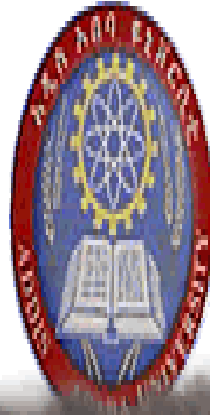


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SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

**Project Delivery Systems and Their Effects on Cost and Time Overrun On
Ethiopian Road Authority Projects**

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ABBREVIATIONS

AC	Asphalt Concrete
ACA	American Contractors Association
A/E	Architect/ Engineer
AGC	Associated General Contractors of America
AIA	American Institute of Architects
CM	Construction Manager
CM@R	Construction Management at risk
DB	Design Build
DBB	Design Bid Build
DBST	Double bitumen surface treatment
EEPCO	Ethiopian Electric Power Corporation
EOT	Extension of Time
ERA	Ethiopian Road Authority
ETB	Ethiopian Birr
GC	General Contractor
GMP	Guaranteed Maximum Price
MoWUD	Ministry of Works and Urban Development

PD	Project Delivery
PDM	Project Delivery Method
PDS	Project Delivery System
ROW	Right of Way
VO	Variation Order

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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 growth from contract amount. This is due to lots of claims, variations and change orders. A project is regarded as successful if the project is delivered at the right time, at the appropriate price and quality standards, and providing the client with a high level of satisfaction. There are lots reasons that lead to unsuccessful projects in Ethiopia and implementation of different delivery methods that fit best with a project can minimize the problem.

Projects can be delivered through traditional delivery method that is DBB or innovative delivery methods such as DB and CM@R. The performance of DB and DBB projects with regard to timely and on cost completion is analyzed in this thesis. Literatures in related topic were reviewed to address the structure and characteristic of different delivery method. The challenges and favorable conditions with local and international experiences for these delivery methods are discussed. In addition, professionals' opinion and experience on different delivery methods were discussed through questionnaire analysis. Additionally, case studies were done on DB and DBB projects of ERA. Time and cost growth of each projects with its reasons are studied. Also challenges faced, variations and EOT on each project is studied, so that selection of appropriate delivery method that helps for better performance of a project can be done for future projects. This thesis mainly focuses on DB and DBB but in literature review CM@R is also included to give an overview about the method so that it can be considered for further study and in the future projects.

From the analysis and case study it is found that DB projects perform much better in cost and time than DBB projects. The only cost increase in DB projects are due to price adjustment so percentage increase in cost is lesser in DB than DBB. Some projects from the study show that there is greater probability for DB projects to be completed on time if capacity of local contractors is improved.

Keywords: Project delivery method, DB, DBB, CM@R, Delay, Variation

CHAPTER ONE

INTRODUCTION

1.1. Back ground

Construction of a large facility takes a long time and usually involves large capital investment. Cost overruns, delays and other problems tend to be huge in accordance with scope of the project. Cost is one of the primary measures of a project's success. This is true, especially for public projects in developing countries like Ethiopia, because public construction projects in these countries are executed with scarce financial resources. In construction projects the common criteria for project success are generally considered to be cost, time and quality.

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. One important influence on this is the type of delivery system implemented.

Ethiopian construction industry is widely affected by time and cost overrun. That is costing the country lots of billions of birr and delays in infrastructure provision. It is taking longer time to return the capital invested on construction industry. So 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.

There are generally two ways of accomplishing construction projects: 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. Outsourcing of capital investment projects to the private sector is not a new or recent practice in infrastructure projects. Hence, there are several methods and combinations of methods to deliver a construction project. 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.

In accomplishing the project by contract, different project delivery system will 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.

Every project has its own characteristic or feature, in order to choose the delivery method which fits best to the project through knowledge on the different delivery methods is a must. There should be clear understanding on different type of delivery system so that the owner can choose the best system to deliver the project by achieving cost and time schedules.

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.

This research will cover different project delivery methods and its effect on timely and with budget completion of the project. The main purpose of this research is to assess the applicability of different project delivery method and its effect on timely and costly completion of the project. Projects performance on timely and costly completion will be assessed through studies on different projects with DB and DBB. The challenges faced, variations, change orders and claims that cause delay and cost overrun will be studied from selected projects. Also projects experienced by professionals' from different stake holders will be analyzed from data collection from questioner. From this study performance comparison on both delivery methods will be done and best performer will be identified and favorable conditions to apply for specific delivery method and draw backs will be identified and recommendations will be forwarded for better performance.

1.2. Statement of the problem

Most of construction projects in Ethiopia are not delivered at the right time, at appropriate price and quality standard and it is not in accordance to client satisfaction. There are lots of claims, variations and change orders that are being experienced which are the main causes for time and cost overrun. There are lots of reasons for these problems to happen and inappropriate project delivery method used is one of the reasons.

