2	0.166	0.166	0.203	19	16	17
Intelligent transport management	3	0	2	2	5	3	5	6	5	2	1	2	0.351	0.194	0.296	11	15	13
Electronic traffic control	0	0	0	4	3	3	6	6	6	2	3	3	0.166	0.138	0.138	19	21	23
Up to date traffic information	0	0	0	5	3	3	6	7	7	1	2	2	0.194	0.157	0.157	18	18	21
Breakdown assistance	0	0	0	4	3	2	5	6	7	3	3	3	0.157	0.138	0.120	22	21	27
Armed police security	0	0	0	3	2	2	7	8	8	2	2	2	0.148	0.129	0.129	23	26	26
Predictable/fast journey time	3	2	2	6	7	7	2	2	2	1	1	1	0.435	0.379	0.379	8	7	5
Reduced accident rate	0	0	0	4	4	4	6	6	6	2	2	2	0.166	0.166	0.166	19	16	20
Low fuel consumption	0	0	0	3	3	3	6	6	6	3	3	3	0.138	0.138	0.138	26	21	23
Low harmful carbon emission	0	0	0	3	2	2	6	7	6	3	3	4	0.138	0.120	0.111	26	28	28

Key: G = Government (Public) sector, P = Private sector, U = User/community sector

Results from Table 7.12 above clearly show a consensus of opinion by all the stakeholders about the need for collaboration in effective management of sustainable road infrastructure. This is demonstrated by the ranking of ‘relationships’ as the most important requirement of the public, private and user stakeholders with Relative Importance Index scores of 0.777, 0.546 and 0.601 respectively. This is strongly supported by the results of the QFD correlation between the ‘pivotal drivers’ and the ‘voice of the customer’ from Table 7.14. Additionally, the Kruskal-Wallis test results from Tables 7.9 and 7.10, and the Relative Importance Index results from Table 7.11 explicitly identified ‘Trust’ as the most important driver of collaboration. Given these, extant literature is replete with a number of transportation infrastructure projects that could not be delivered as a result of deteriorated/broken/adversarial relationships between the project participants (Tam and Leung 1997; Tam 1999; Siemiatycki 2010; Section 2.8.1.6 in Chapter 2; Adetola *et al*, 2011a). An adversarial stance in project management is often characterised with lack of trust, lack of team integration, limited information exchange, reluctance to negotiate, and poor project performance or outright failure (Munns 1995; McGeorge and Palmer 2000; Ling and Kumaraswamy 2005; Grimscheid and Brockmann 2010).

Table 7:13 Key Collaborative Service Elements

Table 7.13 identifies key collaborative elements from the service elements.

Service Elements	Key Collaborative issues' Frequency			Other issues' Frequency		
	G	P	U	G	P	U
Sustainable road asset	5	5	5			
Effective road drainage				5	5	5
Functional traffic lights				5	5	5
Free flowing traffic				5	5	5
Shared responsibility	5	5	5			
Innovative capacity	5	5	5			
Knowledge transfer	5	5	5			
Collective understanding	5	5	5			
New methods	5	5	5			
Relationships	5	5	5			
Transit park & rest area				5	5	5
Accountability	5	5	5			
Productive use of man-hour				5	5	5
Value for money	5	5	5			
Low vehicle maintenance cost				5	5	5
Reduced vehicular wear & tear				5	5	5
Safe & functional road elements	5	5	5			
Regular road maintenance	5	5	5			
Electronic ticketing/tolling system				5	5	5
Intelligent road transport management system	5	5	5			
Electronic traffic control & management				5	5	5
Up to date traffic information				5	5	5
Breakdown assistance				5	5	5
Armed police security				5	5	5
Predictable & fast journey times				5	5	5
Reduced accident rate				5	5	5
Low fuel consumption				5	5	5
Low harmful carbon emission				5	5	5

Key: G = Government, P = Private, U = User

From the service elements identified by the survey respondents (see Section 7.5 in Chapter 7), the case study interview participants (15) identified 12 elements that are critical to collaboration. These include sustainable road asset, Shared responsibility, Innovative capacity, Knowledge transfer,

Collective understanding, New methods, Relationships, Accountability, Value for money, Safe and functional road elements, Regular road maintenance, and Intelligent road transport management system (see Table 7:13; Sections 9.3.1 - 9.3.12 in Chapter 9).

