ADDIS ABABA UNIVERSITY

SCHOOL OF COMMERCE

DEPARTMENT OF PROJECT MANAGEMENT

ASSESSMENT OF PROJECT DELIVERY METHODS (CASE STUDY BAHIRDAR-ZEMA RIVER BRIDGE DESIGN-BID-BUILD ROAD PROJECT AND KOKA-ADULALA DESIGN-BUILD ROAD PROJECT)

BY

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ADDIS ABABA UNIVERSITY
SCHOOL OF COMMERCE
MA PROGRAM

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A RESEARCH PROJECT WORK SUBMITTED TO ADDIS ABABA UNIVERSITY SCHOOL OF COMMERCE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN PROJECT MANAGEMENT

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Approved Board Committee:

Examiner	**Signature**
Examiner	**Signature**
Advisor	**Signature**

Statement of Declaration

I hereby declare that the study which is being presented in this research paper entitled as "**Assessment of Project Delivery Methods (Case Study Bahirdar - Zema River Bridge Design-Bid-Build Road Project And Koka-Adulala Design-Build Road Project)**" was conducted by Filimona Tsegaye for the partial fulfilment of the requirements for the award of Master of Art Degree in Project Management; is to the best of my knowledge an original work conducted by him, had not been resented for a partial fulfilment for any educational qualification at this university or any other.

_____ _____

Teklegiorgis Assefa (Asst. professor) Date
Advisor

I, the undersigned, declare that the study which is being presented in this project work entitled as "**Assessment of Project Delivery Methods (Case Study Bahirdar - Zema River Bridge Design-Bid-Build Road Project And Koka-Adulala Design-Build Road Project)**" is my original work, had not been presented for a partial fulfilment for any educational qualification at this university or any other, all the sources used are also duly acknowledged.

_____ _____

Filimona Tsegaye (GSR/8260/09) Date
Researcher

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Filimona Tsegaye

List of Acronyms and Abbreviations

AC	Asphalt Concrete
CM-R	Construction Management at Risk
DB	Design Build
DBB	Design Bid Build
DBIA	Design Build Institute of America
DBST	Double Bitumen Surface Treatment
DS	Design Standard
EOI	Expression of Interest
EOT	Extension of Time
ERA	Ethiopian Roads Authority
ETB	Ethiopian Birr
GOE	Government of Ethiopia
ICB	International Competitive Bidding
NCB	National Competitive Bidding
PDM	Project Delivery Method
RFP	Request for Proposal
ROW	Right of Way
RSDP	Roads Sector Development Program
URRAP	Universal Rural Road Access Program
VO	Variation Order

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Abstract

The purpose of this study is assessing project delivery methods using the case study projects Bahirdar - Zema River Bridge Design-Bid-Build Road Project and Koka - Adulala Design-Build Road Project. To address the study, a descriptive research design was employed with a mixed approach. This study use both primary and secondary data i.e. interview conduct with key stakeholder of the project from the contract administrator side is done and as a secondary data project documentations including contract documents, progress reports, correspondence letters, variation orders, and claim requests are used. The sampling design used is a purposive sampling, in which 8 top management of the case study projects including regional directors of the project were interviewed. The data obtained from interview and intensively gathered project data were analyzed in both qualitative and quantitative aspects. The quantitative finding of the study indicates an additional time and cost being incurred to the Bahirdar Zema DBB Road Project, whereas the qualitative aspect shows ease of contract administration and transference of project design risk to the contractor in Koka – Adulala DB Road Project. In both type of project delivery methods the quality of the work was control by the contractor and assured by the consultant in compliance to the specification and requirements. Finally, the study recommends, increasing the capacity of the contractor, to use Design Build project delivery method for the upcoming road projects.

Key words: Design – Bid – Build, Design – Build, Contract Administration, Variation Order, Extension of Time, Quality Assurance

Chapter One

Introduction

1.1 Introduction

The highway or road construction sector develops and builds large and complex projects in order to expand, improve and repair the road infrastructure throughout the world, Ethiopia is not exceptional, rather, expansion and improvement occurs more as it is a developing country.

Recognizing the role of road in supporting economic and social growth of the country, the Government of Ethiopia (GOE) has invested majority of the country's annual budget in building new roads and expand the existing road network.

To achieve availability of roads with improved quality and extend road infrastructure in the construction sector, related to restricted road network coverage, the Government launched different Road Sector Development Programs in the past years. The performance of this Road Sector Development Program (RSDP) has brought significant improvements in the restoration and expansion of Ethiopia's road network. Physical achievements have been matched by significant improvements in the condition of the network, strengthening of the management capacity of the road agencies and delivery on policy reform.

The Road Sector Development Programs have accomplished a major physical road construction works of 128,470 km excluding routine maintenance work and community roads. The disbursement of this work composes of 34,195 km on Federal level, 26,239 km on Regional level and the last 68,035 km was done on Woreda/ URRAP level of road construction. Overall physical accomplishment against plan was 86%. Total disbursement was about ETB 266.2 billion and this disbursement was 115% of the plan. (ERA, 2016)

With regard to federal roads, 2,979 km of rehabilitation of trunk roads and 10,236 km of upgrading of trunk and link roads and 7,752 km construction of new link roads were carried out under the program. In parallel with this, heavy maintenance on 13,226 km of federal road was also carried out. (ERA, 2016) with this program Ethiopia has envisaged to join the middle income countries by increasing its road network to 201,750km by 2028. To this end, Ethiopian Roads Authority has

employed different ways of administrating its projects through different methods of project delivery methods.

Project Delivery Method is a comprehensive process including planning, design and construction required to execute and complete a road project or other type of projects. Choosing a project delivery method is one of the fundamental decisions owners make while developing their acquisition strategy

Determining the project delivery method is one of the most important decisions made by every owner embarking on a construction project. Choosing the best method for any project must start with a good understanding of choices available. Owners must also have a firm grasp of the impact of each choice, because the delivery method establishes when parties become engaged; it influences the choices of contractual relationships; and it influences ownership and impact of changes and modification of project costs. In all delivery systems, there is always a minimum of three parties involved: owner (Client), designer (Consultant/ Engineer) and contractor. It is important to choose a delivery method that best meets the unique needs of each owner and their project.

Project considerations have fundamental impacts on the delivery method selected. These considerations include *a realistic budget, a schedule that includes a reasonable performance period, a responsive and quality design process, a risk assessment with allocation of risks* to the appropriate parties and a recognition of the level of expertise within the owner's organization. (DBIA, 2015)

According to Lo. et.al (2009) different alternative of Construction delivery methods are available in the construction field. The client must understand the features of the methods in order to select the most effective ones. The road project delivery methods are traditional Design-Bid-Build (DBB), Design-Build (DB), Construction Management at Risk (CM-R) and Integrated Project Delivery. Based on the analysis of road procurement, more integrated services give better value for money and are of more help to the client in attaining his goals than more traditional methods. Yet, one should realize that each method has its typical applications, and all methods are not suitable for all purposes. For this study the common project delivery methods in our country - Design Bid Build (DBB) and Design – Build (DB) are selected.

Design-Bid-Build (DBB) Design-bid-build contracts represent the most frequently used type of project delivery systems for most construction projects, and are considered to be the “traditional” delivery method. In this delivery system the employer enters in to an agreement with two separate project parties the designer and contractor. The designer is required to provide a complete design documentations whereas the client, usually solicited in a fixed price bid, is required to construct the project in according with the design plan and specifications

Design-Build (DB) is simply a project delivery method in which the Owner/Client selects an organization that will complete both the design and construction under one agreement. (Pakkala, 2002). Portions or all of the design and construction may be performed by a single design-build entity or by a selection of specialized workers. In some cases, all of the activities may be subcontracted to other companies. Up on completion, the Owner is then responsible for operations and maintenance of the project. The Owner is also responsible for all the financing aspects.

With this point in mind, the Government of the Federal Democratic Republic of Ethiopia (FDRE) commits to give the road sector the highest priority and is preparing more projects for funding by donors and from the national budget. Individual road projects are selected for inclusion in the Road Sector Development Program (RSDP) on the basis of needs assessment and taking into account the level of traffic, road condition and access problem, importance of roads, etc. and hence the selected projects will be delivered through the common practiced delivery methods known as Design Bid Build and Design Build methods.

In accordance with above, the FDRE, represented by Ethiopian Road Authority (ERA), has allocated sufficient budget to finance payments for the Construction works of Felegebirhan – Bahirdar Road Project; Contract 1: Bahirdar – Zema River Bridge through Design Bid Build delivery method and construction works of Koka – Adulala – Debrezeit Road Project through the Design and Build delivery method.

1.2 Statement of the Problems

Road are an integral part of our day to day life's activity. We rely on them for movement of goods, for traveling to and from work and many other activities. Rightly so there should be available in abundance and connect different part of the country and town sections together to increase social and economic capacity of the country and help to address the countries' goal in reaching the intended poverty reduction target. However, many of the road construction projects in Ethiopia are facing delays in completing to their intended time and also faced cost overrun and price escalation on their project span.

Even if it is believed that Delay, cost overrun and quality problems are inherent part of most projects despite the much acquired knowledge in project management. The construction sector should properly execute this vast capacity/ budget taking projects to their specific design standard (quality, cost and time) to achieve the interest of the nation. It is therefore much important to look at different ways of addressing this problems through different project delivery methods to increase the perception of project success.

1.3 Research Questions

This Research tries to address the following question main questions:

Basic Research Question:

- What are the differences in using Design-Bid-Build and Design-Build project delivery methods for the case study projects Bahirdar – Zema River Bridge DBB Road Project and Koka - Adulala DB Road Projects from the aspects of :-
    - Contract Administration
    - Time
    - Cost
    - Quality
    - Risk Allocation

Sub Question:

- What are the major challenges faced during project implementation? And how is it mitigated?
- Which type of project delivery method is suitable to undertake for upcoming road projects from the analysis made?

1.4 Objective of the Study

The Main Objective: of this study is to distinguishing the differences in using Design-Bid-Build and Design-Build project delivery methods for the case study projects Bahirdar – Zema River Bridge DBB Road Project and Koka - Adulala DB Road Projects from the aspects of :-

- Contract Administration
- Time
- Cost
- Quality
- Risk Allocation

The Specific Objectives: of this research include

- Addressing the main challenges faced during the project implementation stage along with their respective mitigation majors.
- Selecting the preferable project delivery methods to be adopted for the upcoming road projects from the analysis made.

1.5 Significance of the Study

The study will help the construction sector to evaluate the differences in its project delivery methods. Hence, it is expected to enable key project stakeholders to determine how to go effectively in implementing DBB and DB project delivery approaches in Ethiopian context. Finding and recommendations will also guide the practices of the project implementations to achieve the desired project objectives and project goal which is completing the project with the intended standard of quality, time and cost. The findings may be of great use to the academia, especially to those who may wish to carry out further research on project delivery methods.

