# EFFECT OF DESIGN BID BUILD PROJECT DELIVERY METHOD ON PERFORMANCE OF BUILDING PROJECTS IN SOUTHERN ETHIOPIA

**MSc. THESIS**

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**JUNE, 2019**

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**A THESIS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING, HAWASSA UNIVERSITY, INSTITUTE OF TECHNOLOGY, SCHOOL OF GRADUATE STUDIES, HAWASA UNIVERSITY, HAWASSA, ETHIOPIA**

**IN PARTIAL FULFILMENT OF THE REQUIRMENT FOR THE DEGREEOF MASTERS OF SCIENCE IN CIVIL ENGINEERING (SPECIALIZATION: CONSTRUCTION TECHNOLOGY AND MANAGEMENT)**

**JUNE, 2019**

## ADVISORS APPROVAL SHEET

This is to certify that the thesis **entitled "Effects Of Design Bid Build Project Delivery Method On Performances Of Building Projects In Southern Ethiopia"** submitted in partial fulfillment of the requirements for the degree of **Master's** with specialization in **Construction Technology and Management**, the graduate program of the **School Of Civil Engineering**, and has been carried out by **Rediet Emiru** ID. No. **PGCoTM/041/09**, under our supervision. Therefore, we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

| Dr. Bahiru Bewket | ..... | ..... |
|---|---|---|
| Name of major Advisor | Signature | Date |

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We, the undersigned, members of the Board of Examiners of the final open defense by **Rediet Emiru Mulatu** have read and evaluated his/her thesis entitled "**Effects Of Design Bid Build Project Delivery Method on Performances Of Building Projects In Southern Ethiopia** ", and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree of **Master's** of science with specialization in **Construction Technology and Management**, the graduate program of the **School of Civil Engineering**.

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## ACKNOWLEDGMENTS

I would like to thank GOD for giving me the strength and courage to complete this research. I feel blessed to have his guide and protect me in every step I take towards any achievement.

I would like to pass my sincere gratitude to my advisor and mentor Dr. Bahiru Bewket for his wonderful constructive comments, continued guidance and great support for the successful accomplishment of this research.

I am also deeply grateful to all who have given assistance in obtaining the information and data related to this work especially, the people who took time from their busy schedule to fill my questionnaire.

Finally I must express my very profound gratitude to my family and friends. The blessing and continued support of my parents Mr. Emiru Mulatu & Mrs.Yenalem Lema and the love and care of my sisters all made a tremendous contribution to finish my research.

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## DECLARATION

I declare that, this thesis prepared for the partial fulfillment of the requirement for MSc. Degree in construction technology and management entitled "Effect of design bid build project delivery method on performance of building projects in southern Ethiopia "is prepared with my own effort except for secondary sources which have been acknowledged, as listed in the bibliography. I have made it independently with the close advice and guidance of my advisor.

Rediet Emiru

Signature _____

Date _____

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## ABBREVIATIONS

| | |
|---|---|
| ACA | Americans Contractors Associations |
| A/E | Architect/Engineer |
| AGA | Associated General Contractors of American |
| AIA | American Institute of Architects |
| BCCAM | British Columbia Construction Association manual |
| CM | construction Manager |
| CM@R | Construction management At Risk |
| DB | Design Build |
| DBB | Design Bid Build |
| DBIA | Deign Build Institute of America |
| ERA | Ethiopian Road Authority |
| GC | General Contractor |
| LACCEI | Latin America and Caribbean Consortium of Engineering Institution |
| PD | Project Delivery |
| PDM | Project Delivery Method |

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## ABSTRACT

Construction projects in Ethiopia are usually completed within a period longer than what is agreed upon by the contracting parties and with greater cost differences from contract amount. A project is regarded as successful, if the project is delivered at the right time, at the appropriate price; quality standards and providing the client with a high level of satisfaction. These problems are related with project delivery methods employed by the organizations. Construction industries employ different project delivery methods. Design bid build (DBB) method is one of them and it is widely employed in different countries. This method involves three role players in the project delivery process, the owner, the consultant and the contractor traditionally which involves competitively bid and lump sum construction contracts. The issue is common in developing countries like Ethiopia, where the magnitude of variation between originally contracted amount, time and quality are different with actually executed. By using descriptive survey study design data was obtained from clients, consultants and contractors by using open and close ended self-reported questionnaires and interviews. Descriptive statistics was reported as Mean ± SD, frequency and percentages. Also to compare performance of the projects with budget used to date independent sample t-test was employed. The performance of DBB projects with regard to timely on cost and quality completion is analyzed in this study. Thus, the mean percentage of the projects' current progress (54.41±17.36) compared to mean percentage of costs incurred to date from planned budget (68.41±13.60) indicated a significant difference ($p<0.000$) higher cost incurred with lowest progress. The challenges and role of client, consultant and contractor on timely, quality and on cost completion of projects are discussed. From the study, it was found that DBB projects is poor in cost and time but it is better in maintaining quality whereas DB projects perform much better than in cost and time. The contribution of this study is giving awareness about effect of delivery method on performances of building project and to identify and evaluate favorable condition to apply DBB delivery method.



**Keywords:** Delivery method, Design bid build**,** Cost overrun**,** Time overrun, Quality

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the study

The project delivery method is a process by which a project is comprehensively designed and constructed for the owner and includes project scope definition; organization of designers, constructors and various consultants; sequencing of design and construction operations; execution of design and construction; and closeout and start-up (Ali Touran et al., 2009). In some cases, the project delivery method may encompass operation and maintenance and regardless of how they are structured; all delivery methods involve three parties: owner, consultant and builder/constructor (Ali Touran et al., 2009).

Generally there are two ways of accomplishing construction projects; these are construction by contracts and construction by force account. Construction by contract whereby the owner hires an independent body to execute the construction project is the predominant method of accomplishing civil engineering projects in Ethiopia. The alternative to the contract method is construction by force account, where the owner maintains the labor force, furnishes all materials and equipment, and exercises direct management of both design and construction of works (Lema, 2006). In accomplishing the project by contract, different project delivery system might be used in which project owners determine the assignment of responsibilities to project stakeholders along the construction process. It is often determined during the basic planning phase of the construction project (Rahel, 2016).

Construction industries employ different project delivery methods. Design bid build (DBB) method is one of them and it is widely employed in different countries. This delivery method involves the role of owner, consultant, and contractor in project delivery process, traditionally which typically involves competitively bid and lump sum construction contracts according to documents prepared by consultant (Skitmore and Love, 1995).These contract documents generally include drawings, specifications, and supporting information. The owner contracts with a consultant for design, uses the design documents produced to

secure competitive bids from contractors; and, based on an accepted bid, contracts with a contractor for construction (Skitmore and Love, 1995).It is generally accepted that a project may be regarded as successful if a construction is delivered at the right time, at the appropriate price and quality standards, and providing the client with a high level of satisfaction. According to Flanagan and Norman (1993), delivery method plays crucial roles in project performance, in that it defines the scope of works, establishes the rights, duties, obligations and responsibilities of parties and also it allocates risks between parties.

Jack (2011) identified some limitations associated with the design-bid-build delivery method. Due to owner's misconception in DBB that the bid price is the final price and also plans and specifications are rare to change has untended consequence of placing a stress on the business relationships between the owner, design professional, and the contractor (Gransberg et al., 2006). However, studies are limited in identifying effects of DBB delivery method on cost, time and quality of southern Ethiopia building projects. Ethiopian construction industry is widely affected by time and cost overrun (Rahel, 2016).Thus, it is crucial to identify proper project delivery method in order to overcome time and cost overrun and also to deliver a project with standard quality requirement. The relationships, roles, and responsibilities of the parties involved may vary considerably under the different project delivery systems. Consequently, selection of the project delivery system is one of the most important decisions affecting the success of a project, and is therefore a decision which should be made very early in the process (Rahel, 2016).

## 1.2 Statement of the problem

Successful project can be achieved by accomplishing the project deliverables and objectives within the specified time, quality and within the planned budget by bringing together the tasks and resources necessary for that (Shibnai, 2015). Some of the failures that indicate inefficiency in the construction industries as identified by Mbaya (2004) and Talukhabha (1999) include, poor performance in terms of time, cost and quality and adversarial attitudes between participants leading to poor communication, claims and disputes which is related with type of project delivery methods employed. The issue is

common in developing countries like Ethiopia, where the originally contracted amount, time and quality are different from actually executed (Merid, 2016).

According to Rahel (2016) majority of construction project in Ethiopia are delivered by using DBB project delivery method. In this delivery method the responsibility of a designer is to prepare complete construction document for the owner then the owner receives bids from contractors based on the design documents and awards a construction contract to the lowest responsive bidder and responsible one (Rahel, 2016).Studies in developing nation show that the causes of quality problem, time and cost overruns are known but studies to determine their significance in relation to project delivery method is limited (Jack, 2011).Thus, this study was aimed to investigate the effect of design bid build delivery method on the performance of cost, time and quality of building projects in southern Ethiopia.

### 1.3. Significance of the study

Project cost overrun, time overruns and quality problem occur in the construction industry. Thus, this study;

- May serve the construction projects, who want to be aware of effects of delivery method on cost, time and quality building project.
- May help the stakeholders to identify and evaluate favorable conditions to apply DBB delivery method,
- May serve as a spring board for discussions and supportive information to carry out other in-depth studies in the area.

### 1.4 Research question

1) What are the factors that cause cost, time overrun and quality problem related to design bid build delivery method in southern Ethiopia building projects?
2) Are there favorable conditions to apply DBB delivery method in southern Ethiopia building projects?
3) What roles are the stakeholders play in cost; time overrun and quality problem related to design bid build delivery method in southern Ethiopia building projects?

## 1.5. Objective of the study

### 1.5.1 General Objective

To investigate the effect of design bid build project delivery method on performance of cost, time and quality of building projects in southern Ethiopia.

### 1.5.2 Specific Objectives

i. To identify the factor that causes cost, time overrun and quality problem related to DBB delivery method in southern Ethiopia building projects.
ii. To assess favorable conditions to apply DBB delivery method in southern Ethiopia building projects.
iii. To investigate the role of stakeholders on cost, time overrun and quality problem related to DBB delivery method in southern Ethiopia building projects.

## 1.6 Delimitation of the study

The study was delimited to selected building projects in southern Ethiopia. In addition to this, it was also delimited to investigate the effect of design bid build project delivery method on performance of cost, time and quality of building projects in southern Ethiopia.

## 1.7 Limitation of the study

This thesis work had several limiting factors. Time and financial constraints were the challenges that affected the researchers schedule to conduct the research effectively and it was challenging to get enough local researches performed on related topic most. Thus, references were researches in other settings and articles that focus on comparing performance of different delivery methods. Some respondents were busy to respond questionnaire on time that hindered early completion of the research and delayed the whole process.

### 1.8 Definition of terms

- Time overrun**:** is the extension of time beyond planned completion date specified in contract or beyond the date that parties agreed upon for delivery of project" (T.Subramani et al., 2014).
- Cost overrun: is the difference between the original cost estimate of project and actual construction cost on completion of works of a commercial sector constriction project" (Ubani et al., 2015).
- Project delivery method: is the comprehensive process of assigning the contractual responsibilities for designing and constructing a project (AGC, 2004).
- Design bid build: Work is designed by a team of architects and engineers and then advertises the plan to solicit bids from construction firms (Mastermann, 1996).
- Contract Price: is the price agreed by the contracting Parties for the construction of the works or adjusted in accordance with the contract (PPOAK, 2006).
- Contract Period: is the period agreed by the contracting parties for the construction of the works or adjusted in accordance with the contract (PPOAK, 2006).
- Project: A temporary and one-time endeavor undertaken to create a unique product or service that brings about beneficial change or added value by using resources (money, people, materials, energy, space, provisions, communication, quality, risk, etc.) to meet pre-defined objectives (Hendrickson, 2000)
- Construction Project: A project for carrying out construction operations (Hendrickson, 2000).
- Project performance: defined as the degree to which a project achieves the implementation objectives and stake holder's requirements, primarily to do with the specified time, cost, and quality (Pheng and Chuan, 2006).

# CHAPTER TWO

# REVIEW OF RELATED LITERATURE

In this part of the research paper, thorough review of literature related to the topic was discussed. Some of the topics which were included in the literature review are, an overview of DBB project delivery method, Construction project performance challenges related to delivery method, Delivery method application in Ethiopia, impacts of DBB delivery method on time, cost and quality of construction projects and others topics associated with design bid build in construction industries were discussed.