Table 7.14: Quality Function Deployment Results

Voice of the customer	Government		Private		User			
	Mean Score	Rank	Mean Score	Rank	Mean Score	Rank	Average Mean	Overall Rank
Sustainable road asset.	100.16	3	82	7	123.33	6	101.83	6
Shared responsibility	96	4	99.33	3	160.66	2	118.66	3
Innovative capacity	92.16	5	88.58	6	134.08	5	104.94	5
Knowledge transfer	55.91	11	30.58	12	62.16	12	49.55	12
Collective understanding.	140.75	2	112.5	2	149.91	4	134.38	2
New methods	76.58	8	89.33	4	154.08	3	106.66	4
Relationships	207.33	1	197.91	1	234.08	1	213.10	1
Accountability	84.33	6	89.33	4	96.66	10	90.10	7
Value for money	54.58	12	67	9	78	11	66.52	10
Safe and functional elements.	58.58	10	47.66	10	106.91	7	71.05	9
Regular road maintenance.	81.66	7	68.58	8	106.91	7	85.71	8
Intelligent road management.	62.83	9	34.66	11	99.58	9	65.69	11

7.7. DISCUSSION

The Quality Deployment Function results of the correlation between the ‘pivotal drivers’ and the ‘voice of the customer’ from Table 7.14 above show a consensus of opinion of all the stakeholders about the need for collaboration in infrastructure management in Nigeria. From these results, ‘Relationships’ has the highest Mean score and rank from the public, private sectors and end-user. This is followed by ‘Collective Understanding’ ‘Shared Responsibility’, ‘New Methods’ and ‘Innovative Capacity’ in order of importance. This is corroborated with the ‘Relative Importance Index’ results for the ‘Voice of the Customer’ in Table 7.12. This implies that the end-users of road infrastructure in Nigeria are dissatisfied with the present condition of roads solely financed, constructed, operated, maintained and managed by the public sector/government agencies (see Section 4.7 in Chapter 4). This explains the unanimous desire for collaboration and new relationships between

the public and private sectors of the economy in order to urgently improve the state of road transport infrastructure in Nigeria. A good relationship would engender collective understanding of goals, issues, challenges and priorities relating to road asset provisioning. This would enable the collaborating sector partners to share resources, assets, risks, responsibilities and rewards in order to deliver sustainable and environmentally sensitive road facility that would meet/satisfy the needs, yearnings and aspirations of the general public road users. The advantages of this are many. For example, whilst sustainable road asset will provide ‘value for money’ for the users and operators, it would also secure ‘win-win’ positions for the public and private sector collaborating partners. Above all, it would help to improve the physical, socio-economic growth and development of Nigeria.

A confidence-building relationship will allay fears about the perception and allocation of project risks and engender accountability. Similarly, it would provide a conducive-atmosphere for innovative capacities such as financial engineering; innovative materials; access to new technologies; and facilitate effective transfer of knowledge, skills, abilities and competencies. This would in effect result in innovative road infrastructure management approaches that will considerably reduce the cost and time required to implement sustainable road facility project.

Talking about relationship, the classification of roads under different tiers of government has serious implications for road ownership, funding, rehabilitation and maintenance in Nigeria where different political parties govern different arms of government. Respondents to this study stated that the federal road networks in the States controlled by political parties other than the party in power at the national level suffer neglect from the federal system of government. Similarly, the States in which these federal roads are located do not want to repair, rehabilitate or maintain the networks when there is no assurance that the federal government would refund such expenses. In the same vein, the respondents reported that road infrastructure project initiation and prioritisation is more influenced by political considerations rather than economic importance.

A good relationship and shared responsibility would guarantee regular funding; routine, periodic and recurrent maintenance, and emergency repair that would translate into predictable / fast journey time;

low fuel consumption; productive use of man-hour and reduced rate of accidents on Nigerian roads. Users of well managed road assets will be willing to pay toll on available road that delivers value for money. A new relationship will turn around the conditions of road infrastructure in Nigeria to a free-flowing, happy and environmentally friendly safe road networks with functional elements such as good pavement, culvert, traffic light, street light, road marks, traffic signs, bus shelter, zebra crossing, pedestrian bridge, road median, trash bin, walk way, effective road drainage, transit park and rest area.