1.6 Scope of the Study

The research focuses on Assessment of Project Delivery Methods (Case Study Bahirdar - Zema River Bridge Design-Bid-Build Road Project and Koka-Adulala Design-Build Road Project). The projects are located in the North Western part of Ethiopia (Amhara National Regional State) and Central part (Oromia Regional State, East Shewa Zone) of the country. Even though the performance triangle time-cost-quality is not necessarily the best way to determine the success of a project (Atkinson, 1999), it is still the tool most used by the authors to compare the two construction delivery systems. Because these criteria remain the most representative way to synthesize results from different studies, this study also use the same indicators along with ease of contract administration and risk allocation. Hence, to achieve this, an extensive data collection on the selected projects was made. Further, to collaborate the findings, an interview with the selected key personnel from the contract administrator's side in this case the Owner – ERA and the consultant – Net consult has been made.

To restrict the extent of the differences only on the construction work, the researcher selects the same administrators for the two projects, which in turn helps to focus the findings only on the necessary project delivery method variables.

1.7 Limitation of the Research

The case study was made on two road projects with different project delivery methods. To this end, the researcher has made his at most effort to get an accurate outcome of the study by employing an intensive data investigation and interview with key professionals who are directly involving on the projects.

However, the study has its own limitations. Due to the time constraints and site location it was impossible to make an actual observation of the site by conducting site visits. If site visit had been conducted it would have been easier to incorporate actual site condition pictures to support the overall research. Further, due to the location of the site the researcher is forced to conduct one interview through telephone conversation.

The main limitation the research face was the tight schedule, this force the researcher to work on only one project from each project delivery methods which in turn reduces the representativeness of the study on the country level.

1.8 Organization of the Study

This research is composed of five chapters, the first chapter being the introduction, introduce all the aspects of the research, briefly describing the type of projects under the case study and the type of contract administration methods used to execute the work this chapter also touches the question raised and objectives of the research along with the significance and scope of the study.

The second chapter is the literature review part which tries to address different literatures to have a various concept and overview on the subject matter to help prepare a theoretical perspective of the study. The third chapter, methodology, focuses on the strategy and study design of the research using different data collection methods and the fourth chapter covers the discussion and analysis part of the study. Finally, the last chapter summarize the findings of the research and based on the findings it will give conclusion and recommendations.

Chapter Two

Literature Review

2.1 Project Delivery Methods

Project delivery Methods refer to the overall processes with which a project is designed, constructed, and/or maintained. It is a system designed to achieve the satisfactory completion of a construction project from conception to occupancy by defining the way of organizing the project to achieve the desired project objective and goals.

Because of financial, organizational and time constraints, various project delivery methods have evolved to fit particular project and owner needs. A project delivery method may employ any one or more contracting formats to achieve the delivery. Most delivery methods used today are variations of three methods: Design-Bid-Build, Construction Management at Risk, and Design-Build. A fourth method, Integrated Project Delivery, although to date only used on a negligible number of projects, is also included here in order to cover all aspects of the delivery methods and understand the concept.

Design-Bid-Build (DBB)

This is the most traditional process in the construction industry, where the owner contracts separately with a designer and a contractor. The design firm is hired to deliver 100 percent complete design documents. The owner or agent then solicits fixed price bids from contractors to perform the work. Designers and contractors bear no contractual obligation to one another and the owner bears all risk associated with the completeness of the design documents (Gransberg, D., & Shane, J. 2012).

Construction Management at Risk (CM-R)

Construction Manager (CM) is a firm or an organization specialized in the practice of professional construction management. Conventionally, the CM does not engage its own workforce to perform major design or construction activity. The CM is perceived as a construction consultant with the professional status equal to that of a designer rather than a competitive, price motivated contractor (DBIA, 2015).

Construction management is also viewed as a mechanism of communication whereby construction expertise is spread to the entire project team throughout all phases of project delivery. From a CM's standpoint, the planning, design and construction are integrated tasks. In the CM approach the project sequence starts with design and leads to bidding and culminates in construction of the project with the input from the CM beginning with the commencement of design work and concluding with the expiration of the warranty period.

Design-Build (DB)

Under this method, an owner typically hires a single entity, the design/builder, to perform both design and construction under a single contract. Portions or all of the design and construction may be performed by the entity or subcontracted to other companies. DB is characterized by high levels of collaboration between the design and construction disciplines, input from multiple trades into the design, and a single entity bearing project risk. Typically, the general contractor is responsible contractually for this delivery method. (Hale, 2005)

Integrated Project Delivery (IPD) – A project delivery method that attempts to spread the risk, responsibility and liability for project delivery equally among the primary parties—the owner, the designer, and the builder, whether through partnership agreements or multi-party contracts.

2.1.1 Considerations in Selecting Project Delivery Method

An Employer/ Client has several areas of concern when embarking on a construction program or project. It is necessary to choose an overall project delivery and contracting strategy that effectively and efficiently delivers the project. The following are some of the key considerations that will influence the selection of the project delivery method for a project:

Cost

The employer has the obligation of all project costs. The construction cost is frequently the main concern of design and construction. Construction costs depend on the magnitude of the project, but in general construction costs are very high and the employer has limited funds. To meet the defined budget is important, and it is the high priority of each and every member of the project team. (Gajurel, 2014)

The project must determine a realistic budget before design to evaluate project feasibility, to secure financing, to evaluate risk, and as a tool to choose from among alternative designs or project routes is a primary need. Once the budget is determined, the employer requires that the project be completed at or near the established budget figure. Employer must decide how quickly he need to establish final project costs and with what risk level of exceeding this cost.

Design

The foremost importance thing to the employer is that the desired project function as envisioned while successfully fulfilling the needs of the employer and users. Therefore, the design team should be well qualified in the type of project being designed. In addition, the employer must ensure that the project needs are clearly conveyed to the design team. Since the design of the project must be buildable and design intent must be properly communicated, the employer requires that the design documents are constructible, complete, clear and coordinated. The documents should properly incorporate unique features of the site to include subsurface conditions, Material and Site Investigations further engineering documentations like Inception and Route Selection reports, Environmental Impact Assessment and Final Engineering Design Report will also be included. Hence, owners must decide how much control they need to have over the design elements of a project.

Time

Time is the key factor of the agreement and may be an overriding criterion for completion. The project time available is generally established by the owner in the schedule developed during project conception. The delay in the delivery project may add extra costs on the total costs. Mostly the project is defined by the date of completion. The project includes the time frame within which the project has to be completed. Fulfilling the precise schedule would be the most essential consideration in determining how and when a project would be constructed. Delay would add extra costs to the owner. Meeting the schedule is crucial, especially when the interest rate is very high and capital for project is scarce because a small delay raises the costs of construction. ASCE Manual agrees that owner benefits from completion of a project as soon as Possible.

Risk Assessment

Risk is the factor which needs proper management during construction. It should be handled properly to overcome the cost overrun. All project participants should make their best effort to

manage and reduce the risks as the project unfolds. The key to reduce risk is to understand the project requirements by all the participants. (Gajurel, 2014) Issues of risk are closely tied to the status of the local construction market, on-site safety, the schedule and the budget. The owner requires an understanding of the risks involved in construction, and should make a conscientious decision regarding allocation of these risks among project participants, so that all areas of exposure are properly understood. In considering risk allocation, the employer should strive to assign risks to those parties that can best exercise control over those aspects. For example, it would typically be problematic to require that the contractor correct problems due to design errors or changes at no extra cost since a contractor generally has little control over the cause or magnitude of such errors or changes in DBB projects. An employer must decide how much project risk they are comfortable in assuming.

Owner's Level of Expertise:

Some owners have more experience in project/program delivery than others. Owner's familiarity with the construction process, in-house expertise for project management have an impact on the level of how much outside expertise is required. This influences what project delivery method should be chosen. (Dobre, 2016)

2.1.2 Criteria to evaluate and select project delivery method in Ethiopia

In previous times, there was no clear criterion set for the selection of the project delivery type in ERA. Only urgent projects are procured with DB type of contracts to save the time for the feasibility and detailed design activities, as the feasibility and detailed design of the project will took longer time as compared with the time to perform concept design.

Currently, ERA under its Modernization process identify and set-out the following five criterion/issues to evaluate and select an appropriate project delivery method for road projects, which will be tendered out in its successive Road Sector Development Program (RSDP)

1. Flexibility – to change/modify the design, to instruct additional works depending on available funds and etc.
2. Speed – time required for detail design for DBB type vs Concept design for DB type of contract
3. Value of Money (Cost) - finishing the project with the proposed budget

4. Safeguarding of Public Values (Road Life Time) – availability of warranty period beyond the Defects Liability Period in the case of DB type of Contract
5. Level of the Construction Industry – availability of experienced professional in the construction industry

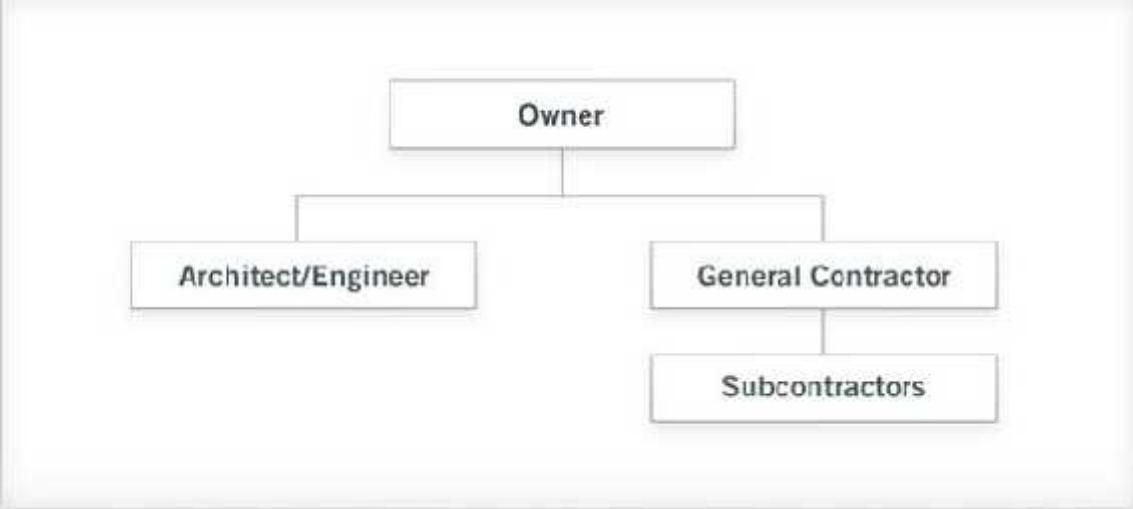
2.2 Design-Bid-Build

In the traditional public sector DBB method, the local government (employer) is responsible for the design, construction and operation of the project. The employer has two contractual relationships: one with the design engineer who designs the project and one with the construction contractor who builds the project. The design engineer and the owner collaborate to establish the project framework and develop the design basis. The design engineer prepares the engineering design and assists with the subsequent bidding process. There is no involvement of the construction contractor during the design stage. (Sanvido, & Konchar, 1999)

The design phase in some construction case can be completed in-house by the employer, some variations of design-bid-build allow the employer to shift project responsibilities to the private sector. This not only mitigates employer's risk but also allows firms specializing in contracted work to complete more demanding tasks. Afterwards a complete set of bidding documents will be floated.