## 2.1 General overview

The construction industry is an important part of the economy and has a considerable impact on the efficiency and output of other industries. It is not possible having extensive investment in manufacturing, agriculture or service sectors without construction of infrastructure facilities in place. One of the main objectives of any public or private construction sectors dealing with the execution of projects is to upgrade project performance through minimization of costs, completion of projects within their assigned budget and time limits and improve quality Chan and Kumaraswamy (1997). Owners are faced with an important question at the start of any construction project. This is related to organization of the project team that will manage the design and construction process or the project delivery method. This decision is important as it affects achieving project objectives such as time, cost and quality. Project delivery systems describe how the project participants are organized to interact, transforming the owner's goals and objectives to finished facilities (Addis, 2014).

Owners and contractors are faced with the challenge of completing projects on time, within budget and deliver a quality product this is because of changes on contract, like changes result from the owners adding additional scope of work, errors or omissions in the contract documents, delays by the owner, unpredicted conditions, and constructive change (Anwar , 2007). At present, there are no industry-wide accepted definitions of project delivery methods, and many groups, organizations, and individuals have developed their own. In so

doing, they have often used different characteristics to define the delivery methods, and this has resulted in a multiplicity of definitions, none of which is either entirely right or entirely wrong (AIA and AGA, 2004).

Project delivery system is the way project owners together with project regulators and Financiers determine the assignment of responsibilities to project stakeholders along the Construction Process. It is often determined during the basic planning phase of the construction project (Zewdu, 2012). According to Flanagan & Norman (1993), project delivery system plays crucial roles in project performance, in that:-It defines the scope of works, establishes the rights, duties, obligations and responsibilities of parties and also it allocates risks between parties.

In El Asmar et al. (2013) study project delivery methods commonly distinguished by two key characteristics:

1. The contractual relationships between project stakeholders and
2. Their timing of engagement in the project

According to Ibbs et al. (2003) study PDMs can be classified into traditional and alternate project delivery methods, Design-bid-build is the main traditional PDM. Design-build (DB) and construction manager at risk (CM@R) (also known as construction manager/ general contractor (CM/GC)) are some of the alternate project delivery methods that are currently used in the industry (Ibbs et al., 2003; Mante et al., 2012; Neill et al., 2011).

According to Kumaraswamy et al. (2002) there are a number of project delivery methods that can be used on construction projects. These can be grouped into three distinct categories: the traditional design-bid-build, construction management, and design-build. The last two categories are commonly referred to as alternative delivery methods. The use of alternative delivery method has increased in recent years due to many factors including the increase in complexity and size of projects, increased owner sophistication and requirements, demand for shorter delivery period and others. The traditional delivery method has many drawbacks when it comes to meeting the new owner requirements.

The drawbacks include longer delivery time, lack of early estimating and potential for disputes and also using the traditional arrangement often results in adversarial relationships among project participants. Project size, complexity, innovation, uncertainty, urgency and the degree of owner involvement all affect delivery method selection and the difficulty of achieving the required results (BCCAM, 2012).

Successful project delivered the building at the right time, at appropriate price and quality standards. According to Skitmore and Love (1995) type of delivery method is one of important factor for the success of the project. Hence, this section of the research intends to discuss empirical information reported by different authors regarding delivery methods in general and DBB in particular.

**2.2 Delivery method selection criteria**

According to Ademola, (2012) from his study identify 13 critical criteria which are classified into 4 major areas of core consideration as follows;

A) Project Technicality

1. Type /complexity of the project
2. Expected performance quality
3. Design and product specification
4. Completion time

B) Project Business Case and Financing,

1. Availability /Funding Structure.
2. Number of competitors
3. Price certainty and market structure

C) Project Risk Management,

1. Controllable variation
2. Responsibility division and integration
3. Risk Sharing and Allocation,

D) Public Policy Requirement.

1. Specific Government Directive
2. Trend in client‘s familiarity
3. political reasons and interference

## 2.3 Types of project delivery method

The project delivery method, is one of the most important decisions made by every owner embarking on a construction project or is address a question that how the project will be designed and constructed. With a variety of delivery methods in use today across the design and construction industry, it is possible to tailor a delivery method that best meets the unique needs of each owner and each project (Rahel, 2016).According to Rahel, (2016) findings currently, the three internationally prominent project delivery methods include, Design-Bid-Build (DBB), Construction Management at-Risk (CM@R) and Design-Build (DB) Project but in this research DBB delivery methods were reviewed which is currently employed in most of the countries especially in our country Ethiopia therefore, DBB delivery method assessed deeply but DB and CMAR were highlighted.

### 2.3.1 Design-Build (DB)

The design-build delivery method allows the owner to contract the design and construction aspects to a single entity known as a design-build contractor. The entity is usually a contractor who has established a joint-venture with a design firm or a contractor that has an in-house design expertise. The delivery of the project is accelerated because construction is overlapped with design also; the risk is minimized for the owner because only one contract is held (Rahel, 2016).

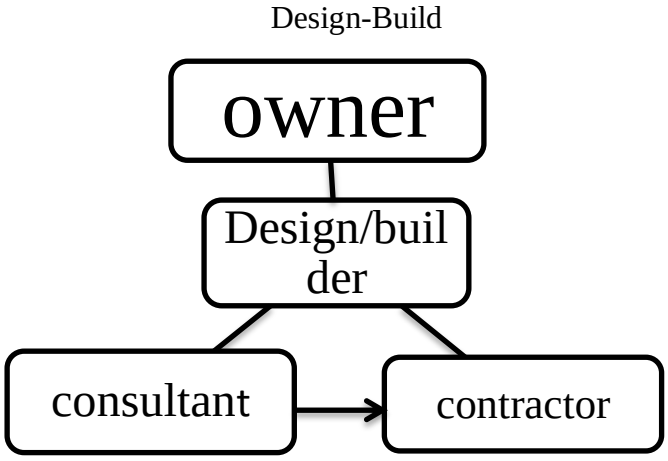


Figure 1 DB contract and communication line (Source: Moruf, 2014)

Description (JBPAAA and APEGGA, 2005)

- ✓ The owner specifies the general requirements for the building.
- ✓ The design-build teams develop detailed schematic designs for the project along with cost and schedule. These are submitted to the owner.
- ✓ The owner selects a design-build team based on the best scheme for the best price and schedule.
- ✓ The design-build team executes the construction of the project.

The circumstances in which DB delivery method is considered appropriate for the following situations :( Lema, 2006)

- ✓ Client not familiar with the construction process
- ✓ Project is technically complexity
- ✓ There is a low likelihood of variations to the project
- ✓ Client desires a single point of responsibility
- ✓ The employer desires a quick start to work on site
- ✓ Client desires to prioritize either – time, quality, price or value for money etc.
- ✓ Client desires an opportunity for effective direct communication/interaction with contractors

  Client desires for an integration of the design and construction process

According to Lema (2006) study the followings are advantages and disadvantages of design-build delivery method

Advantages of DB

- ✓ Best-value selection
- ✓ Better build ability through contractor contribution b/c constructability issues can be addressed early in the design phase by the contractor
- ✓ Risk transfer
- ✓ Innovation encouraged
- ✓ Develops industry via cooperation

- ✓ Better relationships (Team approach) which used to incorporate changes immediately and openly evaluate their impact on cost, schedule and quality
- ✓ Encourages integration of systems
- ✓ Shorten delivery process
- ✓ Few change orders
- ✓ Better control of cost in design phase because contractor could provide accurate pricing
- ✓ Early involvement of specialty contractors could allow early fabrication and purchasing of long lead time items
- ✓ Lowered administrative burden to owner

Disadvantages of DB

- ✓ Limited experiences with DB
- ✓ Less work possibility for small and medium sized contractors
- ✓ Limited competition in large projects
- ✓ Client experience may be lost or diminished
- ✓ Reduced flexibility
- ✓ High tendering cost due to designing requirements
- ✓ Lack of aesthetic consideration
- ✓ Inadequate contractor quality control and assurance
- ✓ No checks and balance

2.3.2 Construction Management at-Risk (CM at-Risk)

This delivery method involves a construction manager who takes the risk of building a project. The architect is hired under a separate contract. The construction manager oversees project management and building technology issues, in which they typically have particular background and expertise. Such management services may include advice on the time and cost consequences of design and construction decisions, scheduling, cost control, coordination of construction contract negotiations and awards, timely purchasing of critical materials and coordination of construction activities (Rahel, 2016).

In CM at-Risk, the construction entity, after providing preconstruction services during the design phase, takes on the financial obligation for construction under a specified cost agreement. This method offers the benefit of construction input during the design phase, which can lead to constructability improvements that can improve the cost, schedule, and quality performance of the project. Additionally, the construction manager can use his input and knowledge of the work to begin work earlier through phased design and construction schedules (Damon, 2000).

Construction Management @ - Risk

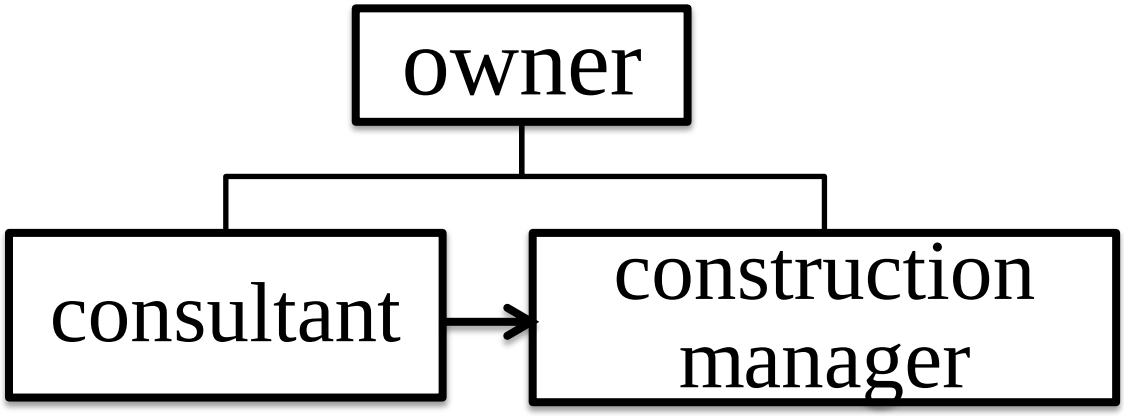


Figure 2 CM@R contract and communication line (Source: Moruf, 2014)

Description (JBPAAA and APEGGA, 2005)

- ✓ In this delivery method, the CM is hired prior to completion of the design, to act as project coordinator and general contractor.
- ✓ The CM assumes all the liability and responsibility of the general contractor
- ✓ The Owner selects the consultants to design the project and prepare the construction documents.
- ✓ The CM-Constructor advises on cost, schedule, building technology and methodology until the competition of construction documents.

- ✓ The CM-Constructor builds the building after re-bidding most or all of the subcontract work.

Construction management at risk method of project delivery is considered applicable in the following situations :( Lema, 2006)

- ✓ If flexibility with regard to schedule and changes is required.
- ✓ If fiduciary relationship with the contractor before and during construction is required.
- ✓ Competition for the work is to be ensured.
- ✓ Early completion of the work is necessitated.

According to Lema (2006) study the followings are advantages and disadvantages of CM @ Risk delivery method

Advantages of CM at-Risk

- ✓ Good for clients with insufficient staff
- ✓ Owner flexibility
- ✓ Responsible for cost and time overruns
- ✓ Holds and manages trade contractors
- ✓ Constructability design review
- ✓ Legal position as a General Contractor
- ✓ Works closely as a teaming effort and encouraging trust and partnering
- ✓ Phased construction (fast tracking) possible

Disadvantages of CM at-Risk

- ✓ Lack of capable construction managers
- ✓ Demanding work organization
- ✓ Lack of cost certainty for each work packages
- ✓ Lack of contractors who can provide both construction management and construction services
- ✓ Fragmentation, as compared to DB
- ✓ No exactly defined work packages (bill quantities)

### 2.3.3 Design bid build (DBB) delivery method

The DBB system was developed during the industrial revolution period, which resulted in the creation of specialized professional movements of Architects, Contractors, and Engineers (Pakkala, 2002.). This approach has been the standard choice of project delivery systems for many years .In this model, an owner/client procures the services of a design consultant to develop the scope of the project and complete design documents, which are then considered as legal documents for use in selecting a contractor who builds according to the specifications developed by the design team (JBPAAA and APEGGA, 2005).