This study has uncovered new meaning and understanding in 'trust'. Hwang and Burgers (1997) perceived trust as the prospect that one partner attaches to cooperative behaviours by another partner. In this respect, Zaghoul and Hartman (2003) acknowledged three categories of trust. These include competence trust, integrity trust and intuitive trust. The duo explained that competence trust might be established when there are observable proofs of the ability and capacity to perform a given or required task and achieve results. Integrity trust on the other hand involves the willingness of one person to protect the interest of others, while intuitive trust is based upon an individual's prejudice, sentiments or other personal feelings. Given these, Wong *et al.* (2000) reported that trust serves as the glue that holds team members together and the lubricant that facilitates project completion. Therefore, trust might be a key component that needs to be earned in the interaction between two or more collaborating project partners. Thus, the willingness to extend trust and to signal trustworthiness at the earliest stage is critical to collaborative project success (Girmscheid and Brockmann 2010).

Mutual trust can lead to good relationships (Macoby 1997), enhance continued relationships (Selnes 1998), produce better (new) relationships (Ndubisi *et al.*, 2011), and can minimise adversarial relationships (Naoum 2003). Additionally, trust saves time (on budget and project delivery), yields increased work output, and makes a high workload manageable (Doloi 2009). Trust is synonymous with team building, reduced controls and easier conflict resolution (Girmscheid and Brockmann 2010).

A sense of unity between collaborating partners would enable them to appreciate each other's requirements and difficulties, and handle conflict in a manner that would improve relationships and

trust. In this regard, problem solving ability might be a key ingredient for building trust (Selnes 1998; Wong *et al*, 2005). A sense of unity may include demonstrating positive attitude during negotiations, avoiding blame or finger pointing culture at partners, and amicable resolution of problems. In this respect, Munns (1995) argued that every dynamic relationship requires the reciprocity of trust. A transparent, functional and enforceable concessional agreement (contract document) might establish a congenial environment to nurture trust and build confidence and comfort in the sector partners. In the same vein, the alignment of efforts and rewards and compatible goals and objectives may develop trust between collaborating project partners. Furthermore, the desire for a win-win resolution through the adoption of alternative dispute resolution techniques rather than litigation suggests harmonious and integrated project partners (Won *et al*, 2005).

According to Gill and Butler (1996), the success of collaborative construction projects often depend on the mutual interdependence of all the stakeholders or partners involved in the project management system. Mutual interdependence demands close interactions and confidence building relationships. The alignment of words and actions consistently determines a partner's reliability, predictability and good judgement in handling situations (Butler 1991). A partner would be trusted when his/her word, promise, verbal or written statement could be relied upon. In this regard, Chan *et al*, (2004) postulated that effective and honest communication may open the frontiers of relationship by its ability to relieve stress, enhance adaptability, smooth information exchange, encourage joint problem solving, and maintain transparency. Similarly, Wong and Cheung (2005) posited that the exchange and sharing of complete, unbiased and accurate information among project stakeholders would reduce project risk and uncertainty, and strengthen or reinforce mutual trust.

Given that road construction projects are resource (capital) intensive, the ability and financial capacity of a concessionaire to fulfil its contractual obligations and responsibilities is crucial to group or organisational level trust (Won *et al*, 2000). In this regard, Hill (1990) observed that reputable individuals and organisations do not exhibit opportunistic behaviours that attract only short-term gains. Hence, they always guard jealously and protect their reputation, knowing fully well that they operate in a network through which they are connected to others. This might be a deliberate attempt to

avoid alienation and eventual loss in business opportunities. Wong and Cheung (2005) observed that collaborating project partners' openness and integrity in communication is vital to building enduring trust. However, this feature may have no significant effect or contribution in a country where corruption is endemic, widespread and constitutes an integral part of the business culture. It is a common practice for financial difficulties to easily trigger sharp malpractices, untrustworthy behaviours, and destroy trust.

In developed economies, transparent, equitable and enforceable concession agreements often boost the development of trust since the perceived gains of collaborating project partners are secured (Bonet *et al*, 2000). Whereas, in developing and politically unstable countries, concessionaires are confronted with the risk of termination of public projects as a result of changes in government and complex bureaucratic administrative system for approvals and permits (Ling and Hoang 2010). Furthermore, the reputation of project partners may be a dependent factor for trust in a society that is characterised with inadequate legal framework and ineffective legal system. Reputation being a product of a person's past behaviour has been acknowledged as a good predictor of an individual's future behaviour and ability to perform (Hogan *et al*, 1996). In this respect, Granovetter (1985) asserted that people may prefer to rely on the reputation of someone instead of some generalised morality or institutional arrangements to guard against legal risk or trouble.

