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DEPARTMENT OF CONSTRUCTION ECONOMICS AND MANAGEMENT

INVESTIGATING THE ALIGNMENT OF PROJECT DELIVERY METHODS AND FINANCIAL CONTRACT TYPES ON CONSTRUCTION PROJECT PERFORMANCE IN UGANDA

BY

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DECLARATION

I, **Rwema Laureen** declare that the content of this report is my original work with the exception of acknowledged citations and that it has never been submitted to any institution by any other person for any purpose.

Signature  .....

Rwema Laureen

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Date15/08/2018.....

APPROVAL

This work has been carried out under my supervision and is now ready for submission to the department of construction economics and management, faculty of technology, Makerere University, Kampala with my approval.

Signature.....Ekyalimpa Ronald.....

DR. Ekyalimpa Ronald

Date.....20/08/2018.....

DEDICATION

I dedicate this report to my mother Ms. Kairungi Jeniffer and my uncle Mr, David Bizimana for the love, encouragement, motivation, time and resources they have invested in me and for guiding me through to the right path. May God forever bless the work of their hands.

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LIST OF ABBREVIATIONS AND ACRONYMS

CM	Construction Management
DB	Design and Build
DBB	Design Bid Build
FCT	Financial Contract Types
GDP	Gross Domestic Product
Ms	Microsoft
PDM	Project Delivery Methods

CHAPTER ONE

INTRODUCTION

1.1 Background

Uganda is a low income developing country with a GDP growing at a rate of 3.4%, against an inflation of 14% (World Bank, 20013). The construction industry contributes over 12% of Uganda's GDP and has witnessed steady growth for the last 20 years and despite recent upsurge in inflation Uganda National Commission for UNESCO (2013). The problems the industry faces are still a downside to the rate of growth. The World Bank (1984) summarizes some of these problems in the developing countries as inexperienced and excessively rigid contract supervision, inadequate training staff, construction business proprietors who tend to outgrow their capacity to manage construction risk and inadequate procurement and contracting procedures leading to delayed payments without adequate compensation for contractors. Contracting procedures include the choice of Project Delivery Methods (PDM) and financial contract types (FCT) to be used for a project. A Project delivery method is a system for organizing and financing design, construction, operations and maintenance activities and facilitates the delivery of a good or service, Miller (2000). Project Delivery Methods have evolved over the years. The master builder was hired by an owner to design, engineer and construct an entire facility. This system was common until the 20th century (Sanvido, 1998)

Continuous changes in technology and the increasing sophistication in buildings required specialization of design and construction services. Designers and constructors began to specialize in the design, fabrication, and/or construction of building systems. This led to the traditional design-bid/build delivery system, which offered clients a sequential design, bid, then build approach Sanvido (1998). With time, this method seemed not to work for all clients' needs and hence there was a need to adjust the method of delivery to suite the different clients and different projects. In the 1970s and 1980s the construction manager was introduced Sanvido (1998). The construction manager's role was to provide input to the designer to increase the constructability of designs and to decrease schedule durations through overlapping the design and construction phases (P.E.D Love, 2002).

The construction manager approach before long became costly and there was a need to reduce the parties involved in the construction process hence most people currently opting for the design and build method Sanvido (1998). Given the history, other factors remaining constant,

PDMs influence a project's cost, schedule, efficiency and success making it a challenging issue for stake holders and decision makers to choose the appropriate method for their project (Kumaraswamy, 2001).

Elshakour (2015) maintains that financial contract types are an agreement of how the owner shall pay the contractor as shown in the Lump-sum and Cost price methods. The delay in payment of the contractor can affect the delivery of works, that is to say works can be also delayed hence leading to a time overrun or delivery of poor quality work, it can also lead to increased cost of the project when the client should pay fines for delayed payment of the contractor. The choice of financial contract types is dependent on several factors i.e. when the drawings of the project are completed, complexity, allocation of risk and the ability to introduce change (Elshakour, 2015).

PDMs and FCTs are key factors contributing to the client satisfaction and project success. The factors that determine choice of PDMs and FCTs overlap which could imply a relationship between the two. There are numerous factors that affect project performance and as earlier mentioned PDMs and FCTs are key factors, this study assumes other factors constant in trying to ascertain the effect of aligning PDMs and FCTs on project success.

1.2 Problem Statement

Poor project performance continues to be a challenge in Uganda's construction industry with projects being grounded to halt by contractual issues which include but not limited to poor contract structuring and administration that continuously lead to hapless project performance in relation to cost, quality and time. There has not been a proper layout on the construction project delivery method let alone a financial contract type alignment that could have been used. This necessitates a need to develop a decision-making tool that will help the stakeholders make appropriate decisions during contract administration process.

1.3 Objectives of Research

1.3.1 Main Objective

The main objective of the research is to investigate the effect of the alignment of project delivery methods and financial contract types on project performance.

1.3.2 Specific Objectives

The specific objectives of the research are:

i. To ascertain the state of practice of PDMs and FCTs
ii. To examine various performance outcomes offered by different combinations of PDMs and FCTs.
iii. To develop a decision-making utility to guide in the choice of project delivery method and financial contract type to be used.

1.4 Significance of the Study

This research will be a study that will have an impact on the academia and the industry where professionals have a practical touch.

1.4.1 Significance to Academia

This study will build on the body of knowledge a rationale behind the choice of PDMs and FCTs used and what alignment will yield better results in terms of project cost, quality and time.

1.4.2 Significance to the Industry

Project delivery methods and financial contract types are usually chosen on the basis of knowledge and experiences of in-house experts and guidance from external consultant without deep exploration of the strength and weaknesses of each method, or any regard to the influencing success factors and characteristics of each project. This shows a need for a decision-making utility tool that will guide the stake holders on the choices to make with a proper baking for the choices made.

1.5 Scope of the Study

1.5.1 Geographical Scope

This study will focus on construction projects around the country with data collected from consultancies, local authorities and clients concentrated in Kampala.

1.5.2 Content Scope

The study will look at building and road construction projects, the project delivery methods used, their characteristics, the criteria used to select the method to use and the effect of each method on the performance of the project in terms of cost, time and quality. It will also look at

the different financial contract types and project types, their characteristics, criteria used to select the method used and the effect on performance of the project to ascertain what delivery method works best with what contract type to give best results in terms of cost, time and quality for a project.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews related literature from books and publications of previous research done on the different construction project delivery methods used, the various financial contract types used and how they affect performance of a project. This review is done to get an intricate understanding of the criteria used in selecting the different PDMs and FCTs used on the various projects and their effect on the project success as well as relate previous studies to the research problem.

2.2 Project Delivery Methods

The construction industry describes a successful project as one that is completed on time, within the budget limits and is to quality. These criteria are dictated by the construction document which in turn reflect the owner's expectations for the project. This success as defined above is influenced by the process used to design, manage and deliver a project and these processes are referred to as project delivery methods, Patterson (2014). Therefore, according to Miller, a PDM is a system for organizing and financing design, construction, operation and maintenance activities and facilitates the delivery of a good or service Miller et al (2000). Sanvido says there are many delivery methods listed in literature but they can be placed into three fundamental types namely: Design-Bid-Build, Design-Build, Construction Management. (Sanvido & Konchar, 1998)

2.2.1 Evolution of Project Delivery Methods

Throughout ancient history, the master builder was the backbone of every large construction project Patterson (2014). His skills were a combined those of an architect, engineer and construction manager hence providing a seamless service. The master builder approach held sway from the middle ages period through the early renaissance period DBIA (2006). However, as the renaissance period progressed, the tasks of design and construct began to diverge becoming separate tasks. The industrial revolution of the 1800s brought about technological advances in material and machinery resulting into more complicated structures encouraging further separation of the design and construction tasks due to the need for specialization.

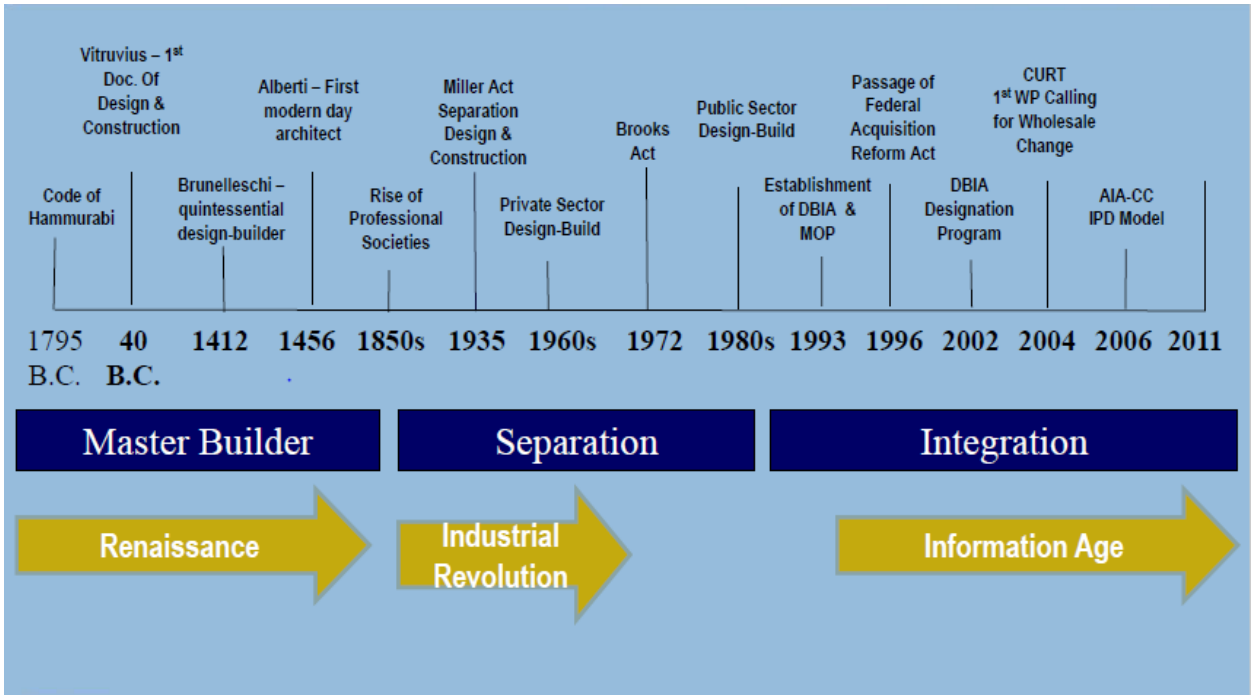

Figure 1: Project Delivery Historical Perspective (Design Build Institute of America, 2015)

This specialization meant the architects and engineers were to handle the designs and the contractors to handle the construction bit. By the end of the nineteenth century the notion of a master builder was long gone or rather it had evolved into the current Design Bid Build (DBB) method. (Patterson, 2014)

During the mid-twentieth century, it became law in virtually every state in the united states that construction contracts would be awarded on basis of lowest price most especially for the public works DBIA (2006). As price became the driving factor for contractor selection, the construction industry responded by working hard to eliminate every extra service or product that might add an extra dollar to the project. This attitude set the stage for a progressive deterioration of the design-contractor-owner relationship. Change orders, claims, litigation became the standard methodology for managing risks and protecting profits. (Sanvidor, 1998) In the 1960's high inflation added to the increasing sophistication of construction systems creating a need for an advocate on behalf of the owner to bridge the gap between owner, designer and contactor. The role of the construction manager was developed with specialized knowledge, experience and resources to navigate through complexities of a construction project. The construction manager is involved in the project from the early design phase. Patterson (2014). There was increase in the interest rates in the 1970's which translated into "time is money". The construction management method was effective but time consuming and this led to a new delivery method being introduced, or the return of an ancient delivery method.