Time overruns is defined as the time increased to complete the project after planned date which caused by internal and external factors surrounding the project. Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase," or "budget overrun [1]. According to Abebe and Girmay cost claims in some projects in Ethiopian construction reach up to 200-300% of project cost [2].

Project delivery method that can overcome this time and cost overrun should be studied and applied in Ethiopian construction industry so that scarce budget funded can be utilized effectively and also infrastructures can be provided on time. In order select delivery method that best suit with the project we need to know about different delivery methods and its features, positive side and the drawbacks. So studying delivery method that can eliminate or minimize cost and time overrun is essential.

1.3. Objective of the study

The objectives of this research are:-

- ❖ Assessing effect of project delivery methods on time and cost overrun
- ❖ Identifying favorable conditions to apply alternative delivery methods and pointing merit and demerit of delivery methods
- ❖ Recommending better project delivery method by making comparison on cost and time performance of DB and DBB projects.

1.4. Scope and limitation of the study

Scope of the study is limited to road projects performed by Ethiopian Road Authority. Completed projects of DB and DBB delivery methods are selected for case study. Time and cost performance of the two delivery methods are studied and compared. It is tried to include the reasons for delay and cost overrun, if any. Claims, variations and EOT are presented for DB and DBB projects. The data for case study were collected from ERA and it was hard to find relevant written and organized data on projects. The way they archive data it is hard to find specific data and finding responsible person for a project were also challenging. Completed DB projects are very small in number and it makes harder to take the right sample so recently completed projects at hand are considered.

1.5. Significance of the study

The expected outcomes of the study are:

- ❖ to organize data on performance of DB and DBB projects
- ❖ to identify different delivery methods being used in ERA
- ❖ to create guide line for proper selection of delivery method
- ❖ to identify better performer for different situations and performance criteria
- ❖ to identify different problems in different delivery method
- ❖ to make suggestion on corrective measures in order to improve time and cost overrun

1.6. Structure of the thesis

This study has been organized into five chapters that discuss various aspects of project delivery methods both traditional and innovative one. Chapter one explains background of the research and what the research intends to achieve. It is followed by chapter two which presents literature review on project delivery methods, its merit, demerit, feature, favorable condition to apply and performance of projects for different delivery methods in international experience. In chapter three, the methodologies used for the research are discussed and highlights of the data collection methods are given. Chapter four is dedicated to the analysis and discussion of the results obtained from the study. The last chapter draws conclusions of the research and provides some recommendations for improvement.

CHAPTER TWO

LITERATURE REVIEW

2.1. General

It is generally accepted that a project may be regarded as successful if the building is delivered at the right time, at the appropriate price and quality standards, and providing the client with a high level of satisfaction. One important influence on this is the type of delivery system implemented [3].

Construction projects frequently suffer from delays and are usually completed within a period longer than what is agreed upon by the contracting parties. The reason could be changes to the base contract. These changes can result from the owners adding additional scope of work differing site conditions, errors or omissions in the contract documents, delays by the owner, unpredicted conditions, constructive change and /or acceleration [4].

Outsourcing of capital investment projects to the private sector is not a new or recent practice in infrastructure projects. Hence, there are several methods and combinations of methods to deliver a construction project. Results from studies, however, indicate that there are no significantly new project delivery methods, but all are merely modifications or slight variations of existing or past methods [5].

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.

There should be clear understanding on different type of delivery system so that the owner can choose the best system to deliver the project by achieving project objectives. Every project has its own characteristic or feature, in order to choose the delivery method which fits best to the project through knowledge on the methods and different types is a must. Different scholars define project delivery methods differently though the basics and main concepts are the same. Some of the definitions are presented below.

According to Associated General Contractors of America project delivery system is defined as the arrangement of relationships among the various parties involved in the design and construction of a project that established the scope and distribution of responsibility and risk. A project delivery system establishes responsibility for how the project is delivered to the owner. The project delivery system defines who is responsible for each of the various phases of the project (the conceptual design, the detailed design and the construction) and establishes the nature, timing and responsibility for work scope boundaries related to the various transitions and ~~handoffs~~” for each of these phases of the project [6].

Project delivery according to Mark Konchar is the process by which all of the procedures and components of designing and building a project are organized and put together in an agreement that results in a completed project. It is the owner’s approach to organizing the project team that will manage the entire design and construction process. Project delivery is the contractual relationships between the owner, architect/engineer (A/E), contractor(s), and the management services utilized to design and construct a project [7].

Zewdu Tefera, in his article entitled DB project delivery system; some legal and contractual issues describe Project delivery system as 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 [8].

According to Mark Konchar, delivery system defines the relationship, roles, and responsibilities of parties and the sequence of activities required to provide a facility. More commonly stated, delivery methods ~~describe~~ describe the role of participants, the relationships between them, both formal and informal, the timing of events and the practices and techniques of management that are used [7].