7.8. SUMMARY

The drawbacks of the conventional/traditional forms of project procurement coupled with population growth, the desire to optimise efficiency, obtain value for money, and transfer risk to the partner best able to manage it prompted the need for innovative forms of infrastructure management. However, the problems and issues associated with the implementation and operation of collaborative engagement approaches worldwide over the last two decades informed the need to identify and analyse the drivers of collaboration. The study specifically focused on the dynamic socio-political relationship of infrastructure projects management between the public, private and end-user sectors in Nigeria.

Public private collaboration schemes are somewhat underutilised in Nigeria, even though the potential financing gaps are significant and enormous for private sector investment/involvement in the

country's highway facility operation/management. The study reveals that there is no significant difference between the perception of the public, private and end-user sectors' stakeholders in Nigeria about the drivers of collaboration. Results of the study also indicate that trust, relationships, communication, legal/regulatory framework, globalisation/collaboration, market maturity, technology, finance, skills/competences, and risk are key/core drivers that need to be aligned to existing business models for the successful implementation/delivery of sustainable collaborative infrastructure projects in Nigeria. A significant part of private sector analysis when considering PPC is the 'weight' of risk. In addition, the private sector also measures confidence in the government through policy certainty and policy coherence, transparent long-term planning, predictability and consistency in how policy is implemented. Thus, forging strong relationships between the public and private sectors, as well as demonstrating political commitment can help to reduce private sector perception of risk.

Public-private sector collaboration can offer the Nigerian government a huge relief from the biting effects of the current global financial crisis, as it gives the private sector a stake in the management of the Nigerian economy, especially in the area of infrastructure provisioning and management. In particular, it can help to deliver expensive, essential and technically complex projects by utilising private sector's financial, technological and managerial resources to leverage scarce public funds. Thus, infrastructure projects which are crucial for future economic growth and development will be delivered in a more cost-effective manner and with reduced risk. However, there is a growing concern that the absence of an adequate and enforceable institutional regulatory framework and government capacity to effectively monitor the collaborative process may limit the accruing benefits from the initiative.

This research focused attention on road transport infrastructure management within the Nigerian context. This chapter has teased out a myriad of issues which need to be carefully managed in order to secure sustainable and meaningful outcomes. Extant literature has identified a set of priorities of which trust, relationships and communication seem to be the three main issues that need further attention and further research. Research findings support similar studies in this area in order to develop 'win-win' positions and 'value for money'. The drivers of collaboration are advocated to be

somewhat synonymous. Findings indicate that there is a congruence of shared views from the public, private sectors and end-users about the main pivotal drivers and service element requirements.

The growing complexity of infrastructure projects, the attendant increase in project risk and uncertainty, coupled with the effects of the current global economic recession, and the unprecedented demand on government agencies/institutions to provide better and efficient infrastructure services, have gradually reduced the need for a single supplier of many infrastructure services. However, the problems and issues associated with the implementation and operation of collaborative engagement approaches worldwide over the last two decades prompted the need to identify and analyse the drivers of collaboration. The aim of this investigation is to determine the core drivers of public-private sector collaboration in road infrastructure project management in Nigeria. The study is a survey which utilises cross-sectional design. Survey questionnaires were administered to relevant professionals and stakeholders in the public, private sectors and end-user in Nigeria. The Mann-Whitney U test and Kruskal-Wallis test showed that there is no significant difference between the perception of the public, private and end-user sectors about the drivers of collaboration. The Relative Importance Index ranked the voice of the customer across sectors. Furthermore, the Quality Function Deployment results showed a consensus of opinions from the public, private sectors and end-user stakeholders about the most important customer requirements in collaborative road infrastructure management. Therefore, there is a need to develop an engagement framework that will capture the voice of the customer in order to guide the actions of the partners, shape and help to deliver sustainable collaborative infrastructure projects in Nigeria.

This chapter has captured, analysed, presented and discussed the findings of quantitative primary data for this study. Information from this phase is further explored through a case study (qualitative) approach in the next chapter.