Addis (2014) states that after the project owner prepare the basic plan that identifies construction project program, they call upon the participation of design/ supervision consultants. These consultants will carry out the design and the necessary tender documents which will be the basis for selecting contractors. Here the design and the construction are performed by two separate parties. Cristian and Kyle (2009), states that the most outstanding character of DBB, also called the traditional approach, is that the procedure of the project construction has to follow the order of Design Bid Build, i.e. only when the former has finished, the later can start.

According to Lema (2006), DBB is a well-known project delivery method that promotes competition and ensures transparency; there are significant problems with the process. The main challenge is the extensive need for client resources in managing the contract and also, it does not allow cooperation between different participants of a project thereby hindering industry innovation (Lema, 2006). Mastermann (1996) argued that the traditional method of project delivery (DBB) where work is designed by a team of architects and engineers and then advertise the plan to solicit bids from construction firms. The winning firm becomes the General Contractor, responsible for overall completion of the project using the firm's own employees, sub-contractors, or a combination of both. The design and construction phases of the project are clear and distinct. A complete set of design documents is finished before the builder becomes involved.

Traditional project delivery system, commonly known as design-bid-build (DBB) method is the most used method for public construction projects .Under DBB, public owners are required to award architectural and engineering contracts solely based on qualification to provide the design services before construction phase. The lowest cost contractors then build such projects. Due to this disconnect, this system has several shortcomings that result in frequent claims and disputes between the project participants and cost and time overruns. In DBB delivery system the roles and responsibilities of all involved parties were clearly defines. There are three main players in this project delivery system: owner, designer and contractor (Mahdi and Alreshaid, 2005).

In the DBB project delivery method, the responsibility of a designer is to prepare complete construction document for the owner. The owner then receives bids from contractors based on the design documents and awards a construction contract to the lowest responsive bidder and responsible one. The contractor builds the project, and upon completion, the owner assumes responsibility for the operations and maintenance of the project. The owner also provides all financing. Typically, in public organizations the proposal is in an open competition for a 'Lowest Responsive Price' ((JBPAAA and APEGGA, 2005).

According to Greg and Thomas, (2008) two areas that set for influence in the early stages of a project are risk and incentives because one function of the project delivery method is the assignment of contractual responsibility. On a DBB delivery method Owners, designers, and contractors all have a vested interest in the assignment of responsibilities under the contract since all responsibilities carry risk.

Typically owners are at risk for the financing, payments to the designer and contractor, and site conditions. The design professionals are at risk to assure the design meets the aesthetic and functional requirements established by the owner, and that the design is code compliant. The contractor is at risk to assure the construction is completed on time, within budget and with the quality specified by taking responsibility for: project site safety, coordination of construction, construction defects, and inflation and therefore to the risks related to these project components. The selection of a particular project delivery method

for a particular project will establish how the risks are to be shared and managed on the project. This in turn will affect the cost of the project (Greg and Thomas, 2008).

Two component of the project delivery method that provides the most incentive are the method of contractor selection and terms of payment. On a DBB delivery method if a contractor is selected on the basis of low cost only then there is little incentive for that contractor to provide anything beyond the minimal to fulfill the requirements of the contract. On the other hand, a contractor selected on the basis best value (qualifications and cost) has an incentive to maintain and enhance their value through performance that meets or exceeds the requirements (Greg and Thomas, 2008).

Design- Bid- Builds

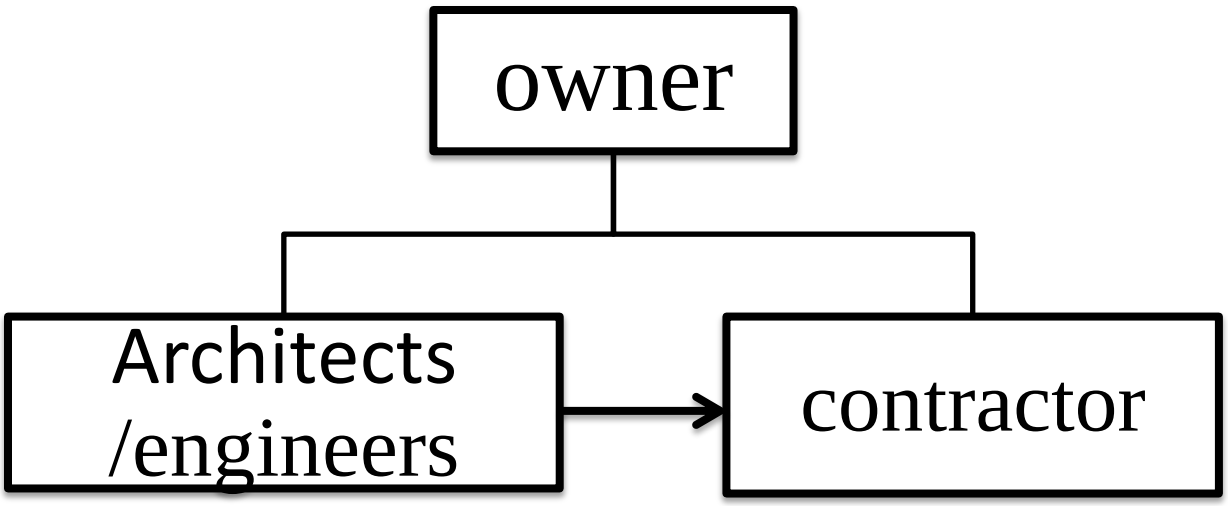


Figure 3 DBB contract and communication line (Source: Moruf, 2014)

Description **(**JBPAAA and APEGGA, 2005)

- ✓ The owner selects Consultants to design and prepare construction documents, usually based on a predetermined budget and a Functional Program or at least some type of description of the project requirements.
- ✓ Construction Firms bid on the work (submit tenders), based on the construction (tender) documents prepared by the Consultants. The work is generally awarded to the lowest bidder, as a fixed price (stipulated sum or lump sum) contract.

- ✓ The Contractor builds the project with the Consultants maintaining a quality assurance role and providing construction administration services on behalf of the owner

According to Rahel (2016), DBB have its own unique characteristics that are the following

1. Three prime players—owner, designer, contractor
2. Two separate contracts—owner-designer, owner-contractor
3. Final contractor selection is based on Low Bid

Typical characteristics of the DBB approach as stated in Lema, (2006**).**

- ✓ Three linear phases – design, bid, and build.
- ✓ Well-established and broadly documented roles.
- ✓ Carefully crafted legal and procedural guidelines.
- ✓ A lowest responsible bidder that provides a reliable market price for the project.
- ✓ Contract documents that are typically completed in a single package before construction begins, requiring construction-related decisions in advance of actual construction.
- ✓ An opportunity for construction planning based on completed documents.
- ✓ Complete specifications that produce clear quality standards.
- ✓ Configurations and details of finished product agreed to by all parties before construction begins

According to Lema (2006) study the followings are advantages and dis advantages of DBB delivery method.

Advantages of DBB delivery method

- ✓ Long history of acceptance
- ✓ Owner flexibility
- ✓ Open competition
- ✓ Distinct roles
- ✓ Ensures work for contractors of all size
- ✓ Low tender cost

- ✓ Allows the lowest contract price
- ✓ Client control over project delivery method
- ✓ Pre-qualification encourages better performance
- ✓ Provides complete documentation allowing bill of quantity before construction
- ✓ Industry capability available

Disadvantages of DBB delivery methods

- ✓ Self-serving adversarial relations
- ✓ Usually cost overruns
- ✓ Lack of innovation
- ✓ Low bid - incentive for change orders
- ✓ Owner responsibility for errors and omissions
- ✓ Linear process (takes too much time)
- ✓ Design suffers from lack of input from contractors
- ✓ Does not encourage technological improvement or integration of systems
- ✓ Lack of cost certainty
- ✓ Multiple change orders
- ✓ Does not promote privatization

## 2.4 Construction project performance challenges related to delivery method

Project performance can be defined as the degree to which a project achieves the implementation objectives and stake holder's requirements, primarily to do with the specified time, cost, and quality (Pheng and Chuan, 2006). Pheng and Chuan (2006) also defined project success as the completion of a project within acceptable time, cost and quality and indicated that project success can be achieved through the good performance of indicators of the project, therefore one of the main objectives and policies of any public or private sectors dealing with the execution of projects is to upgrade project performance through minimization of costs, completion of projects within their assigned budget and time limits and improve quality.

According to Bassioni et al., 2004 and Cheung et al., (2004) studies agree that project performance can be measured and evaluated using a large number of performance indicators or criteria but time, cost and quality appear to be the three commonly preferred performance evaluation dimensions. The loss of control on time and cost leads to failure of projects and the shortage of control may be caused as a result of lack of knowledge and awareness. Completing projects within the time is an indicator of an efficient construction industry (Chan and Kumaraswamy, 1997).

Reaching to the end of any project is not a kind of success for the project owner. For the client or owner of the project, success of a project depends on many factors; the most important factors are finishing the project within the budgeted cost and reaching to the closing date of project without delay and with a good quality of work (Abd Majid & Mc Caffer, 1998; Aibinu & Jogboro, 2002; Choudhury &Rajan, 2003; Koushki et.al., 2005). According to AIA and ACA the main criteria for measuring the success of any project delivery method are cost, time and quality or how the project ultimately meets its intended purpose. However, responsibilities for meeting these criteria vary by method. Each delivery method offers a different level of risk to the owner (AIA, 2004). The traditional delivery method or DBB retain the risks of time and cost overruns to the client but non-traditional delivery methods transfers the risks of time and cost overruns to contractors (Jack, 2011).

Public owners (state agencies, counties and towns, universities and community colleges, and hospitals) often seek new ways to make construction projects adhere to both deadlines and budgets. Many experts believe that the key to the success of a construction project is the process by which it is organized and managed, or the "project delivery method" (Rahel, 2006). According to Bryde and Brown (2004) concluded that the traditional distinction between good and poor project performance focused on the meeting of cost, time and product quality-related criteria. These criteria have been described as the iron triangle of project performance.

Figure 4 shows the iron triangle as adopted by Atkinson (1999).

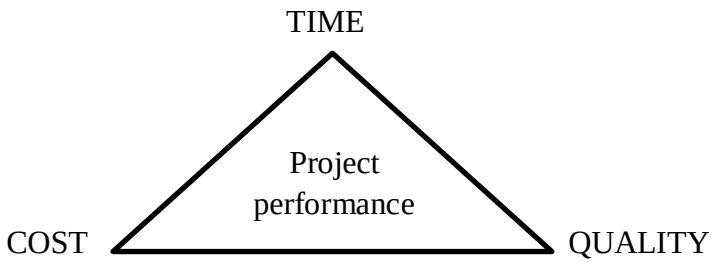


Figure 4 Project performance criteria trade-off triangle (Source: Atkinson, 1999)

Project delivery method is one of the factors that affect performance of project therefore selecting the correct delivery method can have a direct impact on the level of success of your project. This selection affects various factors from them the major factors are time, cost and quality which are the main objectives of any construction project. The decision is usually made by the owner based on the unique characteristics of the project, owner's objectives, degree of risk, level of information available or needed at time of construction, level of desired client's involvement, and interaction between design and construction among other factors (Sameh, 2016).

Owners are usually tempted to use the delivery method that they are familiar with. However, this might be a great mistake since familiar methods are not necessarily effective in all situations because the suitability of the selected PDM can improve the project performance to a great extent (Al Khalil, 2002). It has significant implications on collaboration and partnering between project participants, and therefore, impacting the project success (Ibbs et al., 2003). There are a large number of different project available in the construction industry which aims to overcome the shortcomings of traditional delivery systems (Alhazmi and McCaffer, 2000).

Literatures on the construction industry indicate that from different project delivery method DBB is the most widely used project delivery method globally, and therefore, well understood. It was derived by the convention\belief that a public entity, having been furnished with a detailed set of previously purchased plans and specifications, can achieve

the lowest cost for the public through open competitive bidding and proper supervision. In reality, as different writers justify, these goals are difficult to achieve on many projects. Often several parts of the project can't be constructed as designed due to obstacles encountered in the field or internal design inconsistencies, leading to delays in the project and changes to the design for which the contractor is entitled to additional funds. Thus, the project designer's cost and schedule estimates prove to be inaccurate (Berman, 1999).