Bids are then solicited from contractors based on contract documents developed by the owner and the design engineer. A contract is then typically awarded to the responsive bidder who has the lowest bid or highest score of a combination of technical and financial offers as stipulated in the floated bid. Following procurement through the bidding process, a separate contractor constructs the project. The contractor works to a defined scope of work for a fixed price. Once the project's construction phase is complete and the project has passed an acceptance test, the construction contractor has no remaining connection with the project beyond the defect liability period (typically one or two years) and the employer is responsible for the ongoing operation and maintenance.

Figure 2.1 Design-Bid-Build Project Delivery Method.



Using design-bid-build, the owner often assumes risks for any schedule or cost growth incurred during the project. This differs from design-build and CMR in that the design-builder or construction manager assumes a majority of the risks during design and construction. (Becker & Murphy, 2012)

2.2.1 Administration

In this type of delivery system the client award the design service to the winning consultant/ engineer and follow the progress, check the work and lastly approval the outcome of the design services which include feasibility study, full engineering design and tender document preparation. After the design has been finalized, documented and handed off to the winning contractor, construction commences. The client forms a contractual relationship with the contractor, and the consultant who serves as an 'overseer' of the project to ensure that it is built according to the design documents. The consultant assign professional personals to keep track of the project's progression, and answers any questions that may arise during construction. Additionally, the consultant will review any samples that are turned in by the contractor to ensure that the materials and specifications are upheld. If any changes are needed, the consultant provides documentation which goes into the project records. The consultant approves applications for payments from the contractor throughout the duration of construction, based on the amount of work completed. (Miracle, 2013)

2.2.2 Time (Schedule)

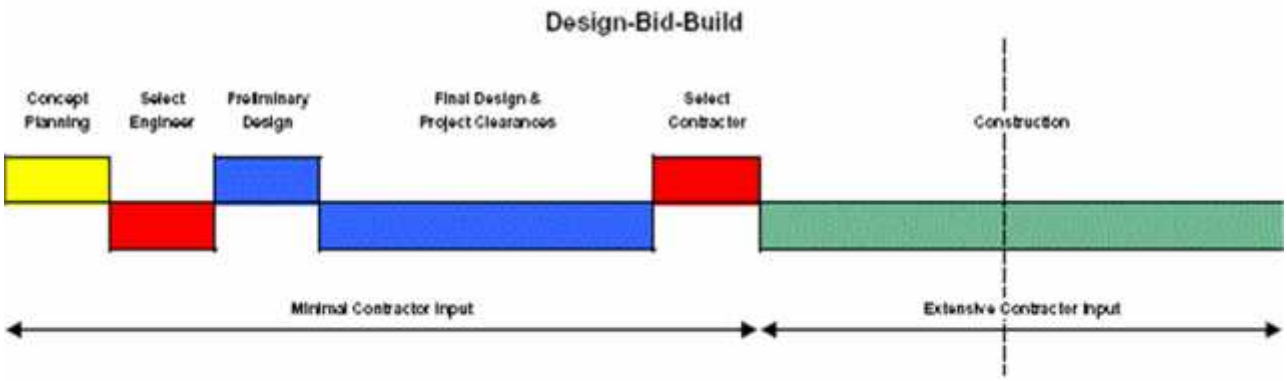
According to Nurkowski (2011) estimating time in DBB projects are decomposed in to the following sections - First the owner hires a consultant to prepare design and bidding documents, the prepared bidding document then are floated to the contractors, following the bid the winner usually the lowest bid will be awarded a contract, finally the construction project will proceeds with the different consultant administering construction on behalf of the owner. Hence, timeframe of DBB projects are composed of all works beginning from the design up to construction completion of the project.

Establishing a Design Schedule - At the scoping stage, the client is required to develop an estimate as to how long it will take to design a project. This estimate is based on input from other experts who will oversees the design, including the highway Engineer, Structural Engineer, Hydrologist, Environmentalist and other professional experts. Based on this input, the client estimates how long it will take, barring unforeseen delays, to reach the bidding stage. Based on the available data and previous experience deadlines are generated for reaching major milestones in the design process. As unforeseen delays occur in the process, the client is supposed to revise the design schedule accordingly.

Determining Construction Schedules - The Consultant develops a project schedule as part of the construction contract. The schedule developed is either a fixed date or calendar day's schedule. Calendar day's contracts calculate the number of days that will be required to complete a construction contract. These contracts provide more flexibility to client to extend the contract beyond the initial deadline as a result of weather or other unanticipated problems that delay the completion of a contract.

The other type of contract is a fixed date contract. A fixed date contract sets a fixed "drop-dead" date for completion of the project. Ordinarily, a contractor is not allowed any extensions under a fixed date contract unless there is an extenuating circumstance such as a major design error. Such extensions may only be granted through an approved change order. Fixed date contracts often contain financial incentives for early completion of the work and disincentives for completion after the set deadline.

Figure 2.2 Design-Bid-Build Project Activity and Time Schedule.



Source: Bekerman et.al, 2016

2.2.3 Cost

A common misconception is that DBB is the most cost-effective approach to designing and building a project. A majority of this misconception comes from a comparison at a point in time on the project that may not accurately capture all aspects of the total project cost. The low bidder in a DBB scenario is forced to ignore project gaps to make sure their price is as low as possible after the design is already completed.

A study by Anyir (2018) shows owners often associating hard bids beating the budget as proof that DBB provides lower overall project cost. However, it is important to compare delivery methods on an equitable basis. Many DBB projects come in over budget – this scenario presents challenges when the design is complete and ready for construction. If a budget relied heavily on backward looking costs from projects that were developed during the recession, the budget may be too low when compared to current market conditions.

2.2.4 Quality

To achieve a high quality level in projects requires dealing appropriately with three main requirements: quality of materials, workmanship and design concept. These requirements are often expressed in terms of technical specification, function, and appearance. It seeks to reflect the degree to which a procurement strategy facilitates the achievement of these requirements. This criterion was thus operationalized in terms of quality of workmanship, suitability of the finished project to users and the clients' satisfaction with the final project quality. (Ghadamsi & Braimah, 2016)

"High quality level required" exhibited a significant negative contribution with cost performance whilst exhibiting a significant positive contribution in terms of quality. This suggests that DBB is not capable of achieving good cost performance for projects requiring high quality standards of finished work. The reason for this could be explained by the way and manner of design and construction teams' work within DBB project settings. High quality standard involves dealing with many different quality parameters, notably quality of materials, equipment, workmanship and design concept, which requires close working collaboration between the designer and the contractor, which tends to be inhibited in DBB contracts.

2.2.5 Risk Analysis

Generally, when the employer idealizes to use DBB project delivery method, there is an implied warranty that the detailed engineering design being capable of constructed. The extent of the obligation of a construction contractor in the DBB approach is the construction of the project in accordance with the detailed plan and specifications. The construction contractor bears no liability for the proposed design. In addition, the design engineering contract in a DBB project is generally not a performance-based contract, which means that the owner must establish the negligence of the design engineer in order to prevail in a claim if there are design issues encountered in a project. This negligence standard creates a bar to relief for an owner that is significantly higher than the claim available under a DB contract in the event design issues cause a project to not operate properly or otherwise fail (Culp, 2013).

DBB is prone to creating more adversarial relationships between all parties when issues develop. It is often unclear if issues that cause a project to fail originate from the design of the project or from its construction. Each party had their own responsibilities and the risks that would accompany them, as there is no contractual relationship between the contractor and the designer and no opportunity for collaboration during the design phase (Sellis, 2016). This uncertainty can leave the owner under in the DBB approach forced to pursue claims against both the design engineer and the construction contractor, with each pointing the finger at the other.

2.2.6 General Role of the Contracting Parties in Ethiopian's context

2.2.6.1 The Client

Having identified the need for the Project the Client will appoint a Consultant to carry out the initial studies, investigations and designs, procure a Contractor, and (usually) supervise the construction by representing an Engineer.

During the course of the construction the Employer's duties and responsibilities are:-

- Appointing the Engineer and advising the Contractor
- Appointing the Contractor and advising the Engineer
- Providing access to the site for the Contractor to undertake the works.
- Making of payments to the Contractor
- Responding promptly on matters for which the Engineer is required to consult the Employer before issuing an instruction, determining an amount to be added to or deducted from the Contract price or granting an extension of time.
- Approving of securities, insurers and terms of the insurance policies
- Taking over the works once substantially completed
- Deducting liquidated damages from monies due to the Contractor when payable
- Terminating the Contract in the event of the Contractor failing to perform

2.2.6.2 Design Consultant/ Engineer

The Design Engineer has a separate contract with the employer to prepare the necessary design process and submit a fully completed design before procuring works contract. The following are the tasks of the design engineer:

- Carry out feasibility study of the project
- Communicating with local administrators for route selection process
- Prepare Detailed Engineering Design
- Prepare Resettlement Action Plan
- Environmental Impact Assessment
- Tender Document preparation

2.2.6.3 The Contractor

The role of the Contractor is to execute and complete the Works, for which he has submitted his Tender, within the time specified in the Contract. In addition he has an obligation to remedy any defects which appear during the Defects Liability Period.

The role of the Contractor includes:

- Constructing, completing and maintaining the works within the contract period.
- Providing all the required labour, materials, plant etc. and avoiding any unnecessary disturbance and damage.
- Carrying out the instructions of the Engineer and his representative.
- Providing adequate superintendence.
- Setting out the works.
- Providing a programme together with methods of working and updates.
- Caring for the works during construction period and making good any damage.
- Providing for the safety and security of the site and all construction operations.
- Providing plant and labour returns.
- Preparing and presenting monthly statements of the value of work executed.
- Notifying any claims for additional payment supported by such contemporary records and particulars as are necessary for proper investigation and assessment.