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Appendices

APPENDIX 1A: SURVEY QUESTIONNAIRE 1

University of Central Lancashire
School of Built and Natural Environment
Preston
PR1 2HE
UK

Dear Respondent,

Infrastructure Development Questionnaire

This questionnaire covers ‘**Collaborative Engagement Opportunities for Road Infrastructure Management within Nigeria**’

I would appreciate if you could please spare about 10 minutes of your time to respond to these questions.

Your responses will be kept in confidence, and only used for the purposes of this study.

Thank you.

AlabaAdetola

E-mail address: aeadetola@uclan.ac.uk

1. Please identify your sector

- Public (Government) ()
Private Organisation ()

2. Please identify your main work remit

- Federal Ministry of Works ()
Civil Engineering Contractor ()
Civil Engineering Consultant ()
Project Promoter ()
Others (Please specify)

3. How long has your organisation been in operation?

- Less than 5 years ()
Between 6 – 10 years ()
Between 11 – 15 years ()
Between 16 – 20 years ()
Over 21 years ()

4. Your work designation

- Director ()
Project Manager ()
Procurement Manager ()

- Engineer ()
 Technical Officer ()
 Others (Please specify)

5. Your highest academic qualification

- PhD/DSc ()
 MPhil/ M.Sc/M.Tech ()
 B.Sc/B.Tech/ B.A ()
 HND ()

Others (Please specify)

6. Professional qualifications held

- MNSE, COREN ()
 MPMI, PMP, APM ()
 MNIQS, QSRB, RICS ()
 MNIOB, CORBON, MCIOB ()
 MNITP, RTP ()

Others (Please specify)

7. How long have you been in the sector?

- Between 1-5 years ()
 Between 6- 10 years ()
 Between 11-15 years ()
 Between 16-20 years ()
 Over 21 years ()

8 In your view/ opinion, please rank as appropriate:

Market Maturity	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
All-weather, safe and reliable road network can reduce the amount of carbon emissions on the environment					
High quality road infrastructure can stimulate economic growth					
High quality road infrastructure can promote social equity					
The goal of the public sector is to provide social welfare services to its citizens					
Privately procured facilities can lead to inequalities in the distribution of infrastructure services					

Inadequate domestic capital-markets is a barrier to the success of collaborative projects					
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9. In your own view/ opinion, please rank as appropriate

Technology	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
There is no technology involved in road infrastructure development.					
Road infrastructure can enhance the production of goods and services					
Modern industry and commercial activities rest on well-developed, effective and efficient road transportation systems					

10. In your own view/ opinion, please rank as appropriate

Skills / Competence	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Road infrastructure projects should not be monitored					
Management has to do with organising resources in order to accomplish desired goals and objectives					
Effective management of resources always satisfies clients' requirements					
Management skills are not required in road infrastructure development					
Skills should be distributed equally between the public and private sector					
Government can manage road infrastructure better than the private sector					
Government can muster sufficient resources to meet road					

infrastructure service requirements					
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11. In your own view / opinion, please rank as appropriate

Finance	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Development of highway infrastructure projects always has a long gestation period					
Capital market funds are short-term in nature					
Road infrastructure projects are not capital-intensive					
A sound financial plan is not important to the success of road infrastructure projects					
The private sector aims to maximise profit on all investments					
In collaborative projects, rewards should be distributed equally between the public and private sector					
The Government provides adequate financial support for current road infrastructure needs					
Budgetary allocation should be aligned to physical infrastructure needs					
Government revenue should be supported by private sector investment in road infrastructure development					

12. In your own view / opinion, please rank as appropriate

Globalisation / Collaboration	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Collaborative effort can successfully deliver road infrastructure projects					

Public -Private Collaboration in road infrastructure management can accelerate socio-economic growth					
Public-Private Collaboration can guarantee 'value for money' benefits to all road users					
Public-Private Collaboration can reduce the failure (risk) of road infrastructure projects					
Public-Private Collaboration can encourage optimal and efficient use of resources					
Public-Private Collaboration can help to secure a sustainable, self-funding road infrastructure					

13. In your own view / opinion, please rank as appropriate

Relationships	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Relationships should not be managed.					
In collaborative arrangement, stakeholders in road infrastructure projects have no different opinions					
Harmonious relationship / interaction between project participants is paramount for effective project management					
Parties in collaboration should instil confidence and trust in one another					
Intra-organisational conflict does not adversely affect construction project performance					
Both public and private parties should be willing to compromise					
Both parties should have a collective understanding of project					

goals and risk					
Effective working relationship is vital for collaborative infrastructure management					
Mutual respect can help foster good relationships					

14. In your own view / opinion, please rank as appropriate

Communication	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
All communication in collaborative projects should be open and transparent					
Conflicts between project team should always be resolved.					
Project documents should always disclose information to all vested parties					
Parties in collaboration should agree to respond to all communication in a timely manner (or face the consequence of penalty clauses).					