According to Mcdermott et al. (2005) and Sidwall (1984), DBB delivery method which means the manner in which a building team and process are organized, has an influence on project cost, time and quality performance, therefore it is a crucial element in a project success. In Ethiopia DBB delivery methods are widely used, its characteristic is the separation of the responsibilities for design and construction of project. According to Sameh ( 2016), when comparing DBB, design bid and construction management at risk based on different factor, the study results indicate that Design-Build methods are more effective in meeting most project objectives followed by construction management at risk and lastly the traditional design-bid-build. Design-build is relatively more effective in ensuring the shortest project duration than Construction Management methods.

The traditional delivery methods are not effective in ensuring the shortest duration. Construction management method is the most effective in ensuring staying within budget. The results also show that the Design-Bid-Build methods provide the greatest flexibility to incorporate changes during the design and construction of the project. However, this may come at a higher cost. DBB is not effective in ensuring the highest quality. In addition, the communication between the designer and the contractor is often not good in this PDM, as they are separate entities and each are waiting for an opportunity to shift the risk in case of an error occurrence (Perkins, 2009). Therefore, there is a common lack of knowledge sharing between the designer and contractor and each one of them are working for their own profit motive instead of collaborating and knowledge sharing.

Finding obtained from Fernane (2011), reveals that construction-manager-at-risk and design-build methods control project costs, reduce time, improve quality, and decrease administrative burden more than the design-bid-build methods. However, public owners

should recognize that additional factors will influence their decision in choosing the best method: whether or not they are developing a project program; whether or not they are working with multiple stakeholders; and whether or not they are using in-house design and construction staff. Rahel (2016) reported that due to design change, change orders quantity increase and late payment time and cost growths from contract amount are higher in DBB projects than in DB.

DB is better because its single point of accountability for design and construction, fast track delivery because of construction begins before design is complete and early definition of project cost in the process but also DB projects has its drawbacks too like quality problems, higher unit cost and it requires high professional skill to clearly and explicitly state employer requirement in order to eliminate changes after commencement to the work and also as she reported in her study majority of the respondents about 88% agrees that cost is increased from contract amount and almost in all projects there were time growth in DBB. In DB projects experienced by the same professionals majority of them says projects were completed with allocated budget on comparison to DBB. DB performs better timely completion. Half of the responses show quality maintenance in DB. In Sameh (2016) study's design-build is relatively more effective in ensuring the shortest project duration than Construction Management methods. The traditional delivery methods are not effective in ensuring the shortest duration. Construction management method is the most effective in ensuring staying within budget. The results also show that the Design-Bid-Build methods provide the greatest flexibility to incorporate changes during the design and construction of the project. However, this may come at a higher cost. Design-Build is better suited to handle changes and ensuring the highest quality.

Mante et al. (2012) study indicated that due to lack of communication, price competition and fragmentation in DBB PDM's increase conflicts and disputes. In Lema's finding there are problems that associated with traditional approach of projects delivering method (DBB), that are: - Scope of the project is changed very often due to lack of timely sufficient fund with the public agencies; No real competition during contractors selection since contract awards are based on price; Procurement procedures are slow and

bureaucratic; Excessive time overruns; Quality is compromised; In the case of disputes, legal procedures are slow and ancient.

According to Lema (2006) study, now-a-days by considering the problems associated with traditional method of delivering public projects (DBB) approach is slightly modified. Hence, once the design of such projects have been completed by the first consultancy firm another and independent consultancy firm comes-in to take care of the design review and construction supervision. The logic behind this approach is that the new consultancy firm will identify the design deficiencies of the former firm so that problems are identified and corrected before the start of construction. It is, however, important to note that it is after such lengthy procedures that the construction of the project commences.

### 2.5 DBB Delivery method application in Ethiopia

Generally in Ethiopia the number of construction projects is increasing from time to time. However it became very difficult to complete a project in a stipulated time, cost and intended quality given in the initial contract document. This phenomenon's are common in almost all construction projects (Merid, 2016). Project delivery method is one of the most important factor that affect time, cost and quality of construction project.

Project delivery method selection is more complex as a variety of alternative delivery methods have been developed. Choosing a project delivery method plays an important role in the ultimate success of your project. Each project delivery method has its advantages and disadvantages and they deal differently regarding the different owners' objectives because each has its own unique characteristics, therefore there is no one delivery approach that is right for all clients or all projects. These circumstances include the project type, budget, and schedule, as well as your available resources, and appetite for risk. Each project has its own set of unique circumstances, requiring a custom approach to construction (Brittan, 2014).

The efficient delivery of construction projects is foundation to the success of the construction industry. To increase the probability of success, owners must choose the appropriate project delivery systems to match their project needs.

Most groups agree that there is no perfect project delivery system. Every project is unique and has its own unique set of challenges. Therefore, industry consensus is that every project should be considered on a case-by-case basis to determine the most appropriate project delivery system (Shaik et al., 2012). In Ethiopia traditional project delivery system called DBB delivery method is employed. It is a characteristic of the traditional system that all project implementation activities revolve around the project architect who is expected to manage the design and the construction process of the project on behalf of the client and the contractor is responsible for the construction (Talukhabha, 1999).

Lema discuses in his study public works have been routinely built using the design-bid-build delivery method. This has included regulatory requirements such as competitive bidding, performance bonds, and employment of various other statutory requirements to protect taxpayers' investments. According to Rahel (2016) the most practiced type of delivery system in the construction industry of Ethiopia are called design bid build(DBB) project delivery method . In DBB delivery method projects are facing significant cost and time overrun that is affecting the country's economy. Though there is good start at ERA there is very few experience of applying innovative delivery method in public constructions. Even though previous researches in Ethiopian construction industry shows better performance in using alternative delivery method than traditional called DBB, usage of alternative delivery method is not developed and cost and time overruns continue to be major challenge in construction industry. Identifying level of influence of delivery methods on project performance of Ethiopian construction projects and shifting to better performer and minimizing cost and time growth of projects is needed (Rahel, 2016).

According to LACCEI (2007), rapid expansion and the increase in projects size and complexity have made owners looking for new methods to deliver their unique projects. However, the decision is not easy as there are many factors that affect the project delivery method decision. These factors are related to time, cost, scope, quality, owner organization, cash flow, project characteristics, risk and relationships. It is important that owners understand these factors as it will assist them in making the right choice for their projects.

According to Cristian and Kyle (2009), the advantage of DBB is that the owner, contractor and consultant are clearly assigned their responsibilities and tasks but its disadvantage is, since the procedure is linear the lifetime is too long; Project owner would be responsible for risks associated with both the design and contract administration and usually there exists severe adversarial relations between the consultant and the contractor. Zewdu, (2009) also agrees with this saying in DBB contract delivery system, the employer carries a lot of risk. The employer signs different contracts with the consultant and the contractor, hence is exposed to risks associated with both contracts.

## 2.6 Impact of DBB project delivery method on cost, time and quality of construction projects

### 2.6.1 Impacts of DBB on cost of the projects

Cost overrun is the difference between the original cost estimate of project and actual construction cost on completion of works of construction project (Choudhry and Phatak, 2004).

It is perceived to be the difference between the final project cost and the original contract amount (Hinze and Selstead, 1991). Angelo and Reina (2002) stated that cost overrun is a major problem in both developed and developing countries. Several studies of major projects show that cost overrun is common. The causes of cost overrun in construction projects are varied, some are not only hard to predict but also difficult to manage. Some of cost overrun causes are related with delivery method that employed on the projects.

According to Kawika (2007) finding owners are finding themselves in situations where they are unable to complete their projects within cost and schedule using the traditional delivery method: Design–Bid–Build (DBB). Under the DBB project delivery method, many of the competent contractors are selecting to send low bids on projects just to keep have work, with plans to receive change orders while it is underway, which is leading to cost and schedule overruns therefore those contracting companies are bidding on jobs that utilize the traditional delivery method, DBB by offering lowest bid. This is leading to more change orders, cost overruns, and the inability to meet the schedule.

The most significant factors influencing project costs in DBB are the engineer perception of the significance of extra work and extended or reduced contract period and importance of delays in preparing detailed drawings. Other factors include design and specification changes, delay in preparing detailed drawings, extended or reduced contract period and late instructions were considered as the main causes of delays (Jack, 2011).

Another perceived problem with DBB is the owner's misconception that the bid price is the final price. A/E plans and specifications are rarely if ever perfect and the contractor's interpretation of the plans and specifications rarely if ever match the intentions of the designer. As result of this, it is common place in construction process that there will be changes and change orders. This often has the untended consequence of placing a stress on the business relationships between the owner, design professional, and the contractor (Greg and Thomas, 2008).Another study by Gransberg et al., (2003) compared the performance of Design-Build and Design-Bid-Build in the US. The study showed that cost growth is significantly lower for DB than DBB.

According to Joint Board of Practice DBB method is not usually the best value to the owner and costs are generally higher due to reduced flexibility to make cost effective changes to the work once construction has started. There is high possibility for a contractor to claim for design errors to recover costs, this is also one of the factors that contribute for cost overrun related to DBB delivery method (CEA, 2016). In contradiction with the above different study Lema (2006) finding shows that it was observed that 57.1% of the respondents indicated the DBB delivery method is preferable to meet project costs. According to these respondents, the public owner benefits from separating the designers from the contractor(s). This separation creates a system of checks and balances, unlike the case with other methods.

### 2.6.2 Impacts of DBB on time of the projects

Construction projects frequently suffer from delays and are usually completed within a period longer than what is agreed upon by the contracting parties this occurs due to different factors related to delivery method employed. Time overrun is defined as the extension of time beyond planned completion date specified in contract or beyond the date

that parties agreed upon for delivery of project (T.Subramani et al., 2014). Delays are incidents that impact a project's progress and postpone project activities; delay causing incidents may include weather delays, unavailability of resources, design delays, etc. In general, project delays occur as a result of project activities that have both external and internal cause and effect relationship (Shibnai, 2015). Ismael (1996), who reported that time overrun, is endemic to construction projects in Ethiopia. He expressed the range of delays in percentage and he said he has examined 13 projects in Ethiopia and obtained the delays encountered in most of the projects range between 100% and 460% of the original contract time. Projects delay is the major cause of claims of time extension and associated cost overrun

Ibbs et al. (2003) compared Design-Build to Design-Bid-Build based on time, cost and productivity. They stated that the timesaving was a definitive advantage of Design-Build.
According to (Gransberg et al., 2003) compared the performance of Design-Build and Design-Bid-Build in the US. The study showed that time growth is significantly lower for DB than DBB. According to Seeley (1997), separation of responsibility for design of the project from that of its construction is one of the basic unique characteristics of DBB project delivery method even where variants of the basic system allow co-operation between the contractor and the client or his consultants, these two fundamental elements remain as two separate entities therefore in this delivery method design of the project is usually completed before work commences on site or the Project is a sequential process. Another consequences of this delivery method on timely completion of the project are a longer period of overall design and construction may make the total project price higher because of increased period of interim financing charges and interim payments to consultants and contractors and also the overall period of design and construction, with design being completed before construction tenders are invited, generally requires being longer than is necessary for project integrating and management contract options.

### 2.6.3 Impacts of DBB on quality of the projects

According to Mahdi and alreshid (2005) study revealed that DBB encourages construction quality because the designer and contractor are separate entities and both are in a position to discover errors made by the other party, resulting in a system of check and balances and

increased number of parties with different perspective. Lema (2006) also conducted a research on Alternative Project Delivery Methods for Public Constructions in Oromia Region also shows that DBB method is effective to maintain a quality construction project. The reason is, as noted, this method creates checks and balances between the design team and the contractor(s) so that the defects of one party are not concealed. According to Rahel (2016) with regard to quality maintenance DB projects faced quality problems due to absence of check and balanced system, all responsibilities of design and build are on DB contractors 'hand. So there may be a chance to the contractor to go for cost effective design by scarifying quality.

Riecke (2004), on her article with a title of Public Construction Contracting: Choosing the Right Project-Delivery Method, in her article discloses 40% of experts responded that functional and aesthetic goals are always met using single-prime bidding, construction manager at risk, or design-build. 27% thought that using DBB is best and experts indicated that public owners have the greatest chance for a quality project using construction manager at risk. Under construction manager at risk, public owners benefit from having input from construction personnel during design. This also is a characteristic of design-build.

According to owners guide to project delivery (2012)**,** Some listed difficulty related to DBB delivery method are if the owner uses the fixed price bidding and compensation method, the contractor may pursue a least-cost approach to completing the project and the owner may receive less scope or lesser quality than expected for the price, requiring increased oversight and quality review by the owner. If the owner uses the unit price bidding and compensation method, the contractor may pursue an increased-scope approach to maximize revenue from the contract, while providing the owner more scope than expected. In DBB delivery method it requires significant owner experience and resources and also it does not provide contractor with incentives for enhanced performance therefor contractors are not initiate to deliver a project with better or enhanced performance without getting additional incentives (CEA ,2016).