In 1978 the American Institute of Architects lifted a ban on architects participating in building contracting thus ushering back the master builder concept with a new name which is the Design Build method (Patterson, 2014).

The project delivery process has evolved from the all-in-one master builder of antiquity to the distinct division of labour inherent in the DBB process dominating the today's modern construction industry. Ironically, shadows of the master builder are reappearing as evidenced with the increasing popularity of collaborative delivery methods such as CMAR and DB.

2.2.2 Design-Bid- Build (DBB)

This is also known as the traditional method; the owner engages a design professional to prepare the plans, specifications, and other contract documents. These documents are used to solicit bids and negotiate the contract with a general contractor who will be responsible for constructing the project in accordance with the contract documents Hosseni (2016). The owner will sign separate contracts with the designer and builder; with the design contract being completed prior to awarding the construction contract.

DBB is a widely used method for public projects. Agencies typically have developed standard contracts and procedures based on experience from many projects and are comfortable with the DBB approach Patterson (2014). This method has advantages for owners in that they ideally have complete control over the design, a fiduciary relationship with the designer to monitor the contractor, a sole source of construction, a known total price before construction starts, price competition, and impartial selection. (Gordon, 1994)

Interaction between the design and construction entities is very low during the design phase, they only interact at the end of the design phase and during construction. This can easily lead to inefficient design, increased errors and disputes, higher costs of construction and prolonged construction time Sanvidor (1998). The linear nature of DBB is time consuming.

2.2.3 Construction Management at Risk (CMAR)

CMAR evolved from the traditional DBB as a method to overlap the design and construction phases and to obtain significant constructability input during the design phase and to obtain significant constructability input during the design phase Patterson (2014). CMAR is where the building owner contracts with the designer to carry out all the design works and a separate contract with the contractor to carry out construction works in accordance with the specifications and plan (Sanvidor, 1998).

The CM model allows for early development and promotion of effective project team building and working relationship since the different team players start working together from the beginning of the project. And the CM firm's inputs enhance the quality and build-ability of design documents Kwan (2014). The building owner is at risk because any risks transferred to the CM's firm have an impact on the project scope, quality and schedule. The CM also has two roles to play on the project, the advisory role of a construction manager in the design phase and then general contractor during the construction phase hence his loyalties are questionable. (Kwan, 2014)

2.2.4 Design- Build (DB)

This is an agreement between an owner and a single entity (the design-build team) to perform both design and construction under a single design-build contract. Portions or all the design and construction may be performed by the entity or subcontracted to other companies Sinem (2013). The design-build team is to plan, implement and control the entire project through to completion and occupancy. The building owner can start a project with relatively little information or building criteria because it allows involvement of both the design team and the construction team who can both contribute to this phase and plan how the works will be done. In the long run, the project risks e.g. time, scope, cost and quality can be mitigated at this stage. (Kwan, 2014)

The design criteria are mostly cost driven in the context of quality and scope in the early design phase. It is difficult to verify if the project has achieved its best performance criteria since in case of any issue it is hard to determine the main cause either the design or construction. (Kwan, 2014)

Design and build has over time has been modified to suite the different clients that want to use it. Some modifications are looked at below:

Design Build Operate (DBO): This project delivery method integrates operation with the tasks of design and construction. The owner choses a single contractor to carry out the design, construct and operate the property for a period of time put out in the contract. (Miller, 2000)

Design Build Finance Operate (DBFO): This method is similar to DBO except that the financing of the project is taken up entirely by the contractor at his own risk. Control of the finished product is returned to the owner at the end of the contract. (Miller, 2000)

2.2.5 Selection of Project Delivery Method

The PDM selected to be used for a project is a basis for success for that project. The choice of the PDM has never been easy due to the characteristics of procurement systems. There are several PDMs to choose from and each varies in several aspects as shown earlier in this section. A PDM that can lead a project to success in some aspects may lead project to failure under different scenarios therefore one PDM will not fit for all projects. There are different considerations and factors that are also looked at when choosing PDM. These can be grouped in three categories: client objectives, project characteristics and external and environmental characteristics (Ali, 2016). The principles considered when choosing PDMs are value, transparency, competition, scope of work, risk, revenue and owner sophistication.

Literature looked at reveals that the first step in PDM selection methods is to establish the procurement selection criteria and interrelationship between them. Procurement selection criteria cannot be a single basis for selecting a PDM due to having to match the PDMs with the factors that were grouped earlier Ali (2016). The National Economic Development Organization listed nine criteria to priorities projects: time, cost, price competition, flexibility, complexity, quality, responsibility and risk. These are also considered when selecting an appropriate PDM for a project in conjunction with the procurement selection criteria (NEDO, 1985).

2.3 Project Performance

A project is a temporary endeavor undertaken to create a unique product, service or result. Project performance can be measure and evaluated using a large number of performance indicators that could be related to various dimensions such as time, cost, quality, business performance, health and safety Cheung et al (2004). However, time, cost and quality are the 3 major performance indicators. Generally, performance dimensions may have one or more indicators, and could be influenced by various project characteristics. For example, project time and cost get influenced by project characteristics, procurement system, delivery method, project team performance, client representation's characteristics, contractor characteristics, design team characteristics, delivery of materials on site, availability of funds among others Dissanayaka & Kumaraswamy (1999). Similarly, Adnan et al (2009) identified many factors having an influence on project cost performance, these include: project manager's competence, top management support, project manager's coordinating and leadership skills, monitoring and feedback by the participants, decision making, coordination among project participants,

owner's competence, social condition, economic condition and climatic condition. Coordination among project participants was identified as the most significant of all factors having a maximum influence on cost and time performance. These relationships can be determined by the delivery approach used to deliver the project. Interestingly Adnan et al (2009) says the factors that affect quality performance are different from those of time and cost and they include: conformance to specifications, unavailability of competent staff, quality of materials used, quality trainings and quality assessment system in the organization. For this research all these factors that have been mentioned above are assumed to be constant and the focus is on the delivery methods used on the project and the financial contract types and how they affect performance measured using the major parameters mentioned earlier which are cost, time and quality.

2.3.1 Project Delivery Methods Performance Outcomes

Performance of a project is measured basing on three major parameters which are; cost, time and quality. A project is considered to be successful if it is completed before or within the allocated time, staying within the budget and having the product to suite the expectations of the client. The projects delivery methods affect these parameters in individually.

2.3.2 Cost

When all other variables are held constant, the effects of project delivery system indicated DB to be at least 6.1% less than DBB projects and 4.5% less than CMAR projects on average in terms of cost Sanvidor (1998). Most cost escalations on projects are due to variations or change orders made on the project. In conventional DBB approach, the construction contractor is entitled to a change order if the project is disrupted by the owner's actions, if project conditions change, or if design problems occur. In DB approach, the first two occurrences may result in a change order while the third ordinarily does not because the design-builder is responsible for the plans and specifications, it cannot use errors in them to expect a change order. Of course, if the client changes the project criteria, the need to change the design may result in a change order. A study of the public sector, DB projects found that the cost growth for construction was 3-4% Gordon (2013). Another study found that the cost growth for DB projects was 5.2% less than DBB projects while CMAR had 7.8% more cost growth than DBB projects. It was observed that DB projects usually finish on or under budget versus DBB projects that have cost escalations mainly because of its flexibility when it comes to making changes (Sanvidor, 1998).

2.3.3 Construction Speed (Schedule)

When all other variables were held constant, the effect of PDMs indicated DB projects to be at least 12% faster than DBB projects and 7% faster than CMAR projects on average in terms of construction speed. In addition, CMAR projects were at least 5.8% faster than DBB projects Sanvidor (1998). Speed of construction is greatly affected by the variations made in the designs and in construction which again reflects back to the delivery method, DBB allows flexibility of designs hence projects conducted using it usually drag because of the constant changes being made. Whereas for DB and CMAR the changes made cost the contractor hence he is the one to incur those costs therefore the changes are minimised as much as possible so that they don't incur loses. It is important to recognise that project delivery, although still significant has become less important. It is found to have a lesser impact on delivery speed compared to project complexity, availability of funding, contractor understanding of the work among others (Sanvidor, 1998). The delivery system mainly affects the initial stages of the construction process because for DBB, one has to wait for the designs to be fully completed before any construction can begin and the design process can take long whereas for DB and CMAR one can start with partial drawings making the process faster. DB has an extra advantage of having one team doing both the designing and construction hence lesser chances of disputes arising between the contractor and the designer that would drag the process.

2.3.4 Quality

A study was conducted where owners were asked to rate how well the quality met their expectations after project completion. They were asked to rank the actual performance of the facilities versus the expected performance. The authors concluded that DB and CMAR significantly outperformed DBB and that DBB, on average barely met facility owner expectations in regard to specific system performance metrics Gordon (2013). The ability in CMAR and DB to consider contractor qualification and quality of the proposed design in selection of the design builder is a key to achieving prequalification. In DBB, the selection of the contractor is driven by the lowest bid and there is less control over the quality of the contractor. The contractor puts in a low bid and therefore the quality of the work being done is questionable. Another factor is that in CMAR and DB all parties are involved from the design stage therefore everyone gets to pitch in ideas and by the time actual construction starts they all know exactly what the client wants and work towards it. Whereas for DBB the contractor doesn't get to be involved in the design stage so they may not understand very well exactly what the client wants.

Various interpretations of rework can be found in the construction management literature. But the most common explanations are quality deviation, nonconformance and quality failures Love (2002). This indicates that quality can be measured using reworks. Reworks can originate from variation orders and as mentioned the delivery methods can affect the ability of one to order for variation orders. The extent to which design changes affects reworks hasn't been researched but this in turn leads to increase in cost of the project.

2.4 Financial Contract Types

According to FIDIC a financial contract is an agreement between the owner and contractor on how payments for the works will be made. These contracts are broken down in two broad categories which are the price given in advance contracts (price-based contracts) and cost reimbursement contracts (cost-based contracts)**.**

2.4.1 Lumpsum/ Fixed Priced

This falls in the category of price given advance contracts because the price of the contract is known beforehand. The contractor agrees to perform a stipulated job of work in exchange for a fixed sum of money. The client pays the fixed sum irrespective of any changes that may occur to the cost of the project Elshakour (2015). This method is appropriate where the project is well defined where by the client clearly defines what exactly they want and the contractor is able to accurately price the works they are being asked to carry out. This method is efficient for obtaining value for money since the client gives his budget and the contractor works within it and time saving in such a way that the person doing the designs is the contractor too hence works can start earlier much as the planning process may take longer hence reducing the possibility of overhead costs. Lumpsum contracts apportion more risk to the contractor than some other contract types as there are fewer mechanisms to allow them to vary their price Kalfakakou (2012). There are high chances of making a profit from this contract types as any remaining money from the contract belongs to the contractor but it is also very possible to make losses since no changes are entirely allowed (Fani, 2013).

