DEVELOPMENT OF CONCEPTUAL MODELS FOR PLANTS AND EQUIPMENT PROCUREMENT IN TERTIARY INSTITUTIONS IN KADUNA STATE

BY

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DECLARATION

I hereby declare that the work in this thesis titled **"Development of Conceptual Procurement models for Plants and Equipment in Tertiary Institutions in Kaduna State"** was performed by me in the Department of Mechanical Engineering under the supervision of Prof. Mohammad Dauda and Dr.F.O. Anafi

The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this work has been presented for another degree or diploma at any institution.

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CERTIFICATION

This is to certify that **BASHIR, GARBA IBRAHIM** with registration number P14EGME9009 carried out this research work titled: Development of Conceptual Procurement Models for Plants and Equipment in Tertiary Institutions in Kaduna State and that this research work has not been previously submitted for the award of any degree in this or any other university.

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DEDICATION

I dedicate this project to God Almighty my creator, my strong pillar, my source of guidance, wisdom, knowledge and understanding. I also dedicate this work to my wife ; Fatima who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started. To my children Jamil and Nabila who have been affected in every way possible by this quest,thank you. My love for you all can never be quantified. God bless.

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ABSTRACT

This research sole aim is to improve on the development of conceptual procurement models that can create direct and indirect impacts of various forms of plant and equipment procurement in Kaduna state Tertiary Institutions in relation to, need assessment, delay in completion, costs and non-conformance with specification by suppliers and installation related issues, likewise the involvement of professionals in procurement activities. The model builds on existing classifications of procurement need assessment, costs benefits and is illustrated by means of diagrams and symbols. Questionnaires, interviews, stakeholder's information and procurements records were used to generate data to acertain the present practice so as to identify strengths and weaknesses of the institutions. Results were analysed using various statistical tools to establish relationships. The development of the models led to the conclusion that assessment of the direct impact can be measured using the models in plant and equipment procurements. A form of engineer procure installs (EPeI) that was developed through many other models using this survey among other conceptual models generated out of the research, can minimise risk associated with procurement supply chain and delays. In addition, e-installation may offer possibilities for structural changes in existing procurement routines and give professionals opportunity to participate in this regard, which may in turn save cost of transportation of trainee and give direct relationship with the manufacturer and assist in technology transfer.

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DEFINITION OF TERMS

Procurement is a process of acquiring goods and services

Driver means those who aid in the successful implementation of the activities of procurement in organizations

Facilitator means those who assist in guiding or given knowledge of implementation of procurements

Barrier means anything that is hindering the implementation of procurements activities

B2B means Business to Business

B2C means Business to Consumers

BPR means Business Process Re-engineering

CCM means Conceptual Change Model

EC means European Commission

EU means European Union

EPC means Engineer Procure Construct

UNDP means United Nation Development Partnership

OEM means Original Equipment Mnaufacturer

SOR means Specification of Requirement

SON means Statement of Need

VFM means Value For Money

VA means Value Analysis

PCA means Principal Components Analysis

RFP means Request For Proposal

RFQ means Request For Quotation

SCM means Supply Chain Mnagement

UNODC means United Nation Office on Drugs and Crime

NFIU Nigerian Financial Intelligence Unit

NESG means Nigerian Economic Summit Group

NUC means Nigerian University Commision

UCEPG means University of Cambridge Equipment Purchase Guide

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Engineering construction projects play an important role in national economic development. Yet the construction industry as a whole faces formidable challenges and suffers from poor performance and low profit margin. Project schedule slips, budget overruns, compromised quality, resulting claims and counter-claims problems have plagued the industry. The reasons for poor project performances abound. Previous researches have dealt much with the problems of project risk and uncertainty, variations in project outcomes, work fragmentation, complex relationships among stakeholders and activities, and excessive phase overlaps in general. Some selected Nigerian Universities were allocated 1.3 trillion annually for Needs Assessment Funds on a three phase disbursement from 2013 to 2018 result of ASUU strike according to NUC but yet equipment procurement is still a major constraint to Tertiary Institutions.

The difficulties associated with procurement of plants and equipment have been identified as one of the most influential problems facing Nigerian Universities (Aniekwu, 2006). Knowledge of engineering fundamental helps to check critical choice of equipment and its financial implication with merits of different approach in selection, best cost effective and alternative to achieve the best approach in eliminating financial waste and enable right-in time job delivery (lekan 2015). According to Onyema2011,procurement is a big challenge being encountered due to the late passage of annual budget by the federal Government and parastatals in Nigeria. Experience has shown that most countries budgets are passed about the first quarter of the Appropriation year or more. Even when passed, it takes quite a long

period of time before financial releases are made to them. The implication is that the Ministries,Departments and Agencies (MDA) of government are usually put under due pressures to start and conclude their yearly procurements within a short period so as to avoid their monies being mopped up. The frosty working relationship between the Ministries and the parastatals under them has been variously reported as a challenge in guaranteeing good public procurement processes. Most of Ministries still insist in micromanaging of the parastatals and even starving those with essential information that was enable them independently conduct their procurement activities. In many instances, the Ministries still insist of approving payments for contracts in the parastatals under them contrary to the relevant circular from the Office of the Secretary to the Government of the Federation (SGF). In spite of the observed shortcomings of the public procurement practice in Nigeria so far, it was believed that based on the newness of the procurement, the existing level of corruption in the country and the general Nigerians' mindset towards getting rich quick syndrome, that the practice need to be applauded, although urgent actions need to be followed to guarantee the public procurement best practices. What remains is to chart away forward towards ensuring the prospects of the practice. In view of this, a strong political and Government supports and professional involvement are needed as this was ensure a holistic economic transformation of the county. It is very heartwarming that critical National and International Institutions are now paying good attention to Nigeria procurement practice. The efforts of the World Bank, United Nations Development Programme (UNDP), United Nations Office on Drugs and Crime (UNODC), Nigeria Financial Intelligence Unit and Nigeria Economic Summit Group (NESG), among others, are commendable in sustaining procurement practice in Nigeria. In its recent Policy Dialogue, the NESG mobilized local and international experts to brainstorm on corruption in Public Sector business or public procurement, its challenges and impact on national development. While commending their efforts, it is expected that they, together with

other relevant Organizations, should partner with Civil Society Organizations and Professional Bodies to make their work people oriented by embarking on mass enlightenment programmes at the rural areas. What remains is Tertiary Institutions to join hands in developing and championing strategies that was sustain procurement, especially, combating public procurement corruption, which has been identified as its greatest challenge. To eliminate corruption in the procurement of plants and equipment and enhance delivery on the right time and place more strategies beyond, procurement act needs to be employed as a method of risk elimination and control.

According to Yeo and Ning (2002), a better management of time uncertainty in major equipment procurement in engineering construction projects can significantly contribute to project performance. A survey study shows that time buffer is a popularly used approach to protect project schedule from activity duration variation and uncertainty,there introduce various models of enhancing procurement performance. The problem is that there are repetitive time allowances inserted in the procurement supply chain process and these time buffers are used ineffectively, thus leading to considerable time wastage. In order to eliminate the time waste in the major equipment procurement process caused by the ineffective use of time buffers, it is proposed that the concept and method of critical chain project management be integrated with the supply chain management and brought to bear on the procurement of major equipment (Yeo and Ning, 2002).

Saunders (2006)research Onion diagram model has been based upon excludes the three philosophies of Ontology, Epistemology and Axiology. Understanding and choosing a philosophy is an important step in planning and carrying out research, so we have included these as three additional elements outside of the main onion.

Wiersman (1995) defined research as a process of systematic inquiry,investigation and analysis of data in order to increase knowledge,test hypothesis where necessary and to arrive at conclusion.The collection of data through inquiry and investigation,records of procurements and analysing of the gathered data in order to find a solution to a specific problem.

1.2 Statement of the Research Problem

Procurement activities in most cases are usually not inline with the special conditions of contract, therefore incomplete supply of equipment that should come with all the necessary accesories as stated in the condition of contract are always missing.Insufficient technical details during procurement planning and need assesment of procurement also contribute to the problems of procurements in our institution, likewise equipment contract administrators negotiating equipment maintenance/service agreements is not always fully described in the scope of the work to avoid any misunderstandings or unsatisfactory levels of service. Terms and conditions that sometimes are agreed upon do not include working hours, labour, excluded services (what the supplier is not obligated to do), warranty, excluding parts, response time, loaner equipment, and appropriate insurance coverage. Procurement of plants and equipments in Nigeria has experience alot of financial wastages,delay in completion and specification related issues due to incompetency of some of the contractors and contracting authorities, which encourage corruption and other procurement related delays and abandonment.The financial wastages and delay in completion and supply of unspecified equipment has necessitated this research to create models for risk avoidance and a better procurement system in our tertiary institutions.

1.3 Present Work

This research wasto investigate the present constraints inview of creating some conceptual models that can provide a total solution to the equipment procurement problems in our tertiary institutions in Kaduna state.

So many procurement projects are abandoned due to the complex nature of its process and insufficient technical details. This research was to investigate the present constraints in view of creating a conceptual model that can provide a total solution to the equipment procurement problems in our tertiary institutions in Kaduna state.

1.4 Aims and objectives

The aim of this research is to investigate the present procurement process in tertiary institutions in Kaduna state and to create various procurement solution models.

The specific objectives are:

i. To determine theeffect of procurement knowledge, skills and experience on the plant and equipment procurement (regression).

ii. To determine the plant and equipment procurement cost,level of completion and completion periods.

iii. To determine the relationship with regards to completion between drivers/facilitators for introducing plant and equipment procurement and the barrier to plant and equipment procurement models implementations (canonical correlation).

iv. To describe the various risks associated with procurement of plants and equipment in tertiary institutions, then determine variety of different strategies of enhancing risk-free plant and equipment procurement (descriptive).

v. To determine the strength of the relationship betweenstrategies and a series of other factors that can contribute to the sucessful implementation of conceptual plant and equipment procurement models using multiple regression.

1.5 Significance of the Study

There are various surveys that highlighted that major plant and equipment procurement represents a critical connecting function between engineering and plant and equipment, as procurement of equipments provide the anchors for the construction facilities. Material costs represent a major portion of the total construction costs in Nigerian Universities and in turn, a high percentage of procurement expenses go into equipment purchases. Equipment procurement requires expediting on the vendors, contractors and manufacturers' progress to ensure on-time delivery and regular communication and occasional re-negotiation by both parties. It is also generally agreed that successful procurement management can lead to improved performance in overall project cost and delivery. The two propositions demonstrate only two relevant aspects of major plant and equipment procurement and associated uncertainty management. To investigate the current practice in tertiary institutions,addition of buffer in proportion to the equipment delivery lead-time that may in fact contribute time waste from a supply chain point of view involving a constellation of supplier and his supply. The non-availability of proper need assessment, brand name and other specification related issues by the procuring entity also contribute to the time wastages, abandonments of projects and supply of plant and equipment that can be rejected by end users which affects the procurement supply chain process. Procurement process is used inefficiently due to task

fragmentation and problems in interfaces or boundaries along the supply chain. Current uncertainty management practices pay too much attention to prevent the negative impact of uncertainty, but give too little attention to exploit the positive aspect of uncertainty as opportunity. The theory of aggregation (Goldratt, 1997) of pluses and minuses of time variation may allow considerably shorter overall procurement lead-time.This research will assist the tertiary institutions in conducting an efficient plant and equipment procurement for value for money through stakeholder participation in procurement activities and conceptual model that could bea guide to achieving an effective and efficient system.

With a view to improve productivity in engineering procurement projects, there is limited previous research efforts being devoted to developing new models, approaches and techniques. This research focused on improvements in major equipment process. The procurement performance and delivery processes can be defined both at the corporate and project levels. These processes can be partly represented as corporate systems, policies and procedures which are influenced by the prevailing, functional operational activities.

1.6 Scope and Limitation

The scope of this research focused on evaluating the procurement processes and identifying their shortcomings and development of conceptual models for procuring plant and equipments that can find a solution or way forward to the plant and equipments procurement shortcomings in tertiary institutions in Kaduna state.Data was obtained from stakeholders, end-users, consultants, contractors and manufacturers, where necessary, other client bodies withintertiary institutions in Kaduna, Nigeria.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The general overview of procurement and its relative term with definitions, parties to procurements, procurement objectives, needs assessment criteria with plant and equipment procurement procedures are explained in this chapter.

2.2 Supply Chain Management

Supply Chain management: This is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective & efficient ways possible. Supply chain activities cover everything from product development, sourcing, production, and logistics, as well as the information systems needed to co-ordinate these activities (Robert Handfield).

2.3 Procurement

Procurement:In accordance to UNDP, 2012 this is a process of acquiring goods,works and services.The process spans the whole cycle from identification of needs,choosing adequate procurement methods,sourcing suppliers and evaluation of their offers up to the award of contract.

Procurementis the process of buying goods, works or services. Procurement comprises the process of buying the basic infrastructure and services. This may, for example, involve the acquisition of operation and management services for a basic service such as water supply.

Procurement is often carried out by the process of tendering, rather than buying products directly from a seller (UNDP, 2015).

A company or organisation (the promoter, client or employer) wishing to obtain goods or services will first specify its requirements. Subsequently, it will open the bidding in a process known as **tendering.** Interested companies can then submit their proposals to the client if they meet requirements. The government or management offering the tender will then evaluate the bids to decide which offer best suits its requirements. The company that has been successful in the tender process will be selected to perform the work by contract.

The underlying objectives of procurement and tendering are concerned with ensuring competition, which is viewed as a key factor in achieving the twin objectives of:

i. **accountability** in the spending of public money; and
ii. **transparency** in the steps of the decision-making processes.

2.3.1 Parties to Procurement

In relation to the actual contract, there is a need to focus on who is involved in a contract and what each of these actors various obligations are. The most commonly used engineering contracts recognise a "triangle of actors': promoter; engineer; and contractor (UNDP, 2015).

(a) The **promoter/client,** otherwise known as the employer, specifies, authorises and pays for the work to be undertaken.

(b)The **engineer** acts as an agent on behalf of the employer. The duties of the Engineer include:

i- evaluation of tenders;

ii- supervision of the work of the contractor;

iii- confirmation of whether or not the work is as been completed to specification; and

iv- mediation between the employer and the contractor in case of dispute.

(c) The **contractor** (the **bidder**) successfully bids for a contract and carries out the work required.

2.3.2 Procurement Objectives

A typical case involves a government establishment or University awarding a contract to a private sector company for the construction of infrastructure improvements as employer. The employer is the promoter; it has planned and designed the work, and is paying for it to be implemented. The government establishment or promoter appoints an engineer, who is usually in the full-time employment of the relevant government department. In accordance with the procedures laid down, a private sector contractor is then appointed to do the actual procurement.

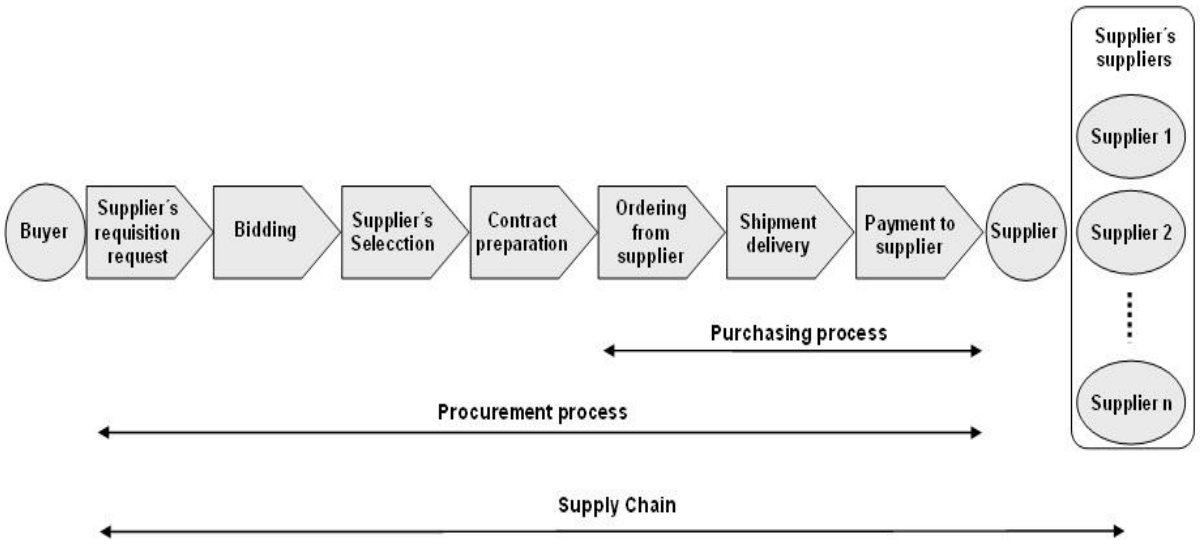


Figure 2.1: Relationship between supply chain and procurement process (Podlogar*et al*, 2007)

The figure 2.1 above shows that in the supply chain, the procurement process is important, because includes business partners as: suppliers, manufacturers, distributors and customers that use transactions to purchase, manufacture, assemble, or distribute products and services to the customers.

In accordance to UNDP, 2012 document (Public Private Partnership in Urban Development), an engineer has the important role of ensuring that the interests of the promoter are met, and that the contractor is duly paid for his/her efforts. The promoter wants the best value for money and the contractor wants to secure a good profit; whilst this dichotomy can involve an enormous range of complex and contentious issues, satisfying the various interests often comes down to ensuring that a "triangle of objectives" are met:

i- **Cost**: has the work been completed within the costs agreed in the contract?

ii- **Quality**: has the work been carried out in accordance with what was specified?

iii- **Time**: has the work been completed satisfactorily within the time specified?

2.3.3 Needs Assesment Criteria

The traditionally accepted objectives of procurement procedures and contract documents are to ensure that works are executed at the minimum cost that is consistent with the need to achieve a product of acceptable quality within an acceptable timeframe (Rana Hennawy, 2013).

Procurement procedures and contract documents do this by reducing uncertainty, which in turn is done by:

i- clearly defining who is liable to take any risk that cannot be eliminated from the project; and

ii- providing information on the work to be carried out so that all concerned are clear about what has to be done and what their role is in doing it.

According to Risk Management Guide for DOD acquisition Sixth Edition (Version 1.0), August, 2006 Department of Defence, the role of the engineers in government establishment is to ensure that objectives relating to cost, quality and time are achieved. The objective which is most difficult to assess, and causes most concern, is the quality of the finished work. The reality is that neither the engineers as supervisors nor the government as promoters are

primary stakeholders with a strong motivation for ensuring that adequate work practices and standards are maintained.

This research concentrated specifically on the problems of uncertainty and variation in the procurement process of major equipment. Special interest is given to engineer–procure–construct (EPC) model to generate models for the procurement of plant and equipment and other process of equipment and plant procurement projects.

2.4 Review of Past Related Research

With a view to improve productivity in engineering procurement projects, there is limited previous research efforts being devoted to developing new models, approaches and techniques. This research focused on improvements in major equipment procurement process. The procurement performance and delivery processes can be defined both at the corporate and project levels. These processes can be partly represented as corporate systems, policies and procedures which are influenced by the prevailing, functional units, risk and cost reduction,delay in completion or supply, planning and controlling,just in time systems and procedures, collaborative procurement, and other auxiliary processes.