Another perceived problem in DBB delivery method is the absence of construction input into the project design may limit the effectiveness and constructability of the design.

Important design decisions affecting both the types of materials specified and the means and methods of construction may be made without full consideration from a construction perspective (owners guide to project delivery, 2012).

## 2.7 Role of stakeholder on the performance of construction projects related to delivery method

In delivery method the main role player professionals are consultant and contractor therefore they have their own influence on cost, time and quality of projects. Clients also have an influence because they are sponsor of the projects. It was further established that for each one of the participant, there are varying levels of influence depending on what role the participant was playing. The primary considerations in the selection of the design and construction team should be suitability of the firms/companies for the specific project to be undertaken and their ability to work together as a team. A client may be an individual, the central government, government agency, the local government authorities and private enterprises. Client's create demand for constructed facilities and finance that construction hence they are the construction business promoters. Contractor is a person or firm that under takes a contract to provide services .consultant is a person or firm who works on behalf of owner.

According to Alaghbari et al. (2007), findings categorize contractor, consultant and owner influence separately. As far as causes related to contractor actions are concerned, financial problems, shortage of materials and poor site management were ranked among the top three. Owner causes included delayed payments, slow decision making and contract scope changes. The top three consultant causes were poor supervision, slowness to give instructions and lack of experience.

Ahmed et al. (2003) and Theodore (2009), identified the following factors causing time overrun in construction projects, the factors that are related to consultant's responsibility are: absence of site staff, lack /inadequate/ of experience, delay in approving major changes in the scope of work, mistakes and discrepancies in design documents and long waiting time for approval of drawings and materials samples. Factors that are related to contractor's responsibility are: poor qualification of the technical staffs, construction mistakes and defective work, poor skills and experience of labor, financial problems,

coordination and communication problems with others, Poor site management. The factors that are related to owner's responsibility are: Delay to furnish and deliver the site, Lack of working knowledge, Change orders during construction (replacement and addition of new work to the project and change in specifications), financial problems (delayed payments, financial difficulties and economic problems), Slowness in decision making process and poor communication and coordination.

### 2.8 Causes of poor cost and time performance related with DBB delivery method

- ✓ According to CEA (2016), DBB method frequently results in adversarial or confrontational relations between Owners, Consultants and Contractors, due to potential problems resulting from lack of clarity or misinterpretation of the contract documents.
- ✓ This method is not usually the best value to the owner and costs are generally higher due to not having the benefit of early input and advice from Contractor and the length of time required to complete the work (JBPAAA and APEGGA, 2005).
- ✓ Designers also have compelled to limit their inspection duties to periodic observation in design or construction (Lema, 2006).
- ✓ Some designers are not aware of the latest construction methods, and therefore, may not always provide the cost savings or benefits associated with the latest construction methods (Lema, 2006).
- ✓ Leading delay to the project and changes to the design for which the contractor is entitled to additional funds (Lema, 2006).
- ✓ In this method owner is responsible for design error and omission, due to this the owner may incur additional cost and also it affect the schedule of the project. In DB Errors and omissions in the construction documents are the design-build team's responsibility and that risk is not passed on to the owner (Lema, 2006).
- ✓ Firm construction costs are not known until the design and bidding process is complete because of this bids may be greater than the estimated costs ,this can cause project delays while the construction documents are redone to reduce costs(Gordon,2016)
- ✓ The absence of construction input into the project design may limit the effectiveness and constructability of the design. Important design decisions affecting the types of materials specified and the means and methods of construction may be made without

appropriate consideration from a construction perspective (DBIA, 2015). Furthermore, early collaboration on projects between designers and contractors usually enhances their relationship and often results in change order minimization because the process encourages the contractor to point out problems in the design or constructability issues early in the bidding or design process (Lema, 2006.)

- ✓ Delays in architects instructions, engineers instructions and details and work material approvals
- ✓ Introduction of extra or additional work to the project leading to requirements for more financial and time resource (Lema, 2006).
- ✓ Changes in design sometimes necessitating demolition of finishes work and reconstruction to fit new designs (Rahel, 2016)
- ✓ Delay in payment leading to suspension or slowing down to work and claims for interest (Lema, 2006).

### 2.9 Key Considerations in choosing DBB delivery method

According to DBIA (2015), lists the followings key considerations to choose DBB delivery methods.

- ✓ This method is widely applicable, well understood, and has well-established and clearly defined roles for the parties involved.
- ✓ This method is presently a very common approach for public owners due to procurement statutes under which they operate.
- ✓ The owner has a significant amount of responsibility for the success or failure of the end product, particularly since the facility's features are fully determined and specified prior to selection of the contractor (Owner "owns" the details of the design).
- ✓ The contractor works directly for the owner.
- ✓ The designer works directly for the owner.
- ✓ Process may have a longer duration when compared to other delivery methods since all design work must be completed prior to solicitation of the construction bids. Construction may not begin until the design and procurement phases are complete.
- ✓ The absence of construction input into the project design may limit the effectiveness and constructability of the design. Important design decisions affecting the types of

materials specified and the means and methods of construction may be made without appropriate consideration from a construction perspective.

- ✓ There is no contractual relationship between the contractor and the designer.
- ✓ There is no opportunity for collaboration during the design phase.

### 2.10 Favorable conditions or circumstances to apply DBB delivery method

According to Lema (2006) DBB method is considered suitable for projects:

- ✓ Which are small, single and less complex or highly constrained?
- ✓ Scope of work is clear and well defined to facilitate detailed design
- ✓ Contractor is selected on the basis of price with a general acceptance that the price may be wrong
- ✓ It is important for client to use a contract form with fair and familiar distribution of risk
- ✓ When the owner wants to carefully settle upon a design before committing to funding construction;
- ✓ Where environmental, geotechnical, or regulatory issues leave no freedom for other options.
- ✓ Where it is appropriate to take advantage of existing design**.**
- ✓ The designer is experienced enough to oversee both the design and construction
- ✓ When the client desires competitive tendering

# CHAPTER THREE

## MATERIALS AND METHODS

This part presents the techniques and methods used in collecting the data, how the data was processed and analyzed which lead to the findings.

### 3.1 Description of the study area

The study was conducted in selected zonal towns of Southern Nations Nationalities and People Regional State (SNNPRS) of Ethiopia; these are Hawassa, Arbaminch, Dilla and Wolaita Sodo towns. The towns were chosen because of the researcher's well awareness and familiarity with the area.

### 3.2 Study subjects

The study subjects include clients, consultants and contractors who participate in selected towns of southern Ethiopia building projects which are currently active or active on 2019 but the progress of the project are not based on planned schedule and budget (the project which is exposed to time and cost overrun).

### 3.3 Research design

For this study, methods employed in order to achieve the objectives stated in earlier parts of the study were basically descriptive survey with qualitative and quantitative approach was employed. Survey research is the method of gathering data from respondents thought to be representative of the same population. It seeks to obtain information that describes phenomena by asking people about their perception, attitudes, behaviors or values.

In the process of conducting such research work, sampling is necessary because in a study of this nature, it is neither desirable nor possible to cover all the entire population. Thus, a multistage sampling technique was employed to select the zonal towns in the study settings. The zonal towns were selected purposely and the number of construction projects, clients, consultants and contractors were selected proportionally using determination formula described below. Thus, the towns contain 58 target projects which are currently active building projects but not execute according to their schedule with 120 target populations which include clients, contractors and consultants. Then, using sample size

determination formula, the samples were proportionally distributed to each zonal town. Details of procedures were explained in the table below. The sample size determination was based on Yamane, 1967, a simplified proportional formula; $n=\frac{N}{1+N(e)2}$ , which considers a 95% significance interval and p = 0.05. Where, n = sample size, N = population, and e = the level of precision.

Thus, N = 120, e=0.05

$n=\frac{120}{1+120(0.05)2}$ , $=\frac{120}{1+0.3}$ , = 92 samples

Table 1 Sample size determination table

| Selected Zonal Towns | No of Projects | Total populations | Proportional Sample |
|---|---|---|---|
| Hawassa | 20 | (20*2) + 1= 41 | 32 |
| Wolaita Sodo | 16 | (16*2) + 1= 33 | 25 |
| Arba Minch | 12 | (12*2) + 1 = 25 | 19 |
| Dilla | 10 | (10*2) + 1 = 21 | 16 |
| Total | 58 | 120 | 92 |

A total of 92 (88 questionnaire and 4 interview) subjects participants involved in the study. However, out of 88 questionnaires distributed, 5 were rejected that means an effective response rate of 90%, and this was believed to be acceptable for the research. Thus, the quantitative analysis was made with 83 participants (43 consultants and 40 contractors).

### 3.4 Data gathering instruments

The data collection approach adopted for conducting this study includes both primary and secondary sources. The Primary data were collected by using both qualitative and quantitative methods of data collection these includes personal interviews using an interview guide and questionnaire, while the secondary data sources include articles,

researches, hand books and internet sources on related topics. The data obtained from these were triangulated to ascertain the validity of data findings.

### 3.4.1 Questionnaire

Questionnaires was employed as a major instrument to collect data not only because it is a popular means of collecting all kinds of data in research, but it is appropriate instrument to obtain information about conditions, practices and problems for sample studies (Kumar, 1999; Best and Khan, 1996).For the purpose of this study both open and closed ended questionnaires were prepared to collect relevant data from respondents.

The questionnaires were designed based on the information acquired from literature reviews. Two types of questionnaires were developed one for contractor and other for consultant, which is used to study their awareness and attitude. The questionnaire for consultant have three parts, the first part is background information about the participant; which help to see experiences and exposure of respondents. The second part designed to acquire information about the projects and the third one about information regarding delivery methods. The questioners for contractor have two parts the first part is background information about the participant and the second part about time, cost overrun and quality problem factors. A copy of each questionnaire is included in the appendix of this study. The intended number of consultants and contractors were more than what is stated. Individuals who filled the questionnaire were contractor and consultant.

### 3.4.2 Interview

In order to validate the information gathered through the questionnaire, the researcher employed an interview. Interview is one of the primary data collection methods which are flexible and adaptive way of investigating underlying motives of a subject in which that self-administered questionnaires cannot. The interview for this study was made with public agencies (publics owners), who acts as client for public building projects.

### 3.4.3 Secondary data sources

Archival documents, books correspondences and other related documents have been reviewed to understand the overview of design bid build delivery method, favorable condition to apply DBB on building projects and its effect on cost, time and quality. These

secondary sources provide a general understanding of the subject area by presenting a wide range of ideas in the field which help to supplement other specific information obtained from the primary data sources.

### 3.5 Data management and Analysis

#### 3.5.1 Quantitative Analysis

The responses obtained from the survey questionnaire were analyzed using descriptive statistical analysis like mean, percentages and frequencies. For continuous nature of data, descriptive statistics were expressed as the mean ± standard deviation (M±SD). To compare the mean percentage of projects current progress with mean percentage of cost incurred to date from planned budget amount independent sample t-test was employed. Finally, linear regression analysis was made to check whether the demographic characteristics predict the cost and time overruns. All statistical analyses were performed using IBM-SPSS version 22 (IBM, Armonk, NY, United States of America). Values of $p < 0.05$ were considered to be significant at 95% confidence interval.

#### 3.5.2 Qualitative Analysis

Here data from the open ended type of the questionnaire and interview were analyzed qualitatively using words.

# CHAPTER FOUR

# RESULTS AND DISCUSIONS

## 4.1 Overview

After collecting data using appropriate tools, analysis and interpretations were made. This chapter presents analysis of major findings. Data obtained from contractors and consultants using questionnaire was analyzed by quantitatively, whereas, data obtained from public owner using interview instruments in Amharic were transcribed and translated into English. The translated data is categorized, then reduced and the data is analyzed qualitatively.

## 4.2 Demographic Characteristics of the Participants (n=83)

Table 2: General characteristics of the participants

| Variables | Frequency | Percent | Mean ± SD |
|---|---|---|---|
| Age of the Participants | 83 | 100% | 28 ± 2.08 |
| Educational Level | 83 | 100% | - |
| Experience in Construction Projects | 83 | 100% | 4.25 ± 2.20 |

SD= standard deviation, n= sample size

The results in the above table 2 indicated that, the total number of participants is 83; the mean age of the participants was 28 ± 2.08. The educational level of all respondents is first degree and above, finally mean experiences of participants in construction projects are 4.25 ± 2.20. Thus majority of the participants were young.