Project delivery systems refer to the overall processes by which a project is designed, constructed, and/or maintained. In the public sector, this has traditionally entailed the almost exclusive use of the design-bid- build system, involving the separation of design and construction services and sequential performance of design and construction. In recent years,

however, the public sector has begun experimenting with alternative methods to improve the speed and efficiency of the project delivery process [9].

British Columbia construction association defines project delivery system as structure of the relationships of the parties, the roles and responsibilities of the parties, and the general sequence of activities required to deliver the project. Regardless of how they are structured, all delivery methods involve three elemental parties: Owner, Consultant and Builder/Constructor. 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. Each of the major project delivery systems has its advantages and disadvantages in different circumstances and suitability should be considered separately for each particular project [10].

The project delivery method is a process by which a project is comprehensively designed and constructed for an 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. In some cases, the project delivery method may encompass operation and maintenance. Currently available project delivery methods have moved far beyond the traditional design-bid-build (DBB) method. Due to changes in procurement laws, public agencies now share the ability of their private-sector counterparts to acquire construction services via alternative project delivery methods, such as construction management, design-build, and other hybrid systems. In some instances, methods (such as design-build) may include operations and maintenance as well as multiyear warranties [11].

2.2. Types of Delivery methods

How the project will be designed and constructed, or the project delivery method, is one of the most important decisions made by every owner embarking on a construction project. 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.

The Owner contracts responsibilities and risks to design professionals, builders and specialists, and retains some risks in-house.

The main differences among delivery methods lie in:

- Contract formation and, most crucially, the parties to whom the various responsibilities and risks are assigned;
- The incentives to meet the contract requirements;
- The assignments to carry out contract administration and other project management services [10].

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. However, the owner chooses how much to be directly involved, by either assigning an in-house project manager or contracting this role out. The project Manager is the owner's representative for delivery of the project, whichever method is selected. The owner's in-house resources – or, should they decide to contract with a single entity – are responsible for overseeing design, planning, scheduling, project accounting, and coordination and control of construction [11].

In examining the multitude of ways that design and construction projects are delivered, it is apparent that project delivery systems are structured in three ways. These structures include single source responsibility, dual source responsibility, and triple source responsibility. All project delivery systems can be derived from these three primary systems or structures, with a number of sub systems or hybrids available for each primary system [10].

In this research three types of delivery methods will be reviewed which are mostly used internationally. DBB and DB will be assessed deeply but CM@R will be highlighted only for the reference purpose for another researchers and owners.

2.3.1. Design-Bid-Build (DBB)

This method involves three roles in the project delivery process—owner, consultant, and contractor—in traditionally separate contracts. “Traditional” is frequently used to describe the Design-Bid-Build method, which typically involves competitively bid and lump sum

construction contracts according to documents prepared by consultant. These documents generally include drawings, specifications, and supporting information. The phases of work are usually conducted in linear sequence. 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 [3].

For most of the 20th century, public work was routinely built using the Design-Bid-Build delivery method. This has included competitive bidding among general contractors, performance bonds, and employment of various other statutory requirements to protect taxpayer investments. It should be noted that the selected price may not be the lowest cost for the project, but it represents the lowest cost associated with the design documents prepared for the project before actual construction begins.

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’ [17].

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 [18].

In figure 2.1 which shows Design Bid Build single prime bidding structure there is one contract between owner and general contractor who takes the whole responsibility for construction and can have different departments or subcontract with other contractors but he is accountable for the work of sub-contractor. Where as in Design Bid Build separate prime bidding which is presented in figure 2.2 an owner contracts with different contractors for different type of works like electrical and plumbing works other than general construction contractor. Both approaches

separate the design process from the construction of the facility which limit the interaction between architects and engineers and the builders being tasked to complete projects as designed. This division led to inefficient and difficult-to-build designs and increased disputes between parties resulting in higher costs, longer schedules and increased management efforts for the owner organizations. With the economic and political environments changing at an ever-increasing pace, such delays and costs became unbearable for owners.