2.2.6.4 Construction Consultant/ Engineer

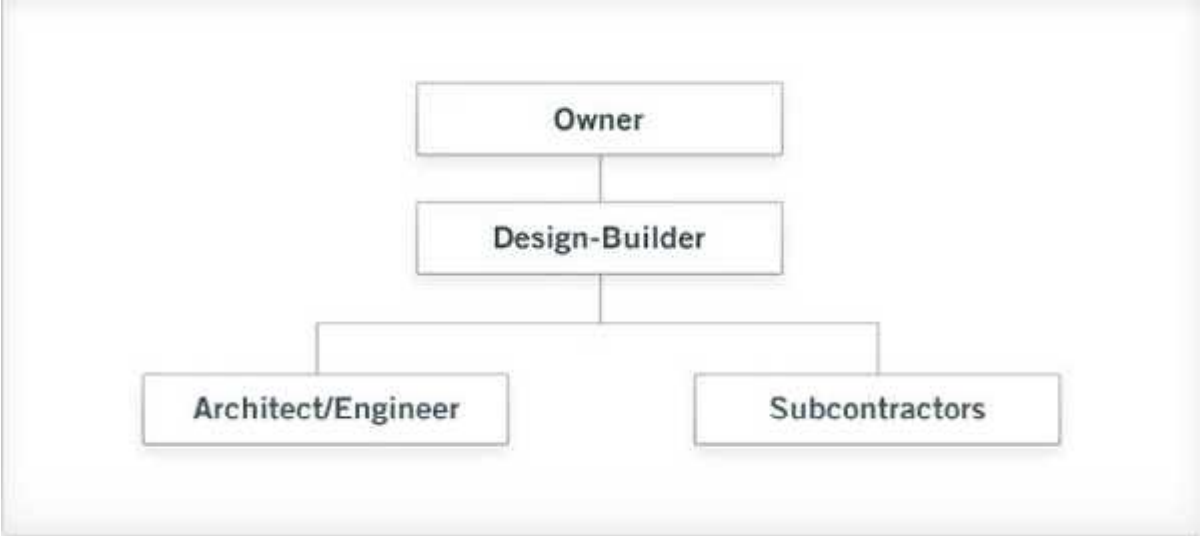
The Engineer is not a party to the contract between the Employer and the Contractor, his terms of engagement are set out in an agreement between the Employer and the Engineer and includes, but are not limited to the following under the Conditions of the Works Contract:

- The issue of information and instructions to the Contractor
- Commenting on the Contractor's proposals for carrying out the work
- Ensuring that materials and workmanship are as specified
- Agreeing measurements of work done
- Certifying to the Employer that the Contractor is eligible for payments
- All other matters of an administrative nature
- Evaluation of claims

2.3 Design-Build

This method of project delivery includes one entity (design-builder) and a single contract with the owner/ client to provide both engineering design services and construction (DBIA, 2015), awarded on either a low-bid or best-value basis.

Figure 2.3 Design-Build Project Delivery Method



Under the design-build project delivery method, the employer receives bids and awards a contract for one Construction Company who is capable of performing both the design and construction work of the project together. Design-build, in theory, reduces the project delivery timeline by eliminating the need to acquire two contracts for separate design and construction phase of the project. Supporters of this method also argue that it allows the contractor to work directly with the project design partner to construct the most cost-effective project possible using the resources and techniques available to that team. This method also allows for construction to begin before the design has been finalized.

2.3.1 Administration

The goal of contract administration is to integrate the design and build process to complete a quality project. Standard operating practices include partnering, kick of meeting, progress meetings, scheduling, quality management, design review, design acceptance, submittals, permits, safety, invoices and payment, contractor performance evaluation, modifications, change orders,

dispute resolution, final acceptance and turnover, project commissioning and receipt of as-builts. Meetings may be held during the design phase with the Contractor and his design team to discuss progress of the design (Design-Build Guide, 2004).

During the design phase the administrative burden is smaller, but there is no difference in the client's burden during construction. This is due to the fact that in traditional procurement most administration is performed by the client's consultant. In DB the need for external advice is reduced than that with DBB.

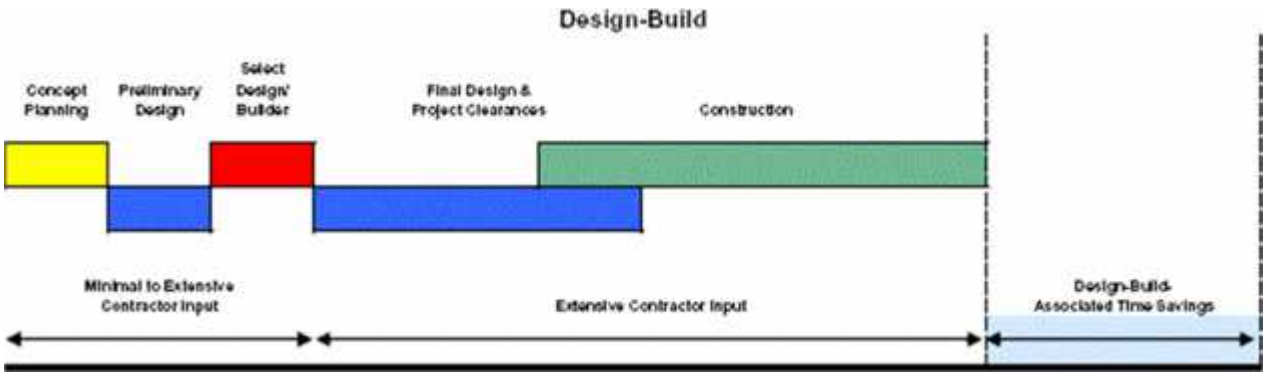
In order to expedite construction frequently called "fast-tracking", the contract may permit the contractor to propose a phased design submittal plan. Expediting construction is an important concern, especially when the design process is behind schedule. In order for fast-tracking to occur the final design package for each fast-track feature of work must be reviewed and accepted by the Client's representative.

2.3.2 Time (Schedule)

According to Nurkowski (2011) estimating time in DB projects are decomposed in to the following sections – Owner specifies detailed program for the project, describing needs and expectations then solicits expression of interest from DB teams (contractors) as per the EOI, DB teams develop design scheme along with cost and schedule accordingly owner selects DB team based on best scheme for the best price and schedule, DB team executes the final design and construction and final inspections and hand over will be made.

DB allows time savings. In addition to the overlapping of design and construction, time is saved also due to no need for multiple separate procurement processes. Also, time certainty of DB projects seems to be better than with DBB projects. This is essential, since one of the key issues inroad project delivery is time. However, to reduce time pressure and to improve design, the client occasionally requires use of an initial design period.

Figure 2.4 Design-Build Project Activity and Time Schedule



Source: Bekerman et.al, 2016

2.3.3 Cost

As a result of savings in costs associated with time extensions, dramatically lower uplifting costs, better build ability and more optimized design, the capital cost of the project is lower than with DBB. Also, the contractor generally pays less for the design than what the client would pay for it, and the client needs less external advice.

Even though there should be no price increases in fixed price DB projects, price increases have been quite common. Increases are not as high as they would be with DBB, but DB has not always offered the cost certainty expected. Even with a very good risk register, the cost is generally underestimated. Post-analysis of major government infrastructure projects has shown that costs between the conception and outturn are underestimated. Typical areas for underestimation are dealings with ground conditions, land acquisition, right of way and structures, that together account for major part of project costs. (Becker & Murphy, 2012)

2.3.4 Quality

The clients and consultants generally think that the quality level achieved is lower than what would be achieved with DBB. The contractor encourages the designer to produce a 'lean′ design that can be constructed at minimum cost and just meets minimum specifications. In DBB the designer, employed directly by the client and independent of the contractor, tends to produce a design at the upper end of the specification range. Also, there are more negotiations about the acceptability of the design and resulting work in DB, since there is always room for different interpretations.

Thus, a client who generally uses DBB may not get exactly what he expects through DB. While everything works satisfactorily, the finishing quality and use of project may be lower than the client expects.

In the majority of cases it is not the procurement route that gives poor quality but the quality of the client's standard, whether DB is able to deliver a quality project, depends to a great extent on the quality and clarity of employer's requirement and specifications (Ling & Leong, 2002)

There are also projects, where use of effective quality systems has eliminated quality-related problems. Performance assessment based on Key performance indicators may also be used to improve quality. Key Performance Indicators make it possible to define who the best suppliers are, and to benchmark the performance encouraging the companies to work together and to adopt each other's best practices

The Key Performance Indicators including satisfaction of clients, predictability of design and construction costs, predictability of design and construction time, profitability, added value of end project, safety, meeting standard/ specifications and requirements are used as an indicator of quality.

2.3.5 Risk Analysis

Risk is regarded as a notion of uncertainty. It directly affects the achievement, so the success of any project depends on the ability to manage it. The main objective of risk allocation is to manage risks in the best possible way to achieve the value of money.

In DB projects, the client transfers extensive risks to the contractor. However, currently the contractors are trying to transfer risks back to the client. Generally, the client thinks that the contractor should bear the risk of unforeseen ground conditions, while contractors feel that this is an unreasonably high risk with their tight margins and does not really bring best value to the client. From the contractor's perspective, the client should also retain risks on issues arising due to his specified specifications. On the other hand, some risks, like weather, should be apportioned between the parties.

When most risks are borne by the contractor, the client can omit extensive risk assessments. However, sometimes improved price certainty has been sought by transferring risks, without

giving full recognition to the contractor's ability to assess and manage these risks. (Tsai & Yang, 2009)

2.3.6 General Role of the Contracting Parties in Ethiopian's context

2.3.6.1 The Client

The client in DB projects first clarify the scope of the project by working the concept design. The concept design may be done by in-house engineering staff or by hiring independent consultant to develop the parameter of the projects.

During the course of the project the Employer's duties and responsibilities are the following

- Being responsible for the execution of the project, from the initial idea to implementation
- Implement a process to select the contracting parties who involved in all stages from design through construction
- Providing access to the site for the Contractor to undertake the works.
- Making of payments to the Contractor
- Taking over the works once substantially completed
- Terminating the Contract in the event of the Contractor failing to perform
- May also be financier and eventual owner of the project

2.3.6.2 The Contractor

The role of the Contractor is to execute the construction and design of the work, for which he has submitted his Tender, within the time specified in the Contract. In addition he has an obligation to remedy any defects which appear during the Warranty Period.

The role of the Contractor includes:

- Provide qualifications proposal and initial renderings to demonstrate their vision of compliance with the criteria documents
- Confirm pricing with design team that meetings design criteria

- Design the project using qualified design professionals and obtain Owner approval of compliant design that meets the criteria documents
- Design team maintains engagement in project throughout construction
- Construct the project, draft changes, punch out and complete
- Carrying out the instructions of the Engineer and his representative.
- Providing a programme together with methods of working and updates.
- Providing for the safety and security of the site and all construction operations.
- Maintain budget and schedule throughout the duration of the project
- Provide clear and regular communication with Owner on project status and any changes

2.3.6.3 The Engineer

Most construction contracts define a third party "The Engineer" to act as the administrator of the contracts with pre-defined authority to ensure the Client's wishes are fulfilled and the Contractor's interests are protected as set out in the contract. This is the role in which the Consultant generally acts during the construction stage of most Projects. (ERA, 2008).

The Engineers duties include

- Design review and approval of the contractor’s design
- The issue of information and instructions to the Contractor
- Ensuring that materials and workmanship are as specified
- Quality assurance during construction
- Agreeing measurements of work done
- Payment verification
- All other matters of an administrative nature
- Dispute resolution

2.4 Comparison of Project Delivery Methods

The advantage and disadvantage of each project delivery method are summarized in the under listed table below.