2.4.2 Ad Measurement

This contract is common for civil engineering projects and is based on estimated quantities of work and unit prices attached to these works. Rates are provided in the contractor's tender, either as part of the priced BOQ or with a schedule of rates. The actual quantities of work carried out are measured and the rates applied to those quantities. Payments are based on

amounts of the actual work done and as a result, the quantities paid for may vary from the original estimate Kalfakakou (2012). There is a difference between admeasurement and remeasurement, in that remeasurement refers to the entire process from measuring again the quantities of work undertaken, whereas admeasurement refers only to the difference between the estimated quantity and the actual quantity. This method is appropriate when here is uncertainty of scope. This is commonly used where the type of work required can be described in reasonable detail but the amount cannot. For example, excavation were the works where the quantity of excavation required is difficult access until after the works have begun. Where there is just a schedule of rates, rather than a BOQ, approximate quantities may be provided to allow the contractor to estimate the amount of work but there is no guarantee that the quantity will be required and so appropriate rates are sometimes difficult to determine. This contract type is commonly used on most projects since the risk is shared by both the client and the contractor (Simister, 2001).

2.4.3 Cost Reimbursement Method

These are sometimes referred to as Cost Plus contracts. The contractor carries out work on the basis that they are paid the actual cost of labour, plant, and materials. In addition, the contractor receives an agreed fee to cover management, overheads and profit Fani (2013). A cost reimbursement contract is used where the scope of the work to be carried out cannot be clearly defined at the outset, and the risks associated with the work are high, such as emergency work for example urgent construction of resettlement homes so that the client can have where to stay. The costs for which the contractor is entitled to be compensated must set out clearly in the contract. This process needs to be carefully considered due to its complexity since some direct costs may be relatively straight forward to determine, others are shared costs. The costs may be calculated on a pro-rata basis and charged along with profits as an agreed sum or percentage fee. Costs are also calculated based on the contractor's accounts and other records, which are made available to the client on an open book basis. The client may also monitor activities onsite to verify the costs are legitimate. This contract type is high risk for the client as the final cost is not known until the end of the project. Hybrids of the cost reimbursement contracts include (Davis et al, 2008):

Cost-plus percentage fee: The client refunds the contractor for the audited works done and adds a percentage fee Kalfakakou (2012). However, the contractor has no real incentive to work at maximum efficiency, and this variant is only likely to be considered where the requirements are particularly indeterminate pre-contract. (Davis et al, 2008)

Cost-plus fixed fee: The client refunds the contractor for the actual works done and pays a fixed amount for the services rendered by the contractor Kalfakakou (2012). This is appropriate provided that the amount and type of work is largely foreseeable. The contractor has an incentive to work efficiently to remain within the agreed fee. (Davis et al, 2008)

Cost-plus fluctuating fee: The fee paid varies in proportion to the difference between the estimated cost and the actual cost. The assumption is that as the actual cost increases, the contractor's supposed inefficiency will result in a fee which decreases. This approach depends upon there being a realistic chance of ascertaining the amount and type of work at tender stage. (Davis et al, 2008)

2.4.4 Guaranteed Maximum Price (GMP)

This FCT is a hybrid of both fixed price contracts and cost-plus contracts. The contractor agrees that the contract sum will not exceed a specified maximum. If the maximum price is exceeded, the contractor incurs that extra cost. If the cost is lower than the GMP then the contract should set out whether the savings made go to the contractor or are shared with the client Gordon (1994). This sort of contract transfers risks for delivering the project from the client to the contractor therefore if events like complex ground works, the nature of which cannot be determined until the ground is opened up which on other forms of contract might have resulted in a claim by the contractor for loss and expense, on GMP contract the contractor has to incur the extra costs Fani (2013). GMP is not necessarily fixed. If the client requests for extra work which leads to an increase in the scope of woks, then the contract must provide for the price to be increased. Similarly, if work is omitted, then the price should be reduced. The problem here is being able to determine if the change should constitute a price adjustment. Before using this contract type, the client should assess the nature of the project, the likely risks and whether it is sensible to expect the contractor to bare those risks. GMP contracts are mainly used on small projects because of the high risk involved and they are not commonly used (Fani, 2013).

2.4.5 Considerations for Type of Financial Contact

When choosing a contract type for the construction of a proposed project, an owner must first understand the various components of the contracting methods, the characteristics of the proposed project and their abilities. Some types are appropriate for some projects than others and an owner should not just pick a method because it is convenient or recommended by the contractor. There are three group drivers that can be used, a risk allocation analysis and a commodity versus service analysis which can guide an owner in choosing the correct method.

A careful selection can result in cost savings and a much more harmonious construction process Gordon (1994). Similarly, Elshakour (2015) suggests these are among the considerations an owner puts in mind when choosing an FCT to use on a particular project: The appropriateness for providing an adequate incentive for efficient performance by the contractor, ability to introduce changes or basically flexibility of the project because change can have very serious cost implications on the project and it needs to be minimised, allocation of risks in such a way that either party in the contract have some risks they are facing but who is willing to risk more than the other, start and completion date of the project which can determine whether someone has money to fund the project within that allocated period for carrying out the project (Elshakour, 2015).

2.5 Alignment of PDMs and FCTs

Project planning for public projects is an owner driven process that must correlate with an owner's overall economic conditions and social policies, not only in the present, but in the future as well. Proper alignment of the way the works are to be done requires an owner, the consultants and engineers to consider finance, management, design, construction, operation and maintenance early in the project life cycle. Decisions made in the initial phases of a project's life cycle have a much greater influence on the project's outcome. The choice of PDM and FCT are one of the fundamental decisions made on the project and they are made in the initiation stage of the project after putting into consideration all the considerations mentioned above (Miller, 2000).

For most projects DBB is the most viable method of delivery. In fact, of all the delivery methods DBB is the one method that can be universally applied. Its place as a fixture in the procurement process is secure. However, each project delivery method supports owner priorities and project goals differently. For example, DB is faster than DBB from start of design to the completion of construction Sanvidor (1998). An owner with a tight schedule may be better served to use DB rather than DBB, but this schedule advantage may not be sufficient, particularly for projects where the owner wants to carefully settle upon a design before committing to funding construction.

For public projects, DBB is the major method of approach. It is well understood by public agencies and their experience with DBB has led to well-developed procurement and contract documents. DBB archives open, aggressive competition for construction that is the largest element of project cost. The involvement of multiple parties in DBB each having their own

interests and liabilities to protect can result in conservative project design and construction that increases project cost Culp (2013). Since when using the DBB approach, the complete designs of the drawings are available for the contractors to bid it means before construction the owner knows how much the project it costs therefore some literature suggests that Lumpsum contracts can be used for this delivery method so that the client pays at once Love (2002). Others disagree that due to the nature of both the DBB method and the lumpsum contract they are not compatible because the contractor carries a lot of risk. This is due to the fact that some contractor because they need to have the lowest bid tend to underestimate or have errors hence variations occur during construction which affect the contract cost and lumpsum contracts don't allow for change in cost Kwan (2014). Gordon suggests that DBB method works well with Ad- measurement contracts which allows for on to measure the works done and attach costs to them.

Much as DBB is widely used for public projects, it is costly in the long run if it is not managed well. There is a lot of cost saving realised from using other delivery methods besides DBB which has led most residential and basically private owners to lean towards using CMAR and DB as alternative delivery methods. CMAR, DBB and DB contracting can all work with fixed prices. CMAR and DBB for the construction work and DB for both design and construction services. The key difference in the three is that under DB the lumpsum price is known by the owner much earlier in procurement process, and for a much lower transactional cost. The design builder can propose a fixed price in response to a request for proposals based on a 20%-30% complete design Culp (2013). From the above information DB is aligned with lumpsum contracts since the design and build team is a single entity entirely responsible for both the design and construction of the projects hence they can tell from the start how much it will cost them to do a certain project. The risk is more on the contractor's side he either make a profit or a loss but the higher the risk the greater the cost.

For CMAR the owner contracts separately with the contractor and the construction manager. the construction manager self performs portions of the construction and selects sub-contractors for the remaining portions. Although on different contracts, the designer and CM work together as a through the construction. Unlike DBB where the contractor is gotten after the design phase, here the contractor is involved from the initiation stage even during making the designs. The owner, designer and CM are also involved during the preparation of projects estimates based on intermediate milestones such as 30%- 60% designs. Because of this Gordon suggests that the GMP financial contract type works best with the CMAR delivery method and often around

the 60%-70% design point, the CM negotiates a price for the project. The GMP is not to be exceeded unless the owner issues a change order (Culp, 2013)

2.6 Decision Trees

Decision trees are a class of data extracting techniques that have their origin in traditional statistical disciplines such as linear regression. Decision trees also share an origin in the same field of cognitive science that produced neutral networks. The earliest decision trees were moulded after biological processes Belson (1956); others tried to mimic human methods of pattern detection and concept formation. Decision trees are used in many different disciplines including diagnosis, cognitive science, artificial intelligence, game theory, engineering, data mining, statistics, machine learning and pattern recognition. Decision Trees model has two goals: producing an accurate classifier and understanding the predictive structure of the problem. The classification accuracy of decision trees has been a subject of numerous studies (Lior, 2005).

A decision tree is a classifier expressed as a recursive partition of the space, Cristina (2010). The decision tree consists of nodes that form a rooted tree, therefore it is a directed tree with a node called root that has no incoming edges. All other nodes have exactly one incoming edge. A node with outgoing edges is called a test node. All other nodes are called leaves or decision nodes. In a decision tree, each internal node splits the space into two or more subspaces according to a certain discrete function of the input attributes values. In the simplest and most common case, each test considers a single attribute, such that the space is partitioned according to the attribute's value. In the case of numeric attributes, the condition refers to a range. Each leaf is assigned to one class representing the most appropriate target value. Alternatively, the leaf may hold a probability vector indicating the probability of the target attribute having a certain value. Spaces are classified by navigating them from the root of the tree down to a leaf, according to the outcome of the tests along the path (Crisitina, 2010).
Lately, decision tree model has been applied in very diverse areas like security and medicine. Decision trees can be used for problems that are focused on either insight or prediction. Even on data sets with very many columns. Decision trees tend to converge very quickly on a decent model.