2.4.1Procurement Effectiveness and Efficiency Models

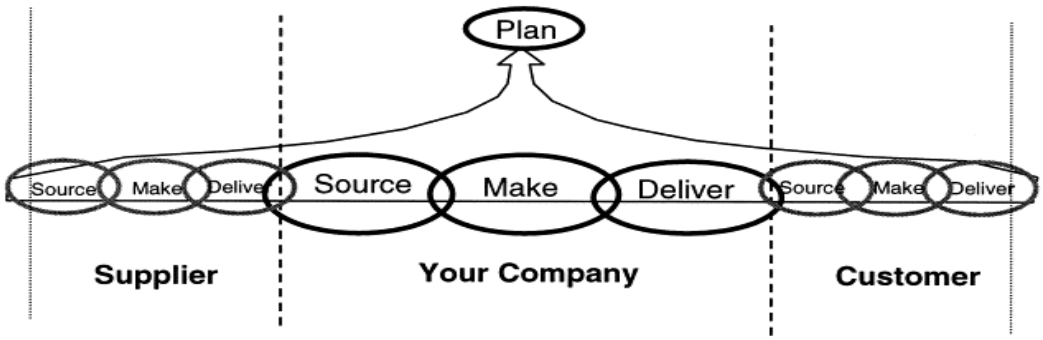


Figure 2.2: SCOR model (Yeo et al, 2008)

The Supply Chain Operations Reference (SCOR) model is developed by the Supply Chain Council to describe the business activities associated with all phases of satisfying a customer's demand. It integrates the well-known concepts of Business Process Re-engineering (BPR), Benchmarking and Best Practice Analysis into a cross-functional framework. SCOR model spans all customer interactions, from order entry through paid invoice; all physical material transactions, from supplier's supplier to customer's customer; and all market interactions, from the understanding of aggregate demand to the fulfilment of each order.

The SCOR model consists of a series of Plan-Source-Make-Delivery functions by an extended supply chain constellation as illustrated in figure 2.2 translating the SCOR model for engineering procurement in tertiary institutions. According to Alhazmi and McCaffer(2002), a survey was conducted in Saudi Arabia with the aim of testing the Project Procurement System Selection Model (PPSSM) for effectiveness and efficiency and assisting the governmental agencies to select the most appropriate procurement system for implementation of their projects. A questionnaire was developed on the basis of the synthesis process of the PPSSM, Saudi public clients selected design and build as the most appropriate procurement system for their projects, with an overall priority of 0.496. The outcome of the study demonstrates the effectiveness of PPSSM in helping the client in the construction industry to choose the procurement system that fulfills the needs of the client and the project (Van Weele, 1994).

2.4.2 e-Procurement

e-Procurement is an internet application in the purchasing process, but it also includes the use of intranet and extranet applications. For example, using this Online procurement (e-procurement) has been identified as the most important element of e-business operational

excellence for large corporations' (Barua *et al*, 2001). An e-procurement technology is defined as any technology designed to facilitate the acquisition of goods by a commercial or a government organization over the Internet. e-Procurement technologies including e-Procurement software, B2B (business-to-business) auctions, B2B market exchanges, and purchasing consortia are focused on automating workflows, consolidating and leveraging institutional spending power, and identifying new sourcing opportunities through the Internet. Future developments are expected to extend these technology models to create collaborative supply chain management tools (Brunnelli, 1999 and Carabello, 2001). Not surprisingly, e-procurement technologies have been credited with providing significant benefits to companies who venture into them. These advantages include reducing administrative costs, shortening the order fulfillment cycle time, lowering inventory levels and the price paid for goods, and preparing institutions for increased technological collaboration and planning with business partners (Croom, 2000;Roche, 2001;Gamble, 1999;Greenemeier, 2000 and Murray, 2001). The relevance of these advantages suggested a rapid migration from traditional to e-based procurement models.

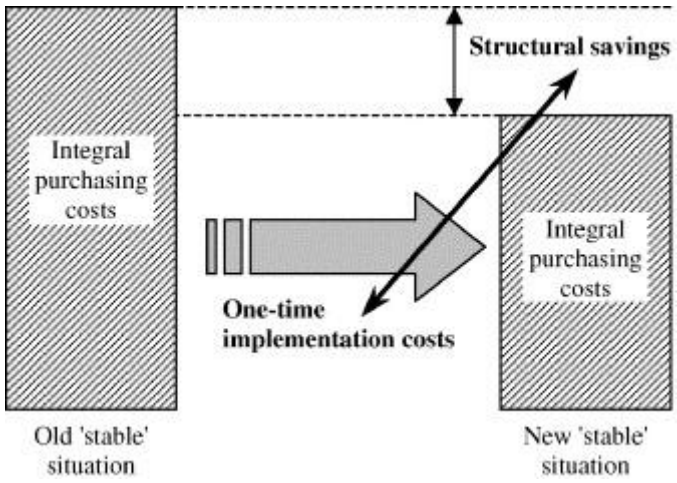


Fig:2.3Structural savings through implementing e-Procurement (Leonard *et al,*1986)

Accordingly, just a few years back, market analysts predicted that Internet B2B transactions a subset of e-procurement technologies would increase from approximately $600 billion in 2000 to over $6.3 trillion by 2004 (Forrester Research, 2000).

Unfortunately, this tremendous expected growth rate has been revised downwards. Recent market observations indicate that the adoption and integration of e-procurement technologies into the business mainstream is occurring at a much slower than expected pace. One reason is the implicit association that investors have made between e-procurement technologies and the business-to-consumer (B2C) models responsible for the Internet bubble. More often, the slow-down has been associated with technology-related issues. A 2001 study by the Conference Board points to problems in the implementation side and concludes that 'organizations are finding (e-procurement) implementation more complex, more expensive, and more time consuming than they originally envisioned' and that consultants have been 'widely criticized for overstating the business case for e-procurement'. Companies were jumping onto the e-procurement bandwagon without fully understanding the inter-organizational collaboration and network effects underlying these technology models, the investment required to move the right information from suppliers to employees, and the complexities of integrating these technologies with existing Enterprise Resource Planning systems (Gilbert, 2000).

This present the results of a research project undertaken to map current practices of e-procurement technologies, understand the drivers benefits and risks of their adoption, and project the expected evolution of these technologies in the near future. The findings are based on a survey supplemented by extensive discussions with industry experts and purchasing managers who are using e-procurement technologies.

The analysis indicates that the slower-than-predicted growth is not the consequence of a single problem. Rather, e-procurement technologies are still in their early stages of the traditional technology S-curve, in which alternative technology models are rapidly evolving and users are still sorting out the winning model. This process is particularly complex because the final outcome may well be that different market segments was adopt different technology solutions. Because a well-defined business process is still unavailable, companies are using different strategies to approach these technologies. Some companies aggressive adopters are investing significant resources to experiment with alternative solutions with the expectation of identifying the technological winner and translating this leadership position into competitive advantage. Other companies conservative adopters are taking a 'wait and see' approach. These companies are investing selectively in a reduced set of technology alternatives with the expectation of learning enough to be ready to move as soon as a winner emerges. Regardless of the current strategy of a company, the overall consensus is that e-procurement technologies will become an important management tool to enhance the performance of supply chains. The current focus on indirect goods as a way of experimenting with the technology is expected to evolve into procurement processes that facilitate inventory management and the purchase of capital goods.

The actual benefits and risks of e-procurement technologies and managers' evolving perceptions about these benefits and risks was determine the speed at which the technology moves from its developmental infancy to the adoption and maturity stages. However, the perceived risks that are holding back companies from investing in e-procurement technologies s definition, ordering office supplies by using a supplier catalogue on a website is a form of e-procurement.

2.4.3 EPC –Engineer Procure Construct

An EPC project can be a complex one of a kind product development, made up of a large number of interconnected subsystems and components, requiring considerable human efforts and financial commitment. The EPC activities are time-phased according to specified precedence and resource requirements and constraints.

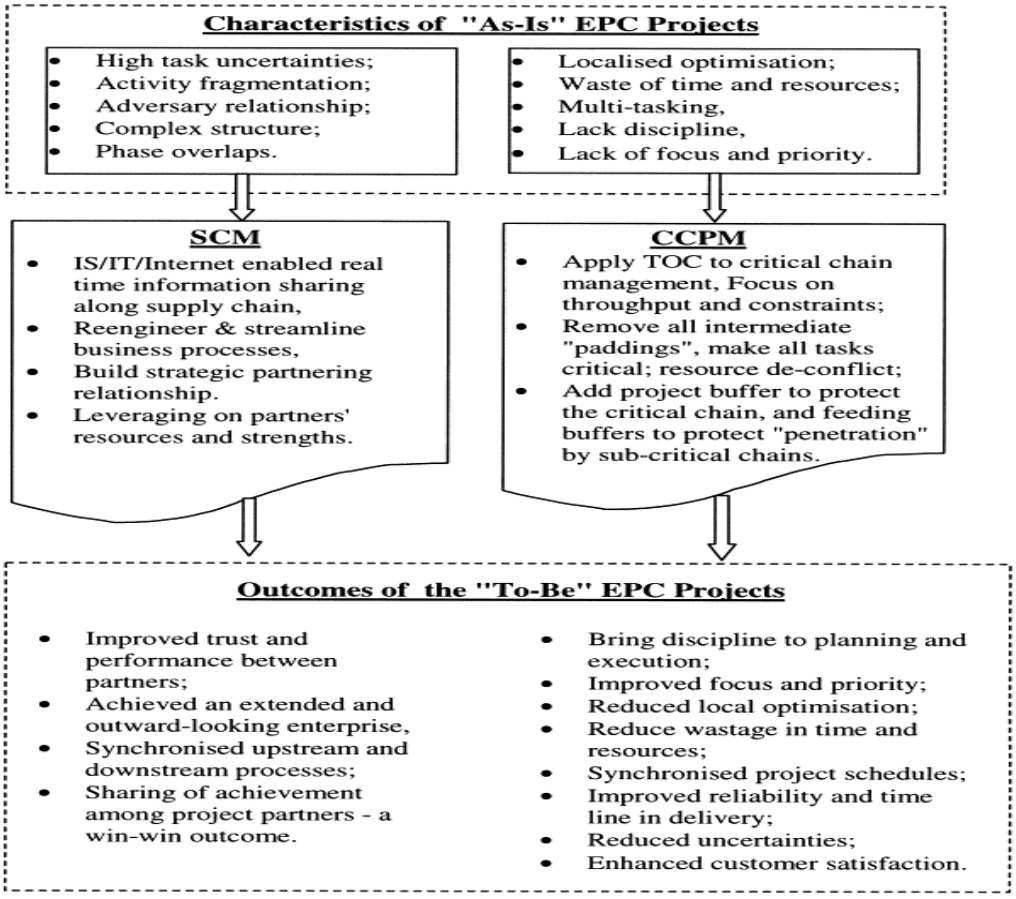


Figure 2.4: EPC Model (Yeo***et al,*****2008)**

The engineering and construction industry faces formidable challenges. As a whole, the industry worldwide continues to perform unsatisfactorily. It suffers from low profit margin, persistent project overruns in schedule and budget, and is plagued with claims and counter-claims (Yeo K.T. *et al*, 2008) . Mohamed and Tucker (1996) claims that the current practices and mechanisms of the construction industry are inherently inefficient, which inevitably leads

to wastes . Lim's study on construction productivity in Singapore shows that the industry is perceived as a low-productivity sector. De la Garza (2001) thinks that the construction industry productivity has been static for almost two decades. An investigation on time waste reveals that the site workforce spends a considerable amount of time waiting for approval or for materials to arrive on site. The amount of work on non-value-adding activities was found to be as high as 40% of the overall project duration from inception to completion.

The Construction Industry Institutes (CII) in the US, in their industry-wide investigation, concludes that project performance, measured in terms of cost, schedule, technical, quality, safety, and profit objectives, has room for substantial improvement for the industry as a whole . The Construction Industry Board (CIB) of the UK specifically suggested that the construction industry should be more competitive and aim at reducing construction costs by 30%(CIB W065/055 Commission, 1996). Mohamed and Tucker (1996) reckoned that 25% time saving is achievable in a typical construction work package without increasing allocated resources. .

The engineering and design phase is closely followed by the procurement (P) phase. A contractor begins to procure project equipment and construction materials upon receipts of engineering drawings, specifications and other relevant documents. The main procurement/logistics activities include sourcing, purchasing, contracting, and on-site materials management. A contractor begins to construct specified facilities in construction phase according to work packages prepared during the engineering phase by using equipment and materials obtained in the procurement phase. The sequencing of construction was to be initially planned to reflect the most logical and cost-effective approach to meet startup and handover dates.

2.4.4Plant and Equipment Procurement

University of Cambrigde Equipment purchase guide 2008 updated version stated their equipment purchase is a ‘one time’ buy, service and maintenance requirements should be addressed in the bid or during negotiations with the supplier. In evaluating an RFQ/RFP, costs for service and maintenance should always be considered as part of the total price of the equipment. The life cycle cost of the equipment includes purchase price for the equipment and the cost of service/maintenance extended over the useful life of the equipment – typically 5 to 10 years.

If feasible, the contract administrator should look at the cost of obtaining an independent contractor to handle repairs and maintenance versus the Original Equipment Manufacturer (OEM). Service representatives from the OEM may have to travel some distance to repair your equipment – travel time the requester will have to pay for, considering the fact that the location of installation of equipment is always some distance from the location of manufacturing company.

Sometimes, an independent contractor will be able to handle service and repair requirements for a lower rate because the service representatives are closer. However, the contract administrator and the requestor must be confident that the independent contractor can obtain the parts and personnel needed to service and repair the equipment.

A Statement of Need (SON) or Requirement (SOR) should set out (UCEPG, 2008):

i- the benefits expected from the equipment.

ii- the total costs of ownership over the whole of its operational life, covering acquisition costs, running and disposal, and

iii- how the acquisition will promote the institution's objectives.

2.4.5Specification of Requirement (SOR)

Good research depends on the right choice of equipment. A well-drafted specification of requirement not only sets the quality and performance standards for the equipment, but also provides the greatest scope for maximising value for money (VFM) (University of Cambridge Equipment purchase guide, 2008).

A good specification should be functional e.g. describing the equipment in terms of its intended function and the required level of performance, rather than by a generic description or brand name. It should be concise, but sufficiently detailed to enable bidders to take all costs into account, and also to offer alternative solutions. In particular it should:

i- abide by international and national quality requirements

ii- include health and safety requirements

iii- if brand names are unavoidable, qualify these by adding "or equivalent"

iv- comply with UK, EU and international law.

When considering VA/VE as part of defining a SON or SOR, it is recommended that a small team consisting of key stakeholders (internal and external) conduct a brainstorming session, identifying major cost elements and components parts of the equipment (examples below) to assess whether or not such component parts may be modified or omitted, etc:

(i)What are its basic functions?

(ii) Are they all necessary?

(iii) Can they be simplified?

(iv) Can they be performed in some other way?

(v) Are performance requirements and tolerances too stringent?

(vi) Can standard methods and off-the-shelf equipment be used?

(vii) Can operations be combined?

(viii) Where can waste be reduced?

(ix) What is the environmental impact, including costs of waste disposal?

(x) What are the staff cost implications in terms of numbers, expertise, etc?

Involvement of suppliers at this stage can help implement the results of the investigation by modifying their equipment so as to reduce cost or improve performance. In doing so they was hope to share in the cost savings and gain additional business, but care should be taken not to favour one supplier unduly, particularly if the purchase subject to the EC directives.

Aggregating similar requirements can substantially reduce purchase prices and costs relating to maintenance, delivery, ordering and payment processing. For specialised equipment, other departments and institutions should be approached to see if there is scope for a co-ordinated approach to suppliers.

For regular purchases of common items, a framework agreement should be set up. Purchases may then be made from designated suppliers at competitive prices and favourable terms, which will cover all whole life costs (UCPEG, 2008):

i- a fixed, or at least index-linked, purchase price

ii- on-site tests and pre-negotiation trials

iii- delivery, installation and commissioning

iv- maintenance cover and costs

v- the price of consumables

vi- spare part cost and availability

vii- provision and updating of maintenance handbooks

The use of existing framework agreements should be mandatory unless there are strong reasons for not using them. A spot price may seem cheaper, but other factors must be considered: time and cost of obtaining competitive bids and selecting the best value;less leverage over the supplier in case of dispute;handling additional invoices from different suppliers and making additional payments;reduced economies from scale;undermines the current framework agreement and weakens the negotiating position.

2.4.6 Equipment Maintenance and Service Agreements

Computers, scientific, diagnostic and testing equipment, and other specialized equipment require on-going periodic maintenance after warranties expire. One of the primary benefits of negotiating a service/maintenance agreement with the manufacturer or authorized representative is that they have ready access to the parts and factory trained personnel required to maintain or repair the equipment University of Cambridge Equipment Purchase guide 2008.

2.4.7 Physical Site Preparation

The questions we need to ask during site preparation are: Does the receiving site have any limitations such as truck size, weight, or accessibility? Have provisions been made to remove old equipment, if necessary? Can the floor structurally support the equipment? Are freight elevators available and will the equipment fit? (Take the time to measure doorways and elevators.) Are electrical connections in place and compatible? Will the new equipment interface with existing equipment and how was this be accomplished? Request that the supplier give notification 24-48 hours before delivery and be sure that arrangements are made to remove any old or existing equipment prior to the arrival of the new equipment.

2.4.8 Installation

Who will be responsible? What does it include? If the installation was be performed by the supplier's personnel, make sure the supplier has adequate liability and worker's compensation insurance. Can University personnel install the equipment? How long will installation take? Is installation a separate cost or included.

Is training available for end users? Where will it take place? How long will it take? Is training included in the purchase price? Is a user's manual included, complete with parts list and schematic, and in English? Will the supplier provide on-going technical assistance if needed?

2.4.9 Acceptance

During inspection equipment is expected to conform to certain performance specifications and should be tested before the contract administrator/end user authorizes payment to the supplier.

2.4.10 Warranties

Warranties should begin from the date of installation, testing and training. The equipment should be operational and personnel fully trained. The contract administrator/end user should avoid taking partial shipments and risk warranties on components expiring at different times. If the equipment is to be stored, arrange with the supplier for an extended warranty or have the supplier activate the warranty after the equipment has been installed and tested. Otherwise, the warranty may expire before the equipment is up and running. Contract administrator/end user may find an extended preventative maintenance agreement more cost effective than whatever discount terms the supplier is offering (UCEPG, 2008).

2.4.11 Payment Terms

Negotiate payment terms with the supplier and specify the terms on the purchase order. Occasionally, suppliers will request a partial payment when the order is placed, another payment when the order is shipped, and final payment when the equipment is accepted. Progress payments are typically made if the equipment is expensive or has been customized to the end user's specifications and some times 15% mobilization fee as requested by the contractor (Public Procurement Act, 2007).

2.4.12 Supplier Terms and Conditions of Sale

Contract administrator/end user should pay particular attention to the fine print on the supplier's written quotation. Some items may be negotiable, some are not. Review order cancellation policies carefully. Penalties for cancellation can involve a substantial portion of the purchase price – particularly if the equipment has already been customized to meet very specific requirements and other conditions (Public Procurement Act, 2007).