Type	Advantage	Disadvantage
DBB	• Well-known delivery method • Design completion can enable scope to be defined substantially • Open competition • Distinct roles • Ensures work for contractors of all size • Provides the lowest initial price that responsible, competitive bidders can offer • Client control over project delivery method • Provides complete documentation allowing bill of quantity before construction • Industry capability available	• Prescriptive scope definition minimizes flexibility and innovation • Initial low bid may not result in ultimate lowest cost and value • Lack of innovation • Low bid - incentive for change orders • Owner responsibility for errors and omissions • Linear process (Cannot be fast tracked) • Design suffers from lack of input from • contractors • Does not encourage technological improvement or integration of systems • Lack of cost certainty • Multiple change orders
DB	• Best-value selection • Enjoy fast tracking opportunity • Allows for innovation and increase constructability by collaborating with the design team • Risk transfer • Develops industry via cooperation • Better relationships • Encourages integration of systems	• Limited experiences with DB - Requires a culture change • Less work possibility for small and medium sized contractors • Owner is disconnected from design-build consultants • Cost estimating difficulties • Requires greater time demands for calculating risk allocation • Limited competition in large projects

	• Integrated design and construction shorten project duration • Few change orders • Lowered administrative burden to owner	• Client experience may be lost or diminished

Table 2.1 Advantage and Disadvantage of project delivery methods

2.5 Evaluation Criteria for Assessing Project Delivery Methods

The criteria used to evaluate the selected project delivery methods are: ease of project contract administration from the perspective of the administrator, project time certainty, finalizing the project within the proposed project cots, control and assurance of quality and allocation of risks into the project contracting parties. Different literatures have considered a number of performance criteria when analyzing the implications of project delivery methods.

This project work characterizes the execution of Design-Bid-Build and Design-Build project delivery methods. It uses the above mentioned parameters for relevant evaluations and measurable differences for the case study projects.

According to Gajurel (2014) projects have their own objectives and goals to achieve: thus it is essential that each contracting parties understanding the goals, objective, and obligations. Hence, each delivery method should define a common framework for the involved persons and organizations so that each one understands its duties and responsibilities so that they can work within the project in a coordinated manner.

Different literatures use the same criteria for evaluation of the delivery methods, even if it is not a perfect and final tool for evaluation it is relatively best mechanism that is achieved so far. From the literature review it can be observed that each project having a different success factor with respect to the different project variables. DB excelling on time factor by encompassing the design and construction within the same phase and hence becoming favorable in urgency conditions, whereas DBB assures a low list cost mechanism even if cost overrun are frequently observed. The one factor both strive for achieving is quality, since project's integrity is directly influenced by the quality exhibited, different project delivery method observed the same type of standard. From the

various ways of risk handling in DBB the client will retain risks associated with design problems whereas on DB projects risks will be transferred to the contractor.

Additional parameters like, Introduction of new innovations technology and methods will change the competitive ground by favoring DB projects and also put the local contractors to a disadvantage to compete with foreign contractor capacities whom are equipped with the latest technology and are financially strong to undertake the design and construction work cohesively. For local contractors to much the required capacity of the project, association in the form of joint venture or sub-contracting has also been observed.

The additional parameters also can be measured by the integration of the five parameters used above to see the performance and success of the project. In fact, these are the criteria's employed for evaluation and comparisons of the selected case study project of this project work.

2.6 Conceptual Framework

The conceptual framework for DDB delivery method involves a traditional way of delivery strategy whereby the feasibility study, detailed Engineering design and tender documents preparation has to be carried out by Employer by hiring Consulting firm and, the same being used for the procurement of the construction works contract. As the design is detailed, the Contractor is required to quote a price to every item of the project works. Payment is authorized later based on the measurement and payment mechanism for every executed work item. Whereas, in DB project delivery method, which is now being widely implemented in Ethiopia and elsewhere in the World, the client will prepare by own staff or hiring a consultant a concept design document which then be used by the Contractor to review the concept design and the Employer's requirement to quote fixed rate (lump sum) amount for the total project volume.

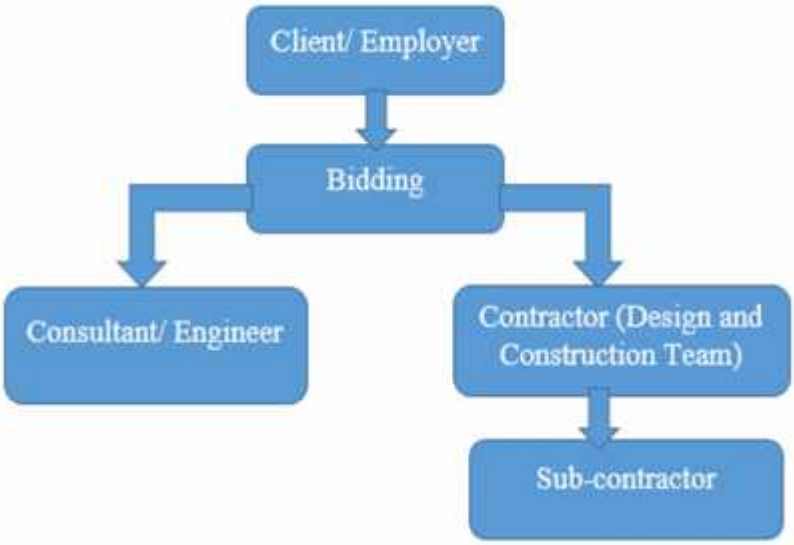
For both type of project delivery methods in Ethiopia, the client will hire a separate consultant to undertake the contract administration works and represent him in all aspects of the project. Further, the client assigns his own staffs to oversee the project work.

Based on the above literature review conceptual framework of the two delivery methods are developed for the purpose of the study.

Figure 2.5 Conceptual framework for Design-Bid-Build Delivery Method

Source: Own survey, 2018

Figure 2.6 Conceptual framework for Design-Build Delivery Method



Source: Own survey, 2018

Figure 2.7 Conceptual framework for Best Project Delivery Method

Source: Own survey, 2018

Chapter Three

Methodology

3.1Research Design

According to Creswell (2009), defines research design as a blueprint or detailed plan for how a research study is to be completed. It is a general plan used to provide how the research questions would be answered, and detail plan for the collection, measurement and analysis of data.

The study apply descriptive research design since it attempt to describe the nature and characteristics of the two different project delivery method types which are applied in the selected two case study projects. According to Neuman (2007), descriptive research is used to describe characteristics of a population or phenomenon being studied. It does not answer questions about how/when/why the characteristics occurred. Rather it addresses the "what" question and helps to present a picture of the specific detail of a situation and describing the characteristics of a particular situation.

3.2 Population of the Study

The population of the study consists of sixteen (16) key staff members from Engineering Department of the Consultant Project Administrative Office who are responsible for the management of contract on the selected case study projects.

Population of Ten (10) staff members from the client Ethiopian Roads Authority (ERA) Engineering Department are also considered as population of the study.

3.3 Sampling Technique and Sample Size

3.3.1. Sampling Technique

The study applied non-probability sampling. According to Neuman (2007), it is useful for certain studies that require the researcher to collect the data from sample of participants that are necessarily sufficient for the study.

The sampling type applied in the study was purposive sampling. It is useful when focusing on a limited number of informants, whom we select strategically so that their in-depth information give optimal insight into an issue. According to (Neuman, 2007), such type of sampling is appropriate when a researcher use it to select unique cases that are especially informative, and when it wants to identify particular types of cases for in-depth investigation. The researcher found it appropriate due to the total population for this study consists of engineers, expertise and surveyors and its appropriate for the researcher to use his judgment to select the interviewees by considering there representativeness, knowledge of the project, work experience and position/ title for their respective fields on the projects.

3.3.2. Sample Size

From consultant side (Net Consult) a total sample of four engineers was approached. The sample consists of one Resident Engineers and one Contract engineers for each selected case study projects respectively.

From the clients Ethiopian Roads Authority (ERA) side a sample one Project Engineer and one Northern Region Contract Management Director was approached for Bahirdar - Zema DBB road project. In addition, one Project Engineer and Central Region Contract Management Director was approached for Koka - Adulala DB road project.

3.4 Sources and Instruments of Data Collection

The research used both primary and secondary source of data collection methods. The primary source of data emanate from the conducted interview with both regional director of the client's office (Northern Region Contract Management Director and Central Region Contract Management Director) and project engineers who are assign to represent the client on this case study projects.

In addition to the client's interview, interview with the consultant side has also been conducted. The interviewees from the consultant side are the Resident Engineers and the Contract Engineer. The Resident Engineers are staffs of the consultant who are fully authorized to represent the consultant on the project site. The other interviewee is the Contract Engineer who is administering the project from head office.

The secondary sources of data used in this research includes project's monthly progress reports; correspondence letters, claim assessments, variation orders, contract agreement documents and completion report of the design service for the design bid build project have been used. Furthermore; articles, magazines, journals, client's website and other related publications are also used for the study.

3.5 Method of Data Analysis

In this section, the gathered data are analyzed using both qualitative and quantitative approaches. The interpretation was made to incorporate the findings of the project to linkup with the performance triangle of the project (time, cost, quality) in addition the research also analyze ease of contract administration and allocation of risks with its' characteristics within the selected delivery methods.

This mixed method of the research use qualitative aspect of the project to explain the necessity of the data gathered from the point of background of the project up to the point of conclusions and decision makings on qualitative characteristics of the project like contract administration, quality and risk allocation. Whereas, the quantitative data was gather from different project documentations e.g. contract documents, variation order issued, extension of time claimed and etc. along with the conducted interviews are used to prepare the quantitative aspect of the study. This in turn helps to analyze and explore quantifiable measure of the projects which can be directly related to numbers like time overrun and amount of cost claims.

3.6 Validity and Reliability of the Instrument

This section consider measurements of validity and reliability of the research data. For a research to be reliable, it also needs to be valid.

Validity

Validity of research refers the degree to which the research findings are true (Creswell, 2009). It is about finding out if the data collected is relevant to the problem being investigated. The validity of the research was considered while developing structured interviews checked by benchmarking the related literature review and questionnaires from previously conducted related researches in

order to generate a valid response. The instrument of data collection validity was checked by asking others that has know-how on the studied area for feedback.

Reliability

Reliability refers the degree to which the results of the research are repeatable (Creswell, 2009). It is about absence of difference in the research findings if the research were repeated. In order to confirm the applied researcher approach is consistent or not, the research has been supported by using reliable sources of information such as related journals, articles, books, websites, and work papers and studies related to the studied area.

The reliability of the interviews was also maintained by having a total of 8 interviews with Resident Engineers, Contract Engineers, Project Engineers and Regional Contract Directors for the selected case studies to ensure the reliability of the information obtained by cross checking the respective responses gained from them.