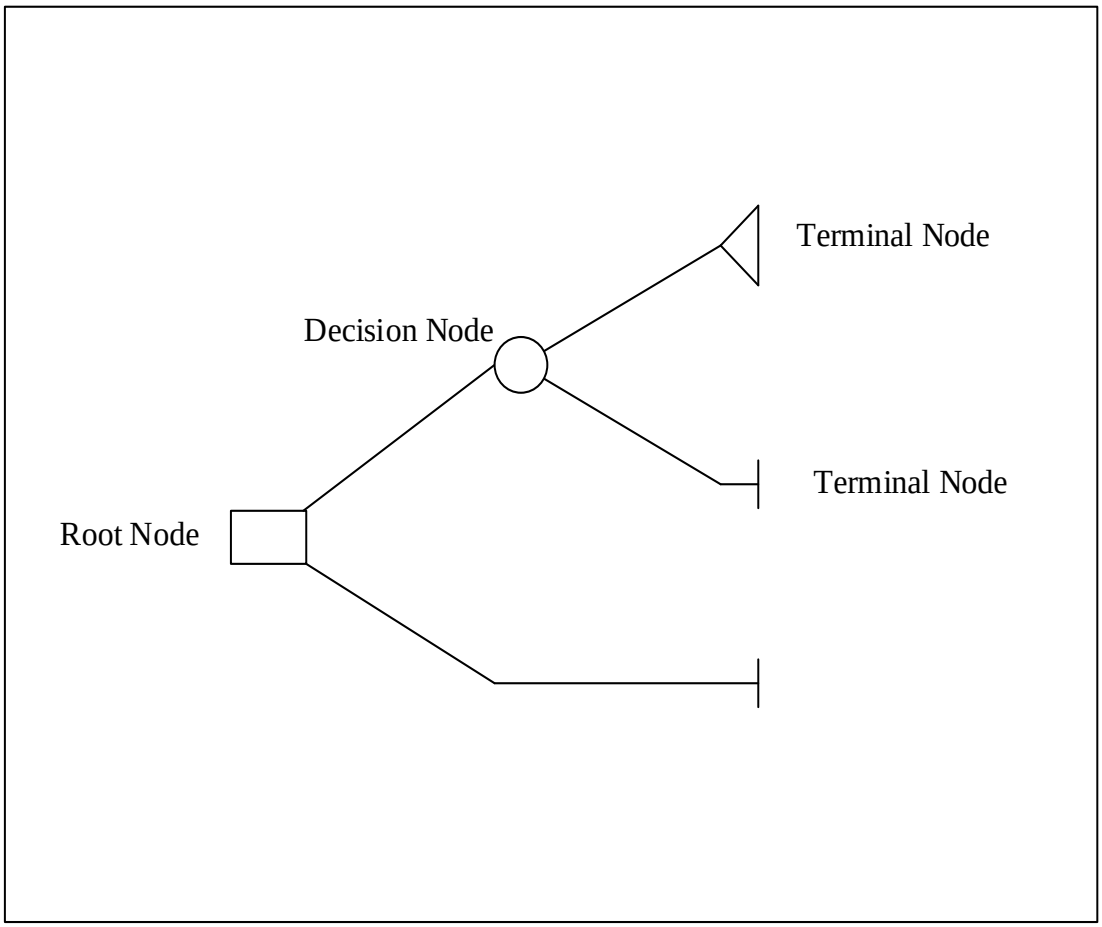

Figure 2: simple diagram showing parts of a decision tree

2.6.1 Advantages of Using Decision Trees

Graphically you can represent decision alternatives, possible outcomes, and chance events schematically. The visual approach is particularly helpful in comprehending sequential decisions and outcome dependencies. Decision trees produce result that communicate well in symbolic and visual forms. You can quickly and efficiently express complex alternatives clearly. You can easily modify a decision tree as new information becomes available. Set up a decision tree to compare how changing input values affect various decision alternatives. You can compare competing alternatives-even without complete information-in terms of risk and probable value, Cristina (2010). The Expected Value (EV) term combines relative investment costs, anticipated payoffs, and uncertainties into a single numerical value. The EV reveals the overall merits of competing alternatives. Decision trees have a complementary aspect in that you can use decision trees in conjunction with other project management tools. For example, the decision tree method can help evaluate project schedules. Decision trees are self-explanatory and when compacted they are also easy to follow. In other words, if the decision tree has a reasonable number of leaves, it can be grasped by non-professional users. Furthermore, decision trees can be converted to a set of rules. Thus, this representation is considered as comprehensible. Decision trees readily incorporate various levels of measurement, including qualitative (e.g., good-bad) and quantitative measures (Lior, 2005).

2.6.2 Disadvantages of Using Decision Trees

Most of the algorithms require that the target attribute will have only discrete values. As decision trees use the divide and conquer method, they tend to perform well if a few highly relevant attributes exist, but less so if many complex interactions are present. One of the reasons for this is that other classifiers can compactly describe a classifier that would be very challenging to represent using a decision tree. The greedy characteristic of decision trees leads to another disadvantage that should be pointed out. This is its over-sensitivity to the training set, to irrelevant attributes and to noise (Crisitina, 2010).

CHAPTER THREE

METHODOLOGY

This chapter outlines the research design, materials, sampling techniques and itinerary that was followed during data collection and analysis exercise. The methodology is a series of methods that were employed in carrying out the different activities required for this research. Details of the research design, study area, sampling, data collection and analysis of data are given in the subsequent sections of this chapter.

3.1 Data Collection

3.1.1 Type of Data

This research study used both secondary and primary data. Secondary data was relevant records like evaluation reports, project reports, financial reports and primary data were obtained from using checklists, interviewing people that were involved in the decision-making process and the other parties from whom data was collected.

3.1.2 Study Population

The target population was public construction projects. This was to focus on road and building projects conducted all over the country. Since the researcher was targeting construction projects, focus was put on the consultancy team since they are the major people involved in the initiation process of a project where these decisions are made. For each project it was assumed that there was at least one consultancy team and contracting team, where the teams were combined as one then the contractors were interviewed too. Data was also collected from the local authorities responsible for overseeing the execution of these projects. The figure of the target population could not be estimated since there were several projects going on all over the country.

3.1.3 Sample Size

Since the target population could not necessarily be calculated, the researcher chose sample size to be 60 projects which will constitute 30 road projects and 30 building projects. This data was collected from 30 consultancy and contracting firms and local authorities. The sampling technique used in choosing the firms to be visited was be purposive and convenience since some of the data sources were uneconomical to visit and some respondents were not willing to participate in the exercise.

3.2 Data Collection Tools

3.2.1 Interview Guide

Semi-structured interview schedules were used to guide the researcher when conducting research. Close ended set of questions were used to help the researcher focus on the main matters of the research, and a few open-ended questions to get information that was not asked directly.

3.3 Methods of Data Analysis and Data Treatment Procedures

Processing of data was done both manually and a computer using MS excel to be exact. MS excel was used because it can easily generate statistical tables, graphs, and charts that will be used in data presentation and interpretation. Manual methods were used mainly in organizing and editing the collected data to come up with a valid analysis depicting the respondents' ideas. Data was tabulated and presented in graphs. Frequencies and probabilities were used to develop decision trees for presentation and comprehension. The decision trees were developed following the following steps;

The outcomes for the different performance measures were allocated on the end nodes. And the expectancy of each end node was calculated using the formula below

Expectancy = probability X outcome

The average expectancy was then calculated of each branch which was used to determine which branch had the higher expectancy making it the better option. The formula that was used to calculate the average expectancy is below:

$$AE = \frac{1}{n}\sum_{i=1}^{n} E_i$$

The average average expectancy was also calculated. This was an average of the average expectation on each branch. The branch with the higher average average expectancy was the better option to guarantee average performance of the project. The formula that was used is below;

$$AAE = \frac{1}{n}\sum_{j=1}^{m} AE_j$$

Separate trees were drawn for the PDMs and FCTs of the different project types. Comparisons were made basing on the AAEs for the different trees to develop a combined tree of both PDMs and FCTs. The PDM with a high AAE and the FCT were aligned together to get the good combination to guarantee good performance.

CHAPTER FOUR

FINDINGS, ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter consists of the findings of the research analysis, presentation, interpretation and discussion. This chapter has information of the respondents. The analyzed data was presented using frequency distribution tables and decision trees proceeded by interpretation and discussions of findings on the effect of aligning project delivery methods and financial contract types on performance of projects.

4.2 Interviewee's Responses

30 interviews of different professionals involved in the construction processes were carried out and all were willing and eager to participate. Interviews were done to get quick and reliable responses which is exactly what happened. This represented a 100% response rate from the interviews. The table below shows the different professionals that were interviewed.

Table 4. 1: Professionals Interviewed

Respondent	**Frequency**
Architect	8
Quantity surveyor	10
Structural Engineer	7
Construction manager	5

4.3 Knowledge of PDMs and FCTs

Table 4. 2: Respondent's knowledge of FCTs and PDMs

Methods	Architect	Quantity Surveying	Engineer	Construction Manager	Total	Percentage
PDMs (yes)	8	10	7	5	30	100%
No	-	-	-	-	-	-
FCTs (yes)	8	10	7	5	30	100%
No	-	-	-	-	-	-

When respondents were asked if they knew about PDMs and FCTs as shown in the table 100% of them knew what they were. Most of the PDMs and FCTs though were known in theory and in practice only two of each were used on the projects that were studied. That is DB and DBB for PDMs and lumpsum and ad measurement for FCTs these are looked at further in the findings below.

4.4 Types of Projects Studied

A total of 60 projects were looked at. Of these 30 were building projects and 30 road projects. These particular project types were considered because they are the major public projects that are carried out here in Uganda and their information well documented. Also, the criteria followed to select the particular projects studied was based on cost of the project which was projects costing one billion and above. Information about these projects was acquired from the relevant authorities handling the construction of these projects, quantity surveying firms and contracting firms.

Table 4. 3: Types of Projects Studied

Type	Frequency
Buildings	30
Roads	30

4.5 Use of Delivery Methods on the Different Project Types

This research required the researcher to study the different delivery methods used on the project types in order to determine which method is commonly used and why? The research also wanted to determine if there was a relationship between PDMs an FCTs.

4.5.1 Building Projects

These projects comprised of commercial and institutional buildings. The table below shows the usage of the different PDMs on these projects.

Table 4. 4: The PDMs used in Building Projects

PDM	Building Projects	Percentage
DB	7	23%
DBB	23	77%
CMAR	-	-
Total	30	100%

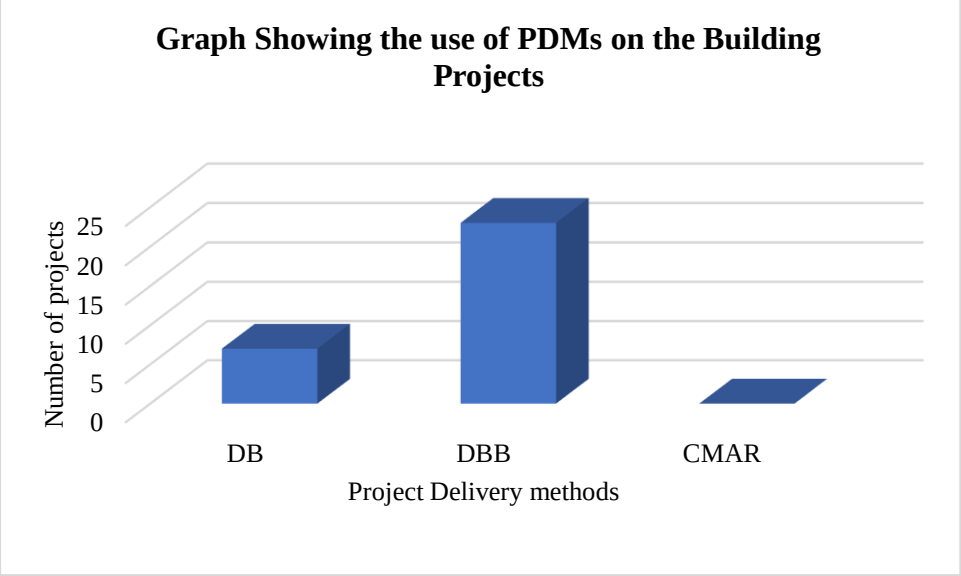

Figure 4. 1: Graph Showing use of project delivery methods on building project

The graph shows that the commonly used PDM is DBB which is 77% of the building projects. As earlier mentioned according to literature this is the oldest and most used delivery method

for public projects in that most Governments have mastered the art of using them and formed procurement guidelines based on it. DB is just starting to be looked as an alternative method in Uganda hence it representing 23% of the projects. It is rare because there are few contractors who can do both and those that form a team managing both can be a problem and issues arise from there. CMAR is being used but in an informal way in that the contractors get sub-contractors to do all the work without the consent of the client therefore in actual sense it is not in use.