Figure 5: Age distribution of the participants

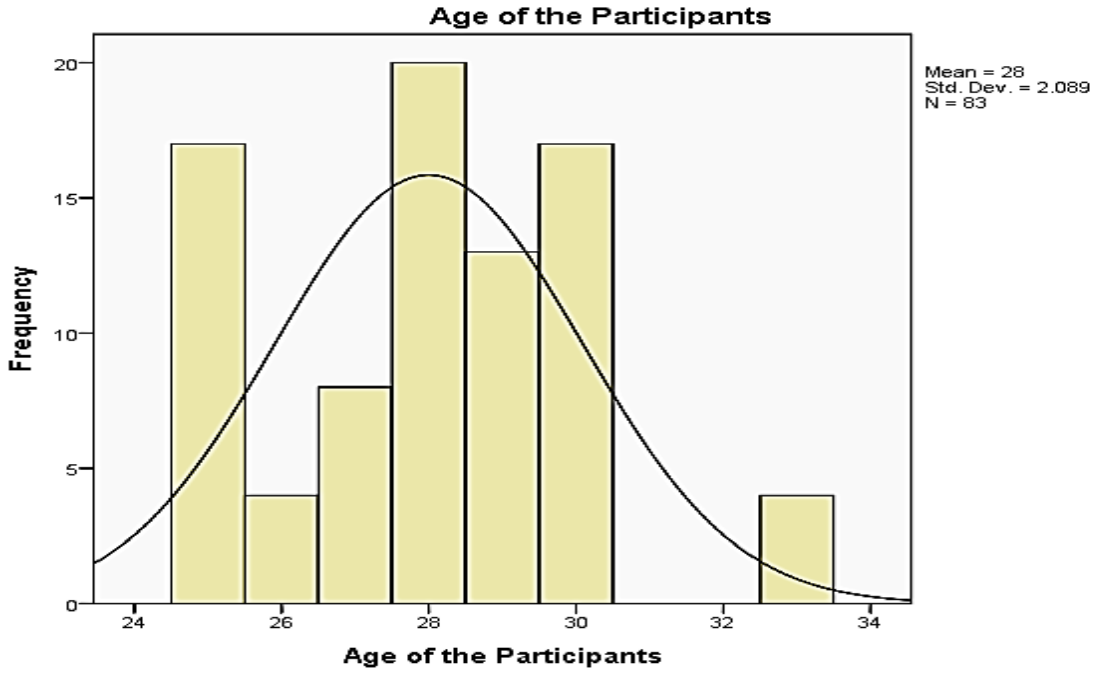


Figure 6: Experience in construction projects

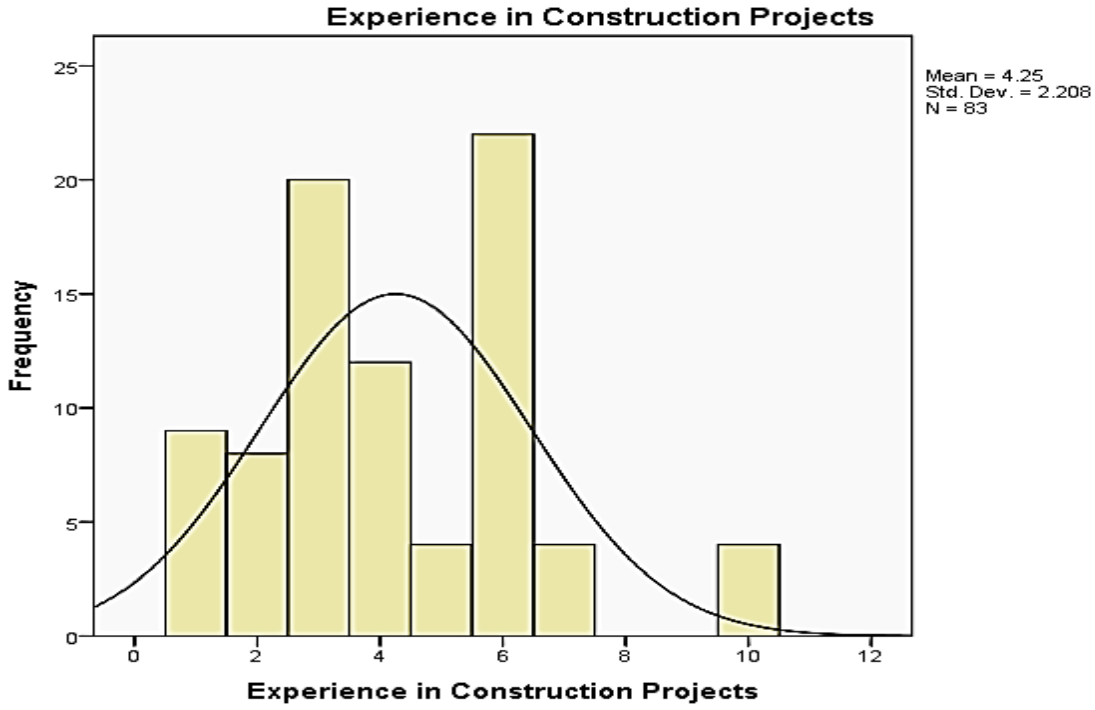

Table 3: Information regarding building projects (n=43)

| Date when the project started | | Average planned Completion date | Average current approximate progress (%) |
|---|---|---|---|
| **Year** | Number of projects | | |
| **2004 E.C** | 5 | 366 days | 73.5% |
| **2006 E.C** | 8 | 731 days | 55% |
| **2007 E.C** | 9 | 366 days | 61.7% |
| **2008 E.C** | 4 | 1095 days | 60% |
| **2009 E.C** | 9 | 527 days | 39.6% |
| **2010 E.C** | 8 | 554 days | 47.5% |

n= sample size

As mentioned earlier in the third chapter, out of the returned 83 questionnaires 43 were consultants. Information regarding the year when the projects started were reported by the consultants. Thus, the obtained results in table 3 indicated that 5 of the projects were started on 2004E.C, 8 of them were started on 2006 E.C, 9 of them were started on 2007, 4 of them were started on 2008 E.C, 9 of them were on 2009E.C and 8 of them were started on 2010 E.C. More than half of the projects were started before years ago.

On the same table average planned completion time for 5 of the project were 366 days,8 of the project were 731 days,9 of the project were 366 days,4 of them were 1095,9 of them were 527 and 8 of them were 554 planned completion time. The current approximate progress of the projects in percentage was 73.5% for 5 of the projects, 55% for 8 of the projects, 61.7% for 9 of the projects, 60% for 4 of the projects, 39.6% for 9 of the projects and 47.5% for 8 of the projects.

Figure 7: Project start date in Ethiopian calendar


### 4.3 Delivery methods

Table 4: Information regarding delivery methods (n=43)

| No. | Variables | | Frequency | Percent |
|---|---|---|---|---|
| 1 | Type of Delivery Method Chosen | DBB | 43 | 100% |
| 2 | Who made delivery method choice? | Consultant | 4 | 9.3% |
| | | Client | 26 | 60.5% |
| | | Consultant and Client | 13 | 30.2% |
| 3 | Do you have an opportunity to choose Project delivery Method? | Yes | 4 | 9.9%9 |
| | | No | 39 | 90.7% |
| 4 | Do you think that Project delivery Method affects project performances like time, cost and quality? | Yes | 34 | 79.1% |
| | | No | 9 | 20.9% |

As the information indicated in the above tables 4 the entire project used DBB delivery method. Based on the above respondents response regarding choice of delivery method from the total of 43 respondents 26 or 60.5 % of the responses shows that choice of

delivery method was done by clients, 13 or 30.2% are responded that it was chosen by both consultant and client and 4 or 9.3% of them shows that it is done by consultants. Concerning on the above issue, most of the response 39 or 90.7% shows that they (consultant) have no opportunity to choose their preferred delivery methods and 4 or 9.9% they have an opportunity to choose PDM as indicted in their responses.

Regarding effects of PDM on project performance like cost, time and quality most of the respondents (34 or 79.1%) believe that it has an effect on project performance and 9 or 20.9% response shows that it has no effect on project performance like cost, time and quality. Furthermore, the responses in open ended questions reveal that, DBB delivery method is favorable or suitable in the following situation for governmental, small, uncomplicated, not schedule-driven, not exposed to change order, bidding process is reliable and if regulatory issues leave no freedom for other options, it is suitable to apply DBB delivery method. Also, the responses obtained from open ended questions indicated that the reasons why delivery method affects project performance like cost, time and quality are; the delivery methods determine responsibility, allocation of risk, involved parties in the project and scope of works, and also there is no delivery method which is suitable for all types of project or situation but it depends on the project situation.

**Discussion**

The result obtained in this investigation shows that, the entire project used DBB delivery method and regarding choice of project delivery method, the choice done by clients whereas consultant and contractor have no opportunity to choose their preferred delivery methods. The finding shows that project delivery method have an effect on project performance like cost, time and quality because responsibility, scope of works, allocation of risk and involved parties are determined by delivery methods and also there is no delivery method which is suitable for all types of project or situation but it depends on the project situation therefor it have its effect on performance of projects. DBB delivery method is favorable or suitable for the projects in the following situation for governmental projects, small projects, uncomplicated projects, not schedule-driven, not exposed to change order, bidding process is reliable and if regulatory issues leave no freedom for other options.

This the above finding regarding delivery method is in agreement, with the following studies ( DBIA, 2015; Rahel, 2016 and Sameh, 2014) who reported that owner should have clear understanding about different types of delivery method because project delivery method, is one of the most important decisions which is usually made by the owner based on the unique characteristics of the project, owner's objectives, degree of risk, level of information available or needed at time of construction, level of desired client's involvement, and interaction between design and construction among other factors.

Furthermore, studies (AIA and ACA, 2004, Ibbs et al., 2003, Rahel, 2016 and Sameh, 2014) that reported the main criteria for measuring the success of any project are cost, time and quality or how the project ultimately meets its intended purpose and PDM has significant implications on collaboration and partnering between projects participants are also in agreement with our findings. Therefore, impacting the project success like cost, time and quality, the process by which a project organized and managed, or the "project delivery method is a key for the success of a construction project.

### 4.4 Building projects performances regarding cost

Table 5: Types of delivery methods for better cost performances

| Variables | PDM | Frequency | Percent |
|---|---|---|---|
| Which of the delivery methods will give better COST performances? | DBB | 17 | 39.5% |
| | DB | 21 | 48.8% |
| | CM@R | 5 | 11.6% |

DBB=design bid build, DB=Design build, CM@R=construction management at risk

As it is indicated in the above table 5, concerning better cost performance from total of 43 respondent 21 or 48.8% of the respondent replied that design build delivery method was better in cost performance, 17 or 39.5% of the response show that DBB have better cost performance and the rest 5 or 11.6% responds that CM@R is better in cost performance.

Table 6: Cost overrun variables in DBB delivery method

| No | Variable | Magnitude of variables on cost overruns | | | | |
|---|---|---|---|---|---|---|
| | | 0=NSG | 1=SSG | 2=MSG | 3=VSG | 4=ESG |
| 1 | Contractor not having received in due time all necessary instructions, drawings , details from the architect for which he applied in accordance with the contract | | | 30% | 50% | 20% |
| 2 | Delay in appointing a replacement architect or Engineers. | 20% | 10% | 30% | 40% | |
| 3 | Contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default | | | 20% | 40% | 40% |
| 4 | Delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment. | | 10% | 40% | 30% | 20% |
| 5 | Failure from inspection and supervision of works by consultants. | | | 50% | 40% | 10% |
| 6 | Failure due to absence of consultant on the date of material tests | 10% | 40% | 40% | 10% | |

Information regarding cost overrun variables in DBB delivery method is explained in table 6. Out of a total respondent 50% agree that contractor not having received in due time all necessary instructions, drawings , details from the architect is very significant factor for cost overrun. Regarding delay in appointing, from total respondent 40% agreed that delay in appointing a replacement architect, Quantity Surveyor or Engineers is very significant factor for cost overrun. ,A total of 40% respondent replied that contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default is extremely significant factor for cost overrun.