3.7 Ethical Considerations

The researcher ensures the quality and integrity of this project work. The data was collected with the full consent of the participants. The confidentiality and anonymity of the voluntary respondents was also guaranteed. This independent and impartial project work considered not to cause harm to respondents in what so ever way. Accordingly, the researcher followed ethically and morally acceptable processes throughout the research process. In addition, all documents which are referred throughout the research are fully acknowledged.

Chapter Four

Research Analysis and Discussion

4.1 General Overview

The development of various Project Delivery Methods has raised issues among stakeholders as to which delivery method is suitable for which types of projects. This is because, the choice of a Project Delivery Method greatly influences the project outcome and is one of the most important factors that determines a project's success.

Accordingly, most roadway projects use the traditional delivery method of the Design-Bid-Build method, open competitive with least bid procurement method and admeasurements or unit price contract type. However, currently Design-Build delivery method is being widely introduced on vast number of new and urgent projects.

Adopting the most suitable project delivery method is a process that entails through analysis of multiple criteria and does not follow a one size fits all approach. That is, no one method is optimal for all types of construction industry projects and determining an appropriate method needs to be done on a project by project basis.

4.2 Case Study 1 - (Bahirdar-Zema River Bridge Road Project – Design Bid Build)

4.2.1 Project Description

The Felegebirhan - Bahirdar Road Project is located in the North Western part of Ethiopia, Amhara National Regional State. The project road starts from the Ring Road of Bahirdar town, which is located at a distance of 565km North West of Addis Ababa and stretches until it reaches Zema River Bridge. The case study's project consists of the construction of 91.75 km road to DS-4 standard with an Asphalt Concrete Surfacing of 50mm thickness and cross section of 10m (7m AC carriageway and 1.5m gravel shoulder on each side). The works also includes construction of minor and major drainage structures.

Figure 4.1 Location Map of Bahirdar – Zema DBB Road Project

Source: ERA, 2014

4.2.2 Basic Contractual Information

Name of the Project	Bahirdar – Zema River Bridge Road Project(Contract 1)
Client	Ethiopian Roads Authority (ERA)
Design Consultant	CORE Consulting Engineers Plc.
Planned Duration	15 Months - starting from September 12, 2011
Project Cost	Total = 3,818,575.00 ETB (VAT inclusive)
Construction Contractor	Sino hydro Corporation Ltd.
Length	91.75km
Construction Type	Asphalt concrete
Original total contract	ETB 1,236,755,640.33 (including 15% VAT)
Percent payable	foreign currency USD = 30 % local currency ETB = 70%
Original Contract Period	1096 Calendar Days – starting from October 11, 2014
Consultant	NET Consult
Original total contract	ETB 13,000,750.00 (including 15% VAT)

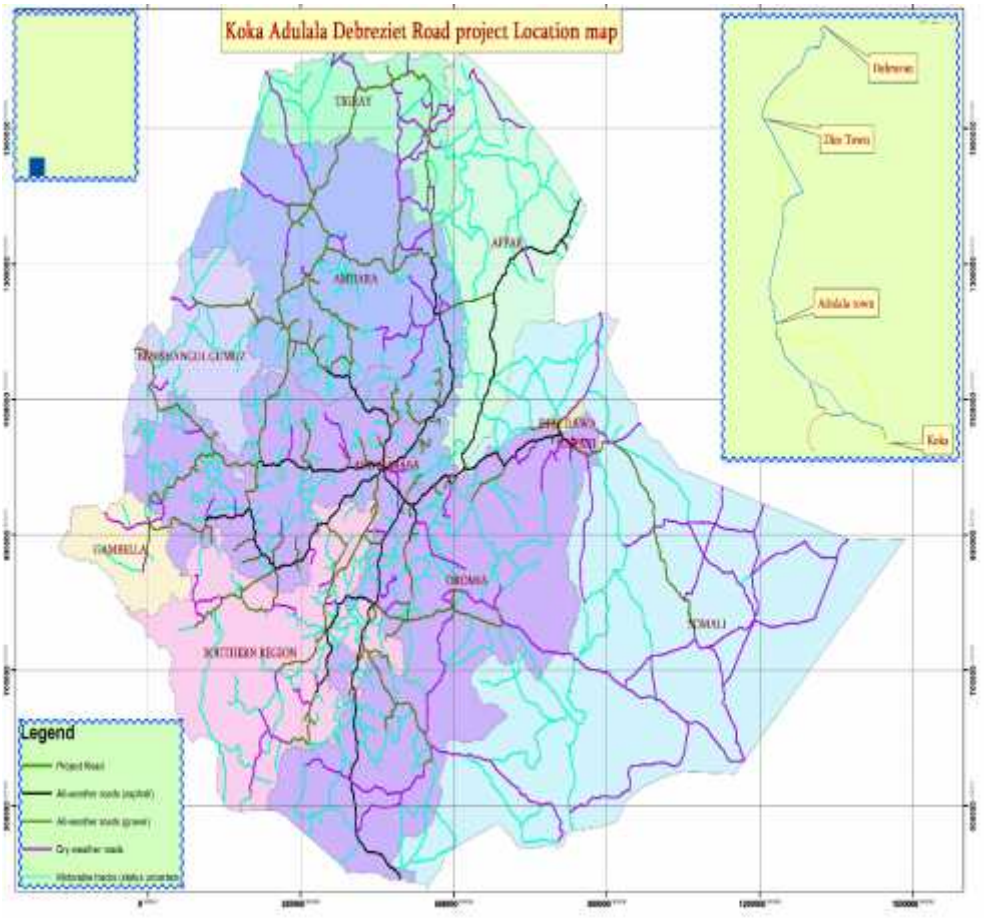
Table 4.1 Contract Information for Bahirdar – Zema DBB Road Project

4.3 Case Study 2 - (Koka - Adulala - Debrezeit Road Project – Design Build)

4.3.1 Project Description

The project road is located in the Central part of Ethiopia, in Oromia Regional State, East Shewa Zone. The project road starts at a distance of 21 Km from Modjo town (94 Km from Addis Ababa) branching to the right from the existing Modjo - Hawassa trunk road at the exit of Koka town and traverses through the outskirt of Adulala town towards Dire Town; then after it traverse in the North East direction to terminate at Debrezeit Town having a total length of about 50.88 Km.

Figure 4.2 Location Map of Koka Adulala DB Road Project



Source: ERA, 2015

The road generally passes through flat terrain and has a carriage way width of 7 meters with shoulder widths ranging from 1 up to 1.5 meters in the rural section and a double carriage way width in Adulala and Debrezeit towns with 2.5 meters concrete tiles side walk.

The works under this Contract originally consists of the Design and Construction of 52.22 Km road which start at the outskirt of Koka Town and connect to Debrezeit passing through Adulala and Dire town with the following design standard of DS4 DBST surface condition for the first 39.7 km and Asphalt Concrete tor the rest 12.52 km.

However, the actual length of the project length has been revised to 50.88 km. Moreover, the DBST pavement surfacing which was originally proposed in the Employer's Requirement has been varied to 50 mm AC surfacing for the first section due to change in the magnitude of diverted traffic after thorough traffic analysis study including the axle load survey conducted at appropriate stations.

4.3.2 Basic Contractual Information

Name of the Project	Koka – Adulala – Debrezeit Road Project
Client	Ethiopian Roads Authority (ERA)
Contractor	ASER Construction Plc.
Type of service	Design and Construction
Length	52.22km
Project Location	Oromia Regional State
Funding	Federal Democratic Republic Of Ethiopia (FDRE)
Date of Contract Signing	5 February 2015
Construction Type	DBST and Asphalt concrete
Original total contract sum	ETB 613,165,000.00[including 15% VAT]
Original Contract Period	730 Calendar Days (Commencement date 9 March 2015 - Planned Completion Date 8 March 2017)
Consultant	NET Consult Consulting Engineers and Architects P.L.C.
Original total contract sum	ETB 16,136,800.00

Table 4.2 Contract Information for Koka Adulala DB Road Project

4.4 Analysis of Result Due to Delivery Method

4.4.1 Contract Administration

Contract administrators for the case study projects are the client – Government of Ethiopia (GOE) represented by Ethiopian Roads Authority (ERA) and the Consultant – Net Consult Consulting Engineers and Architects Plc. (Net Consult).

Difference in Contract Administration of the Delivery Methods

Most of the administrative activities which are undertaken by the administrators are the same. However, there are some differences in contract administration between the two delivery methods. The differences are discussed in the following paragraphs:

DBB type delivery method requires longer design phase, which by itself requires another set of professionals form the Owner's side to check and approve the necessary engineering design of the design consultant output. The major design activities as stated in section 4.3.3.A starts from feasibility of the project to final cost estimate and tender document preparation. Using the final tender document, the employer will procure capable Contractor to build the road and Supervision Consultant, to supervise the works executed by the Contractor.

On construction phase the Owner (ERA) will oversee the construction of the road project and closely follow the service provision of the Supervision Consultants to ensure that the road is built with the specified quality standard, allocated budget/contract cost and stipulated time period. Further, with the help of the consultant on the project site, ERA will facilitate removal of the ROW problems, pay the Contractor an Interim Payment for the works executed during the claimed month.

Consultant (employer's representative) will began the project with design review (3-4 months) of the project, monitor project quality compliance with specification and drawing requirements, assist the employer in removal of obstructions, monitor progress of the project and advice the contractor make/ take corrective actions if slippage is recorded and assist the employer on contractual issues.

On DB delivery type, the design and construction phase are integrated and the Contractor is the designer and builder of the road. Hence, in addition to the traditional contract administrative activities, the consultant is required to monitor design activities of the contractor, review and approval of design documents and construction documents, quality assurance activities as per employer's requirement.

4.4.2 Time

Time is an important and key element for any kind of a project. Especially for the road construction, timely completion of the project will have enormous importance for the socio-economic development of the project area in particular and for the country in general.

Thus, time is one of the important factors used to evaluate the project performance. In this regard, both the case study projects have encountered time overrun during the duration of the Contract. However, since the selected project have different scope and size to differentiate and evaluate the project with time aspect, the results are converted to percentages of progress.

Project time for DBB type

Time overrun observed on Bahirdar – Zema River Bridge Road Project – DBB Method

No.	Description	EoT(Day)	Status
1	Due to exception rain, the site work is affected.	18	Reject
2	Due to delayed payment, claim EOT and interest.	62	Reject
3	EOT for variation order No.1 (Modification of Bahirdar Town)	478 *	Approved 150 days
4	EOT for variation order No.2 (Provision of Green area to Bahirdar town)	116	Approved 209 days
7	Cost and Time Claim for Losses Occurred due to Riot	46	Approved 46 days
8	Additional time for delay in possession of quarry and borrow site	101	Rejected
10	Disruption of work due to Adverse weather condition	102	48 calendar days granted
11	Additional time required for additional work variation order No.6 (Construction of service ducts in Bahirdar Town)	130 *	Under Review by Client
12	Additional time for delay in clearing obstruction from the ROW	123	
13	Employer's Failure to pay contractors payment Timely	183	
14	Delayed instruction of km 2+820pipe culvert	26	

* Time claim which can be eliminated by changing the delivery method

Table 4.3 Extension of time for Bahirdar – Zema DBB Road Project

- Contract time =1096 days (October 09, 2016)
- Approved Revised Contract time = 1549 days (January 08, 2018)
- Additional Total time claimed by the contractor = 1385 days including the 462 days which are under review by the Client
- Total time granted by the owner to date = 453 days
- Additional time elapsed beyond the revised time up to preparation of this research (May 31, 2018)= 143 days

- Approved additional time beyond the anticipated construction period → 453/1096= 41.33%
- Time elapsed beyond the revised time → 143/1549= 9.23%

Effect of Project Delivery Method

Additional time requested and approved by the Owner which would have been prevented if the delivery method used was Design Build Method.