4.5.2 Road Projects

A total of 30 road projects were looked at mainly tarmac roads within Kampala and a few areas around.

Table 4. 5: The PDMs used on Road Projects

PDM	Road Projects	Percentage
DB	5	17%
DBB	25	83%
CMAR	-	-
Total	30	100%

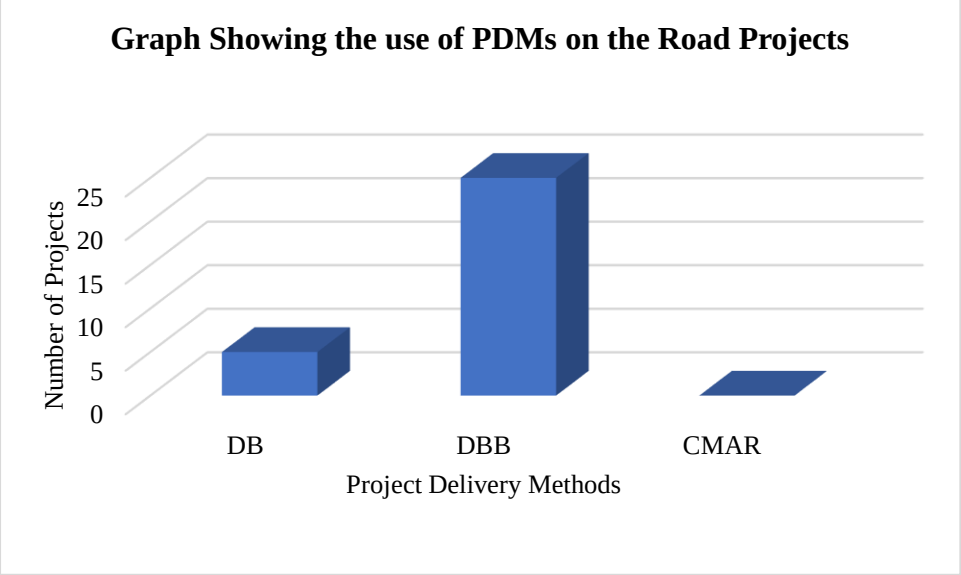

Figure 4. 2: Showing use of delivery methods on Roads Projects

Just like the building projects, according to this graph DBB is the commonly used delivery method representing 83% of the projects partly because people take it as rule of thumb since it

has been used on most projects they see no need to change. DB comes in second covering 17% of the project and it has just recently been used on the new roads being put up as a trial method to see if its more effective in terms of performance and the results were positive except for it being expensive compared DBB.

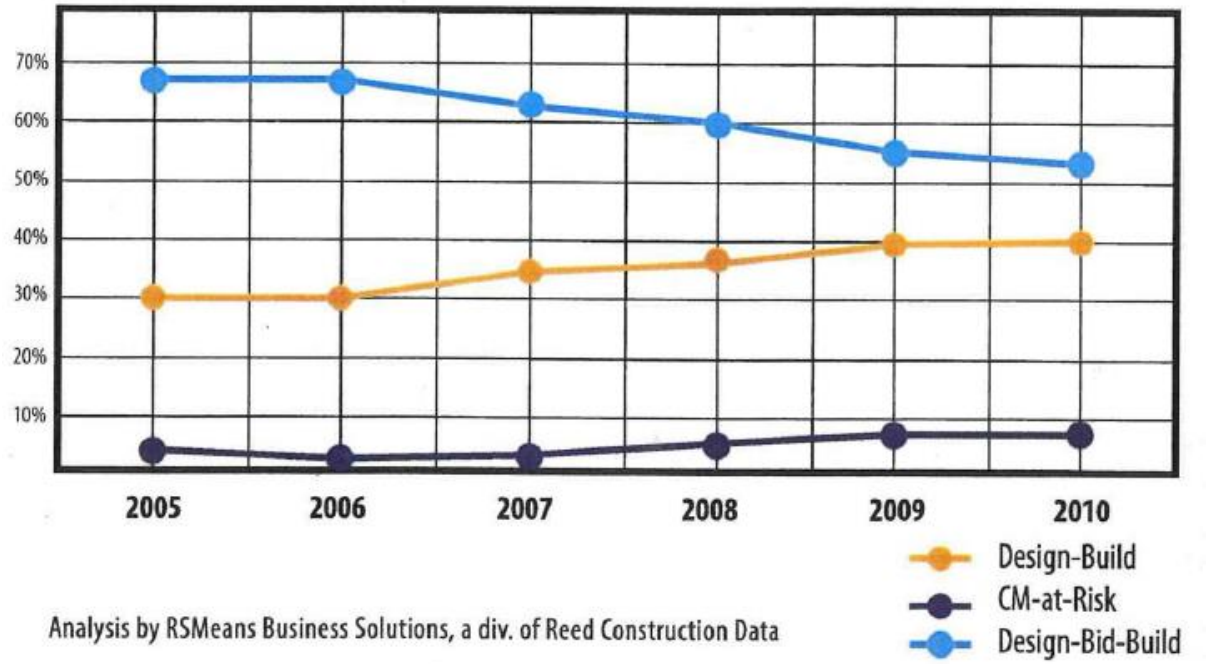

Figure 3: Use of PDMs in the USA construction industry (Design Build Institute of America, 2015)

The use of PDMs here in Uganda is similar to that of the USA with CMAR not being popular too and DBB taking the lead.

4.5.3 People Responsible for Choosing the PDM to use

The choice of delivery method used on a project was made by various people depending on the project being handled. The table below shows the people who made the decisions in the projects looked at.

Table 4. 6: Decision Makers in Choosing PDMs

Person	Frequency
Architect	16
Engineer	34
Client	6
Quantity Surveyors	0
Funder	4

The architects and engineers on these projects where they chose the PDM to use were also the project managers of these projects hence them having the power to make this decision. From

the table above, we notice the engineers made most of these decisions this is because all road projects were managed by an engineer and therefor the director of engineering for urban planning was the on to make the decision for all these projects. For some projects the client made the decision and this was possible because they had knowledge in construction and also for others it was with the advice of the project manager. Then for some projects that were funded by foreign aid the funders dictated what PDM to use (most chose DBB) to enable all contractors to be able to compete for the projects making it a fair thing for all people.

4.5.4 Factors Considered When Choosing the PDM to use

The factors considered were common for almost all the projects the leading one being the fact that most projects have always used DBB so it is basically a rule of thumb for most people since it has always worked for them. Secondly the funder/ client in some cases would decide what they want whether good competition among the people that would lead the to opting for DBB. Also, the PPDA recommends the contractor to be chosen to work on a project ought to be the lowest bidder and this is achieved using DBB since the rest are quite expensive so indirectly the people are cornered to use it if they are following the PPDA which is the way for public projects. And lastly the urgency of the project. If it is needed so fast then the whole bidding process can be done away with. This is mainly done by the disaster preparedness department when rehabilitating people.

4.6 Use of FCTs on Projects

The projects that were looked at also employed the use of FCTs to dictate how the contractor would be paid.

4.6.1 Building Projects

Table 4. 6: The FCTs used for Building Projects

FCT	Building Projects	Percentage
Lumpsum	6	20%
Ad Measurement	24	80%
Cost Reimbursement	-	-
Total	30	100%

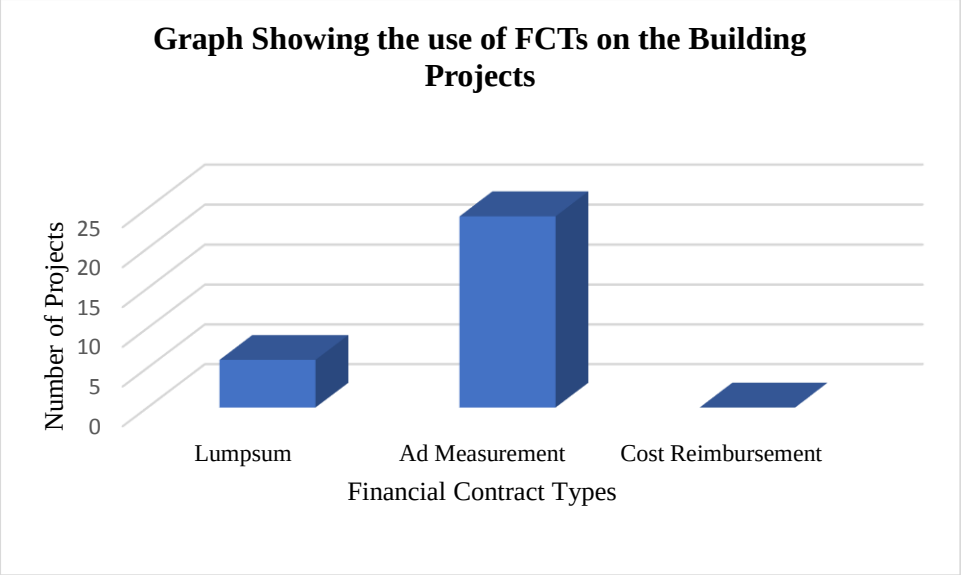

Figure 4. 3: Showing the FCTs used for Building Projects

According to the graph, the commonly used FCT is Ad Measurement which covers 80% of the projects. This is because of the rate at which the finances for these kinds of projects are provided. Most of these are government funded projects therefore the money is released every financial year meaning the costs of different materials vary from year to year hence the failure to use lumpsum method. Lumpsum contracts cover 20% of the project, they are not commonly used because it is risky for the contractors they stand a chance to make a great loss or gain but not many are willing to take that risk.

4.6.2 Road Projects

Table 4. 7: The FCTs used in Road Projects

FCT	Road Projects	Percentage
Lumpsum	2	7%
Ad Measurement	28	93%
Cost Reimbursement	-	-
Total	30	100%

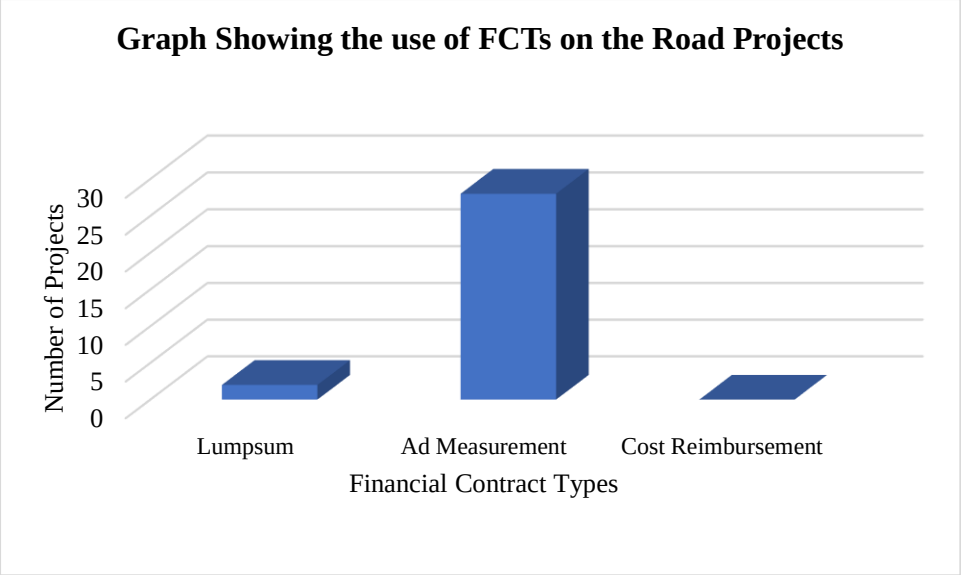

Figure 4. 4: Showing FCTs used in Road Projects

The scenario in road projects is quite similar to that of building projects where we have Ad measurement as the commonly FCT covering 93% of the projects. Lumpsum types of contracts are just starting to be used but they are rare because they are quite expensive to use. Cost Reimbursement has not been used for these projects because trust is a big factor believing that one will actually be paid for there works which is a hard promise to believe in here in Uganda.