Concerning timely submission, a total of 40% respondents agreed that delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment had moderate significant factor for cost overrun, whereas 50% agreed that failure from inspection and supervision of works by consultants is middle significant factor for

cost overrun. Finally out of the total respondent 40% agreed that failure due to absence of consultant on the date of material tests had moderate significant factor for cost overrun**.**

**Discussions**

The obtained result shows that DB delivery method is better than DBB and CM @R in cost performance which means cost growth in DB is less than the other two delivery methods because DB is not flexibility to incorporate changes and also due to all responsibilities of design and build are on DB contractors 'hand, contractors are not entitle to initiate a claim for additional payments from client for delay in preparing detailed drawings, late instructions ,delay in replacement architect or engineer, delay in giving contractors monthly statement to client for contractors' payment because, there is no external consultants whereas both consultant and contractors' are work in the same DB contractors companies due to this reason the above listed factors cannot be the challenges in DB delivery method .

This study finding regarding cost is in agreement with the results obtained from previous studies (Sameh, 2014**,** Rahel, 2016; J.C. Kawika, 2007; Gransberg et al., 2003; Ibbs et al. 2003; Ismael, 1996), that reported cost saving as a definitive advantage of design-build because, DB is not flexibility to incorporate changes and Cost control could have been maximized early because the design-builder would take responsibility for protecting the budget and also due to all responsibilities of design and build are on DB contractors 'hand. Delay in preparing detailed drawings, late instructions ,delay in replacement architect or engineer, and longer period of overall design and construction which make the total project cost higher because of increased period of interim financing charge are not a problem that is in count in DB delivery method but it is serious problem in DBB projects.

### 4.5 Building projects performance regarding time

Table 7: Mean percentage of projects current progress with mean percentage of cost incurred to date amount from planned amount (n=43)

| Compared variables | Mean Differences | | | | T | df | p-value |
|---|---|---|---|---|---|---|---|
| | Mean ± SD | SE of the Mean | 95% CI | | | | |
| | | | Lower | Upper | | | |
| Progress in Percentage Vs. Cost incurred to date from the planned amount | 54.41±17.36<br>68.41±13.60 | 2.64804<br>2.07427 | -18.60467 | -9.39998 | -6.140 | 42 | .000* |

SE = standard error, CI= confidence interval, n=sample size, df=degree of freedom, p-value=significance level or critical value, *=significant difference

Table 7 shows the mean percentage of projects' approximate current progress(54.41±17.36) and the mean percentage of cost incurred to date from the planned amount (68.41±13.60).Thus, the mean percentage of the projects' current progress compared to mean percentage of costs incurred to date from planned budget indicated a significant difference($p<0.000$).Therefor, the result reveal that the progress of the projects is less than that of the cost incurred which may cause overruns in both time and cost.

Table 8 : Types of delivery methods for better time performances

| Variables | | Frequency | Percent |
|---|---|---|---|
| Which of the delivery methods will give better time performances? | DBB | 9 | 20.9% |
| | DB | 34 | 79.1% |
| | CMAR | - | - |

DBB=design bid build, DB=Design build, CMAR=construction management at risk

Regarding better time performances out of total participants most of them (34 or 79.1%) replied that DB has better time performance, 9 or 20.9% of the response shows that DBB is better in time performances.

Table 9: Time overruns variables in DBB delivery method

| No | Variable | Magnitude of variables on time overrun | | | | |
|---|---|---|---|---|---|---|
| | | 0=NSG | 1=SSG | 2=MSG | 3=VSG | 4=ESG |
| 1 | Contractor not having received in due time all necessary instructions, drawings , details from the architect for which he applied in accordance with the contract | | | | 40% | 60% |
| 2 | Delay in appointing a replacement architect, Quantity Surveyor or Engineers. | | | 12.5% | 47.5% | 40% |
| 3 | Contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default | | | 10% | 40% | 50% |
| 4 | Delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment. | | | 20% | 10% | 70% |
| 5 | Failure from inspection and supervision of works by consultants. | | 40% | 40% | 20% | |
| 6 | Failure due to absence of consultant on the date of material tests? | | 40% | 30% | 30% | |

NSG=not strongly significant, SSG=strongly significant, MSG=moderately significant, VSG=very significant, ESG=extremely significant.

As mentioned in table 9 above the obtained result regarding time overrun factors out of a total respondents 60% agree that contractor not having received in due time all necessary instructions, drawings , details from the architect is extremely significant factor for time overrun.

A total of 47.5% respondents agree that delay in appointing a replacement architect, quantity Surveyor or Engineers is very significant factor for time overrun. 50% of the respondents replied that contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default is extremely significant factor for time overrun.

Regarding submission, a total of 70% respondents agreed that delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment is extremely significant factor for time overrun.

A total of 40% respondents agreed that failure from inspection and supervision of works by consultants is moderately significant factor for time overrun and finally out of the total respondents 40% agreed that failure due to absence of consultant on the date of material tests is slightly significant factor for time overrun.

**Discussion**

The obtained result shows the mean percentage of the projects' current progress compared to mean percentage of costs incurred to date from planned budget indicated a significant difference($p<0.000$).Therefor, the result reveal that the progress of the projects is less than that of the cost incurred which may cause overruns in both time and cost. Based on this investigation DB is most effective in ensuring shortest project duration therefor, the project are not slow down due to absence of separate consultant there is no delay for contractor's payment that caused by late submission of contractor's monthly statement to employer, no delay instructions, drawings and details from the architect and also no delay in replacement engineer or architect.

The result obtained from this study regarding time performances is in agreement with (Ibbs et al., 2003; Sameh, 2014; Ismael, 1996; Gransberg et al. 2003; Lema, 2006 and Rahel, 2016), who reported that design-build is relatively more effective in ensuring the shortest project duration. Because, all responsibility is on the hands of design build contractors therefore, no need of taking necessary instructions, drawings , details from the architect and instruction to proceed or terminate suspended works, which is not as a result of contractor default, no delay in replacement engineer or architect. Also due to absence of separate consultant there is no delay for contractor's payment that caused by late submission of contractor's monthly statement to employer and that is the reason why time growth is significantly lower for DB than DBB and CM@R.

### 4.6 Building projects performances regarding quality

Table 10 Types of delivery methods for better quality performances

| Variables | | Frequency | Percent |
|---|---|---|---|
| Which of the delivery methods will give better quality performances? | DBB | 23 | 53.5% |
| | DB | 12 | 27.9% |
| | CM@R | 8 | 18.6% |

DBB=design bid build, DB=Design build, CM@R=construction management at risk

Regarding better quality performances, the obtained result shows that out of the total respondents 23 or 53.5 % of them replied that DBB is better in quality performances, 12 or 27.9% of response shows that DB is better in maintaining good quality performance.

Table 11: Quality Problem variables in DBB delivery method

| No | Variable | Magnitude of variables on time overrun | | | | |
|---|---|---|---|---|---|---|
| | | 0=NSG | 1=SSG | 2=MSG | 3=VSG | 4=ESG |
| 1 | Contractor not having received in due time all necessary instructions, drawings , details from the architect for which he applied in accordance with the contract | | 20% | 40% | 40% | |
| 2 | Delay in appointing a replacement architect, Quantity Surveyor or Engineers. | 20% | 10% | 10% | 40% | 20% |
| 3 | Contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default | 10% | 20% | 20% | 40% | 10% |
| 4 | Delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment. | | 40% | 60% | | |
| 5 | Failure from inspection and supervision of works by consultants. | | | 10% | | 90% |
| 6 | Failure due to absence of consultant on the date of material tests? | | 10% | 10% | 10% | 70% |

NSG=not strongly significant, SSG=strongly significant, MSG=moderately significant, VSG=very significant, ESG=extremely significant.

As mentioned in the above table 11, the obtained result regarding quality problems, out of a total respondents 40% agreed that contractor not having received in due time all necessary instructions, drawings , details from the architect is very significant factor for quality problems.

Regarding delays, 40% of them agreed that delay in appointing a replacement architect, quantity Surveyor or Engineers is very significant factor for quality problems.

A total of 40% respondents replied that contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default is very significant factor for quality problems.

60% of them agreed that delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment is moderate significant factor for quality problems.

Concerning supervision, a total of 90% of the respondents agreed that failure from inspection and supervision of works by consultants is extremely significant factor for quality problems and finally 70% agree that failure due to absence of consultant on the date of material tests is extremely significant factor for quality problems.

Furthermore, the responses obtained from open ended question for factor affect the quality of building projects in DBB projects include; not having received the benefit of early input and advise from contractor, highly exposed to lack of clarity or misinterpretation of the contract document, limited opportunity to incentivize contractors to provide enhanced quality performance, error on drawing or contract document and misunderstanding of the drawing by contractor.

**Discussion**

The finding in this study shows that DBB delivery method is effective to maintain better quality in construction project than the other two delivery method because the designer and contractor are separate entities and both are in a position to discover errors made by the other party, resulting in a system of check and balances and also increased number of parties with different perspective. However the results obtained from contractors indicated

some limitations regarding quality in DBB that are; failure due to absence of consultant on the date of material tests, failure from inspection and supervision of works by consultants, not having received the benefit of early input and advise from contractor, highly exposed to lack of clarity or misinterpretation of the contract document, limited opportunity to incentivize contractors to provide enhanced quality performance and error on drawing or contract document and misunderstanding of the drawing by contractor.

This result regarding quality problems factors of building projects is in agreement with (Lema, 2006; Mahdi and alreshid, 2005; Rahel, 2016) findings that indicated DBB method is effective to maintain a quality construction project because the designer and contractor are separate entities and both are in a position to discover errors made by the other party, resulting in a system of check and balances and increased number of parties with different perspective. Whereas, Riecke, 2004 study disclosed that functional and aesthetic goals are always met using single-prime bidding, construction manager at risk, or design-build. This variation might be in case of Valerie's findings construction managers are involved in all stages of the project and incase of DB design error or misinterpretation is the risk of Design builder, therefor they work by giving special attention for each and every works.

### 4.7 Qualitative analysis

In this part of the research the researcher tried to make qualitative analysis of data collected through interview from clients. Before analyzing the data collected it is again needed to provide some additional background information as well as code interviewees.

Table 12: Interview code and information about interviewees

| Town | Town code | Participant code | Sex | Educational level |
|---|---|---|---|---|
| Hawasa | H1 | 001 | M | 1st degree |
| Wolaita Sodo | W2 | 002 | M | 1st degree |
| Arbaminch | A3 | 003 | M | 1st degree |
| Dilla | D4 | 004 | M | 1st degree |

On table 12 above for the analysis of qualitative data it is required to give code for participants in the study. In first column the name of town selected for the study is mentioned, next to that all towns are provided with code H1,W2,A3 and D4, again code is given for participants' or interviewees beginning from 001 – 004, and finally their sex and educational level is mentioned. Thus, the analysis of semi structured interview questions is discussed below as follow.

First the interviewees were asked about what type of delivery method they used for their projects and all the respondents indicated by code 001-004 replied that they used DBB delivery method. In line with this they are also asked about how they determine suitable delivery method for their project. According to their responses all of them are preferred to use most widely used project delivery method because it is well understood and also they believe that having a detailed set of previously purchased plans and specifications that can achieve the lowest cost for the public projects through open competitive bidding and proper supervision.

Thirdly, the interviewees were asked about performance of DBB delivery method with respect to time, cost and quality, as they mentioned on their response, based on their experience DBB is better for enhancing quality due to check and balance system, thus, an error which is made by one party are not canceled and also it have great chance to get variety of perspectives from different parties. However, regarding cost and time it is not preferable, in line with this they responded that currently they are suffering with a lot of overruns in their projects. In line with this they also responded that there projects are face both cost and time overrun.

Fourthly, the interviewees were asked about situations or favorable conditions to apply DBB delivery methods, as they mentioned on their responses it is;

- ✓ suitable to apply in governmental projects, small project, uncomplicated projects,
- ✓ not schedule- driven and not exposed to change order
- ✓ where the designer is experienced enough to oversee both the design and construction,
- ✓ where regulatory issues leave no freedom for other options,
- ✓ appropriate to take advantage of existing design and also if the bidding process is reliable

Next interview question states about effects of errors on drawing or contract document on quality of building projects related to DBB delivery methods, regarding this all interviewees responded that it has significant effects on qualities of the project because the product or service can't fulfill their required specification and standard this also causes for adversary relationship between owner, contractor and consultant.

Finally the researcher posed the participants in the interview to mention the role of participant (stakeholder) on performance of projects; delivery method involves the role of owner, consultant, and contractor in project delivery process. Because project delivery system is the way that project owners together with project regulators and financiers determine the assignment of responsibilities to project stakeholders along the construction process. They also replied that owner influence the project by delaying payments and excessive design change. Contractor's influence includes poor skills, experience of labor and financial problem and Consultant influence the project with poor supervision, late submission of drawing, detail and delay instruction.