2.4.13 Bonds

If the equipment is complex, customized, and expensive, the buyer may require a Bid Bond, which binds the supplier to his offer (the supplier's quotation or proposal) to sell the equipment; a Supply Bond, which guarantees delivery of the equipment and is used primarily for customized equipment or components; or a Performance Bond, which guarantees that the supplier was deliver and install the equipment according to a specified schedule. Most common equipment purchases do not require bonds. (Public Procurement Act, 2007)

CHAPTER THREE

MATERIALS AND METHODOLOGY

3.1 Introduction

Secondary data for this research was obtained from comprehensive literature review, to gain the general overview of various procurement models and to identify barriers hindering the procurement of plant and equipment in tertiary institutions, while taking the objective of the research to serve as a basis for the preparation of questionnaire. The primary data was collected from stakeholders within the tertiary institutions, using questionnaire and withinterviews,all data collected were analysed using (SPSS) and to relate the plant and equipment's procurement activities and design the communication procedure and methods.The design wasrefined through interviews with numerous managers, both users and suppliers, professionals involved in procurement and to check available documents. These interviewswerealso used to sure that the questionnaire addressed the most relevant issues in plant and equipment procurement technology. The interviews were also used to pre-test the questionnaire design before the final version of the questionnaire wasadministered.

In this research,some procedureskнown as result-based management techniques were employed.In this research cluster sample techniques were employed. Data collection was by the use of both primary and secondary data collection instruments.For harmonization of responses from questionnaires,personal interviews with stake holders and end users,procurement document reviews were conducted.The data were presented and analyzed using descriptive statistics. SPSS will be involved the use of framework in procurement elements (goals,objective,outputs, outcomes) their causal relationship and the external factors that may influence successs or failure of procurement. This was used to create a conceptual

framework to show the relationship factors that were believed to impact or lead to target condition.The evaluation of the input,process,output, outcome,and impact to help indentify strategic elements of procurement and causal relationships and the external factors that may infleunce success to provide a basis for monitoring progress achieved and evaluating procurement results by international financial reporting standard (2015).

3.2 Material or data collection Instrument

Sample survey was carried out on several randomly selected establishment and relevant professionals to get information from all categories of Tertiary Institution,professionals,contractors and consultants,client as regard to plant and equipment procurement in Tertiary Institution within Kaduna State.

This research include oral interviews with the establishments, parastatals,and end users on the process involved in plant and equipment procurement cases of delay in supply and specification related problems and value for money.

The relevant procurement documents in tertiary institutions within Kaduna state and organizations published articles,books, seminar papers, interviews, were also toolsused for data collection.

3.3 Data Collection Instrument

In this research,data were collected by both primary and secondary sources.

3.3.1 Primary source of data: The primary source of data is the questionnaire which composed of technical body of questions formulated to collect information or data for assessment and the use of result based management approach.Others are observation and interviews.The observation part is an action research part participating in the target under

study and interviewing on the subject matter in question.These techniques were adopted for this research.

3.3.2 Secondary source of data: This has to do with literature reviews textbooks,journals, newspapers,interviews,internet and magazines,procurement documents on the subject under study.

3.4 Design Of Questionnaire

The design of questionnaire was based on the objectives of the study.The questions were clustered to investigate each of the objectives.Hence,the nature of the objectives to be achieved by the study was a major factor in structuring of the questionnaire so as to be able to solicit for sufficient data from the respondents.In order to ensure free and accurate responses,respondents identity are not disclose,but their academic background,years of experience in the relative field are disclose.

The questionnaire consist of four parts; A, B, C and D. Part A seeks general information about the respondents, part B invites opinion on the level of experience of the members of the implementation of Plant and Equipment procurement using models within Kaduna State Tertiary Institutions, part C invites opinion on the level of existence of the barriers to introduction and implementation of Plant and Equipment procurement selection models within the Nigerian Tertiary Institutions and part D invites the respondent(consultant, contractors, suppliers, client) opinion on the level of existence of the essential requirements for Plant and Equipment procurement models in his or her organisation.

The drivers/facilitators required to introduce and implement the Plant and Equipment procurement model in Kaduna StateTertiary Institution were categorised using scale numbers. Using a scale 1 to 5, where 1 represents “never exist ”, 2 represents “rarely exist ”,

3 represents “sometimes exist ”, 4 represents “most of the times exist” and 5 represents “always exist ”, indicate the respondents assessment of the level of existence of each of the drivers/facilitators within the Tertiary Institutions inKaduna State in particular.

Similarly, certain barriers involved in introducing and implementing Plant and Equipment procurement model the Tertiary Institutions were also categorised. Using a scale 1 to 5, where 1 represents “never exist ”, 2 represents “rarely exist ”, 3 represents “sometimes exist ”, 4 represents “most of the times exist ” and 5 represents “always exist ”, indicate respondents assessment of the level of existence of each of the barriers within the Tertiary Institutions in Kaduna State.

The essential requirements for introducing and implementing Plant and Equipment procurement models in Tertiary Institutions in Kaduna State in particular were categorised using scale numbers. Using a scale 1 to 5, where 1 represents “never”, 2 represents “rarely”, 3 represents “sometimes”, 4 represents “most of the times” and 5 represents “always”, indicate respondents organization’s current level of existence of each of the requirements in readiness for introducing and implementing procurement models.

Another scaling method called the Likert scaling can also be used. This is a bipolar scaling method. It measures either the positive or negative response to a statement. An even point scale can also be used.

3.4.1 Administration of Questionaire

The study was carried out by administering well-structured questionnaires(Appendix A) on target respondents comprising the client,consultant, professionals, suppliers and the general public who are stakeholders in the plant and equipment procurement process in Kaduna State. Questionnaireswere personally administered on respondents with the asistance of few

colleagues and the retrieval of which required frequent visits to respondents.A total of 200 questionnaires were distributed to the respondents(consultants,contractors,suppliers,clients).

3.4.2 Reliability and Validity on Questionnaire

The questionaires were validated before administration on respondents to ensure that the instrument measured the quality of which the research was designed to measure and establish the reliability of the instrument which the result based management approach allow for the analysis of various practices in the procurement of plant and equipment.

3.5 Sample Population

This research work was carried out on plant and equipment procurement models in Tertiary Institution in Kaduna State.The entire Kaduna state of Nigeria was considered as a sample frame.The categories of contents include clients,suppliers,consultants,agents,government and professionals.The target is Tertiary Institutions of learning within Kaduna State.

3.6 Sampling

The area sampling technique is employed for the collection of data for this study. The adoption of the technique is due to the nature of the similarity in all procurement processes in Kaduna state. However, area sampling technique can be defined as a non-random sampling where the population is extensive and scattered over a wide area in Nigeria. The sampling of this study was done from the educational, construction, contracting, others services, manufacturer, agents, suppliers and industrial sectors, this is reported in table 3.1:

Table3.1:Sample size

SN	**Sectors**	**No of firms**	**Percentage firms**
1.	Clients	60	35.3
2.	Construction	5	8.8
3.	Contracting	10	5.9
4.	Other services	5	2.9
5.	Manufacturer	5	8.8
6.	Agents	10	5.9
7.	Suppliers	40	23.5
8.	Industries	5	8.8
	Total	140	100.0

3.7Data Analysis

Four different tools were employed to analyze the data collected, these are:

i Descriptive statistic: Descriptive statistical analysis was employed in order to summarize data and show the distribution of variable based on their mean and the standard deviation. This is done to achieve objective of understanding the levels at which each institution is and quantify the degree of inefficiency.

ii Canonical correlation analysis: Canonical correlation was employed to assess the nature of relationship existing between two sets of variables as regard the hypothesis concerning the relationship between drivers and facilators in implemmenting plant and equipment procurement model also Barriers to implemantation of plant and equipment procurement model.

iii Principal component analysis: Principal Component Analysis (PCA) was employed in order to assess the behaviour of data and also for variable extraction to reduce the number of unwanted data.

iv Multiple Regression analysis: Multiple regression analysis is used to test the magnitude and nature and also the effect size of the relationships existing between the selected Independent variables and dependent variable of interest (Cohen and Cohen,1975).However, hierarchical regression allows groups of variables to be entered into the regression equation in steps.The first group of variables is allowed to explain as much of the variability of the dependent variables as possible,as subsequent variables were entered, then the amount of variance of the dependent variables that were explained by the newly entered independent variable to be calculated.In the study,variables describing the drivers and facilitators were entered in the first step.In second step,the Barriers to implementing plant and equipment procurement model were entered and so other variables. A significant R^2 in the second or third step could be interpreted as support for the hypothesis that there are relationships between drivers and facilitators and Barriers in implementing plant and equipment procurement models.The F-statistic if incremental that is they are associated with change in R^2occurring when variables were entered .The variables were measured so that positive β's are consistent with the hypothesis. Positive β's indicate that with greater complexity the more the barriers increase. However, Berry (1993) and Fox (1991) offer some other interesting insights into regression assumptions and diagnostic which are not to be considered within the scope of our analysis.

β

3.7.1 Multiple regression model

This was used to achieve objectives to determine the strength of the relationship between strategies and a series barriers. The empirical multiple regression model is specified as follows:

$$E\ and\ P\ model = \beta_0 + (\beta_1 facilitators + \beta_2 Barriers) + (\beta_3 A_i + \beta_4 B_i + \beta_5 C_i + \beta_6 D_i + \beta_7 E_i \ldots\ldots) + \varepsilon_i$$

…….. (3.1)

Where

β = Unknown parameters

A = Environmental Legal Issues

B = Cultural issues

C = Size of organisation

D = Integration

E and P = Equipment and Plant

ε_i = Constant

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the result and discussion of the analyzed data collected for this study which is based on development of a conceptual procurement models for plant and equipment procurement in Tertiary Institution in Kaduna State. However, 200 questionnaires where distributed, but only 140 where correctly filled and returned giving a response rate of 70%.

4.2 General Information of the Respondents

Table 4.1:Size of Tertiary Institution of respondents

Size of Tertiary Institution	Frequency	Percentage
Very large	87	62.1
Large	46	32.9
Medium	4	2.9
Small	2	1.4
Very small	1	0.7
Total	140	100.0

Table 4.1above shows that 62.1% of the Tertiary Institutions are very large in size while only 0.7% are very small in size. More so, a significant count of 32.9% indicated large, 2.9% medium and 1.4% small Tertiary Institutions. The analysis is showing the magnitude of plant and equipment procurement activities carried out in the Tertiary Institutions.

Table 4.2:Years of experience of respondents

Years category	Frequency	Percentage
Less than 5 years	24	19.3
6-10 years	37	22.4
11-15 years	28	20.0
16-20 years	22	17.7
21years and above	29	20.6
Total	140	100.0

Table 4.2above shows the experience of the respondents with respectto plant and equipment procurement, this shows level of understanding of the subject matter from the general information about respondents, with22.4% of the respondents which constitute the majority are having 6-10years of working experience. More of the respondents covering 20.6% have 21 and above years of experience. Further more, 20.0% of the respondents are reported to have 11-15 years of experience, 19.3% are reported to have less than 5 years of experience while only 17.7% which are the minority are reported to have 16-20 years of experience. (Appendix B)

Table 4.3:Position of respondents

Position	Frequency	Percentage
Top management level	70	50.0
Middle management level	70	50.0
Total	140	100.0

From table 4.3,the level and position of the respondents in their various tertiary institutions are taken so as to be able to understand which position and level have abetter understanding of the plant and equipment procurement, equal distribution on the position of respondents is observed, these are recorded with 50% each.

Table 4.4:Knowledge of procurement of respondent

Response	**Frequency**	**Percentage**
High knowledge	84	60.0
Medium knowledge	52	37.1
Low knowledge	4	2.9
Total	140	100.0

Regarding the knowledge of respondents as reported in table table 4.4 above,to establish the level of understanding of each respondent, we need to investigate their level of knowledge first on the subject matter as a way of determining the level of professionalism. The majority of respondents have high knowledge of procurement. This is recorded with 60.0% followed by those with medium knowledge as recorded with 37.1% while, only 2.9% covering 4 respondents have low knowlegde of procurement. Thus, respondents have adequate knowledge on procurement. (Appendix A)

Table 4.5:Plant and Equipment Procurement Cost and Contract Completion

Level of Completion Cost and Duration	Frequency	Percentage
Completed within cost estimate and time	42	26.1
Completed outside cost estimate and time	72	53.7
Abandoned	26	21.2
Total	140	100.0

As observed in table 4.5, more than a half of the procurement cost and contract completion are being completed outside cost estimate and time, with a response of 53.7% of respondents which constitute the majority. Further more, only 26.1% respondents pointed out that, projectsare being completed within cost estimate and time, while 21.2% reported that projects were abandoned.Thus, it can be said that more than half of the projects are being completed outside cost estimate and time. However, more than a quarter are completed within cost estimate and time while a little more thanone-fifth as well are abandoned. (Appendix A)

Table 4.6: Plant and Equipment Procurement Completion and Specification

Level of Completion and Duration	Frequency	Percentage
Completed within specification	22	10.5
Completed outside specification	67	49.2
Rejected by client or Accepted but not in use	51	40.3
Total	140	100.0

As observed in table table 4.6, the interview conducted shows that 49.2% of the procurements are completed outside the specification and 40.3% are either rejected or accepted but not in

use by the end user which is clearly indicating that there is no value for money on the procurements. Furthermore,10.5% respondents pointed out that the procurement are completed within specification.This shows a very high level of financial wastage. (Appendix A)

4.3 Solution for Research Questions

Development of a Conceptual Procurement Model for Plant and Equipmentin Tertiary Institutions in Kaduna State is the major objective of this study. For assesment of the objective, a summary of the investigated variables which was obtained in the data as an average mean, the practices as rated by the respondents was presented subsequently. For assesment, the four point scale was used for the rating. A mean score of 3.2 was therefore used in this research as the decision for and against. A mean score of 3.2 and above would mean agreement while mean score lower than the 3.2 midpoint would imply disagreement. The mode as a measure of central tendency between all the data and was considered as the threshold in the range on all the items in providing solution for the research question. It is possible to test for other correlation with ranked data. In accordance with Coombs (1953), the two main methods are Spearman's Ranked Correlation Coefficient and Kendall's Coefficient of Concordance. Using either procedure one can, for example, ascertain the degree to which two or more survey respondents agree in their ranking of a set of items. The researcher might wish to measure similarities and differences in the rankings of pesticide brands according to whether the respondents' farm enterprises were classified as "arable" or "mixed" (a combination of crops and livestock). The resultant coefficient takes a value in the range 0 to 1. A zero would mean that there was no agreement between the two groups, and 1 would indicate total agreement. It is more likely that an answer somewhere between these two extremes would be found.

However, table 4.7 is the presentation of the analized data. The response to the questionnaire is as stated in the table 4.7 to 4.15 with details of research questions.

Table 4.7: Drivers/facilitators

Response	N	Mean	Std. Deviation
Client's interest in the use of the procurement models	140	3.2	1.424
Availability of well-trained individuals to act as facilitators	140	3.0	1.292
Government policy support through procurement Act 2007	140	3.2	1.233
Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models	140	3.0	1.112
Other stakeholders interest/support in the use of the Plant and Equipment procurement models	140	2.8	1.170
Commitment and cooperation of professional bodies to the implementation of the Plant and Equipment procurement models	140	2.9	1.209
Advantage of the Plant and Equipment procurement models over conventional process	140	2.9	1.252
Alignment of stakeholders objectives in your organization	140	2.8	1.143
Is your environment conducive for good procurement	140	3.1	1.272
Roles and Standard of your procurement process	140	2.8	1.105
Just in time delivery and proper need assessment	140	2.9	1.174
Management commitments to new procurement technology	140	2.9	1.197
Contractors compliance to new technology in procurement	140	3.2	1.165
Are your procurement base on value for money	140	2.9	1.161
Supplier performance measurement and improvement	140	2.9	1.244
Knowledge about Strategic sourcing	140	2.8	1.289
Assessing supply market knowledge	140	3.2	1.242
Ideas on how Engineers can procure and install EP	140	3.2	1.306

Considering the threshold, table above 4.7 shows that, (a) Clients have interest in the use of the procurement models and there is the support of government policy through procurement Act 2007 (b) Contractors comply to new technology in procurement (c) Assessing supply market knowledge andengineer have ideason how to procure and install during plant and equipment procurement using direct procurements as a solution to procurement problems.All these are recorded with the mean score above 3.2 which means respondents agree to the questions. However, respondents disagreed to the following research questions from the questionnaire (See Appendix A): (a) there areAvailability of well-trained individuals to act as facilitators (b) Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models (c) Other stakeholders interest/support in the use of the Plant and Equipment procurement models (d) Commitment and cooperation of professional bodies to the implementation of the Plant and Equipment procurement models (e) Advantage of the Plant and Equipment procurement models over conventional process (f) Alignment of stakeholders objectives in your institution (g) conducive environment for good procurement (h) Roles and Standard of your procurement process (i) Just in time delivery and proper need assessment (j) Management commitments to new procurement technology (k) procurement based on value for money (l) Supplier performance measurement and improvement and knowledge about Strategic sourcing. This is observed from the reported mean score which falls below 3.2 as the level of disagreement to these research questions.

Table 4.8: Barriers to plant and equipment procurement models implementation

Response	N	Mean	Std. Deviation
Plant and Equipment procurement schedule	140	3.4	1.064
Institution's resistance for change to Plant and Equipment procurement models process	140	3.4	1.207
Lack Plant and Equipment procurement models knowledge	140	3.2	1.263
Communication problems	140	2.8	1.373
Failure to use Plant and Equipment procurement models in project execution	140	3.1	1.241
Misunderstanding of Plant and Equipment procurement models concept	140	3.0	1.108
Uneven commitment	140	2.9	1.207
Lack of continuous procurement improvement	140	2.9	1.126
Inefficient problem solving procedure	140	3.1	1.223
Inadequate training and management support	140	3.1	1.159
Lack of strategic sourcing	140	2.6	1.106
Lack of appropriate skills and competencies	140	3.3	1.240
Incompatible institutions' structures and cultures	140	2.7	1.133
Incompatible procurement engineers	140	2.7	1.101
Plant and Equipment procurement and without risk mitigation	140	2.6	.969
Legal/Legislative considerations	140	2.7	1.119
Difficulties in establishing mutual objectives by all project team	140	2.7	1.071

and members institutions			
Difficulties in the involvement of all key engineering stakeholders in procurement processes	140	2.7	1.187
Stakeholders resistance to its introduction and implementation of new strategies in procurement	140	2.9	1.188

Table 4.8 reported that, regardingrespondents response to the research question on barriers are hindering the implementation of plant and equipment procurements models based on the threshold of 3.2 as agreement and less than 3.2 as disagreement: (a) improper Plant and Equipment procurement schedule (b) lack of adequate institution's resistance for change to Plant and Equipment procurement models process (c) Lack of Plant and Equipment procurement models knowledge and Lack of appropriate skills and competencies, this was observed from the reported mean score (≥ 3.2). However, the following are not considered as barriers to procurement: (a) Communication problems (b) Failure to use Plant and Equipment (c) Misunderstanding of Plant and Equipment procurement models in project execution (d) Uneven commitment (e) Lack of continuous procurement improvement (f) Inefficient problem solving procedure (g) Inadequate training and management support (h) Lack of strategic sourcing (i) Incompatible institutional structures and cultures, Incompatible procurement engineers (j) Plant and Equipment procurement and without risk mitigation (k) Legal/Legislative considerations (l) Difficulties in establishing mutual objectives by all project team and members organization (m) Difficulties in the involvement of all key engineering stakeholders in procurement processes, and (n) Stakeholders resistance to its introduction and implementation of new strategies in procurement. The Model figure 2.4 shows the relationship between startegies and barrier to the implementation of plant and equipment procurement models using literature and research data.