4.6.3 Factors Considered when Choosing what FCT to use

The decision of the FCT to use was independent of the delivery method being used on the project but it was made after choosing the delivery method. The first and major factor followed is the availability of funds. For the projects that used Lumpsum the funds were readily available and the vice versa true for Ad measurement projects.

4.7 Performance Outcomes of PDMs used on the Projects

The performance outcomes are shown below in the decision trees. As mentioned, the measures of performance used were (cost, time and quality). Cost was measured basing on the percentage of cost overruns, time was measured in terms of time overruns and quality was measured based on the percentage of reworks. These parameters were further divided into (good, bad, fair) and the probabilities allocated to these basing on the scales of measure that were mentioned in the methodology which were [≤1% - Good, 1≥ x≤5-Fair, 5≥ x≤ 10-Bad]. The average expectancy of the three performance measures was gotten to give us the average performance of the projects in terms of the performance measures. An average of the average expectancy was

gotten to give us the general performance of a particular PDM. The decision trees below are for both the building and road projects.

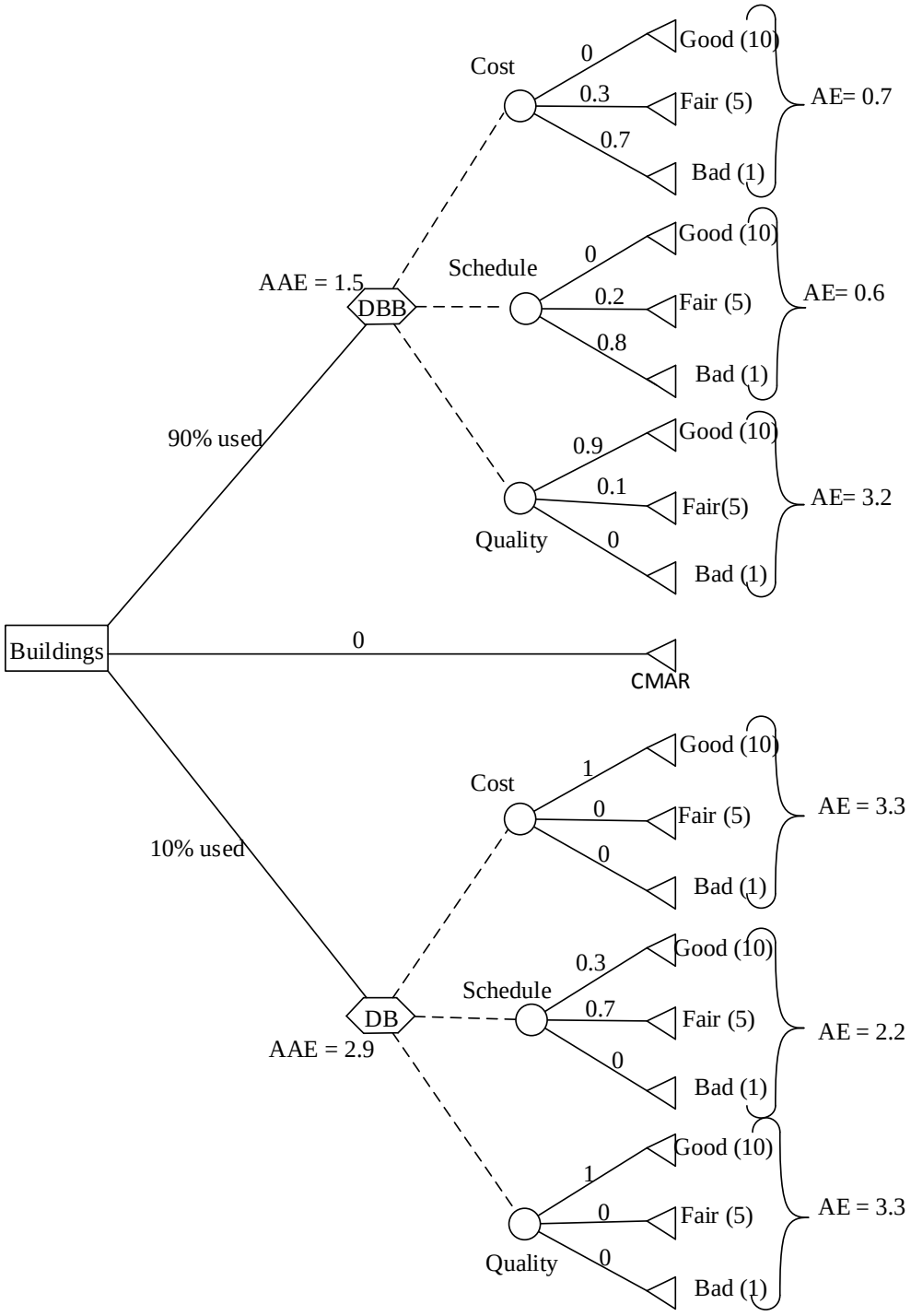

Figure 4. 5: Decision tree showing the performance outcomes of PDMs on building projects

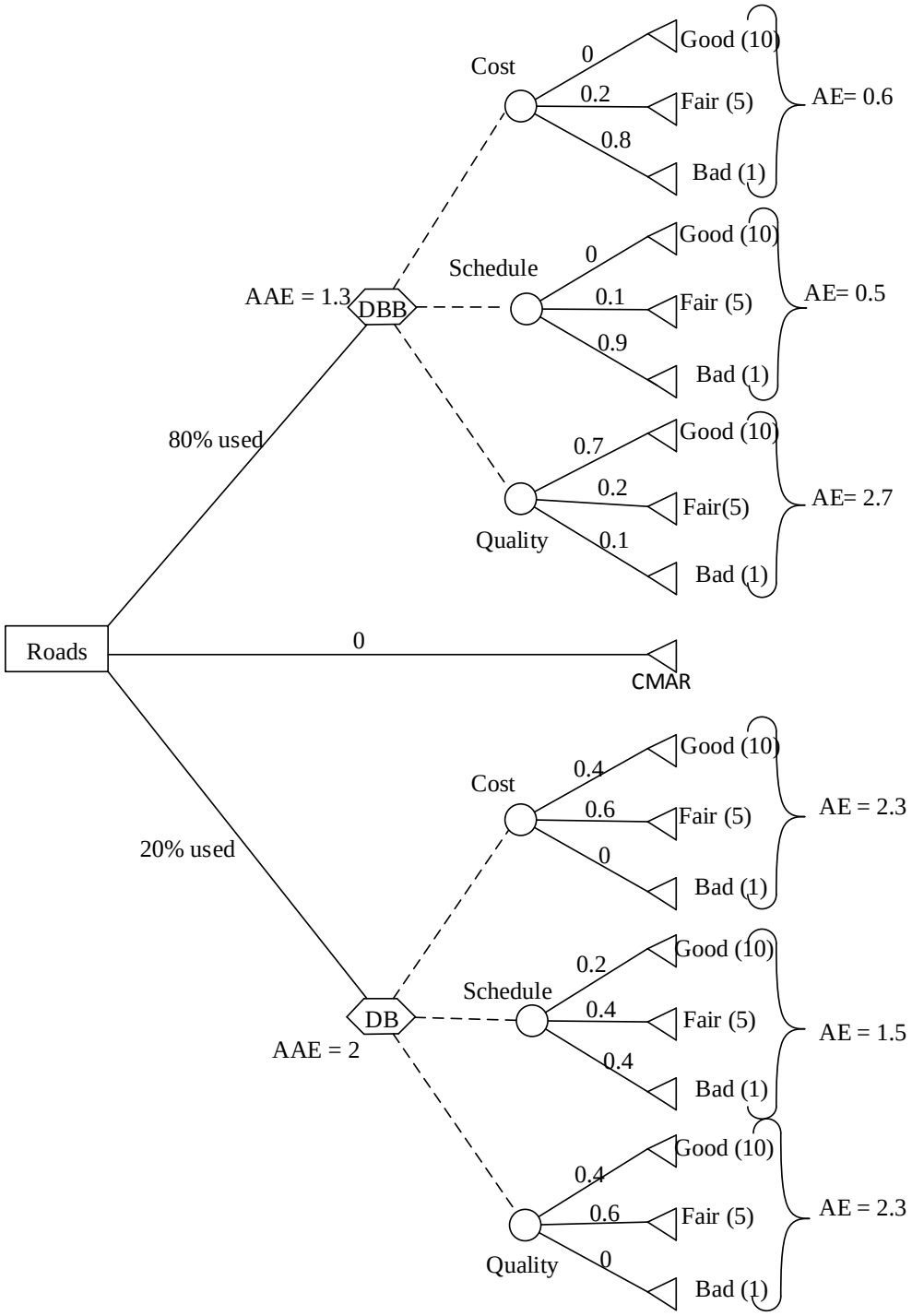

Figure 4. 6: Decision Tree showing performance outcomes of PDMs on Road projects

4.8 Performance Outcomes of the FCTs used on the Projects

The performance outcomes are shown below in the decision trees. Just like the PDMs, also for the FCTs, the measures of performance used were (cost, time and quality). The average expectancy of the three performance measures was gotten to give us the average performance of the projects in terms of the performance measures. An average of the average expectancy

was gotten to give us the general performance of a particular FCT. The decision trees below are for both the building and road projects.