15. In your own view / opinion, please rank as appropriate

Legal and Regulatory Framework	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Contracts should not be enforced					
Poor road maintenance policies have no effect on the state of road infrastructure					
Weak institutional arrangements for managing and financing road					

projects always results in poor road networks					
A functional legal and regulatory framework could align the interests of partners and provide confidence to both the public and private sectors					
Unstable foreign investment policies have no effect on collaborative arrangements.					
Enforceable legal and regulatory collaboration frameworks can attract private sector participation in road infrastructure management					
Measures for promoting effective road development and maintenance are not always necessary					

16. In your own view / opinion, please rank as appropriate

Trust	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Trust is a hallmark of effective relationships					
Increased levels of trust result in more positive attitudes					
Increased levels of trust generate higher levels of cooperation					
Increased levels of trust generate superior levels of performance					
High levels of trust often enable relationships to be built up faster and better					
Increased levels of trust can reduce					

the occurrence of litigation					
Trust can facilitate group efficiency by allowing parties to focus resources toward a common goal					

17. In your own view / opinion, please rank as appropriate

Risk	Strongly Agree	Agree	Disagree	Strongly Disagree	No Opinion
Road infrastructure project costs and needs should be assessed only in the short term					
Road infrastructure projects do not attract risk					
Risk should be distributed equally between the public and private sectors					
Risk is often higher on infrastructure projects before the contract is commenced.					
Partnerships do not attract risk.					
There is no need to negotiate partnership terms of reference					

18. Please, identify the main barriers or risks that may be encountered when setting up collaborative infrastructure projects in Nigeria.

19. Please, kindly identify and state the service and availability elements that you require in a collaborative road infrastructure project.

Thank you

APPENDIX 1B: SURVEY QUESTIONNAIRE 2

In your own view, please, kindly rank the following variables as appropriate using the following scale: SA = Strongly Agree, A = Agree, D = Disagree, SD = Strongly Disagree, NO = No Opinion.

Pivotal drivers of collaboration	SA 4	A 3	D 2	SD 1	NO 0
Communication					
Project information must be made available to all project stakeholders					
Alternative dispute resolution techniques enhance collaboration					
Concession agreement must be transparent, functional and enforceable					
Litigation encourages win-win position					
Stakeholders' consultation is paramount in a collaborative project					
Trust					
Trust is not a critical success factor in collaborative projects					
The alignment of words and actions determines a partner's reliability					
Trust is a hallmark of effective relationship					
Collaborating partners must act consistently with established procedures					
A transparent process is necessary for confidence building between partners					
Globalisation/ Collaboration					
Project stakeholders operate in a network					
Activities in one part of the world have no consequences in the distant parts of the globe					
Project stakeholders operate within a national network					
Road asset management requires no network					
Project stakeholders operate within an international network					
Market Maturity					
A market is a place where forces of demand and supply operate					
The money-market fund is appropriate for concession projects					
Countries are at different levels of market development					
The capital-market fund is suitable for road concession projects					
Local market capacity needs to be developed					
Technology					
Modern technology uses innovative materials					
Intelligent transport system does not improve mobility on road facility					
Modern technology applies innovative (new) methods					
Road infrastructure can be developed through indigenous technology					
Technology must be accessible					
Relationships					
Interpersonal interaction is a form of relationship					
Relationships need not to be managed					
The success of a project depends on the interaction between the organisations involved in the project					
Adversarial relationships are desirable in collaborative projects					
Project success requires team building spirit					
Finance					
Complex projects may require innovative financial strategies					
Road projects do not require financial model					
User-charges (tolls) are essential sources of generating revenues on highways					
A highway concessionaire needs no financial capacity to fulfil its contractual obligations					
The operation and maintenance of highways cost money					
Skills					
Technical know-how is essential in road construction					
Public (Government agencies) can manage road asset better than the private					

sector					
Entrepreneurial skills are necessary in managing road infrastructure					
Road project resources include manpower, money, machines, materials and time					
Efficient management of resources is a key factor in project management					
Legal and Regulatory Framework					
Institutional framework is required in road infrastructure management					
A comprehensive concession law is not required for collaborative road projects					
Extant financial model is pivotal in collaborative road infrastructure management					
Road infrastructure management needs no framework					
Regulatory framework aligns the interest of collaborating partners					
Risk					
Road infrastructure management has design risk					
Road facility is not prone to force majeure risk					
Road infrastructure management has political risk					
Road infrastructure management has construction risk					
Road infrastructure management has operation and maintenance risk					