Table 4.9: Social Cultural issues

Response	N	Mean	Std. Deviation
Institutions members embrace changes which the organization undergo and the opportunities it brings easily.	140	2.7	1.010
Institutions do recognize value and the cultures of all other stakeholders participating in engineering procurement.	140	2.9	1.166
There are no complex and complicated bureaucratic procedures as policies in Institutions.	140	3.0	1.196
We are prepared for cultural change and the adoption of mutually agreed culture as a result of collaborative working arrangement between Institutions and others.	140	2.7	1.139
Institutions' structure provides an environment that suit the adoption of Plant and Equipment procurement principle in the management of projects.	140	3.0	1.181
We do attend jointly organized social/cultural activities between procurement stakeholders.	140	3.0	1.240
There is compatibility between our Institutions' cultures/structures with other participating Institutions in our current and past engineering procurement.	140	2.9	1.198

Table 4.9 revealed that, from our threshold of response to the questions on plants and equipments procurment is not determined by cultural issues. This observation is made from the mean score value which is < 3.2. Thus, cultural issues should not be considered as an influence as far as plant and equipment procurement is concerned based on our result.

Table 4.10: Integration

Response	N	Mean	Std. Deviation
Availability and willingnessto share information amongst procurement participants	140	2.8	1.196
Recognition and involvement of plant and equipment procurement consultant contribution in procurement processes	140	3.4	.803
Alignment of institutional objectives with other stakeholder's in training and workshops on engineering procurement management	140	3.4	1.240
Acceptance of risk schedule in engineering procurement execution and risk transfer through consultant, insurance and others	140	2.6	1.154
Institutionsdo establish long-term Plant and Equipment procurement strategies	140	3.1	1.360

As shown in Table 4.10 respondents agreed that, there is recognition and involvement of plant and equipment procurement consultant contribution in procurement processesin their tertiary institution and also alignment of institutions' objectives with other stakeholder's in training and workshops on engineering procurement management. These were observed from the recorded mean score value (≥3.2). However, respondenrts disagreed that (a) there is availability and willingness to share information amongst procurement participants (b) acceptance of risk schedule in engineering procurement execution and risk transfer through consultant insurance and others and (c) the Institutions do establish long-term plant and equipment procurement strategies are integrated into plant and equipment procurement process.

This implies that, recognition and involvement of plant and equipment procurement consultant contribution in procurement processes and also alignment of institutions'

objectives with other stakeholder's in training and workshops on engineering procurement management are integrated in the tertiary institutions involved in this research.

Table 4.11: Top management support and commitment

Response	N	Mean	Std. Deviation
Top Management support and commitment our top management are interested in collaborative working arrangement	140	3.2	1.271
There is consistent and effective support from the top management which could encourage the introduction and implementation of collaborative Plant and Equipment procurement working arrangement	140	3.1	1.343
There is commitment from the of top management to Plant and Equipment procurement new working principles	140	3.0	1.179
Management wasingness to provide financial and other relevant resources to ensure successful introduction of Plant and Equipment procurement procedures	140	3.0	1.335
We do assign appropriate duties to our staff which was best ensure smooth achievement of procurement objectives	140	3.1	1.253
We have change management strategy that was ensure smooth introduction of new procurement techniques	140	2.7	1.276

As revealed in table 4.11 respondents agreed that,Top Management have support andare committment. They arealso interested in collaborative working arrangement, (mean score >3.2). However, respondents disagreed that (a) There is consistent and effective support from the top management which could encourage the introduction and implementation of collaborative plant and equipment procurement working arrangement (b) There is commitment from the of top management to plant and equipment procurement new working principles (c) Management willingness to provide financial and other relevant resources to ensure successful introduction of Plant and Equipment procurement procedures (d) Assigning appropriate duties to our staff which will best ensure smooth achievement of procurement objectives (e) Change management strategy that will ensure smooth introduction of new procurement techniques.

This implies that, Top Management are supported andcommitted to plants and equipment procurement. They arealso interested in collaborative working arrangement but their support lack continuity, adoption of new strategy and financial support.

Table 4.12: Communication

Response	**N**	**Mean**	**Std. Deviation**
Participation in an open and effective communication between the end users and consultant and manufacturers or vendors.	140	2.7	1.084
Conduct strategic sourcing of plant and equipment before procurement process and advert.	140	2.5	1.186
Attend regular procurement workshops to discuss progress and concerns about the procurements.	140	2.8	1.338
Committed to transparency and due process in plant and equipment procurement communication.	140	2.6	1.252

Make sure that specification and quality control are met and communicated to stakeholders.	140	3.2	1.239
Make good use of internet during information and specification and description of plant and equipment. We are committed to open and conduct direct procurement procedure in the procurement of plant and equipment to save cost and delay.	140	3.1	1.398
Committed to open communication on conduct direct procurement procedure in the procurement of plant and equipment to save cost and delay.	140	2.7	1.344

As reported in Table4.12, respondents agreed that, specification and quality control are met and communicated to stakeholders (mean >3.2), and disagreed to (a) participate in an open and effective communication between the end users and consultants and manufacturers or vendors (b) conduct strategic sourcing of plant and equipment before procurement process and advert (c) attend regular procurement workshops to discuss progress and concerns about the procurements (d) committed to transparency and due process in plant and equipment procurement process communication (e) make good use of internet during information,communication and specification and description of plant and equipment (f) committed to open communication on conduct of direct procurement procedure in the procurement of plant and equipment to save cost and delay.

This implies that, adequate communication is given in order to ensure proper specification and quality control in every procurement only but other various strategies as mentioned in table 4.12 are neglected.

Table 4.13: Plant and equipment procurement strategy

Response	N	Mean	Std. Deviation

Established and do put to use risk identification process in procurement of plant and equipment	140	2.8	1.061
Ready to put procurement models into action	140	2.5	1.162
Lack any equipment procurement strategy presently	140	3.1	1.077
Experience a lot of problems in procurement of Plant and equipment	140	2.8	1.311

Considering strategies for procurement, respondents disagreed that (a) have established and do put to use risk identification process in procurement of plant and equipment (b) are ready to put procurement models into action (c) lack any equipment procurement strategy presently and (e) have experienced a lot of problems in procurement of plant and equipment.

This implies that, considering the present condition/state, all strategy needed for equipment procurement is avaiable except that majory if not all are not properly implemented by the appropriate personnel.

Table 4.14: Mutual trust

Response to the questionnaire	**N**	**Mean**	**Std. Deviation**
Rely on the integrity and honesty of other procurement stakeholders	140	2.5	11.191
Confidence in the expertise and competence of other procurement stakeholders in guiding our needs	140	2.5	1.104
Working to be vulnerable to the actions of other procurement stakeholders based on the expectation that they will perform an important action in return, irrespective of our ability to monitor them	140	3.4	1.158

Working to accept new strategies for engineering procurement	140	3.2	1.350
Expect, believe or assume that there is likelihood that other procurement models will be beneficial, favorable, or at least not detrimental to our institution's interest	140	3.0	1.418

As revealed in table 4.14, respondents agreed that (a) working to be vulnerable to the actions of other procurement stakeholders based on the expectation that they will perform an important action in return, irrespective of our ability to monitor them (b)working to accept new strategies for engineering procurement, (mean score ≥3.2), which implies that the tertiary institutions are vulnerable to the actions of [rofessionals because they are lacking qualified staff. And disagreed that (a) rely on the integrity and honesty of other procurement stakeholders (b) confidence in the expertise and competence of other procurement stakeholders in guiding our needs (c) expect, believe or assume that there is likelihood that other procurement models will be beneficial, favorable, or at least not detrimental toinstitutions' interest.

Table 4.15: Knowledge, skills and experience

Response	N	Mean	Std. Deviation
Institutions members have attended Plant and Equipment procurement workshop within or outside Nigeria.	140	3.1	1.222
Institutions do managed projects using Plant and Equipment procurement model procedures and techniques within Nigeria.	140	2.8	1.200
Plant and Equipment procurement is in the curriculum (i.e. a course, a core or elective course unit, main heading, subheading etc) in the department and/or faculty of the institutions attended.	140	3.5	1.115
Plant and Equipment procurement experience and knowledge is one of the yardstick/criteria for the engagement of our services or patronization of our product by others within the Nigerian Industries.	140	2.8	1.230
We have within our institutions people who can conduct engineering procurement workshop by acting as facilitators.	140	3.1	1.331
There is clear definition of roles and responsibilities of each staff working within the institutions based on experience and skills.	140	3.2	1.230
There is recognition of the importance and benefits of collaborative working arrangement with stake holders by our institution members.	140	3.2	1.224
We do have staff with the ability to implement newly introduced concept quickly and accurately.	140	2.9	1.273
We have within our institutions people with the ability and will to contribute in other stakeholder's field other	140	3.0	1.229

than their main area of specialization, by using their knowledge, experience and resources to ensure achievement of project objective.	

From amongst the identified knowledge, skills and experience in table 4.15, respondents agreed that (a) Plant and equipment procurement is in the curriculum in the department and/or faculty of the institutions they attended (b) There is clear definition of roles and responsibilities of each staff working within the institutions based on experience and skills (c) There is recognition of the importance and benefits of collaborative working arrangement with stakeholders by institution members. However, respondents disagreed that (a) Institution members have attended plant and equipment procurement workshop within or outside Nigeria (b) Institutions do managed projects using plant and equipment procurement model procedures and techniques within Nigeria (c) Plant and equipment procurement experience and knowledge is one of the yardstick/criteria for the engagement of suppliers, contractors within Nigeria (d) within our institutions people who can conduct engineering procurement workshop by acting as facilitators (e) staff with the ability to implement newly introduced concept quickly and accurately (f) within institutions people with the ability and wllingness to contribute in other stakeholder's field other than their main area of specialization, by using their knowledge and experience resources to ensure achievement of project objective.

This implies that, respondents have adequate knowledge on procurement due to the fact that proper awareness are being created in course, a core or elective course unit, main heading, subheading etc in most department and/or faculty of the institutions for proper enlightment whereas lack basic skills and experience because staff are not opportuned to attend plant and equipment procurement workshop within and outside Nigeria and due to these reasons staff with ability to implement newly introduced concept quickly and accurately are lacking.

4.4 Correlation analysis

After the statistical analysis of the mean of all the variables to ascertain the level of agreement and disagreement we further need to conduct another statistical analysis to determine the relationship between procurement project completion and cost which suffers from delay, completion outside specification and other problems like abandonment of procurement which is sometimes the order of the day, as observed in the previous investigation/statistical analysis.

Thus, cultural issues should not be considered as far as plant and equipment procurement is concerned in the tertiary institutions. Recognition and involvement of plant and equipment procurement consultants' contribution in procurement processes and also alignment of institutions' objectives with other stakeholders in training and workshops on engineering procurement management are integrated in the tertiary institutions. Adequate communication is given in order to ensure proper specification and quality control in every procurement in tertiary institutions as reported.

Considering the present condition/state of the tertiary institutions, all strategies needed for equipment procurement are available except that majority but not all are properly implemented by the appropriate personnel. There is likelihood that other procurement

models were beneficial, favorable, or at least not detrimental to tertiary institutions' interests as observed in the variables and how each affect one another using canonical correlation.

Canonical correlation provides a statistical analysis for research in which each subject is measured on two set of variables and if we want to know if and how the two sets relate to each other,canonical reveal that there are two statistically significant ways that the two set of variables are related.Gebers and Peck (2003) examined the relationship between trafic citations and accidents in a subsequent 3-year period from those variables plus a variety of demographic variables in the prior 3-year period.Two canonical variable pairs were identified that,taken together,predicted subsequent trafic incidents.

Canonical correlation has several important theoretical limitations that help explain its scarcity in the literature. Perhaps, the most critical limitation is interpretability.Therefore,canonical solutions are often mathematically elegant but uninterpretable(Barbara and Linda,1999).

4.5 Relationship between knowledge and cultural issues

From the full canonical model shown, knowledge and cultural issues are not significantly related (Wilks's λ, $F(28,466.5)=1.07$, $p > .05$) (see Appendix B, Table B1). However, by taking $(1-\lambda)$, the effect size of 0.201 was observed. Considering the proportion of variance shared between the variable set across all canonical functions $(1-\lambda)$ and the $p > .05$, cultural issues have more or less no effect on the knowledge of respondents.

4.6 Relationship between barriers and cultural issues

As reported, barriers and cultural issues of respondents are not significantly related (Wilks's, λ, $F(126,765.5)=.878$, $p > .05$). However, a large effect size i.e. the proportion of variance

shared between the variable sets across all canonical functions of 0.588 is observed (See app I, table 2).

Given the effects for each function, only the first function is considered noteworthy in the context of this study (27.1% of shared variance). The remaining 6 functions only explained 18.0%, 14.0%, 10.0%, 5.0%, 4.0% and 3.0% respectively, of the remaining variance in the variable sets after the extraction of the prior functions. Therefore table below presents the standardized coefficient, structure coefficient and the squared structure coefficient on function (1).

Table 4.16: Canonical solution for cultural issues predicting Barriers of function 1

Variable	Function 1		
	Coef.	R_s	R_s^2%
Plant and Equipment procurement schedule	-0.21	-0.09	0.81
Institutions' resistance for change to Plant and Equipment procurement models process	0.18	.019	3.52
Lack plant and equipment procurement models knowledge	-0.16	-0.19	3.47
Communication problems	0.02	-0.07	0.47
Failure to use plant and equipment procurement models in project execution	0.11	0.12	1.46
Misunderstanding of Plant and Equipment procurement models concept	-0.37	-0.23	5.11
Uneven commitment	0.44	0.42	17.97
Lack of continuous procurement improvement	-0.07	-0.08	0.60
Inefficient problem solving procedure	0.18	0.12	1.34
Inadequate training and management support	0.34	0.42	17.65
Lack of strategic sourcing strategies	0.42	0.30	9.16
Lack of appropriate skills and competencies	-0.27	-0.05	0.30
Incompatible institution structures and cultures	0.58	0.53	28.36
Incompatible procurement engineers	0.07	0.06	0.35
Plant and Equipment procurement and without risk mitigation	0.06	0.09	0.82
Legal/Legislative considerations	0.02	0.13	1.59
Difficulties in establishing mutual objectives by all project team members in organization	0.01	0.07	0.48
Difficulties in the involvement of all key engineering stakeholders in procurement processes	-0.07	-0.03	0.11
R^2_c			27.0

Our institution members embrace changes which the organization undergo and the opportunities it brings easily.	-0.13	-0.17	3.50
Our institutions do recognize and value the cultures of all other stakeholders participating in engineering procurement.	0.67	0.50	25.05
There are no complex and complicated bureaucratic procedures as policies in our organization.	-0.41	-0.37	13.75
We are prepared for cultural change and the adoption of mutually agreed culture as a result of collaborative working arrangement between our organization and others.	0.70	0.49	24.08
Our current institutions' structure provides an environment that suit the adoption of plant and equipment procurement principle in the management of projects.	0.04	0.09	0.81
We do attend jointly organized social/cultural activities between procurement stakeholders.	-0.45	-0.28	8.06
There is compatibility between our institutions's' cultures/structures with other participating institutions in our current and past engineering procurement.	-0.13	-0.11	1.11

R_c^2%> 10.0 are considered

From the squared structure coefficient as reported in table above, the primary criterion (dependent) variables are incompatible institutions' structures and cultures with 28.36%, inadequate training and management support with 17.7 % and uneven commitment with 17.4%, all these have positive relating nature. However, from the predictor variables: 'Our institutions do recognize and value the cultures of all other stakeholders participating in engineering procurement', 'we are prepared for cultural change and the adoption of mutually agreed culture as a result of collaborative working arrangement between our institution and others' are equally observed to be the primary contributing variables to the effect size on the canonical model, 28.08% and 25.05% respectively.

Thus, it can be said, the inability of institutions not recognizing and value the cultures of all other stakeholders participating in engineering procurement also the inability of respondents been prepared for cultural change and the adoption of mutually agreed culture as a result of collaborative working arrangement between institutions and others, might lead to barriers such as:

i Incompatible institutions' structures and cultures

ii Inadequate training and management support

iii Uneven commitment

4.7 Relationship between barrier and top management support

Between barriers and top management support, a statistical significant relationship is observed (Wilks's λ, $F(114,669.38)=1.299$, $p < .05$). However, by taking $(1-\lambda)$, a large effect size of 0.683 is observed (See AppendixB, Table B3). Having identified a noteworthy relationship between barrier and top management support, further examinations were made.

From the effects for each function, only the first two functions are considered fit (28.9% and 25.7% of shared variance) which explains 54.6% of the shared variance. The remaining 4 functions only explained only 45.4% in total of the remaining variance in the variable sets after the extraction of the prior functions. Therefore table below presents the standardized coefficient, structure coefficient and the squared structure coefficient on function 1 and 2.