Therefore, majority of the interview responses supports the data obtained by questionnaires.

Generally this analysis and study reveals that, choice of project delivery method is done by client whereas consultants and contractors' have no an opportunity to choose their preferred delivery methods. It is observed that project delivery method have an effect on performances of project like time, cost and quality because delivery method determine scope of work, responsibility, allocation of risk and also involved parties in the projects.

Almost all studies reviewed and analysis share the same stands regarding to timely and with budget completion of the projects, DB delivery method is preferable than other because DB is not flexibility to incorporate changes and also due to all responsibilities of design and build are on DB contractors 'hand, contractors are not entitle to initiate a claim for additional payments and extension of time from client for delay in preparing detailed drawings, late instructions, delay in replacement architect or engineer, delay in giving contractors monthly statement to client for contractors' payment, because there is no external or separate consultants whereas, both consultant and contractors' are work in the

same DB contractors companies due to this reason the above listed factors cannot be the challenges in DB delivery method. Besides it is a serious problem in DBB delivery method resulting separate entities of designer and constrictors.

DBB delivery method is preferable in maintain quality because of a system of check and balances and also increased number of parties with different perspective. whereas the results obtained from contractors indicated some limitations which needs to improve regarding quality in DBB that are; failure due to absence of consultant on the date of material tests, failure from inspection and supervision of works by consultants, not having received the benefit of early input and advise from contractor, highly exposed to lack of clarity or misinterpretation of the contract document, limited opportunity to incentivize contractors to provide enhanced quality performance and error on drawing or contract document and misunderstanding of the drawing by contractor.

# CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

The study attempted to seek effects of design bid build project delivery method on performances of building projects in southern Ethiopia. In this chapter conclusion was drawn from the analysis and recommendation is forwarded. According to the finding conclusions on causes or factors that affect performance of DBB building projects, role of consultant, contractor and client for cost overrun, time overrun and quality problems and suitable condition to apply DBB delivery methods are drawn and also recommendations to overcome the challenges related with DBB delivery method are forwarded.

## 5.1 Conclusions

- ✓ It is found that project delivery system plays crucial roles in project performance like cost, time and quality because successful project delivered the building at the right time, at appropriate price and quality standards.
- ✓ The choice of project delivery methods are made by owners or clients because they are project sponsors.
- ✓ The DBB method has been the widely used project delivery method in the region of southern Ethiopia.
- ✓ Almost every project in a region is facing time and cost overruns. Thus, the mean percentage of the projects' current progress (54.41±17.36) compared to mean percentage of costs incurred to date from planned budget (68.41±13.60) indicated a significant difference ($p<0.000$) higher cost incurred with lowest progress. Therefore, the result reveal that the progress of the projects is less than that of the cost incurred which may cause overruns in both time and cost.
- ✓ The main reasons for time and cost overrun in DBB projects are;
    - Design and specification changes
    - Delays in preparing detailed drawings
    - Extended or reduced contract period
    - Contractor not having received in due time all necessary instructions

- Drawings from the architect for which he applied in accordance with the contract
- Errors or omissions in the contract documents
- Delays in appointing a replacement architect or Engineers
- Contractor not having received in due instruction to proceed or terminate
- Suspended works which is not as a result of contractor default
- Delayed payment caused by late submission of contractor's monthly statement by engineer to employer
- Late payments are causes for delay in DBB.

✓ It was also found that experience in construction projects and age significantly predicts cost overrun in DBB projects with ($p<0.024$ and $p<0.031$) respectively.

✓ It is found that DBB is better in maintaining quality because the designer and contractor are separate entities and both are in a position to discover errors made by the other party, resulting in a system of check and balances and increased number of parties with different perspective.

✓ However the results obtained from contractors indicated some limitations regarding quality in DBB that are;

- Failure due to absence of consultant on the date of material tests
- Failure from inspection and supervision of works by consultants
- Not having received the benefit of early input and advise from contractor
- Highly exposed to lack of clarity or misinterpretation of the contract document
- Limited opportunity to incentivize contractors to provide enhanced quality performance
- Error on drawing or contract document and misunderstanding of the drawing by contractor.

✓ Favorable condition to apply DBB delivery methods includes

- For governmental projects
- Small project
- Uncomplicated projects
- Not schedule- driven
- Not exposed to change order

- Designer is experienced enough to oversee both the design and construction
- Where regulatory issues leave no freedom for other options
- Where it is appropriate to take advantage of existing design and also if the bidding process is reliable.

✓ The delivery method involves the role of owner, consultant and contractor in project delivery process, the role of participants (stakeholder) on performance of projects involves;

- The owner influence the project by delaying payments and excessive design change
- The contractor's influence includes poor skills, experience of labor and financial problem
- The consultant influence includes poor supervision, absent in date of test, late submission of drawing, detail and delay instruction.

## 5.2 Recommendations

- ✓ Owners are usually tempted to use the delivery method that they are familiar with which is called DBB delivery methods. However, this might be a great mistake since familiar methods are not necessarily effective in all situations. Therefore, they should have to consider different situations to select delivery method because there is no single delivery method which is suitable for all situations.
- ✓ Owners and contractors are faced with the challenge of completing projects on time, within budget and deliver a quality product therefore in choosing delivery method the owner should have to consider time, cost and quality problem which is related to that delivery method.
- ✓ In using DBB delivery method the capacity of the designer or consultant should have to develop and also awarding contract for better qualified and experienced construction companies which may contribute for minimizing the problem related to delivery methods.
- ✓ Since, delivery method selection is owner responsibility, regulatory body should prepare clear guidelines or manuals to select appropriate delivery method for the projects.
- ✓ DBB is better in maintaining quality, however regarding contractors responses it have some limitations which needs to be improved or modified, thus, modifications or improvements to be made on DBB may include,
    - o statements related with supervision should be modified,
    - o absence in date of joint test of material with contractors should be strictly forbidden and to be clearly mentioned in the document
    - o errors on drawing and contract documents and limited opportunity to incentivize contractors for enhanced quality need modification
    - o An issue of quality in DBB needs further deep study.

- ✓ In order to overcome quality problem in DB delivery method owner should have (in house) or hire project management expertise in order to strict follow-ups on design approval

- ✓ Use an alternative way of delivery methods like DB rather than stacking on DBB (traditional) delivery methods because DB is better in cost and time saving.

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# APPENDICES

Appendix ‘A’

HAWASSA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND BUILT ENVIRONMENT

**Questionnaires for contractor**

Dear Respondents,

This questionnaire is designed to assess effects of design bid build project delivery method on the performance of construction project in southern Ethiopia. The information provided in this questionnaire is highly confidential and shall be used **ONLY** for academic purposes. It would be grate full if you spare a few minute and fill this questionnaire. You are kindly requested to complete the attached questionnaire and return back as soon as possible. Your perfect information will be appreciated as it will assist to complete the study. I would like to thank you for your indispensable cooperation in advance.

**Note**:

1. No need of writing your name.
2. For alternative answers encircle your response.
3. Please return the completed questionnaire in time.

**PART ONE: Demographic Characteristics of the participants**

1. Sex

☐ Male ☐ Female

2. Age _____

3. Educational level

☐ High school completed ☐ Certificates ☐ Diploma ☐ First Degree and above

5. Experience in construction projects _____

**PART TWO: Cost overrun, time overrun and quality problem reasons**

**Instructions:** Please tick as appropriate magnitude on a rating scale of 0-4, where 0- Not significant; 1-slightly significant, 2-moderatly significant, 3-very significant and 4-exteremly significant.

I. Delay in receiving in due time all necessary instructions, drawings and details

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

II. Delay in replacement of consultant

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

III. Contractor not having received in due instruction to proceed or terminate suspended works, which is not as a result of contractor default.

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

IV. Delay caused by late submission of contractor's monthly statement to employer by engineer for contractor's payment.

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

V. Failure from inspection and supervision of works by consultants.

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

VI. Failure due to absence of consultant on the date of material tests?

| Factor | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Project cost | | | | | |
| Project time | | | | | |
| Project quality | | | | | |

VII. What are the factors that affect the quality of building project related to DBB project delivery method? You can tick one and more than one

☐ Not having the benefit of early input and advice from a CM or Contractor

☐ Highly exposed to lack of clarity or misinterpretation of the contract documents

☐ Limited opportunity to incentivize contractors to provide enhanced quality performance

☐ Errors on drawings or contract documents

☐ Others please specify……..

_____

_____

Thank you for your cooperation!!!

Appendix 'B'

HAWASSA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND BUILT ENVIRONMENT

**Questionnaires for consultant**

Dear Respondents,

This questionnaire is designed to assess effects of design bid build project delivery method on the performance of construction project in southern Ethiopia. The information provided in this questionnaire is highly confidential and shall be used **ONLY** for academic purposes. It would be grate full if you spare a few minute and fill this questionnaire. You are kindly requested to complete the attached questionnaire and return back as soon as possible. Your perfect information will be appreciated as it will assist to complete the study. I would like to thank you for your indispensable cooperation in advance.

**Note**:

1. No need of writing your name.
2. For alternative answers encircle your response.
3. Please return the completed questionnaire in time.

**PART ONE: Demographic Characteristics of the participants**

1. Sex

   ☐ Male ☐ Female

2. Age _____
3. Educational level

   ☐ High school completed ☐ Certificates ☐ Diploma ☐ First Degree and above

4. Experience in construction projects _____

**PART TWO: Information about the project**

1. When was the project started?

   _____

2. What is the planned completion time for the project?
   _____
3. What is the current approximate progress of the project in percentage?
   _____
4. What is the planned budget for the project?
   _____
5. How much cost was incurred to date from the planned budget?
   _____

**PART THREE: Information regarding delivery method**

1. What type of delivery method was chosen for this project?

   ☐ Design bid build ☐ Construction management at risk

   ☐ Design build ☐ Other_____

2. Who made the choice of the delivery method to be used? You may tick more than one

   ☐ Consultant ☐ Client

   ☐ Contractor

3. Do you have an opportunity to use your preferred or different type of delivery method?

   ☐ Yes ☐ No

4. If "yes" to question no. 3, what is your preferred delivery method?

   ☐ Design bid build ☐ Construction management at risk

   ☐ Design build ☐ Other _____

5. Do you believe that project delivery method can affect the project performance like cost, time and quality of the project?

   ☐ Yes ☐ No

6. If your answer is "yes" for question number 5 how it can affect?
   _____
   _____
   _____

_____

7. What are favorable conditions to apply DBB delivery methods?
   _____
   _____
   _____

8. In your opinion what are the role of professionals and client on quality problem, time and cost overrun.
   _____
   _____
   _____

9. In your opinion, which of the following types of delivery method can give better **cost** performance?

   ☐ Design bid build ☐ Construction management at risk

   ☐ Design build ☐ Other_____

10. In your opinion, which of the following types of delivery method can give better **time** performance?

    ☐ Design bid build ☐ Construction management at risk

    ☐ Design build ☐ Other _____

11. In your opinion, which of the following types of delivery method can give better **quality** performance?

    ☐ Design bid build ☐ Design build

    ☐ Construction management at risk ☐ Other_____

Thank you for your cooperation!!!

Appendix 'C'

HAWASSA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND BUILT ENVIRONMENT

**Interview guide**

This interview is designed to investigate effect of design bid build project delivery method on the performance of building projects in southern Ethiopia .The information provided in this interview is highly confidential and shall be used only for academic purposes. It would be grateful if you spare a few minutes to respond the interview question.

I would like to thank for your indispensable cooperation in advance.

**PART ONE: Demographic Characteristics of the participants**

1. Sex

☐ Male ☐ Female

2. Age _____
3. Educational level

☐ High school completed ☐ Certificates ☐ Diploma ☐ First Degree and above

4. Experience in construction projects _____

**PART TWO: Information regarding delivery method**

1. What type of delivery method was chosen for this project?

☐ Design bid build ☐ Construction management at risk

☐ Design build ☐ Other

2. How do you determine suitable delivery method for your project?

_____

_____

_____

_____

3. Do you think that participants (stakeholders) affect the performances of projects related to DBB delivery method? How? Why?

_____

_____

_____

_____

4. Do you think that errors on drawing or contract document affect the quality of building projects related to DBB delivery methods? How? Why?

_____

_____

_____

_____

5. Do you think that design bid build delivery method can give better time, cost and quality performance than other methods? How? Why?

_____

_____

_____

_____

Thank you !