- Additional time requested in relation to Variation Order No. 1(Modification of Bahirdar Town) = 478 day for which the client has approved 150 days of time extension.
- Additional time requested in relation to Variation Order No. 6 (Construction of service ducts in Bahirdar Town) = 130 days in this regard the client is reviewing the issue

- Approved additional time beyond the anticipated construction period which could have been eliminated by changing the delivery method → 150/1096= 13.68%
- Possibility of additional time period which could have been eliminated by changing the delivery method → 130/1096= 11.86%

Project time for DB type

Time overrun observed on Koka – Adulala - Debrezeit Road Project – DB Method

No.	Description	EoT(Day)	Status
1	Due to Pavement Change and Riot	296	Approved 214 days
2	Due to Adverse Weather condition	37	Unable to substantiate with document
3	Removal of Obstruction in Debrezeit Town Section	241	Under Review by Client

Table 4.4 Extension of time for Kkoka Adulala DB Road project

- Contract time =730 days (8 March 2017)
- Approved Revised Contract time = 914 days (8 October 2017)
- Additional Total time claimed by the contractor = 537 days including the241 days which are under review of the client
- Total time granted by the owner to date = 214 days
- Total time granted in regard to Removal of obstruction from the interview = 116 days
- Additional time elapsed beyond the revised time up to preparation of this research (May 31, 2018)= 235 days

- Approved additional time beyond the anticipated construction period → 214/730= 29.32%
- Time elapsed beyond the revised time → 235/914= 25.75%

From the interview conducted it is learned that extension of time to be extended to the contractor is up to February 01, 2018. However, the project was substantially completed and officially opened for public use.

- Time elapsed beyond the revised time → 119/914= 13.02%

Effect of Project Delivery Method

By changing the delivery method to DBB there would have been no changes, inference is made from the observed extension of time claims.

4.4.3 Cost

The major difference of the two project delivery type lies on the project cost. The DBB type of delivery method uses a unit rate for each of the particular work item and measurement and payment is made based on the measurement of the executed works. Whereas, the DB type of project delivery uses a lump-sum amount for the total project cost. Since there is a need of additional works in both project delivery method, the administration of instructing the additional works is easy on DBB type of delivery system as compared with DB type, as the same will require to fix a reasonable rates for each and every items of the newly instructed works. The cost overrun recorded on projects will also be used to analyses the effect of the delivery method.

Project cost for DBB type

Cost overrun observed on Bahirdar – Zema River Bridge Road Project – DBB Method

Under Variation Order

VO. No.	Description	Amount of Varied Work	
		Addition as result of VO (ETB)	Reduction as result of VO (ETB)
1	Modification of Bahirdar Town	39,773,527.10*	
2	Provision of Green area to Bahirdar town	16,168,260.64	
3	Modification of the design of Bridge at km 11.02	1,184,882.18*	
4	Change of Design of Bridge at km 80.36		-1,887,165.48*
5	Provision of Roundabout in Adet Town	823,606.22*	
6	Construction of service ducts in Bahirdar Town	550,147.30*	

* cost variation which can be eliminated by changing the delivery method

Table 4.5 Cost under Variation Order for Bahirdar Zema DBB Road Project

Under Claim

No.	Description	Claim Amount	Status
1	Additional Payment for Temporary Engineer's Facility	1,415,341.17	Submit more supporting document
2	Borrow to Fill for Replacement of Unsuitable Material	29,248,494.84*	Rejected
3	Cost and Time Claim for Losses Occurred due to Riot	1,310,494.78	Approved
4	Material Hauling for additional distance	10,559,646.61*	Rejected

* cost claim which can be eliminated by changing the delivery method

Table 4.6 Cost under Claim for Bahirdar Zema DBB Road Project

- Contract Price =ETB 1,236,755,640.33
- Total value of valuation to date = ETB 56,613,257.96
- Additional Claim amount for Riot approved by the client = ETB 1,310,494.78
- Total cost amount requested by the contractor = ETB 88,587,588.75
- Total additional cost granted by the client to date = ETB 57,923,752.74

➢ Approved additional cost beyond the anticipated construction budget → 57,923,752.74/1,236,755,640.33= 4.68 %

Effect of Project Delivery Method

Additional cost approved by the owner in the form of variation and claims as indicated in the above table with an asters tics (*) would have been prevented if the delivery method used was Design Build Method.

- Additional cost approved in the form of variation and claim (*) items amount = ETB 40,444,997.32

➢ Approved additional cost beyond the anticipated construction budget which could have been eliminated by changing the delivery method → 40,444,997.32/1,236,755,640.33 = 3.27%

Project cost for DB type

Cost overrun observed on Koka – Adulala - Debrezeit Road Project – DB Method

Under Variation Order

VO. No.	Description	Amount of Varied Work	
		Addition as result of VO (ETB)	Reduction as result of VO (ETB)
1	Due to Change of Pavement design	77,223,567.44	
2	Additional Work due to Bishoftu Automotive Engineering Industry's[METEC] and Kajima access roads	20,581,753.20	
3	Reimbursement of Defense Force Camp Construction after Irecha 2016 Annual ceremony incidence	1,536,927.22	

Table 4.7 Cost under Variation Order for Koka – Adulala DB Road Project

Under Claim

No.	Description	Claim Amount	Status
1	Cost Claim by Riot	40,179,809.64	Under review by Client

Table 4.8 Cost under Claim for Koka – Adulala DB Road Project

- Contract Price =ETB 613,165,000.00
- Total value of valuation to date = ETB 99,342,247.86
- Additional Claim amount for Riot approved by the client = ETB40,179,809.64
- Total cost amount requested by the contractor = ETB 139,522,057.50
- Total additional cost granted by the client to date = ETB 99,342,247.86

- Approved additional cost beyond the anticipated construction budget → 99,342,247.86/613,165,000.00= 16.20 %

Effect of Project Delivery Method

By changing the delivery method to DBB there would have been no changes, inference is made from the observed cost variation and cost claims.

4.4.4 Quality

Quality control by the condition of the contract for both type of delivery methods are the responsibility of the contractor. Hence, from the administer side the consultant is responsible for the quality assurance of the project, to this end, the consultant will prepare quality assurance document to be used in every activities of the work. The client oversees the quality of the work with its required regulations and specifications.

Effect of Project Delivery Method

The main difference observed from the delivery methods in Quality aspect are on Bahirdar (DBB) project the contractor is liable only for the construction work of the project. However, on Koka (DB) project the contractor is also liable for the quality of the design work.

There is no major quality problems encountered on the case study projects. However, there were minor quality problem encounter on both project and the necessary rectifications measures are taken accordingly.

Hence, in Bahirdar (DBB) project the problems encountered are quality of curbstone production which was due to poor workmanship and same has been mitigated by providing improving the workmanship by training the workers and supervising the production activities. The second minor quality problem encounter on the project was defect in some section of asphalt concrete which is mainly related to bleeding and at this time the contractor is expected to come up with his mitigation measure.

On Koka (DB) project the quality problem was encountered on the completed asphalt concrete surfacing. The defective asphalt sections were rectified by using two methods the first major is by reconstruction (by removing the defective asphalt of the road) and for those sections with high air

voids, placing additional thickness of Asphalt Concrete to account for the performance reduction on defective sections.

In general for both project types the main activities done to prevent quality problems are routine supervision of work on site by the consultant, frequent site visits by the client and recently audit report of the projects including quality issues have been conducted by the owner to confirm the fulfillment of the specification requirements on the works executed . On most minor problem the major used to rectify the problems was removal of the defect sites and reconstruction and/or asphalt overlay on minor cracks.

4.4.5 Risk allocation

Risks anticipated in the project were allocated to the contractor and the employer by appropriately defining or specifying the risks in the condition of contract based on their capacity or potential to best deal with a given risk element. Accordingly, risks are mitigated either by preventing them before the occurrence and/or by taking the necessary steps once it happened.

To this end, the contract document of both Contracts allocate the way-forward for similar kind of risks at different sub-clauses. The above two projects experienced riot and the implication of the same is treated in accordance with the Contract requirements.

Effect of Project Delivery Method

The main difference between the two delivery methods in risk allocation are associated with design output. Hence, in DBB type delivery method, since detailed engineering design is done by another Consultant (Core Consult), the Contractor is free from any risk and design changes that comes with the project. This is also seen from the claim and variation orders in the project (e.g. Modification of the design of Bridge) which leads to cost and time overrun on the employer.

In the other hand, on DB type delivery, design and construction is done by the Contractor, hence risk associated with design change and modification within the employer's requirement will be covered by the contract. In addition to the above, the Contractor is also required to bring warranty bond valid for 5 years for the works executed beyond the defects liability period.

On both type of delivery methods, for any risks which are beyond the control of the Contractor and Owner, the Contractor is required to transfer those risks to the third party i.e. insurance company in the form of CAR policy.

4.4.6 Major Challenges Faced during Project Implementation

Project Challenges for DBB type

Project Challenges observed on Bahirdar – Zema River Bridge Road Project – DBB Method

- Slow progress of the construction work due to the poor efficiency of old heavy machineries and rain.
- Delay in commencing crushing activity and pipe culvert construction
- Delay of forwarding the compensation fees from the employer to ROW affected communities.
- Delay in settling total advance payment and Interim Payment Certificate's (IPC's)
- Poor project management
- Escalated Security breach (theft) around the main camps and sub camps
- Delay in the removal of obstructions in different sections of the road
- Security problem, which forced the suspension of the project
- Poor progress on the construction of box culverts, slab culvert, sub base, road base and asphalt concrete and embankment on all sections
- Delay in the rehabilitation of borrow pits, detours and access Roads

Project Challenges for DB type

Project Challenges observed on Koka – Adulala - Debrezeit Road Project – DB Method

- Design Change –the first 39.2 km of the project was intended to be constructed with a DBST asphalt surfacing condition. However, during the course of the construction, it was noted that the proposed pavement composition may not serve its intended purpose.
- Route Change - The Employer's Representative through the course of construction noted that the proposed route should be change to reach adjacent existing village (Bekejo) and forward his finding to the employer.
- Town Section Elongated - The Debrezeit town section length as indicated in the Employer's requirement was 4.423 km. However, it is exhibited that it is not aligned with the Town's Master plan.
- Minor quality problem on asphalt construction and Right of way problems on the route.
- Security problems (riot) on the project site has be exhibited in relation to the annual Irecha ceremony in 2016.