Table 4.17: Canonical solution for top management support predicting Barriers

Variables	Function 1			Function 2			
	Coef	r_s	R^2_c%	Coef	r_s	R^2_c%	h^2%
Plant and Equipment procurement schedule	-0.09	0.03	0.09	-0.02	0.11	1.21	1.3
Insitutional resistance for change to Plant and Equipment procurement models process	0.12	0.07	0.49	-0.33	-0.23	5.29	5.78
Lack Plant and Equipment procurement models knowledge	0.38	0.37	13.69	0.18	0.15	2.25	15.94
Communication problems	-0.15	-0.16	2.56	0.11	0.13	1.69	4.25
Failure to use Plant and Equipment procurement models in project execution	-0.37	-0.16	2.56	0.34	0.25	6.25	8.81
Misunderstanding of Plant and Equipment procurement models concept	-0.23	-0.17	2.89	-0.27	-0.30	9	11.89
Uneven commitment	0.38	0.20	4	0.20	0.14	1.96	5.96
Lack of continuous procurement improvement	-0.35	-0.24	5.76	0.38	0.48	23.04	28.8
Inefficient problem solving procedure	0.43	0.43	18.49	-0.12	-0.10	1	19.49
Inadequate training and management support	0.06	0.12	1.44	-0.01	-0.02	0.04	1.48
Lack of strategic sourcing	-0.03	-0.16	2.56	0.53	0.39	15.21	17.77

Variables	Function 1			Function 2			
	Coef	**r_s**	**R^2_c%**	**Coef**	**r_s**	**R^2_c%**	**h^2%**
Lack of appropriate skills and competencies	-0.01	-0.10	1	0.17	0.21	4.41	5.41
Incompatible institutions' structures and cultures	0.01	0.04	0.16	0.35	0.26	6.76	6.92
Incompatible procurement engineers	0.14	0.14	1.96	-0.06	0.13	1.69	3.65
Plant and Equipment procurement and without risk mitigation	0.07	0.15	2.25	-0.07	0.06	0.36	2.61
Legal/Legislative considerations	-0.55	-0.44	19.36	-0.35	-0.26	6.76	26.12
Difficulties in establishing mutual objectives by all project team members organization	0.21	0.22	4.84	-0.11	-0.17	2.89	7.73
Difficulties in the involvement of all key engineering stakeholders in procurement processes	0.23	0.27	7.29	0.25	0.24	5.76	13.05
Stakeholders resistance to its introduction and implementation of new strategies in procurement	-0.01	0.07	0.49	0.03	0.11	1.21	1.7
Covariates			28.9%			25.7%	
Top Management support and commitment. Our top management are interested in collaborative working arrangement.	0.25	0.11	1.29	0.38	0.06	0.36	1.64
There is consistent and effective support from the top management which could encourage the introduction and implementation of collaborative Plant and Equipment procurement working arrangement.	-0.46	0.05	0.26	-0.40	0.00	0.00	0.26
There is commitment from the of top management to Plant and Equipment procurement working principles.	-0.16	-0.33	10.61	-0.09	-0.22	4.80	15.40
Management willingness to provide financial and other relevant resources to ensure successful introduction of Plant and Equipment procurement procedures.	-0.60	-0.01	0.01	-0.61	-0.03	0.10	0.11
We do assign appropriate duties to our staff which was best ensure smooth achievement of procurement objectives.	0.49	0.38	14.81	0.55	0.26	6.98	21.79
We have change management strategy that was ensure smooth introduction of new techniques.	0.23	-0.94	87.75	0.29	-0.88	76.60	164.36

R_c^2%> 10.0 are considered

From Table 4.17 under function 1 $R_c^2\%$, one sees that relevant criterion variables were 'Lack of Plant and Equipment procurement models knowledge', 'Inefficient problem solving procedure' and 'Legal/Legislative considerations' is contributing to the synthetic criterion variable. Furthermore, with the exception of Legal/Legislative, all of these variables' structure coefficients had the same sign, indicating that they were all positively related. Regarding the predictor variable set in Function 1, 'there is commitment from the of top management to Plant and Equipment procurement working principles', and 'we have change management strategy that was ensure smooth introduction of new techniques' have negative relating nature while 'assign appropriate duties to our staff which was best ensure smooth achievement of procurement objectives' have positive relating nature. Moving to Function 2, the coefficients in Table 1 suggest that the only criterion variables of relevance were 'Lack of continuous procurement improvement' and 'Lack of strategic sourcing'; these are positively related. On the side of predictor variable, only 'change management strategy that ensure smooth introduction of new techniques' is considered as the contring variable to the synthetic variable.

Thus, barriers such as 'Lack of Plant and Equipment procurement models knowledge', 'Lack of continuous procurement improvement', 'Inefficient problem solving procedure' and 'Lack of strategic sourcing' are increasing which might be due to the decrease in 'commitment from the top management support to Plant and Equipment procurement working principles and 'change in management strategy that ensure smooth introduction of new techniques'. However, result further show that, as the 'assigning of appropriate duties to our staff which best ensure smooth achievement of procurement objectives' increase, 'Legal/Legislative considerations' decreases, this might due to the fact that the duties assigned are to incompetent staff, hence legal/legislators loss interest in consideration.

4.8 Relationship between communication and mutual trust

Communication and mutual trust are not significantly related (Wilks's λ, $F(35,540.88)=1.248$, $p > .05$). However, by taking (1-λ), the effect size of 0.279 is observed. Considering the proportion of variance shared between the variable set across all canonical functions (1-λ) and the $p > .05$, communication have no effect on the mutual trust of respondents. (See AppendixB, Table B4)

4.9 Relationship between cultural issues and mutual trust

As reported, cultural issues and mutual trust are not significantly related (Wilks's λ, $F(35,540.88)=1.317$, $p > .05$). However, by taking (1-λ), the effect size of 0.291 is observed. Considering the proportion of variance shared between the variable set across all canonical functions (1-λ) and the $p > .05$, cultural issues have no effect on the mutual trust of respondents. (See AppendixB, Table B5).

4.10 Relationship between drivers and integration

The canonical correlation analysis conducted using integration variables as predictors of drivers/facilitators variables to evaluate the multivariate shared relationship between the two variable sets shows that, there is a statistical significant relationship between drivers/facilitators and integration, (Wilks's λ, $F(90,572.11)=1.459$, $p < .05$). Also, by taking (1-λ), a large effect size of 0.633 is observed hence, only the first two functions are considered fit (36.0%% and 19.0% of shared variance) which explains 55.0% of the total shared variance. Therefore table below presents the standardized coefficient, structure coefficient and the squared structure coefficient on function 1 and 2. (See AppendixB, Table B6).

Table 4.18: Canonical solution for drivers and integration

Variables	Function 1			Function 2			
	Coef	r_s	R^2_c%	Coef	r_s	R^2_c%	h^2
Client's interest in the use of the procurement models	0.16	0.16	2.56	0.21	-0.09	0.81	3.37
Availability of well-trained individuals to act as facilitators	-0.09	0.03	0.09	-0.08	-0.09	0.81	0.9
Government policy support through procurement Act 2007	0.04	0.16	2.56	0.21	0.16	2.56	5.12
Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models	0.06	-0.78	60.84	0.01	-0.78	60.84	121.68
Other stakeholders interest/support in the use of the Plant and Equipment procurement models	0.21	-0.08	0.64	0.3	-0.12	1.44	2.08
Commitment and cooperation of professional bodies to the implementation of the Plant and Equipment procurement models	0.18	-0.08	0.64	0.08	0.05	0.25	0.89
Advantage of the Plant and Equipment procurement models over conventional process	-0.01	0.28	7.84	0.01	0.06	0.36	8.2
Alignment of stakeholders objectives in your organization	0.05	-0.12	1.44	0.07	-0.03	0.09	1.53
Is your environment conducive for procurement	-0.31	0.3	9	-0.31	0.29	8.41	17.41
Roles and Standard of your procurement process	0.39	-0.21	4.41	0.33	-0.24	5.76	10.17
Did have Just in time delivery and Need assessment	-0.2	-0.14	1.96	-0.18	-0.11	1.21	3.17
Management commitments to new procurement technology	-0.14	0.14	1.96	0.02	0	0	1.96
Contractors compliance to new technology in procurement	0.04	0.12	1.44	-0.03	-0.07	0.49	1.93
Are your procurement base on Value	0.52	0.01	0.01	0.48	0.05	0.25	0.26
Supplier performance measurement and improvement	0.28	0.44	19.36	0.21	0.42	17.64	37
Did know about Strategic sourcing	-0.38	-0.18	3.24	-0.39	-0.14	1.96	5.2
Assessing supply market knowledge	0.4	0.05	0.25	0.38	-0.02	0.04	0.29
Did have an idea how an Engineer can procure	-0.01	-0.11	1.21	0.04	-0.03	0.09	1.3

Variables	Function 1			Function 2			
	Coef	**r_s**	**R^2_c%**	**Coef**	**r_s**	**R^2_c%**	**h^2**
and install							
Predictors		36.0 %			19.0%		55.0 %
Availability and willingness to share information amongst procurement participants	0.55	-0.85	72.25	0.52	-0.84	70.56	142.81
Recognition and involvement of plant and equipment procurement consultant contribution to the arrangements or procurement consultant contribution procurement processes	0.44	0.16	2.56	0.44	0.25	6.25	8.81
Alignment of our institutions' objectives with other stakeholder's in training and workshops on engineering procurement management	-0.35	-0.28	7.84	-0.42	-0.24	5.76	13.6
Acceptance of risk schedule in engineering procurement execution and risk transfer through consultant, insurance etc	-0.64	-0.44	19.36	-0.55	-0.36	12.96	32.32
Institutions do establish long-term Plant and Equipment procurement strategies	0.13	0.14	1.96	0.13	0.19	3.61	5.57

R_c^2%> 10.0 are considered

Looking at Function 1 coefficients as shown above, one sees that relevant criterion variables were primarily 'Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models' and 'Supplier performance measurement and improvement', contributing to the synthetic criterion variable. These key variables also tended to have the larger canonical function coefficients. Regarding the predictor variable set in Function 1, 'Availability and willingness to share information amongst procurement participants' and 'Acceptance of risk schedule in engineering procurement execution and risk transfer through consultant, insurance' variables were the primary contributors to the predictor synthetic variable. All the four identified variable on the side of criterion and predictor variables are

positively related to each other. These results were generally supportive of the theoretically expected relationships between drivers/facilitators and integration.

Moving to Function 2, same variables on the side of criterion and predictors and observed, the variables are also positively related.

Thus, this study reveals that, the availability and willingness to share information amongst procurement participants and also the acceptance of risk schedule in engineering procurement execution and risk transfer through consultant and insurance, leads to public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models and also effective supplier performance measurement and improvement.

4.11 Relationship between drivers and top management support

As reported, there is a statistical significant relationship between drivers/facilitators and top management support (Wilks's λ, $F(108,671.98)=1.383$, $p < .05$). Considering $(1 - \lambda)$, a large effect size of 0.683 is revealed. Given a large effect for each function, only the first two functions are considered fit for exploring relevant criterion and predictor variables (32.6%% and 24.9% of shared variance) this explains 57.5% of the total shared variance (See AppendixB, Table B7). However, table below presents the standardized coefficient, structure coefficient and the squared structure coefficient on function 1 and 2.

Table 4.19: Canonical solution for drivers and top management support

Variables	Function 1			Function 2			h^2(%)
	Coef	r_s	R^2_c%	Coef	r_s	R^2_c%	
Client's interest in the use of the procurement models	-0.29	-0.28	8.08	-0.13	-0.19	3.45	11.53
Availability of well-trained individuals to act as facilitators	-0.14	-0.22	4.87	-0.08	0.03	0.07	4.94
Government policy support through procurement Act 2007	-0.01	-0.09	0.89	0.48	0.53	27.87	28.76
Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models	0.19	0.32	10.15	0.61	0.64	40.33	50.47
Other stakeholders interest/support in the use of the Plant and Equipment procurement models	0.45	0.41	16.79	-0.35	-0.27	7.32	24.10
Commitment and cooperation of professional bodies to the implementation of the Plant and Equipment procurement models	0.04	0.13	1.64	-0.03	0.06	0.39	2.04
Advantage of the Plant and Equipment procurement models over conventional process	0.11	0.09	0.77	-0.01	-0.07	0.45	1.22
Alignment of stakeholders objectives in your organization	0.12	0.20	4.12	0.07	0.10	0.93	5.05
Is your environment conducive for procurement	0.48	0.38	14.71	-0.08	-0.07	0.47	15.18
Roles and Standard of your procurement process	0.01	0.00	0.00	0.08	-0.04	0.16	0.16
Did have Just in time delivery and Need	0.08	0.18	3.17	-0.25	-0.17	2.93	6.09

assessment							
Management commitments to new procurement technology	0.06	-0.02	0.04	-0.24	-0.30	9.00	9.04
Contractors compliance to new technology in procurement	-0.40	-0.33	11.00	0.14	0.09	0.87	11.87
Are your procurement base on Value	-0.41	-0.39	14.97	-0.09	0.01	0.01	14.98
Supplier performance measurement and improvement	-0.17	-0.14	1.83	0.04	-0.03	0.10	1.93
Did know about Strategic sourcing	0.28	0.29	8.38	-0.04	0.12	1.44	9.82
Assessing supply market knowledge	0.03	0.05	0.28	0.26	0.35	12.08	12.36
Did have an idea how an Engineer can procure and install	0.04	0.14	1.83	0.15	0.16	2.51	4.34
Covariates			32.6%			24.9%	
Top Management support and commitment Our top management are interested in collaborative working arrangement	0.29	0.35	12.18	0.53	0.39	14.99	27.18
There is consistent and effective support from the top management which could encourage the introduction and implementation of collaborative Plant and Equipment procurement working arrangement	-0.07	-0.01	0.02	0.12	0.14	1.89	1.91
There is commitment from the of top management to Plant and Equipment procurement working principles	-0.05	-0.21	4.51	0.75	0.65	42.57	47.08
Management willingness to provide financial and other relevant resources to ensure successful introduction of Plant and Equipment procurement procedures	-0.20	-0.18	3.23	0.05	-0.03	0.07	3.30
We do assign appropriate duties to our staff	-0.67	-0.59	34.22	-0.43	-0.30	8.96	43.19

which was best ensure smooth achievement of procurement objectives							
We have change management strategy that was ensure smooth introduction of new techniques	0.69	0.67	45.01	-0.40	-0.40	16.0	61.01

$R_c^2\%$> 10.0 are considered

From Function 1 coefficients as shown 4.19, one sees that relevant criterion variables were primarily 'Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models', 'Other stakeholders interest/support in the use of the Plant and Equipment procurement models', 'Is your environment conducive for procurement', 'Contractors compliance to new technology in procurement' and 'Are your procurement base on Value' contributing to the synthetic criterion variable. However, except for 'Contractors compliance to new technology in procurement' and 'Are your procurement base on Value', the entire three identified variable on the side of criterion and predictor variables are positively related.

Regarding the predictor variable set in Function 1, 'Top Management support and commitment our top management are interested in collaborative working arrangement' and 'Change management strategy that was ensure smooth introduction of new techniques' have positive relating nature, while 'Assign appropriate duties to our staff which was best ensure smooth achievement of procurement objectives' have negative relating nature. These variables were considered the primary contributors to the predictor synthetic variable.

Considering Function 2, the coefficients in Table 1 suggest that the only criterion variables of relevance were 'Government policy support through procurement Act 2007', 'Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models' and 'Assessing supply market knowledge' are positively related. On the side of predictor variable, 'Top Management support and commitment Our top management are

interested in collaborative working arrangement', 'There is commitment from the of top management to Plant and Equipment procurement working principles' and 'Change management strategy that ensure smooth introduction of new techniques' are considered as the contributing variable to the synthetic variable.

Thus, it can said that, the staff which appropriate duties are assigned to are incompetent for the duty. This is because if there is decrease in the 'assigning of appropriate duties to our staff which best ensure smooth achievement of procurement objectives' there will be increase in 'Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models', 'Government policy support through procurement Act 2007', 'Other stakeholders interest/support in the use of the Plant and Equipment procurement models' and 'Is your environment conducive for procurement'. More so, from the inverse relationship between 'Top Management support and commitment Our top management are interested in collaborative working arrangement', 'There is commitment from the of top management to Plant and Equipment procurement working principles', 'We have change management strategy that was ensure smooth introduction of new techniques' and 'Contractors compliance to new technology in procurement', 'Are your procurement base on Value'. It is evident that, top management are concentrating on supporting less important areas. Therefore, it is recommended that proper education on the appropriate areas that need support should be given.

4.12 Relationship between knowledge and top management support

As reported in table above, knowledge and top management support are not significantly related (Wilks's λ, F(54,641.97)=1.195, p > .05). However, by taking (1-λ), the effect size of 0.386 is observed. Considering the proportion of variance shared between the variable set across all canonical functions (1-λ) and the p > .05, knowledge have no effect on top management support.

4.13 Principal component analysis

Principal component analysis are statistical techniques applied to a single set of variables when there is interest in discovering which variables in set form coherent subsets that are relatively independent of one another.Variable that are combined into factors.These factors are to reflect underlying processes that have created the correlations among variables. Barbara et al, 2000 stated the major goal of principal components analysis are to identify how different variables work together to create the dynamic of the system,decrease redundancy in data,compress data and prepare tha data for further analysis likewise reveal hidden structure in a data set. However, the main purpose of conducting PCA in this study is to extract one variable which account or have the component of all the variables in a set of variables. Across each set, the highest eigenvalue was used in order to have one component accounting for all the variables. The sets of variable of interest are:

i. Drivers/facilitators
ii. Barriers
iii. Environment legal issues
iv. Cultural issues

Hence, for drivers/facilitators and barriers, the eigenvalue of 1.7 was used. On environment legal issue, the eigenvalue of 1.3 was used and on cultural issue 1.4. (See Appendix B).

4.14 Multiple regression analysis

Multiple regression is a statistical measure that attempts to determine the strength of the relationship between one dependent variable (usually denoted by Y) and a series of other changing variables (known as independent variables). The two basic types of regression are linear regression and multiple regression. Linear regression uses one independent variable to explain and/or predict the outcome of Y, while multiple regression uses two or more independent variables to predict the outcome. The general form of each type of regression is:

Linear regression: $Y = a + bX + u$……..…..... 4.1

Multiple regression: $Y = a + b_1X_1 + b_2X_2 + B_3X_3 + ... + B_tX_t + U$…….... .....4.2

Where:

Y= the variable that we are trying to predict

X= the variable that we are using to predict Y

a= the intercept

b= the slope

u= the regression residual.

In multiple regression, the separate variables are differentiated by using subscripted numbers. Regression takes a group of random variables, thought to be predicting Y, and tries to find a

mathematical relationship between them. This relationship is typically in the form of a straight line (linear regression) that best approximates all the individual data points.

4.15 Important assumptions

The first assumption is that the dependent variable can be calculated as a linear function of the covariates, plus an error term.

The second assumption is that the expected value of the error term is zero, which can be expressed mathematically as E[e] = 0. An estimator with the expected value of zero is called unbiased.

The third assumption is that the error terms all have the same variance and are not correlated with one another.

The fourth assumption is that the covariates can be considered fixed in repeated samples, which means it is possible to redraw the sample with the same values for the covariates. This can be expressed mathematically as E[**eeT**] = σ**I**.

The fifth assumption is that the number of dependent variables is greater than the number of covariates and that there are no exact linear relationship between the covariates. (Kennedy, 2008).

4.16 Estimation of multiple regression model

Two methods are considered in estimating the model, namely, Ordinary Least Square-based (OLS) method and Maximum Likelihood-based (ML) method.

Ordinary least square method:OLS method assumes that the expected value of the regress and or the probability that the regress takes on the value 1 is a linear function of the observed characteristics of the observations. The model encompasses a number of lapses in the sense that the assumptions underlying a probabilistic model are not satisfied. For instance when OLS technique is employed ($\hat{p}y_i - 1|X_i$) does not always fall between 0 and 1. Secondly,

when the values of the covariates increase $(\hat{p}y_i - 1|X_i)$ does not always increase suggesting that $(\hat{p}y_i - 1|X_i)$ is not always an increasing function of X_i. Thirdly, because $X_i$may be non-linearly related to $(\hat{p}y_i - 1|X_i)$ the error term ε_i is heteroscedastic, suggesting the parameters are inconsistent and thus inference is deceptive (Gujarati, 2004). In order to correct for the inconsistency of OLS method based on Log-likelihood function are adopted.

Before undertaking a formal regression analysis of these data, graphical examination of the data was done using scatterplot matrix. Such a display is useful in assessing the general relationships between the variables, in identifying possible outliers, and in highlighting potential collinearity problems amongst the explanatory variables(See Appendix D).

The resulting scatterplot matrix shows evidence of outliers from several of the scatterplots. The relationships of particular interest, namely those between strategy and the explanatory variables, indicate some possible non-linearity. However, the outliers were omitted before conducting further analysis.

The following equation was used for the multiple regression of data in this study.