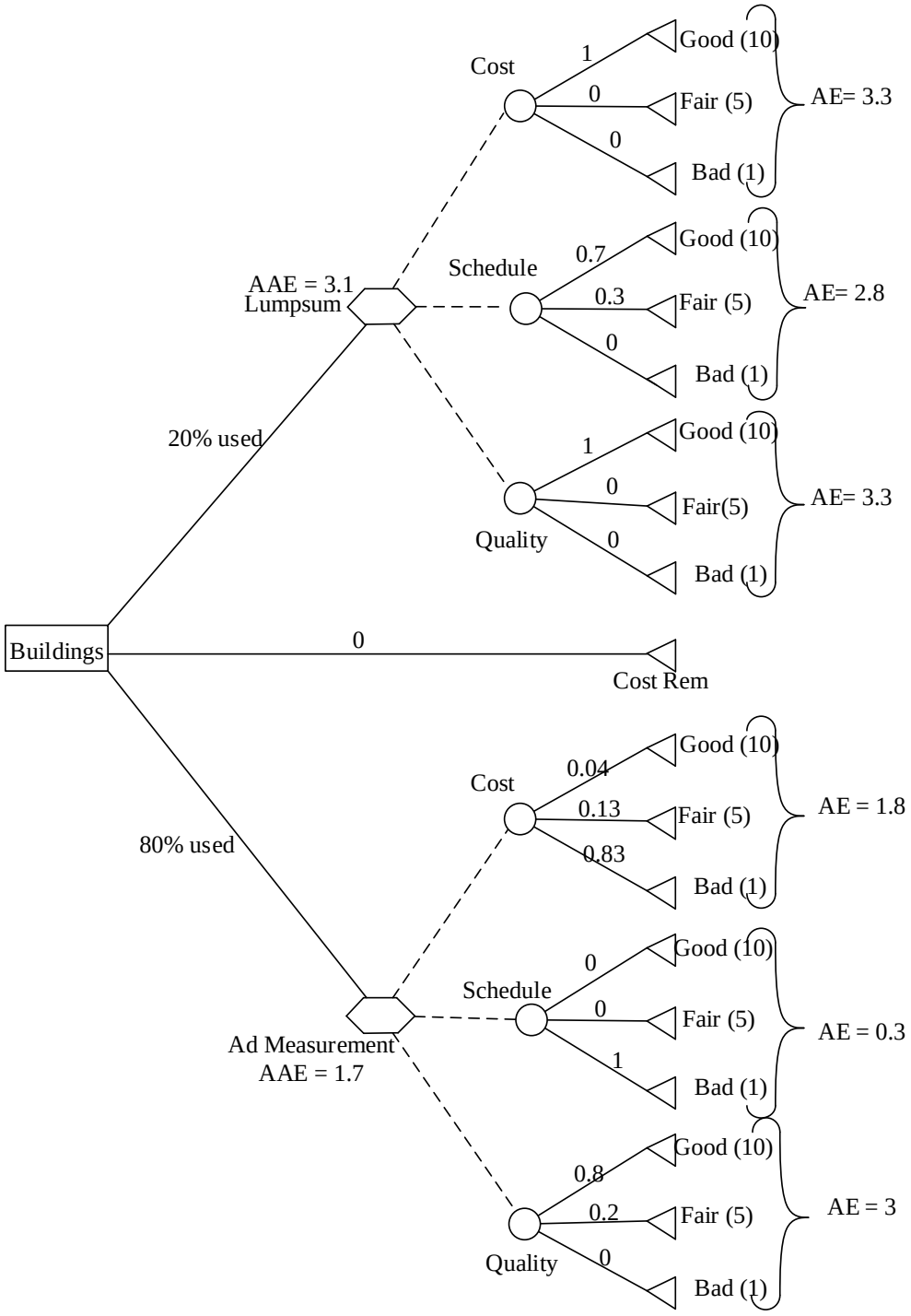

Figure 4. 7: Decision tree showing the performance outcomes of FCTs for building projects

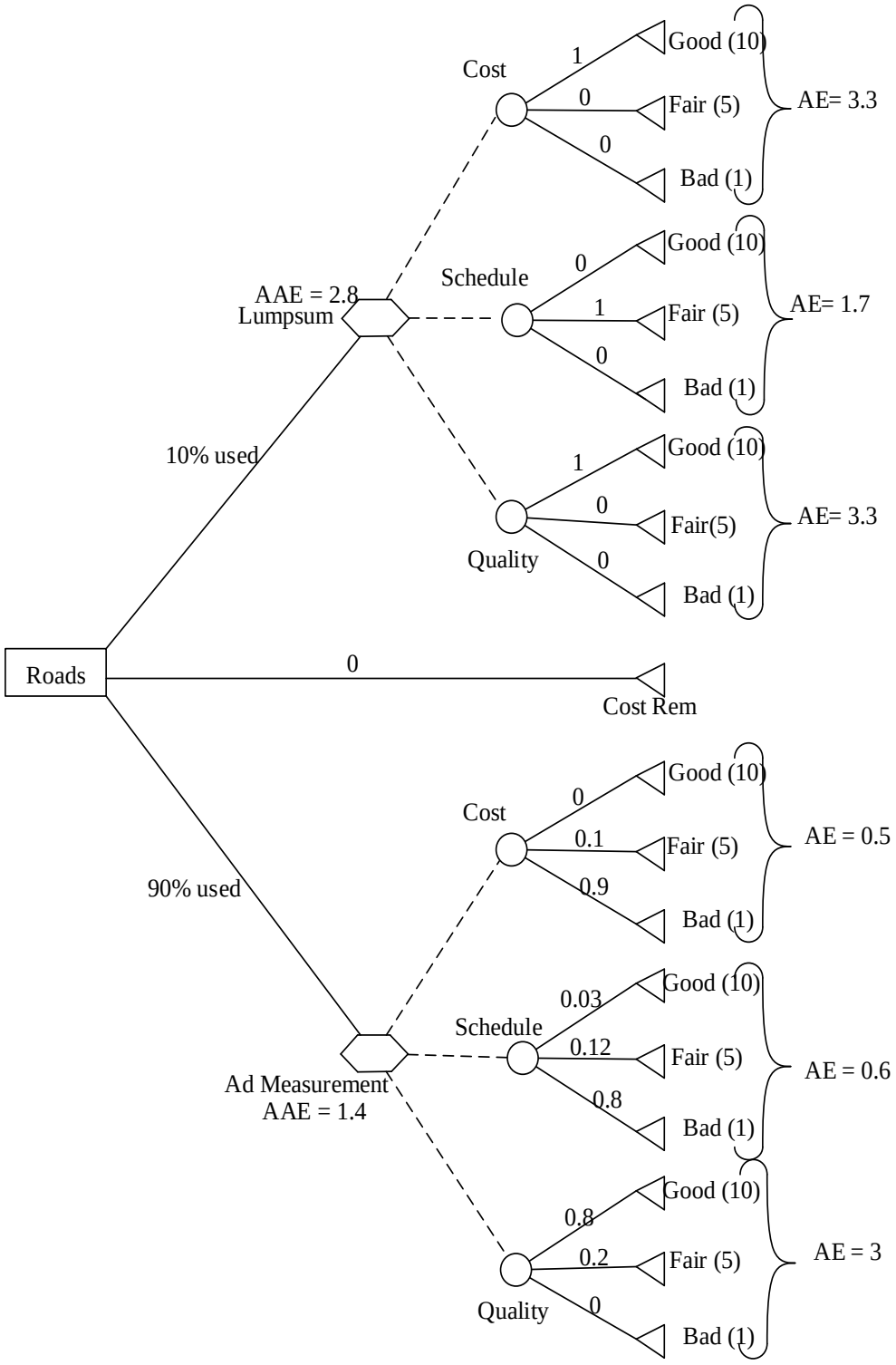

Figure 4. 8: Decision tree showing performance outcomes of FCTs for road projects

4.9 Alignment of PDMs and FCTs

From the trees above the average average expectancy (AAE) was used to show the performance of each PDM and FCT. From the methodology it was mentioned that the higher AAE indicates better performance in general that is on average putting into consideration cost, time and quality performance. Therefore, the PDM that had a higher AAE was aligned with the FCT with a

higher AAE with the assumption that they would both achieve better results in terms of performance. The tree below shows the different alignments that gotten from the findings.

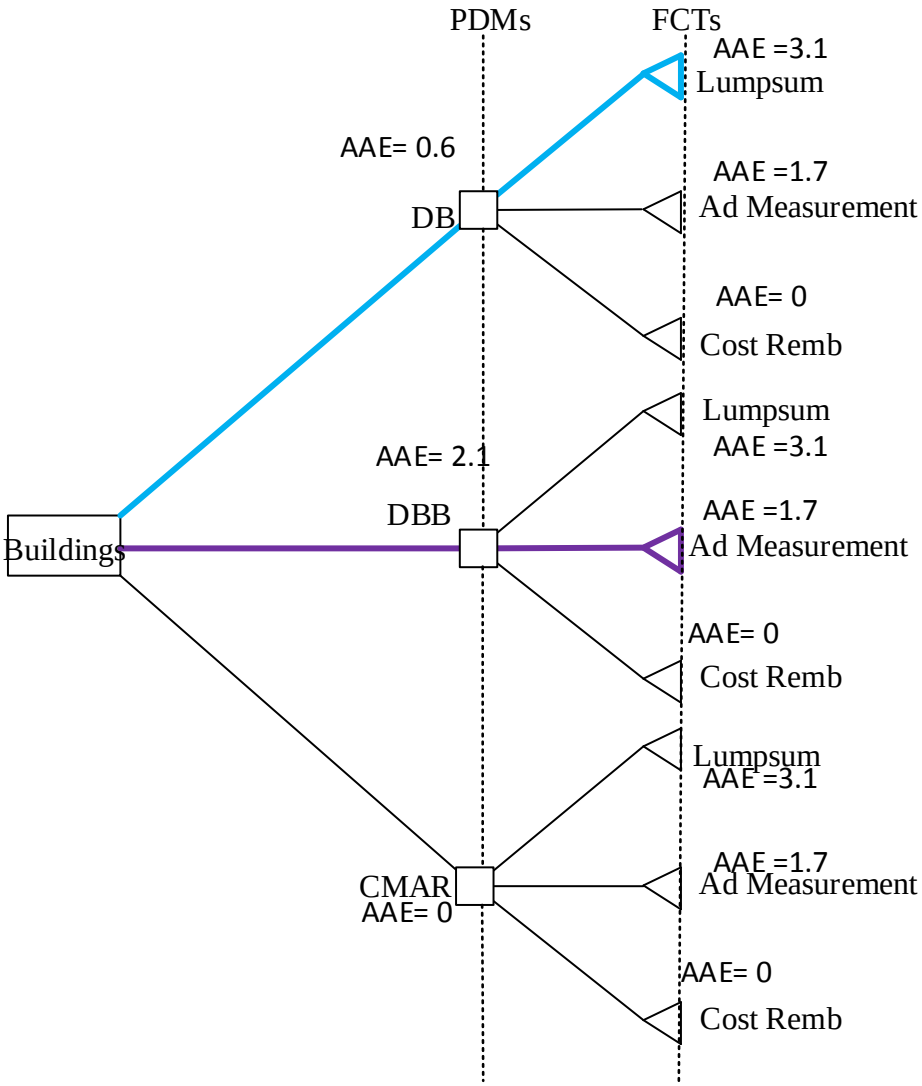

Figure 4. 9: Decision tree showing the alignment of PDMs and FCTs for Building projects