Please identify the main problems, challenges, barriers or risks that may be encountered when setting up collaborative infrastructure projects in Nigeria

What is your opinion about the classification of roads in Nigeria?

Please, kindly identify and state the service and availability elements that you require in a collaborative road infrastructure project.

Thank you

APPENDIX 2: CASE STUDY INTERVIEW SCHEDULE/GUIDE

Purpose of the Interview

The purpose of the interview is to probe significant core drivers of public private collaboration, explore issues, challenges and priorities of the public, private and user/community stakeholders in a case highway project.

Target respondents

Public sector stakeholders

Private sector stakeholders

User/community stakeholders

Date:

Respondents' details:

Name of respondent:

Position/Designation:

Sector:

Name of Organisation:

Professional Qualification:

Academic Qualification:

Years of experience:

Project details:

Name of Project:

Location:

Estimated cost:

Current stage:

Interview guide/Schedule

Number	Interview questions
1	Why do you think that the public and the private sectors should collaborate in order to manage road infrastructure?
2	What is your role and the role of your organisation in the Etiosa-Lekki-Epe expressway project?
3	Is this the first public-private collaborative highway project that you/your organisation would be involved in?
4	How is the project financed?
5	How are the project risks shared between the public and private sector partners?
6	What would you consider/ describe as the pivotal drivers of this project?
7	What are the issues and challenges of Etiosa-Lekki-Epe highway project?
8	What benefits can be derived from this road project?
9	What is/are your priorities concerning the project?
10	If you were to roll back this project, what would you want to do differently?

Thank you

APPENDIX 3B: CORRELATION MATRIX ANALYSIS

QFD Results

Voice of the Customer	Government			Private			User			Overall Mean
	Score	Mean	Rank	Score	Mean	Rank	Score	Mean	Rank	
Sustainable road asset	1202	100.16	3	984	82	7	1480	123.33	6	101.83
Effective road drainage	278	23.16	19	237	19.75	19	178	14.83	23	19.24
Functional traffic lights	431	35.91	15	272	22.66	18	196	16.33	21	24.96
Free flowing traffic	400	33.33	17	766	63.83	10	252	21	19	39.38
Shared responsibility	1152	96	4	1192	99.33	3	1928	160.66	2	118.66
Innovative capacity	1106	92.16	5	1063	88.58	6	1609	134.08	5	104.94
Knowledge transfer	671	55.91	12	367	30.58	15	746	62.16	12	49.55
Collective understanding	1689	140.75	2	1350	112.5	2	1799	149.91	4	134.38
New methods	919	76.58	8	1072	89.33	4	1849	154.08	3	106.66
New relationships	2488	207.33	1	2375	197.91	1	2809	234.08	1	213.10
Transit park & rest area	371	30.91	18	220	18.33	20	455	37.91	15	29.05
Accountability	1012	84.33	6	1072	89.33	4	1160	96.66	10	90.10
Productive use of man-hour	433	36.08	14	320	26.66	16	557	46.41	14	36.38
Value for money	655	54.58	13	804	67	9	936	78	11	66.52
Low vehicle maintenance cost	230	19.16	21	280	23.33	17	260	21.66	18	21.38
Reduced vehicular wear	170	14.16	24	179	14.91	23	290	24.16	17	17.74
Safe & functional elements	703	58.58	11	572	47.66	11	1283	106.91	7	71.05
Regular road maintenance	980	81.66	7	823	68.58	8	1283	106.91	7	85.71
Electronic ticketing/tolling	170	14.16	24	190	15.83	21	220	18.33	20	16.10
Intelligent road management	754	62.83	9	416	34.66	13	1195	99.58	9	65.69
Electronic traffic control	198	16.5	22	150	12.5	24	150	12.5	24	13.83
Up to date traffic information	415	34.58	16	413	34.41	14	439	36.58	16	35.19
Breakdown assistance	178	14.83	23	150	12.5	24	130	10.83	27	12.72
Armed police patrol	160	13.33	26	140	11.66	27	140	11.66	26	12.21
Predictable fast journey time	739	61.58	10	569	47.41	12	575	47.91	13	52.3
Reduced accident rate	232	19.33	20	180	15	22	180	15	22	16.44
Low fuel consumption	150	12.5	27	150	12.5	24	150	12.5	24	12.5
Low carbon emission	150	12.5	27	130	12.5	28	120	12.5	28	12.5