$\text{Log}_{10}(y_i)^2 = \beta_0 + \beta_1 df + \log(br) + (\beta_3 br_i + \beta_4 EL_i + \beta_5 SO_i) + \varepsilon_i$ 4.3

Where:

y = Strategy of procurement

df = drivers/facilitators

br = Barrier of procurement

EL = environment legal issue

SO = Size of organisation(or institution)

β = Unknown parameters

ε_i = Constant

Table 4.20: Regression analysis of strategy of procurement models

Source	SS	df	MS	Number of obs	14
				F(6, 7)	17.36
Model	9.407953	6	1.56799209	Prob > F	0.0007
Residual	0.632372	7	.090338876	R-squared	0.937
				Adj R-squared	0.883
Total	10.04032	13	.772332668	Root MSE	0.30056

Strategy	**Coef.**	**Std. Err.**	**T**	**P>t**	**[95% Conf.**	**Interval]**
Df	-0.49444	.0957436	-5.16	0.001	-0.71523	-0.27366
Log(Bar)	-0.52969	.1481488	-3.58	0.007	-0.87133	-0.18806
EL	0.424314	.0776928	5.46	0.001	0.245154	0.603474
Log(CI)	-0.19853	.0826441	-2.40	0.043	-0.38911	-0.00795
SO	0.782048	.1602678	4.88	0.001	0.412469	1.151626
_cons	-0.84614	.2674035	-3.16	0.013	-1.46277	-0.22951

Source: Field work (2015) factors to consider key are:

Y = Strategy

df = Diver/facilitators

bar = Barriers

EL = Environment legal issue

CI = Cultural Issue

SO = Size of organization

Table 4.20 shows the analysis of variance table and the parameter estimates. In the former, the ratio of the model mean square to the residual mean square gives an *F*-test for the hypothesis that *all* the regression coefficients in the fitted model are zero (except the constant β_0). The resulting *F*-statistic with (6, 7) degrees of freedom takes the value 18.04 with associated *p*-value < 0.01. Consequently, the hypothesis is rejected. The square of the multiple correlation coefficient (R^2) is 0.937 showing that 94% of the variance of procurement strategy is accounted for by the five explanatory variables of interest.Thus, basing all discussions at 5% level of probability. From table 4.20, the expected sign of the

coefficient of driver/facilitators, Barrier and Cultural issue is hypothesized to be negative, implying to every 1% decrease in strategy of procurement, drivers/facilitators decrease with 49%, barriers decrease with 52% while cultural issues decrease with 19%. However, environment and legal issue are hypothesised to have positive sign implying that, to every 1% decrease in strategies of procurement, environment legal issues increases with 42%, while size of organisation increases with 78%.

Procurement model were further used to show relationships and logical approach toward plant and equipment procurement in Tertiary institutions in Kaduna State, from showing relationship to practical methodologies likewise EPeI model.

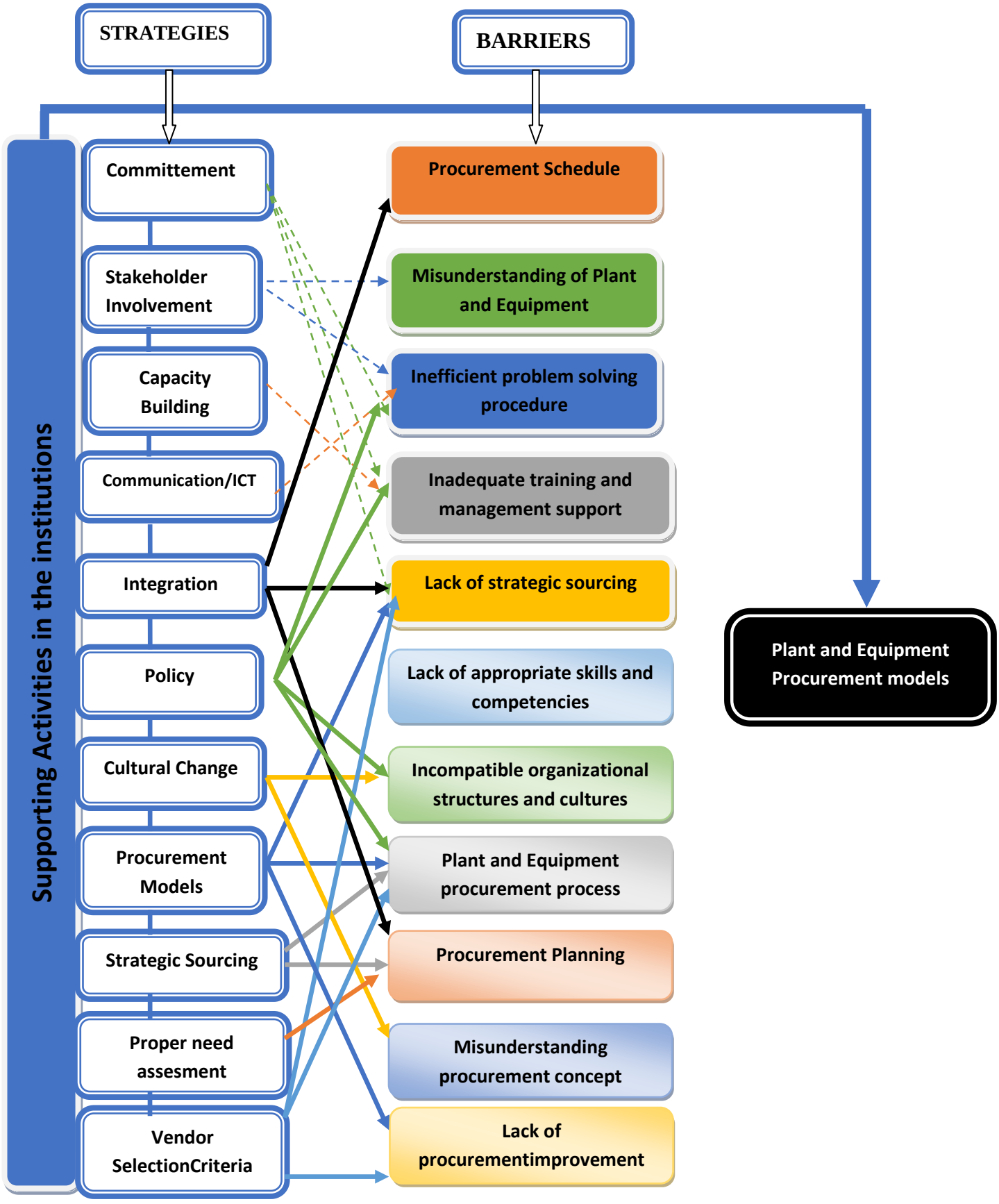


Figure 2.5: Strategies and barriers to the implementation of plant equipment procurement models in Tertiary institutions (Source: Field survey, 2016)

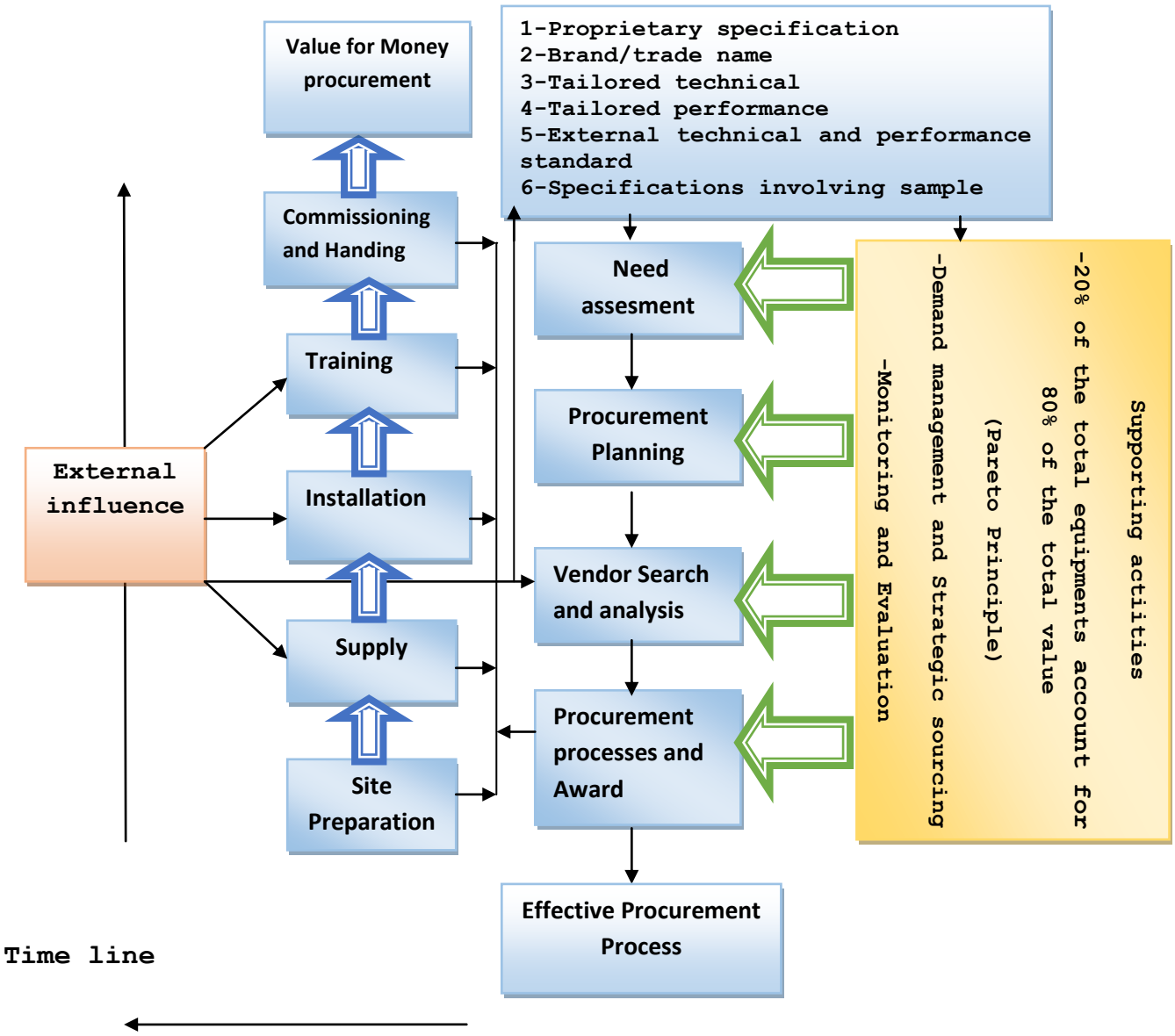


Figure 2.6:Logical model in procurement of plants and equipment (Source:Field survey, 2016)

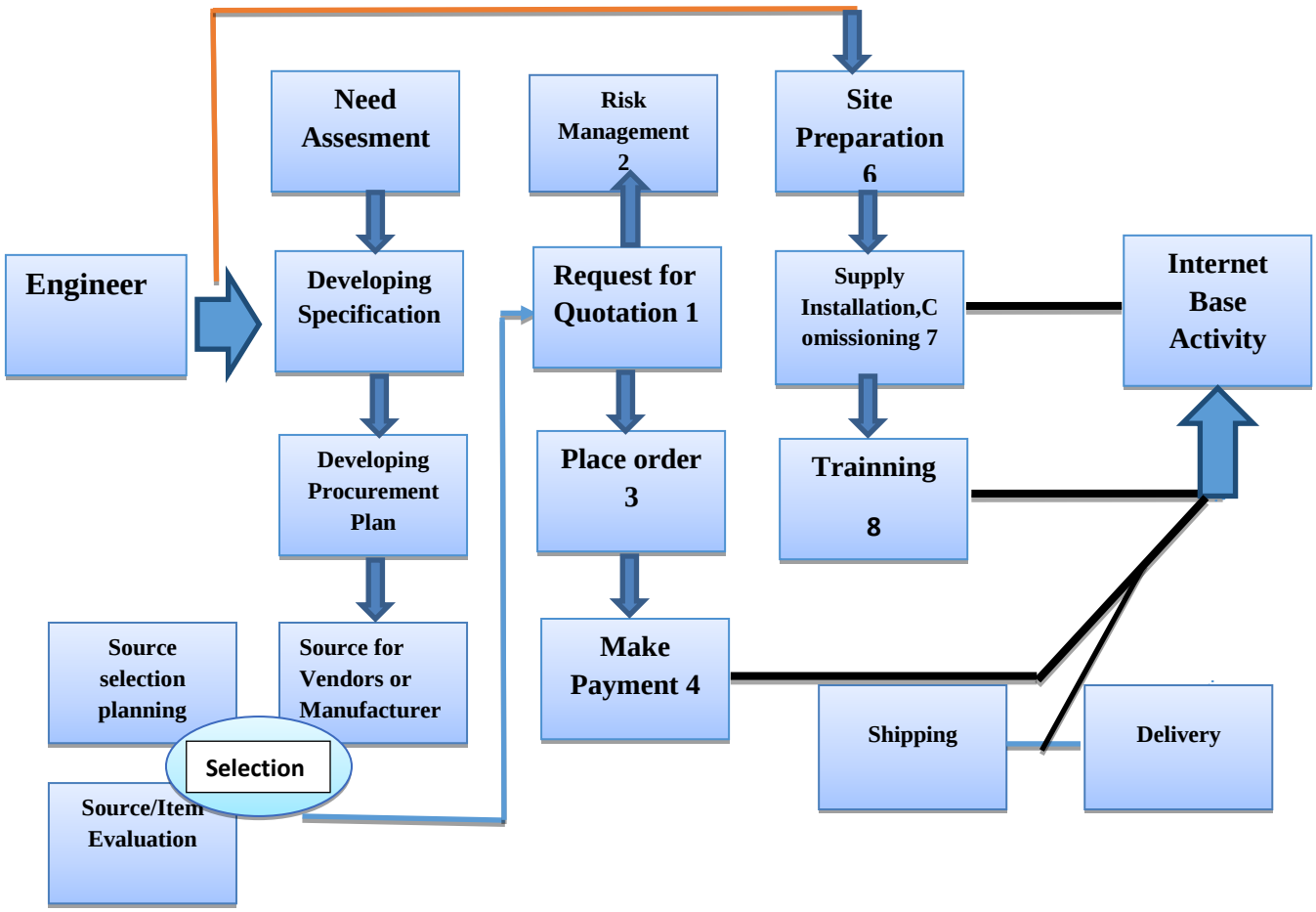


Figure 2.7:Engineer procure install model EPe-I (Source:Field survey 2016)

4.17 Plant and Equipment Procurement Models

The models in figure 2.4 shows the relationship between strategies and barriers using our literature for scenerion analysis of various (what if situations on the barriers and strategies) so as to generate a conceptual logical model in figure 2.5 that can enhance and improve the logical procurement methodology for effective plant and equipment procurements as a process that has a start and finish using our data and literature in line with the provisions of the Public Procurement Act, 2007 after series of brainstorming. Therefore, the models can be used to generate another conceptual Engineer Procure e-install model as illustrated in figure 2.6 as a buyer to consumer (B2C) interface.

In order to show the contribution of this research to knowledge and startegies of providing solutions to plants and equipment procurement, the models in which the various component represent strategies, guide and simplified process is employed throuhg our literature .EPeI-Engineer Procure e-Install model**.**These model were generated in the process of this research as a new technology for the general use in plant and equipment procurement in Tertiary Institutions and was enhance the use of professional engineers in every procurement for efficiency and cost saving and right on time delivery as a contribution to knowledge. The survey also shows that 62.1% of the Tertiary Institutions are very large in size,while22.4% of the respondents are 6-10years of experience and 50% of the respondents are at middle management level,which clearly indicated the degree of success if the models are implemented. Also 60%of the respondents as reported has high knowledge of procurement in accordance to their understandard.Further result shows that 53.7% of contract awarded are outside cost estimate and time,and 21.2% are abandoned.The percentage of contract awarded outside specification is very alarming while 40.3% were neither rejected nor not inproper use.The multiple regression analysis shows that the square of the multiple correlation coefficient (R^2) is 0.937 showing that 94% of the variance of procurement strategy is accounted for by the five explanatory variables of interest.

The results suggest that procurement models have become an important part of procurement management and that the rate of adoption was accelerate as aggressive adopters share their experience.Most respondents are not using procurement models they are relatively new to to this procurement technology.

CHAPTER FIVE

SUMMARY,CONCLUTION AND RECOMMENDATION

5.1 Summary

The study examines the relationships between various variables and predict other unknown relationships, the overall respondent perception is that procurement models technologies was become an important element in the management of plant and equipment procurement in Tertiary Institutions. Except for a small group of Tertiary institution that have chosen to sit on the side and let others experiment, none of this institutions are actively involved in these technologies. Most organizations are participating in our traditional ways of procurement and they are not making the use of ourengineering professionals,people are not aware of new developments in procurments and develop the required capabilities to move into these technologies. These procurement model technologies are run on plant and equipment supply processes such as teaching and research supplies and heavy duty equipments. A selected group, however, is ready for changing the traditional procurement technologies with the expectation of deriving the promised benefits ahead of institutions in securing funding.

The economically determined selection procurement process model at this early stage suggests that the outcome may not be anonly single dominant design but a set of technological solutions that vary in the methods of procurements involved. Thus, institutions planning to move their core supply processes to direct procurement solution should carefully weigh the economics of the various e-procurement technologies.

The logical framework presented is based on the initial framework presented in literature and on the outcome of empirical research. Also, evidence from the literature has been employed to develop a more practical framework for the adoption of e-procurement. It should be noted

that some articles appearing in the literature do discuss various issues related to the adoption of procurement models procurement. Some of them have been discussed as background information for the developed framework and logical models.

Explaining the overall development processes that include generic procurement processes, data entities used in the system, functional diagram, and technical architecture as a guideline for procurement model system development in Nigerian Institutions for value for money.

5.2 Conclusion

Based on the findings of this research,the following conclusions can be drawn:

i. Procurement project investigated suffers delay in completion and or completion outside specification and cost, with abandonment of procurements sometimes the order of the day.
ii. Thus, cultural issues should not be considered as an influence as far as plant and equipment procurement is concerned in the Tertiary institutions.
iii. Recognition and involvement of plant and equipment procurement consultants' contribution in procurement processes and also alignment of institutions' objectives with other stakeholders in training and workshops on engineering procurement management are integrated in the Tertiary institutions.
iv. Adequate communication is given in order to ensure proper specification and quality control in every procurement in Tertiary institutions as reported.
v. Considering the present condition/state of the Tertiaty institutions, all strategies needed for equipment procurement is available except that majority not all are not properly implemented by the appropriate personnel.
vi. There is likelihood that other procurement models are beneficial, favorable, or at least not detrimental to Tertiary institutions' interest as observed.

vii. Adequate knowledge on procurement is available in the Tertiary institutions, due to the fact that proper awareness are being created in course, a core or elective course unit, main heading, subheading etc in most department and/or faculty of the institutions for proper enlightenment whereas lack of basic skills and experience, because staff are not opportuned to attend plant and equipment procurement workshop within and outside Nigeria and staff with ability to implement newly introduced concept quickly and accurately are lacking.

Various models for procurements in the literature are not applicable to our problems and procurement process, therefore more conceptual models are to be created to solve our daily plant and equipment procurement problems.

5.3 Recommendations

Based on findings and analysis carried out in this research, the researcher strongly recommends that:

i. Further research should be carried out on a software development to ease plant and equipment procurements using information technology.

ii. Professional engineers must be involved in plant and equipment procurement as consultant to reduce cost and delay in completion likewise,quality,risk control and management.

iii. From the researcher's investigation there isthe need for re-orientation of the members of Tertiary institutions with regards to plant and equipments procurements.

iv. There is the need to review government policies on plants and equipment procurements in Nigeria with regards to direct procurements.

v. Creation of new procurement models that will enhance just-in-time delivery of projects and reduce procurement process timelines.