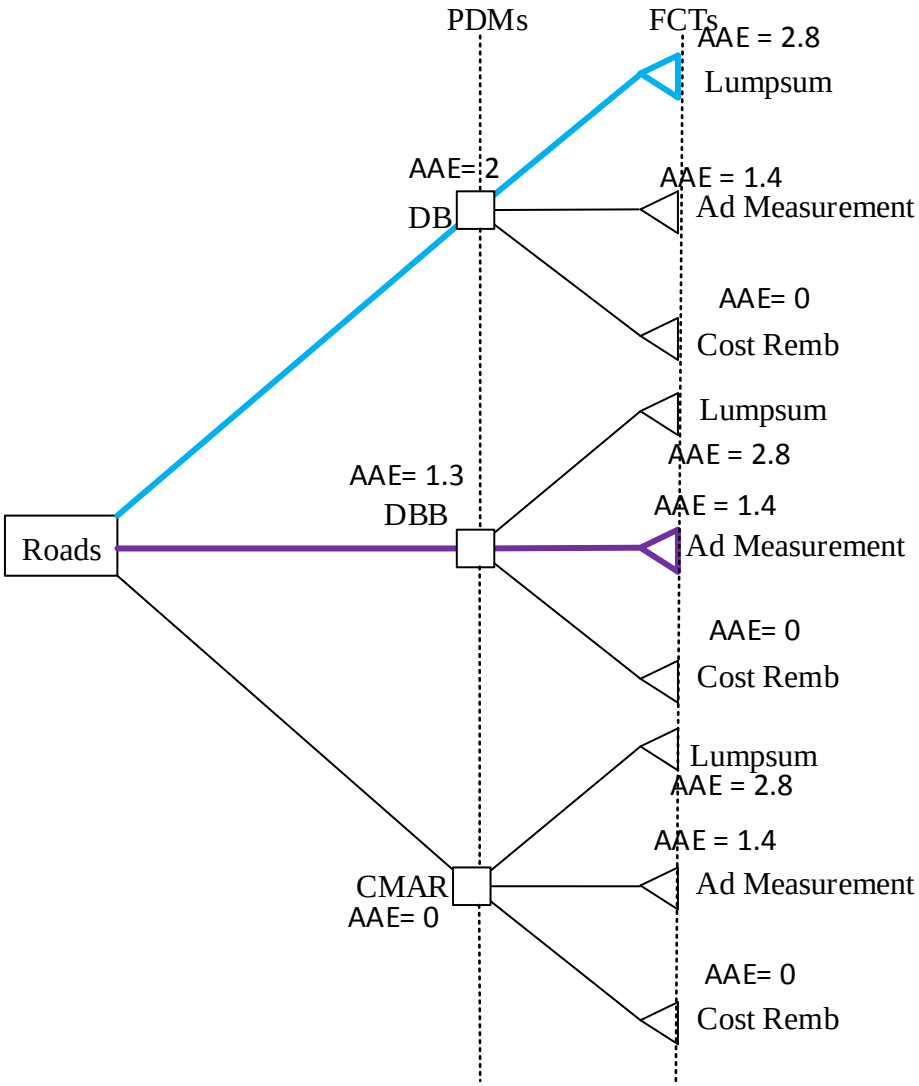

Figure 4. 10: Decision tree showing the alignment of PDMs and FCTs for Road projects

The trees above apply for building and road projects whose costs are beyond one billion. According to literature, CMAR is commonly aligned with guaranteed maximum price (GMP) contracts. They either use design and build with lumpsum contracts or design bid build with ad measurement contract types.

CHARPTER FIVE

CONCLUSIONS, RECOMMENDATIONS AND CHALLENGES

5.1 Conclusions

The researcher's findings indicate that there is an effect of alignment of project delivery methods and Financial Contract types on performance of the project. Different arrangements of PDMs and FCTs were used on the projects studied for example DBB-lumpsum, DB-lumpsum, DBB-ad measurement and DB-ad measurement. There were different performance outcomes as demonstrated in the trees above. The better performance outcomes were when DBB was aligned with ad measurement and DB aligned with Lumpsum. Much as most people are aware of the benefits associated with using design and Build aligned with lumpsum contracts, they stick to using the traditional method which is the most commonly used delivery method for public projects and Ad measurement.

From the findings above 13% of the projects used DB and lumpsum contracts and they performed well on average compared to those that used a combination of DBB and ad measurement which was the most used combination used by 87% of the projects. However, despite the low usage of DB and Lumpsum in Uganda, the respondents indicate that it is more time and cost saving as compared to DBB and the kind of work produced is to quality hence having a satisfied client. 97% of the respondents think that DB should be used more often but first people need to understand how to manage their contracts. Projects where they tried to interchange and use DBB and lumpsum didn't perform well and also DB with admeasurement which helps support the conclusion further that DB produces better results when aligned with lumpsum and the alternative being true as well.

5.2 Recommendations

Given the fact that the construction industry in Uganda constantly faces the problem of time and cost overruns. Research has been done to find the cause and recommend ways on how to improve but the issue still persists. One of the major problems is poor management of the contracts which involves what kind of contracts, the organization of how the works will be done and also the payment agreements. One of the ways of achieving proper management and organization of the contract is by having a proper alignment of the delivery method and financial contract type. The decision trees in this research are rudimentary and the researcher recommends more research to be done to determine what alignment works best for civil

projects, building and road projects that cost below one billion Uganda shillings. The researcher recommends a study to be done on how to implement the use of other PDMs and FCTs that are more efficient and eliminate this whole concept of rule of thumb.

5.3 Challenges

The research was to some extent challenging especially in the following ways

1. Most of the respondents who were highly resourceful did not have enough spare time to exhaustively respond to the researcher's questions and therefore some important information was missed out. However, the researcher tried to minimize this by being straight to the point in her research tools.
2. Another challenge of the research was resources limitations in terms on money, personnel and time.

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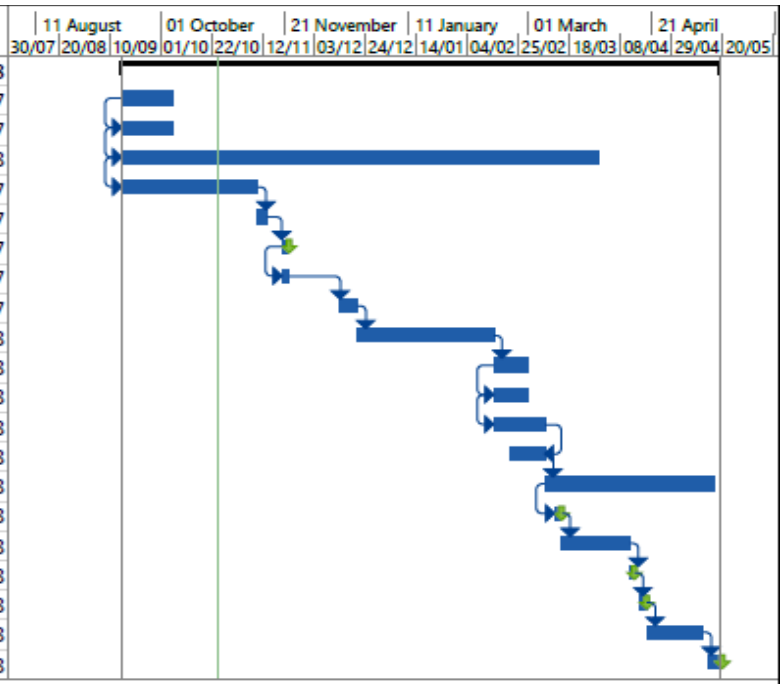
APPENDICES

Appendix one: Budget

No	Item	Description	Qty	Unit	Rate	Amount
1	Stationery	Plain Paper	2	Rims	15,000	30,000
		Note Books	1	No.	2,000	2,000
		Pens /Pencils	3	No	500	1,500
2	Materials	Flash Disks	1	No.	25,000	25,000
3	Travel	Transport		Lump sum	150,000	150,000
4	Assistant		1	No.	100,000	100,000
5	Communication	Airtime	6	Months	5,000	30,000
6	Services	Secretarial	50	Pages	300	15,000
		Photocopying	1		Lump sum	20,000
		Scanning	1		Lump sum	10,000
		Printing	100	Pages	200	20,000
		Binding	3	Copies	5,000	15,000
7	Subtotal					418,000
8	Contingency	15% of Sub-total				62,775
9	**TOTAL**					**480,775**

Appendix two: Activity Schedule

ID	Task Name	Duration	Start	Finish
1	**Proposed Work plan**	**176 days**	**Fri 15/09/17**	**Fri 18/05/18**
2	Problem definition	3 wks	Fri 15/09/17	Thu 05/10/17
3	Preliminary literature review	3 wks	Fri 15/09/17	Thu 05/10/17
4	Literature review	28 wks	Fri 15/09/17	Thu 29/03/18
5	Writing proposal	8 wks	Fri 15/09/17	Thu 09/11/17
6	Developing slides	2 days	Fri 10/11/17	Mon 13/11/17
7	Proposal presentation	3 days	Mon 20/11/17	Wed 22/11/17
8	Proposal submission	3 days	Mon 20/11/17	Wed 22/11/17
9	Designing data collection tools	5 days	Thu 14/12/17	Wed 20/12/17
10	Collecting data	8 wks	Thu 21/12/17	Wed 14/02/18
11	Writing findings	2 wks	Thu 15/02/18	Wed 28/02/18
12	Data Interpretation	2 wks	Thu 15/02/18	Wed 28/02/18
13	Data Analysis	3 wks	Thu 15/02/18	Wed 07/03/18
14	Update literature	10 days	Thu 22/02/18	Wed 07/03/18
15	Writing the report	50 days	Thu 08/03/18	Wed 16/05/18
16	Mid presentation	3 days	Mon 12/03/18	Wed 14/03/18
17	Editing	4 wks	Thu 15/03/18	Wed 11/04/18
18	Submit Draft report	2 days	Thu 12/04/18	Fri 13/04/18
19	Final presentation	3 days	Mon 16/04/18	Wed 18/04/18
20	Report editing	17 days	Thu 19/04/18	Fri 11/05/18
21	Submit Final Report	5 days	Mon 14/05/18	Fri 18/05/18



Project: laureen
Date: Wed 25/10/17

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Page 1

SEMI- STRUCTURED INTERVIEW SCHEDULE

1. What is your position on the project?

☐ Quantity surveyor ☐ Engineer ☐ Architect ☐ Project manager ☐ Others

2. What project are you working on?

……

3. What is the nature of project?

☐ Private ☐ Public

4. What Project Delivery Method was used on this project?

☐ Design-build ☐ Construction Management at Risk ☐ Design-Bid-Build

☐ Others

5. What is the state of practice of PDMs? Basically, how many projects have you had to work on that don't use either of these?

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6. Who makes the decision on what project delivery method is used on the project?

…….....

7. At what point in the project is this decision made?

……..

8. What is the rationale behind their choice? If there is any followed?? Basically, interested in the procedure followed?

……..

9. How did the project perform in terms of? (fair, good, bad)

Cost measured in terms of percentage of cost overruns (≤1% good, 1≥ x ≤ 5% fair, 5≥ x ≤10% bad)

Time measured in terms of percentage of time overruns (≤1% good, 1≥ x ≤ 5% fair, 5≥ x ≤10% bad)

Quality measured in terms of percentage of reworks (≤1% good, 1≥ x ≤ 5% fair, 5≥ x ≤10% bad)

Cost…….....

Time……...

Quality…….....

10. Do you think if a different PDM was used the results would have been different? And if yes what are these alternative methods that you suggest for this project?

……..

11. What Financial Contract Type was used on this project?

☐ Lumpsum ☐ Ad-measurement ☐ Cost reimbursement ☐ Cost plus percentage

☐ Cost plus fixed fee ☐ Guaranteed Maximum Pricing ☐ others

12. When is the choice of FCT made? Is it before or after choosing the PDM to be used?

……

13. What was the basis for this choice of FCT?

……..

14. Who makes the decision on what FCT should be used on the project?

……..

15. Do you think if a different FCT was used the results would have been different? And if yes what are these alternative methods that you suggest for this project?

……

…….