4.4.7 Mitigation Method Used

Mitigation Method used for DBB type

Mitigation Method used to resolve the above mentioned problems on Bahirdar – Zema River Bridge Road Project – DBB Method

- Working extended hours to improve the progress. The Engineer has to follow the ROW issues all time as to minimize the impacts of this construction on the environment and there may be some underground utilities.
- The Contractor has tried his best to maintain his old machineries by his mobile garage immediately during breakage.
- The Employer has arranged monthly Meeting at Head office level to discuss the progress and the encountered problem with the recommendation of solutions.
- The contractor has leased excavator and dump trucks
- The contractor is instructed to confine his work in the ROW limit and dispose all wastes (construction waste or cut to waste or removal of unsuitable materials) in approved disposal site.
- Preparation traffic management plan to be used in the rainy season and the supervision crew is following its execution on the site.
- Arranging joint meeting with the local administration and stakeholders to alleviate the breach of security (theft),
- The engineer has tried his best to resume the construction activity at least at the areas where there was no security problems, but the security confirmation letter is expected from the employer to resume the whole activity.

Mitigation Method used for DB type

Mitigation Method used to resolve the above mentioned problems on Koka – Adulala - Debrezeit Road Project – DB Method

- After a thorough investigation and traffic count, the originally proposed DBST surfacing section is believed not to have to be capable to serve the intended purpose and hence a mitigation method changing the pavement surface type was needed from DBST to Asphalt

Concrete (AC). Accordingly, the proposed pavement change from DBST to AC type leads to addition cost and time overrun on the employer.

- The employer assessing the newly proposed route agreed with the consultant and ordered the contractor to change his route to pass through the adjacent existing village (Bekejo) the contractor accepted the decision and continued his work on the proposed route.
- The Contractor has to manage the quality of material properties of the asphalt pavement in consistent manner to insure the quality of asphalt pavement works.
- The Employer and the consultant working hard to finalize the removal of all outstanding obstructions in order to avoid any Contractual claim from the Contractor side ahead of time.
- The client checks the proposed design town section of the project along with the Debrezeit Town's Master plan and adopted the length of the town's master plan and order the design to be changed from 4.42km to 5.53 km.
- The contractor suspend the work until the broken out riot there stabilizes.

4.5 General overview from Interview

Interview conducted with higher officials of the administrators organizations share bright ideas and put good perspective of the projects as well as their respective project delivery methods. Accordingly, following the reality that we are in a developed country, it is hard to emphasizes only on one project delivery method because of the capacity of the sector (Client, Contractor and Consultant) and the nature of the projects, this is also shown from a mixed view and opinions of the interviewees with respect to their respective case study projects and their previous experiences in different projects.

The interview (Appendix) question 1 -12 has been incorporated in the preparation of section 4.4 (Analysis of Result Due to Delivery Method) of the research.

4.5.1 Project performance

Even though there is no specific evaluation criteria, the administrator (client and consultant) usually use to the following evaluate criteria to assess the contractor's performance:

- Financial accomplishment
- Contractor's approved work program
- Timely delivery of the project
- Quality assurance and control manual

4.5.2 Success of the project

The Bahirdar (DBB) got an evaluation success rate from fairly successful to fully successful rate of evaluation, the reasons presented for this success rates include:

- Viewing in terms of the volume of the additional works instructed to the contractor
- The persistent delay in affecting monthly interim payments by the owner

With all the challenges presented on the Contractor including additional work orders, weather condition, security problems and others the Contractor surpass those problems and becomes fairly successful on the project implementation in accordance with the view of the interviewees.

Whereas, Koka (DB) road project is perceived as fully successful project with the following justifications:

- The contractor being local contractor surpass challenges like change in pavement type, suspension of the work due to riot and delay in removal ROW obstruction within a reasonable time
- Previous experience of the contractor on road projects specially in town section become handy on resolving issues which rise from local administers and other stakeholders
- The contractor is financially strong and finance the project even when he faced delay in project payment

4.5.3 Delivery methods ability to enable or hinder the ability to perform

On Bahirdar (DBB) the reasons raised for hindrance on the ability of the performer is that the delivery method like this has risk to the employer via unexpected variations and additional works encountered during the implementation of the project.

The methods ability to enable the performer with that if the detailed design are made properly and scope as defined clearly, project contract can be managed easily. If variation is deemed necessary the additional work will be entertained based on the pertinent unit rates provided by the Contractor on the original scope of the works.

However, on DB type project delivery, the client have to negotiate with the contractor both on the cost and additional time necessary to implement the project. On this type of project delivery method, the client may change the required parameters of the work within the allowable limit of the employer's requirement, which is part of the contract documents signed between the contracting parties.

4.5.4 Preferred method of project delivery method for the case study projects

On Bahirdar (DBB) project the interviewee's opinion is divided in to two equal sections (2-2) on the selection of the project deliverable method the one half implies the selected method fits the project by indicating that the selected method gives chance to the employer to issue a number of varied works executed using the contract unit rates. Had it been a DB project, it would have been difficult to negotiate with the contractor on the value for varied works.

On the other hand, some argue that DB type of project delivery method would be the perfect choice considering project's complexity, employer's requirement and the current design capability of the Owner. The interviewees also indicated that, implementing a project using DB type project delivery method could also have prevented instructing additional works through various variation orders and reduced risk on the employer.

For Koka (DB) project the opinion recorded was (2-1-1) 2 being the method employed was successful, 1 DBB would have served a better purpose and 1 there would have been no change if either of project delivery methods employed.

Reasons indicated for agreed with the selected project includes no recorded complaint from the three contracting parties of the project (client, contractor and consultant). One interviewee has a

view that no different result would have been recorded/ achieved had the method of delivery was different. On the other hand the last interviewee is of a view that DBB method should have been employed on the project mentioning the length of the project (short length 51km) with simple terrain (flat to rolling) so DBB could have handled the project well with minimal risk.

Chapter Five

Conclusion and Recommendation

5.1 Conclusion

In this research paper, an attempt has been made to evaluate the preferable project delivery methods suitable for road construction projects in Ethiopian context. While doing same, case study projects are selected and evaluation is being made using five parameters. Those are, contract administration, Time, Cost, Quality and Risk allocation.

The finding of the case study has been evaluated with the basic principles of both type of delivery methods, in order to draw a conclusion and recommend the preferred delivery method for executing of road construction project. Hence, based on the finding of the study, the following conclusion are drawn:

A. Contract Administration

Koka Adulala Design Build Road project is preferable in contract administration. This type of delivery method involve less effort to the Employer because there is no design change proposal brought to the Employer for approval and the client does not fully involve in design preparation as in the case of Bahirdar Zema Design Bid Build Road Project. Further, in association with the integrated time for Design and Construction phase, the project reduces the overall assigned project duration in other words period of contract administration is also reduced along with the project duration.

B. Time

The Koka Adulala Design Build Road project is substantially completed and open for public use within the time frame allocated for the project which are the original contract period of the project plus the approved extension of time by the client. However, Bahirdar – Zema River Bridge DBB road project did not finish within the project schedule and gets an additional 150 calendar days (13.68%) due to the delivery method selected. Hence, Design Build delivery method is the preferred project delivery method to save time.

C. Cost

The Koka Adulala Design Build Road project is neared completion using the originally proposed project budget and additional approved cost amounts which could not be rectified by changing the delivery method to DBB. However, because of the delivery method, Bahirdar – Zema River Bridge DBB road project incurred addition ETB 40,444,997.32 (3.27%) to the originally proposed cost on the project. Hence, Design Build delivery method is the preferred project delivery method to reduce project cost.

D. Quality

In terms of quality, as inferred from the analysis both delivery methods appoint the contractor to quality control and the consultant to quality assurance. Noting both project delivery method use the same standard and requirement for quality it can be established that the same quality output is achieved.

E. Risk Allocation

From risk allocation point of view, Koka Adulala Design Build Road Project transfer much of the risks associated with design process to the contractor and also have an additional 5 year warranty period to assure the integrity of the work unlike the Bahirdar – Zema River Bridge DBB road project which only have 1 year defect liability period and hence Design Build project delivery method is the ideal choice for risk allocation and guaranty.

Therefore, from the above parameters, it can be concluded that Design-Build project delivery method is the better choice than that of Design-Bid-Build project delivery method and hence it is preferable to implement this project delivery method for the upcoming road projects.

5.2 Recommendations

This research paper focus on the case study on two road construction projects which are being implemented by the Ethiopian Roads Authority in DBB and DB type project delivery methods. Although, conclusive recommendation is difficult to make with respect to the most preferable type of project delivery method, from the case study of the two projects, the following recommendations is made:

A. In DB project a clear and well-defined Employer's requirements has to be prepared by revising the available Employer's requirement and the lesson learnt from past experiences. Preparing a well-defined Employer's requirement would have prevented the additional cost and time observed in the case study project. Hence, attention should be given to preparing a well-defined Employer's requirement for the upcoming new road projects.

B. For DBB types of Contracts, the design detail shall be exhaustive and, taking the lesson learnt from the vast experience of DBB type delivery method, similar kinds of design related risks shall be avoided.

C. In DBB type of contract, the Contractor has certain responsibilities with respect to the design of the project works. Hence, it would have been better to introduce additional project warranty period beyond the defects liability period as in the case of DB type of project delivery method.

D. ERA should further evaluate the execution of the works by the DBB and DB types of project delivery methods and should devise such mechanism/selection criterion for the selection of project delivery types.

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Appendix

Appendix

Interview Conducted for Assessment on Project Contact Administration for Design Bid Build and Design Build project delivery methods (Case Study Bahirdar – Zema River DBB Road Project and KokaAdulala DB Road Project)

1. Project Name: _____
2. Project Delivery Type:_____
3. Name of Respondent: _____
4. Organization: _____
5. Position on the Project:_____
6. Do you have previous experience on Design –Bid – Build and Design – Build project Delivery Methods? YES ☐ NO ☐
7. What are the administrative activities being done from your office?

   _____

   _____

   _____
8. What are the major challenges you faced during the implementation the project? Both on Design and Construction?

   _____

   _____
9. Does the project take additional time beyond the contract period? Why?

   _____

   _____

10. Does the project encounter cost overrun? Why?

_____

_____

11. Do you encounter Quality problem on the project? How is it mitigated?

_____

_____

12. How is risk allocated in the project? How is it mitigated?

_____

_____

13. What are the criteria you use to evaluate project performance?

_____

_____

14. Was the project successful? Why?

_____

_____

15. Did this delivery method enhance or hinder your ability to perform? How?

_____

_____

16. In your opinion what would be the best project delivery method that should have been used to implement this project? Why?

_____

_____