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APPENDIX A

DEPARTMENT OF MECHANICAL ENGINEERING

FACULTY OF ENGINEERING

AHMADU BELLO UNIVERSITY, ZARIA

M. PHIL/PhD ENGINEERING MANAGEMENT

QUESTIONNAIRE SURVEY

Development of Conceptual Procurement Models for Plant and Equipments in Tertiary Institutions in Kaduna State

INTRODUCTION

This questionnaire survey is part of the study entitled "**Development of Conceptual Procurement models for Plant and Equipments in Tertiary Institutions in Kaduna State**".The success of the study will provide a clear indication on the current Plant and Equipment procurement status of the Kaduna State and Institutions selected in Nigeria with a view of providing guide and standards for adopting the procedures discussed. It will also inform the stakeholders of their areas of strengths and weaknesses which will help them to plan ahead.

The questionnaire consist of four parts: A, B, C and D. Part A seeks general information about the respondents, part B invites opinion on the level of experience of the staff to the implementation of Plant and Equipment procurement using models within the Tertiary Institutions in Kaduna State, part C invites opinion on the level of existence of the barriers to introduction and implementation of Plant and Equipment procurement models within the Tertiary Industry and other enterprise and part D invites the respondent opinion on the level of existence of the essential requirements for Plant and Equipment procurement models in his institution.

Your participation in the survey is very crucial to the success of this research. All information provided will be treated with utmost confidentiality and no personal information about you or your institution will be disclosed in the final report.

I would be glad to share the summary of findings with you if you are interested.

Thank you.

Ibrahim, Bashir Garba P14EG9009

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PART A
GENERAL INFORMATION

For each of the following questions, you are required to write the requested information in the space provided or indicate, using a tick (√), the options that best represent your situation/opinion.

1	Personal Information (optional)				
1a	Name:	1b	Telephone No.	1d	Email:
1e	Contact Address			1f	Date:

2	How many years have you been involved in the Equipment and Plant Procurement?				
Less than 5 years	6-10 years	11-15 years	16-20 years	21-25 years	More than 25 years

3	What is your rank/position in your organisation?	
Top management Level	Middle management Level	Low management Level

4	Do you have knowledge about Procurement?
Yes	No

5	Characteristics of Organisation

Role of your organisation in the Procurement of Plant and equipment

Client			Consultant			Contractor			
Public Sector	Private Sector	Semi-Public	Architect	Quantity Surveyor	Engineer	Main - Contractor	Sub-Contractor	Supplier	Manufacturer

Size of your organisation, in terms of workforce & annual turnover, compared to others in the same sector

Very large		Large		Medium		Small		Very small	

Geographical catchments of your organisation's operations

Local (working within one state only)		Regional (working within one geo-political zone only)		National		International	

6	Has your organisation ever participated in Engineering Procurement?		
Yes		No	

SECTION B

DRIVERS/FACILITATORS FOR INTRODUCING PLANT AND EQUIPMENT PROCUREMENT IN KADUNA STATE AND OTHER ENTERPRISE

The following are some drivers/facilitators for introducing and implementing Plant and Equipment procurement selection model in Tertiary Kaduna State. Using a scale 1 to 4, where 1 represents "never exist ", 2 represents "rarely exist ", 3 represents "sometimes exist ", 4 represents "most of the times exist", indicate your assessment of the level of existence of each of the drivers/facilitators within the Tertiary Institution.

S/NO	Drivers/Facilitators	LEVEL OF EXISTENCE				
		1	2	3	4	
1	Client's interest in the use of the procurement models					
2	Availability of well trained individuals to act as facilitators					
3	Government policy support through procurement Act 2007					
4	Public awareness by the stakeholders on the benefits of the Plant and Equipment procurement models					
5	Other stakeholders interest/support in the use of the Plant and Equipment procurement models					
6	Commitment and cooperation of professional bodies to the implementation of the Plant and Equipment procurement models					
7	Advantage of the Plant and Equipment procurement models over conventional process					
8	Alignment of stakeholders objectives in your organization					
9	Is your environment conducive for procurement					
10	Roles and Standard of procurement process					
11	Did the organization have Just in time delivery and Need assessment					
12	Management commitments to new procurement technology					
13	Contractors compliance to new technology in procurement					
14	Are the procurement based on Value for money					
15	Supplier performance measurement and improvement					
16	Did know about Strategic sourcing					
17	Assessing supply market knowledge					
18	Did have an idea on how an engineer can procure and install online procurement					

SECTION C:

BARRIERS TO INTRODUCING AND IMPLEMENTING PLANT AND EQUIPMENT PROCUREMENT MODELS IN INSTITUTIONS IN KADUNA STATE

The following are some barriers to introducing and implementing Plant and Equipment procurement models in the Tertiary Institution in Kaduna State. Using a scale 1 to 4, where 1 represents "never exist ", 2 represents "rarely exist ", 3 represents "sometimes exist ", 4 represents "most of the times exist ", indicate your assessment of the level of existence of each of the barriers within the Tertiary Institution in Kaduna State.

S/NO	Barriers to Plant and Equipment procurement models implementation	LEVEL OF EXISTENCE				
		1	2	3	4	
1	Plant and Equipment procurement schedule					
2	Organizational resistance for change to Plant and Equipment procurement models process					
3	Lack Plant and Equipment procurement models knowledge					
4	Communication problems					
5	Failure to use Plant and Equipment procurement models in project execution					
6	Misunderstanding of Plant and Equipment procurement models concept					
7	Uneven commitment					
6	Lack of continuous procurement improvement					
7	Inefficient problem solving procedure					
8	Inadequate training and management support					
9	Lack of strategic sourcing					
10	Lack of appropriate skills and competencies					
11	Incompatible organizational structures and cultures					
12	Incompatible procurement engineers					
13	Plant and Equipment procurement and without risk mitigation					
14	Legal/Legislative considerations					
15	Difficulties in establishing mutual objectives by all project team members organization					
16	Difficulties in the involvement of all key engineering stakeholders in procurement processes					
17	Stakeholders resistance to its introduction and implementation of new strategies in procurement					

The following are some essential requirements for introducing and implementing Plant and Equipment procurement models in Kaduna State and other enterprise in Nigeria. Using a scale 1 to 4, where 1 represents "never", 2 represents "rarely", 3 represents "sometimes", 4 represents "most of the times" ,indicate your organization's current level of existence of each of the requirements in readiness for introducing and implementing procurement models.

SECTION D:

ESSENTIAL REQUIREMENTS FOR INTRODUCING AND IMPLEMENTING PLANT AND EQUIPMENT PROCUREMENT MODELS IN THE TERTIARY INSTITUTIONS IN KADUNA STATE

S/NO	ENVIRONMENT	LEVEL OF EXISTENCE				
		1	2	3	4	
A	**Legal Issues**					
1	The Procurement Acts 2007 practiced in Nigeria support all standards for carrying out any procurement activities but with limited risk avoidance procedure in Plant and Equipment procurement implementation.					
2	Our professional practice / organizational operations / trade practices etc are guided by our professional body's ethics /articles of association / statute that formed our organization etc and they are supporting Plant and Equipment procurement implementation strategies.					
3	The conduct of procurement is guided by procurement Act 2007 and the nine steps of procurement for the value of money and quality assurance supporting plant and Equipment procurement implementation strategies.					
4	There are other laws which are supporting Plant and Equipment procurement procedures within our organizational/procurement environment.					
B	**Cultural Issues**					
1	Our organization members embrace changes which the organization undergo and the opportunities it brings easily.					
2	Our organizations do recognize and value the cultures of all other stakeholders participating in engineering procurement.					
3	There are no complex and complicated bureaucratic procedures as policies in our organization.					
4	We are prepared for cultural change and the adoption of mutually agreed culture as a result of collaborative working arrangement between our organization and others.					
5	Our current organizational structure provides an environment that suit the adoption of Plant and Equipment procurement principle in the management of projects					
6	We do attend jointly organized social/cultural activities between procurement stakeholders					
7	There is compatibility between our organizational					

	cultures/structures with other participating organizations in our current and past engineering procurement.					
C	**Integration**					
1	Availability and willingness to share information amongst procurement participants.					
2	Recognition and involvement of Plant and Equipment procurement consultant contribution to the arrangements or procurement processes.					
3	Alignment of our organizational objectives with other stakeholder's in training and workshops on engineering procurement management.					
4	Acceptance of risk schedule in engineering procurement execution and risk transfer through consultant, insurance etc.					
5	Our organization do establish long-term Plant and Equipment procurement strategies.					
S/NO	**PEOPLE**	**LEVEL OF EXISTENCE**				
		1	2	3	4	
A	**Knowledge and skills**					
1	Our organizational members have attended Plant and Equipment procurement workshop within or outside Tertiary Institutions in Nigeria.					
2	Our organization do managed projects using Plant and Equipment procurement model procedures and techniques within Nigeria.					
3	Plant and Equipment procurement is in the curriculum (i.e. a course, a core or elective course unit, main heading, sub-heading etc) in the department and/or faculty of the institutions I attended.					
4	Plant and Equipment procurement experience and knowledge is one of the yardstick/criteria for the engagement of our services or patronization of our product by others within the Tertiary Institution in Kaduna State.					
5	We have within our organization people who can conduct engineering procurement workshop by acting as "facilitators".					
6	There is clear definition of roles and responsibilities of each staff working within the organization.					
7	There is recognition of the importance and benefits of collaborative working arrangement to Tertiary Institutions in Kaduna State by our organizational members.					
8	We do have staffs with the ability to implement newly introduced concept quickly and accurately.					
9	We have within our organization people with the ability and willingness to contribute in other stakeholder's field other than their main area of specialization, by using their knowledge and experience resources to ensure achievement					

	of project objective.					
B	**Mutual trust**					
1	We do rely on the integrity and honesty of other procurement stakeholders.					
2	We have confidence in the expertise and competence of other procurement stakeholders in guiding our needs.					
3	We are willing to be vulnerable to the actions of other procurement stakeholders based on the expectation that they will perform an important action in return, irrespective of our ability to monitor them.					
4	We are willing to accept new strategies for engineering procurement.					
5	We expect, believe or assume that there is likelihood that other procurement models will be beneficial, favorable, or at least not detrimental to our organization's interest.					
S/NO	**PROCESS**	**LEVEL OF EXISTENCE**				
		1	2	3	4	
A	**Plant and Equipment procurement strategy**					
1	We have established and do put to use risk identification process in procurement of plant and equipment					
2	We are ready to put procurement models into action					
3	We lack any equipment procurement strategy presently					
4	We have experience a lot of problems in procurement of plant and equipment					
B	**Communication**					
1	We do participate in an open and effective communication between the end users and consultant and manufactures or vendors.					
2	We do conduct strategic sourcing of plant and equipment before procurement process.					
3	We do attend regular procurement workshops to discuss progress and concerns about the procurements.					
4	We are committed to transparency and due process in plant and equipment procurement.					
5	We do make sure that specification and quality control are met in every procurement.					
6	We are make good use of internet during information and specification and description of plant and equipment.					
7	We are committed to open and conduct direct procurement procedure in the procurement of plant and equipment to save cost and delay.					
S/NO	**MANAGEMENT**	**LEVEL OF EXISTENCE**				
		1	2	3	4	
A	**Top Management support and commitment**					
1	Our top management are interested in collaborative working arrangement.					
2	There is consistent and effective support from the top management which could encourage the introduction and					

	implementation of collaborative Plant and Equipment procurement working arrangement.					
3	There is commitment from the of top management to Plant and Equipment procurement working principles.					
4	Management willingness to provide financial and other relevant resources to ensure successful introduction of Plant and Equipment procurement procedures.					
5	We do assign appropriate duties to our staff which will best ensure smooth achievement of procurement objectives.					
6	We have change management strategy that will ensure smooth introduction of new techniques.					
B	**Knowledge and experience**					
1	Our top management have knowledge and experience about plant and equipment procurement models.					
2	There are sufficient seminars / symposiums / workshops organized by our institution/professional body/ our projects stakeholders / our organization's top management/our trade association etc aimed at creating awareness on plant and equipment procurement.					
3	Engineers are not directly involved in plant and equipment procurement.					
4	Our management is aware of the success recorded by using Engineers in Plant and Equipment procurement in projects elsewhere and its effect on the successful achievement of our organization objectives while reduction of cost and delay in delivery.					

APPENDIX B: Canonical correlation

Table B1:Full Canonical Model on Knowledge and Cultural Issues

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.21618	1.07735	28.00	528.00	.361
Hotellings	.23328	1.06224	28.00	510.00	.381
Wilks	.79893	1.07034	28.00	466.54	.371
Roys	.09959				

Effect size (1-λ)= 0.201

Table B2: Full canonical model onBarriers and Cultural Issues

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.80486	.87334	126.00	847.00	.829
Hotellings	.98180	.88273	126.00	793.00	.808
Wilks	.41227	.87756	126.00	765.49	.819
Roys	26951				

Effect size (1-λ) = 0.588

Table B3: Full canonical model on Barrier and Top Management Support

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	1.01898	1.29204	114.00	720.00	.030
Hotellings	1.30865	1.30100	114.00	680.00	.027
Wilks	.31656	1.29860	114.00	669.38	.028

Roys	.28946				

Effect size (1-λ) = 0.683

Table B4: Full Canonical Model on Communication and Mutual Trust

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.30910	1.24257	35.00	660.00	.162
Hotellings	.34616	1.25012	35.00	632.00	.156
Wilks	.72127	1.24817	35.00	540.88	.159
Roys	.15533				

Effect size (1-λ) = 0.2782

Table B5: Full Canonical Model on Cultural Issues and Mutual Trust

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.32654	1.31756	35.00	660.00	.107
Hotellings	.36318	1.31159	35.00	632.00	.111
Wilks	.70888	1.31714	35.00	540.88	.109
Roys	.14377				

Table B6: Full canonical model on Drivers and Integration

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.87566	1.42722	90.00	605.00	.009
Hotellings	1.16357	1.49195	90.00	577.00	.004
Wilks	.36704	1.45885	90.00	572.11	.006
Roys	.35971				

Table B7: Drivers and Top Management Support

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	1.01074	1.36181	108.00	726.00	.013
Hotellings	1.32188	1.39940	108.00	686.00	.008
Wilks	.31664	1.38259	108.00	671.98	.010
Roys	.32648				

Table B8: **Knowledge and Top Management Support**

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	.46258	1.20666	54.00	780.00	.152
Hotellings	.51653	1.17972	54.00	740.00	.183
Wilks	.61359	1.19508	54.00	641.97	.167
Roys	.14231				