$$\text{QFD Formula: } \left[(W_j) = \sum_{i=0}^{i=9} d(i) * r(ij) \right]$$

Where (W_j) = score, $d(i)$ = degree of importance of pivotal driver, r = relationship between the pivotal driver (i) and VOC (j)

APPENDIX 4: QUESTIONNAIRE FOR VALIDATING CEFRIM

Name of respondent (optional):

Sector:

Public (Government)

Private

End-user/Community

Designation:

Organisation:

In your own views, please kindly rank the following variables as appropriate

S/No	CEFRIM variables	Very High	High	Low	Very Low	Not Applicable
1	What is your opinion about the component (main parts) of CEFRIM?					
2	What is your view about the logic flow/sequence/arrangement of CEFRIM?					
3	Does the scope of CEFRIM cover central issues relevant to the public, private and end-user stakeholders?					
4	Would the CEFRIM facilitate dynamic relationships/partnership/collaboration between sectors?					
5	Is the CEFRIM easy to understand?					
6	Would you accept, implement and recommend CEFRIM for your organisation?					

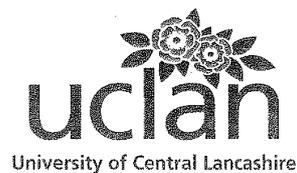
Do you have further comments/ suggestions regarding any area that needs to be improved/ included/ deleted within the proposed framework?

Thank you

APPENDIX 5: INTRODUCTION LETTER

5 July 2012

Chief Opuiyo Oforiokuma
Managing Director
Lekki Concession Company Limited,
Lagos, Nigeria



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Formal Letter of Introduction: Alaba Adetola

I would like to introduce to you Mr Alaba Adetola. Alaba is a leading researcher within the Centre for Sustainable Development at the University of Central Lancashire, United Kingdom. He is currently investigating collaborative engagement frameworks for road infrastructure management in Nigeria.

I would appreciate it if you could assist Alaba with his case study research – leading to the development of a collaborative engagement framework. This work is likely to be directly beneficial to you and your organisation.

Should you require any further information, please do not hesitate to contact me.

Yours sincerely,

Prof. Jack Goulding
Director of Centre for Sustainable Development
University of Central Lancashire
United Kingdom
Tel: +44 (0)1772 894213



englandsnorthwest
BE INSPIRED

APPENDIX 6: ANNOTATED IMAGES OF ‘TRUNK A’ ROADS IN NIGERIA



Plate 1: Collapsed portion of Lagos – Ikorodu road



Plate 2: Collapsed portion of Ijebu Ode- Itoikin road



Plate 3: Collapsed portion of Lagos –Ibadan expressway



Plate 4: Collapsed portion of Ikorodu – Shagamu road



Plate 5: Collapsed portion of Benin - Ore - Shagamu expressway



Plate 6: Onitsha - Awka - 9th Mile road



Plate 7: Flooded Ikorodu - Shagamu road



Plate 8: Flooded Herbert Macaulay road



Plate 9: Collapsed portion of Ikorodu - Itoikin - Ijebu Ode road



Plate 10: Collapsed portion of 9th Mile - Nsukka road



Plate 11: Flooded Lagos – Ikorodu road due to blocked drainage system



Plate 12: Flooded Herbert Macaulay Abuja road due to blocked drainage system



Plate 13: Erosion of road shoulder along Lagos - Ibadan expressway



Plate 14: Flooded Lagos – Abeokuta expressway due to blocked drainage system



Plate 15: User/ Community stakeholders protesting against tolls collection on case road/ highway



Plate 16: Deep crater at the centre of Benin Asaba road



Plate 17: Indiscriminate parking of heavy duty vehicles along Mosimi Shagamu road



Plate 18: Collapsed portion of Ojuelegba – Funsho Williams road

APPENDIX 7: SELECTED PUBLICATIONS OF THE AUTHOR

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