Effect size $(1-\lambda)= 0.386$

APPENDIX C

REGRESSION ANALYSIS

Figure C1: Drivers/Facilitators

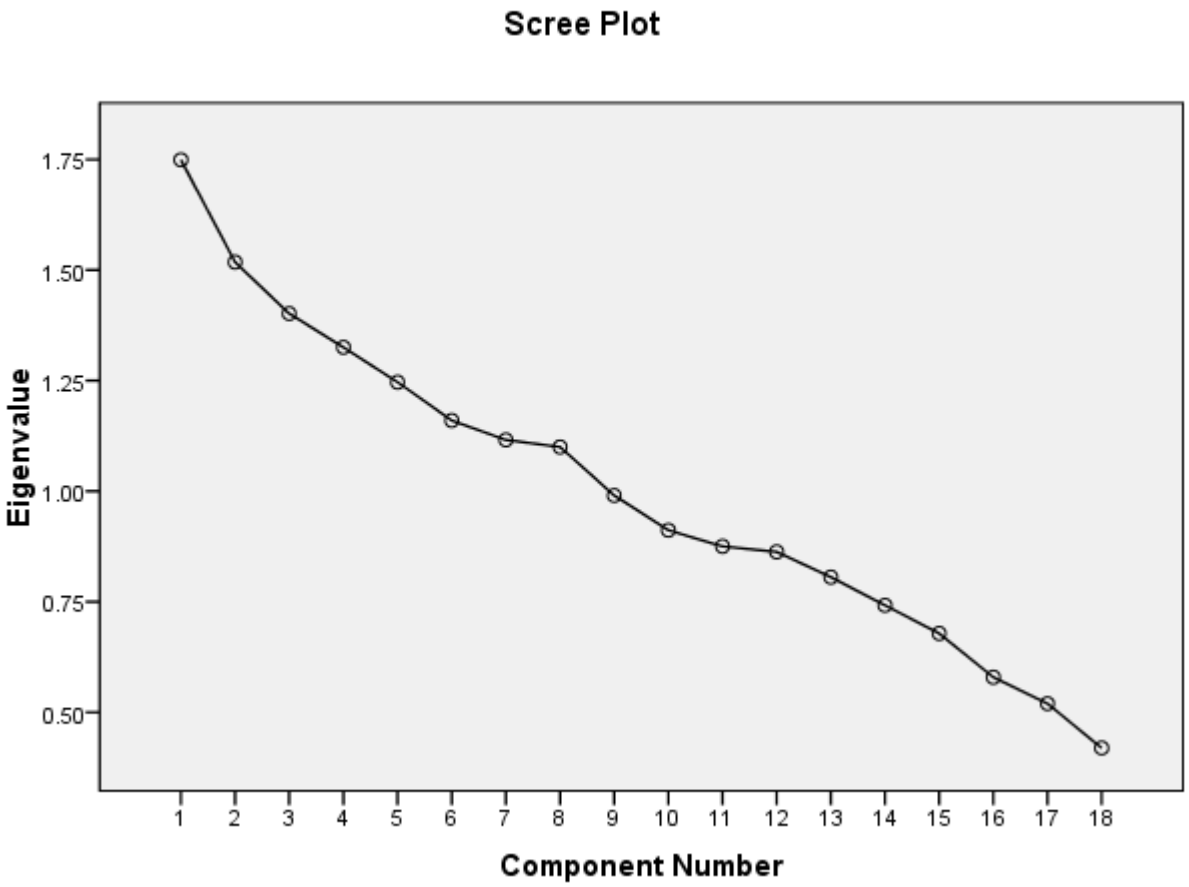


Figure C2: Barriers

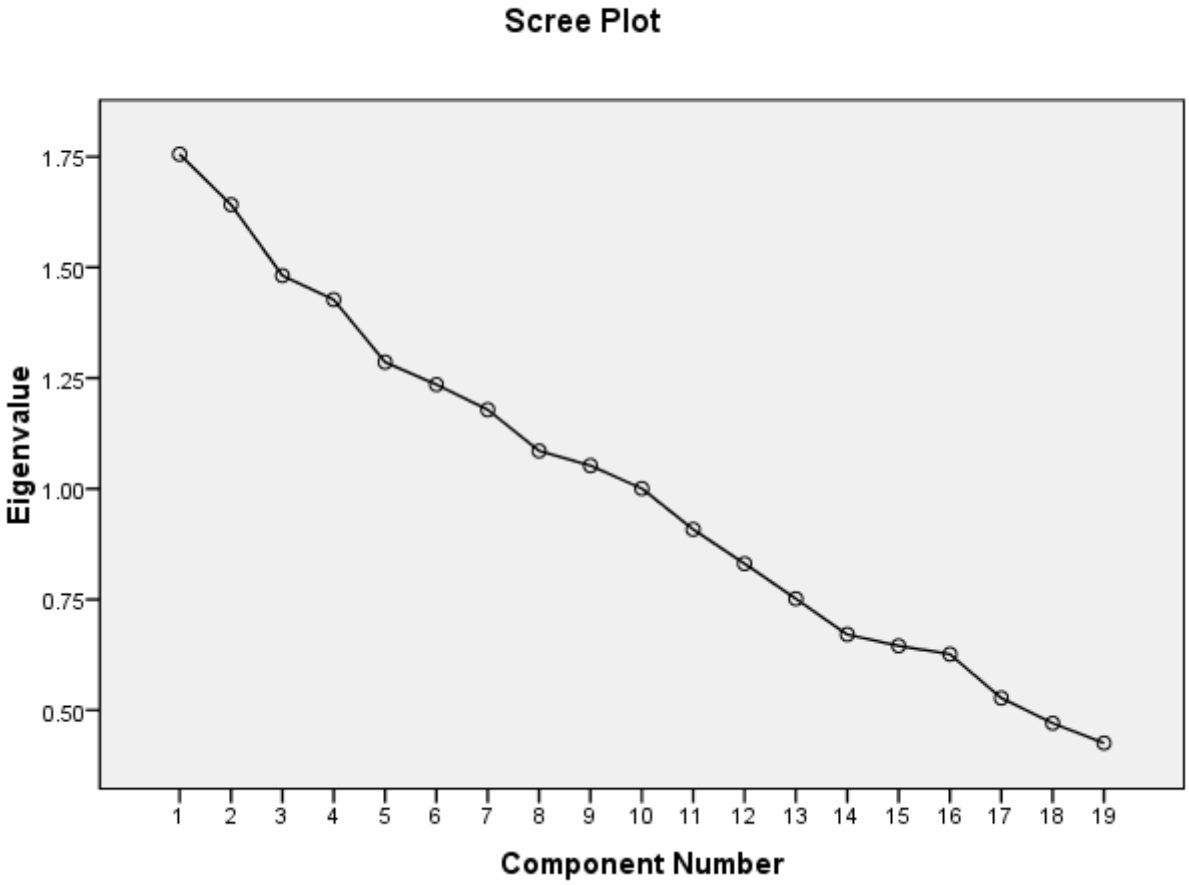


Figure C3: Environmental/Legal

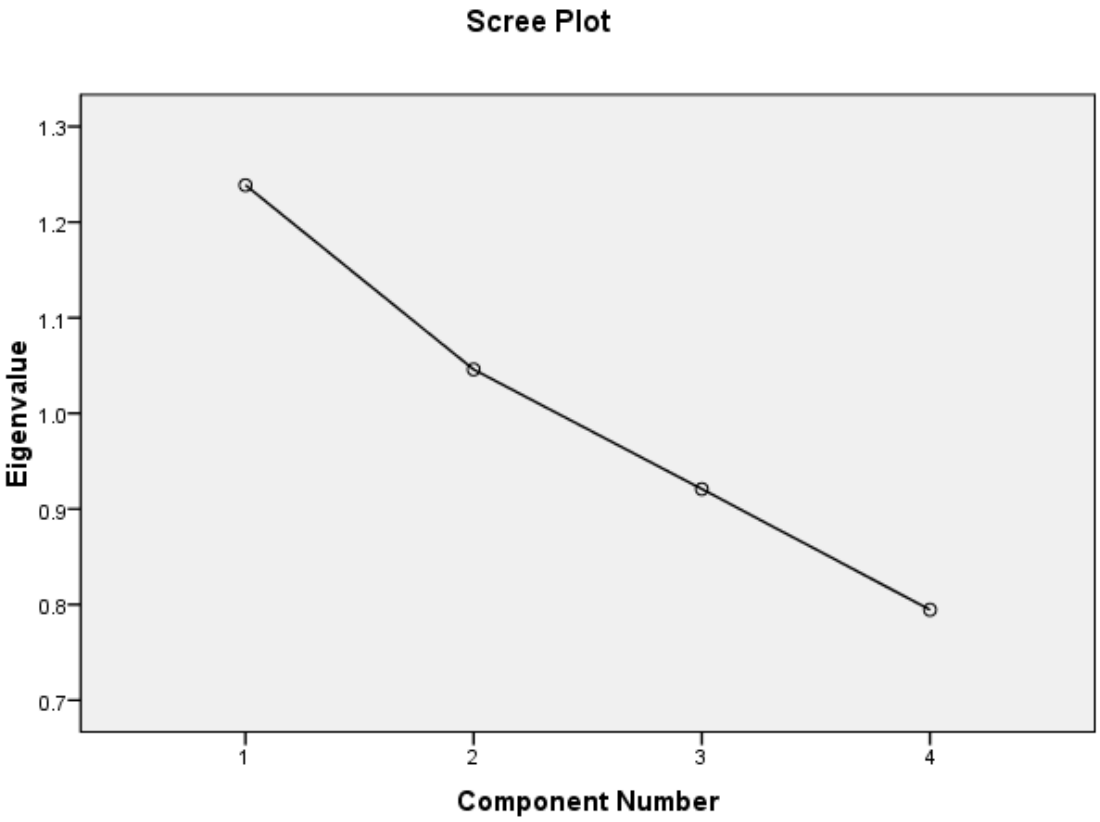


Figure C4: Cultural Issues

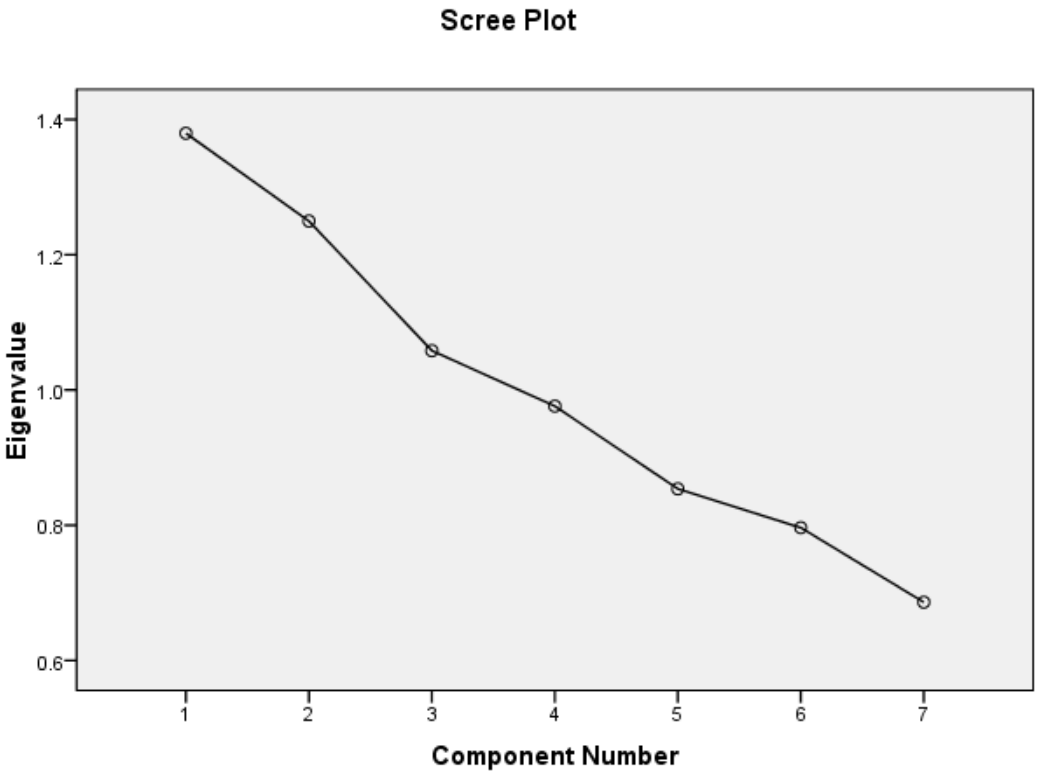
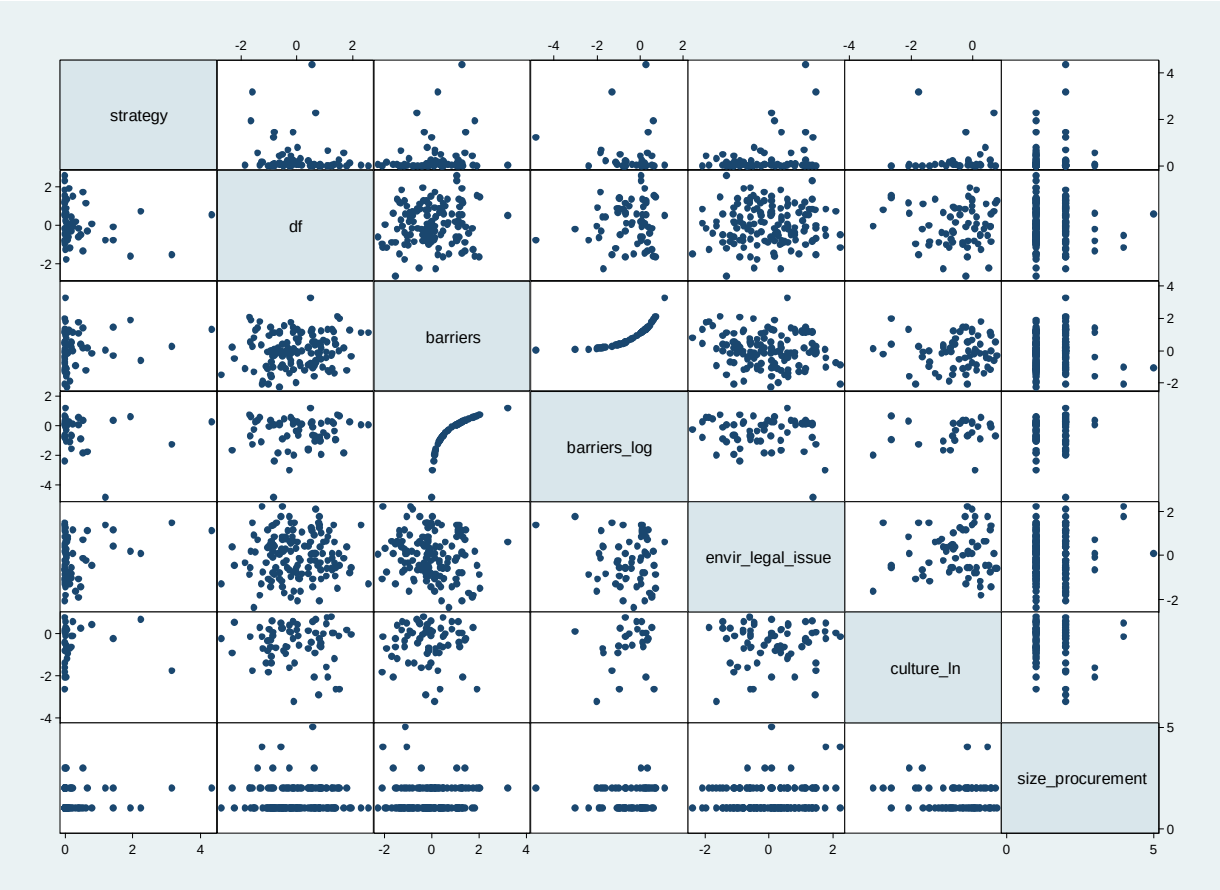


Figure C5: Regression analysis



APPENDIX D

PRINCIPAL COMPONENT ANALYSIS EXTRACTION

In conducting the Principal component analysis,

Drivers/facilitators

Table D1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.441
Bartlett's Test of Sphericity	Approx. Chi-Square	156.820
	Df	153
	Sig.	.400

Table above shows KMO value of 0.441 < 0.50, the p-value of 0.40 > 0.05 is also revealed. This implies that the data collected on drivers/facilitators is not fit for factor analysis hence only Principal Component Analysis (PCA) is reported.

Table D2: Communalities (Drivers)

	Initial	Extraction
clients interest	1.000	.660
Driver2	1.000	.728
Driver3	1.000	.647
Driver4	1.000	.575
Driver5	1.000	.491
Driver6	1.000	.506
Driver7	1.000	.634
Driver8	1.000	.450
Driver9	1.000	.579
Driver10	1.000	.534
Driver11	1.000	.548
Driver12	1.000	.603
Driver13	1.000	.725
Driver14	1.000	.702
Driver15	1.000	.503
Driver16	1.000	.460
Driver17	1.000	.692
Driver18	1.000	.579

Extraction Method: Principal Component Analysis.

As observed from table above

Table D3:Total Variance Explained (Drivers)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.749	9.717	9.717	1.749	9.717	9.717	1.484	8.245	8.245
2	1.518	8.433	18.150	1.518	8.433	18.150	1.366	7.592	15.837
3	1.402	7.786	25.937	1.402	7.786	25.937	1.329	7.383	23.220
4	1.325	7.363	33.300	1.325	7.363	33.300	1.317	7.316	30.536
5	1.246	6.925	40.224	1.246	6.925	40.224	1.298	7.211	37.747
6	1.160	6.443	46.667	1.160	6.443	46.667	1.293	7.185	44.932
7	1.116	6.200	52.867	1.116	6.200	52.867	1.266	7.032	51.964
8	1.100	6.110	58.977	1.100	6.110	58.977	1.262	7.013	58.977
9	.990	5.502	64.479						
10	.912	5.066	69.545						
11	.875	4.862	74.406						
12	.863	4.794	79.200						
13	.806	4.476	83.675						
14	.742	4.122	87.797						
15	.678	3.768	91.565						
16	.579	3.219	94.784						
17	.520	2.887	97.671						
18	.419	2.329	100.000						

Extraction Method: Principal Component Analysis.

Table D4: Component Matrix[a](Drivers)

	Component							
	1	2	3	4	5	6	7	8
clients interest	.575							
Driver2						-.614		
Driver3				.671				
Driver4								
Driver5								
Driver6	-.524							
Driver7		.583						
Driver8			.535					
Driver9								
Driver10								
Driver11								
Driver12								
Driver13					-.562			
Driver14								
Driver15								
Driver16	-.547							
Driver17				.511				
Driver18							.608	

Extraction Method: Principal Component Analysis.

a. 8 components extracted.

As revealed above, the first and second component

Barrier

Table D5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.454
Bartlett's Test of Sphericity	Approx. Chi-Square	204.800
	Df	171
	Sig.	.040

Table D6: Total Variance Explained (Barriers)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.756	9.240	9.240	1.756	9.240	9.240	1.732	9.116	9.116
2	1.642	8.641	17.881	1.642	8.641	17.881	1.665	8.764	17.881
3	1.481	7.797	25.678						
4	1.427	7.511	33.189						
5	1.286	6.768	39.957						
6	1.235	6.502	46.459						
7	1.178	6.202	52.661						
8	1.086	5.713	58.374						
9	1.052	5.539	63.913						
10	1.000	5.266	69.178						
11	.908	4.780	73.958						
12	.831	4.374	78.331						
13	.752	3.955	82.287						
14	.671	3.531	85.818						
15	.645	3.396	89.214						
16	.626	3.296	92.510						
17	.527	2.775	95.284						
18	.470	2.476	97.760						
19	.426	2.240	100.000						

Extraction Method: Principal Component Analysis.

Table D7: Component Matrix[a](Barriers)

	Component	
	1	2
Barriers1		
Barriers2		
Barriers3		
Barriers4		
Barriers5		
Barriers6		
Barriers7		
Barriers8		
Barriers9		
Barriers10		
Barriers11		
Barriers12	.585	
Barriers13		
Barriers14		
Barriers15		
Barriers16	.554	
Barriers17		
Barriers18		
Barriers19		

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Environmental and legal

Table D8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.513
Bartlett's Test of Sphericity	Approx. Chi-Square	7.321
	Df	6
	Sig.	.292

Table D9: Communalities (Environmental)

	Initial	Extraction
Envr1	1.000	.504
Envr2	1.000	.527
Envr3	1.000	.670
Envr4	1.000	.584

Extraction Method: Principal Component Analysis.

Table D10: Total Variance Explained (Environmental)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.239	30.968	30.968	1.239	30.968	30.968	1.183	29.568	29.568
2	1.046	26.147	57.115	1.046	26.147	57.115	1.102	27.547	57.115
3	.921	23.021	80.136						
4	.795	19.864	100.000						

Extraction Method: Principal Component Analysis.

Table D11: Rotated Component Matrix[a] (Environmental)

	Component	
	1	2
Envr1		-.710
Envr2		.723
Envr3	.805	
Envr4	-.729	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Cultural Issues

Table D12: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.513
Bartlett's Test of Sphericity	Approx. Chi-Square	25.173
	Df	21
	Sig.	.240

Table D13: Communalities (Cultural)

	Initial	Extraction
cultural1	1.000	.660
cultural2	1.000	.647
cultural3	1.000	.426
cultural4	1.000	.541
cultural5	1.000	.355
cultural6	1.000	.639
cultural7	1.000	.420

Extraction Method: Principal Component Analysis.

Table D14: Total Variance Explained (Cultural)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.380	19.710	19.710	1.380	19.710	19.710	1.289	18.420	18.420
2	1.250	17.854	37.565	1.250	17.854	37.565	1.269	18.132	36.552
3	1.058	15.116	52.681	1.058	15.116	52.681	1.129	16.129	52.681
4	.976	13.944	66.625						
5	.854	12.197	78.822						
6	.796	11.375	90.197						
7	.686	9.803	100.000						

Extraction Method: Principal Component Analysis.

Table D15: Rotated Component Matrix[a](Cultural)

	Component		
	1	2	3
cultural1			.721
cultural2			-.697
cultural3			
cultural4		.619	
cultural5	-.594		
cultural6		.785	
cultural7	.622		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Integration

Table D16: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.523
Bartlett's Test of Sphericity	Approx. Chi-Square	6.383
	Df	10
	Sig.	.782

Table D17: Communalities (Integration)

	Initial	Extraction
integra1	1.000	.373
integra2	1.000	.267
integra3	1.000	.775
integra4	1.000	.546
integra5	1.000	.326

Extraction Method: Principal Component Analysis.

Table D18: Total Variance Explained (Integration)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.231	24.628	24.628	1.231	24.628	24.628	1.228	24.569	24.569
2	1.055	21.105	45.733	1.055	21.105	45.733	1.058	21.163	45.733
3	.980	19.607	65.339						
4	.908	18.155	83.494						
5	.825	16.506	100.000						

Extraction Method: Principal Component Analysis.

Table D19: Rotated Component Matrix[a](Integration)

	Component	
	1	2
integra1	.608	
integra2		
integra3		.872
integra4	.700	
integra5		

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

APPENDIX E

Table EI: Variance Inflation Factor

Variable	VIF	1/VIF
df	1.26	0.795985
barriers_log	1.26	0.796647
envir_lega~e	1.22	0.819139
culture_ln	1.18	0.844404
size_procu~t	1.08	0.92758
Mean VIF	1.2	

APPENDIX F

INTERVIEW QUESTIONS

1- What are the past experiences on procurement of plant and equipment in your tertiary institution?

2- How many plant and equipment procurement were completed within the cost and completion periods?

3- How many plant and equipment procurement were completed within the cost and specification?

4- How many plant and equipment procurement were abandoned and what was causes the abandonment?

5- How many plant and equipment were delivered to end users and accepted?

6- What are the likely problems associated with your suppliers, contractors, vendors in the supply of plant and equipment?