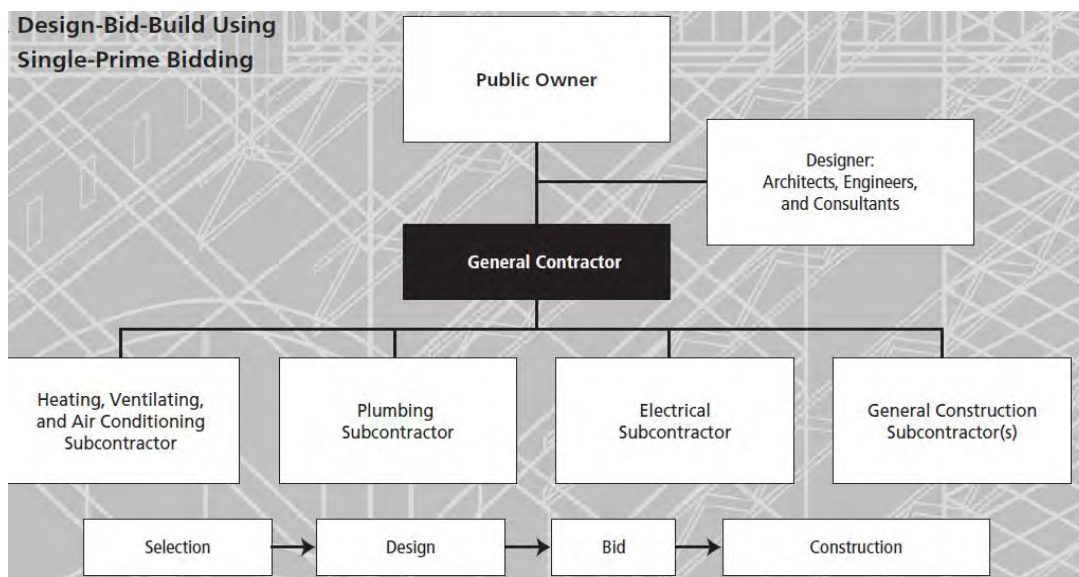


Figure 2.1. Design-Bid-Build single-prime bidding structure [5]

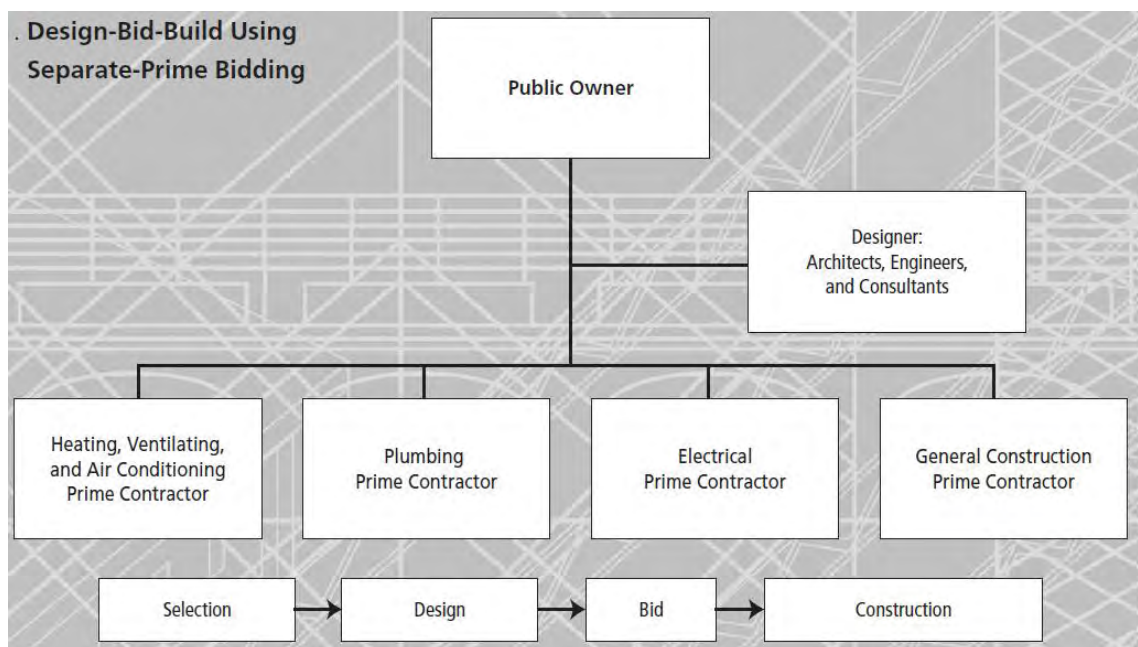


Figure 2.2. Design-Bid-Build separate-prime bidding structure [5]

The following defining characteristics identify Design-Bid-Build:

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 Design-Bid-Build approach include the following [13].

- ✓ Three phases—design, bid, build. These phases may be linear or overlapping if a project is fast-tracked or bid-out to multiple prime contractors
- ✓ Well-established and broadly documented roles
- ✓ Contract documents that are typically completed in a single package before construction begins, requiring construction-related decisions in advance of actual execution
- ✓ Construction planning based on completed documents
- ✓ Complete specifications that produce clear quality standards
- ✓ Configuration and details of finished product agreed to by all parties before construction begins.

Being well-known delivery method, simple procurement process, defined scope and lowest price accepted are some of the advantages of this delivery method. And it is good for simple, uncomplicated projects that are not subject to change.

The disadvantages are longer schedule for linear process, minimum control over subcontractor selection, no design input from contractor, not well suited for complicated projects that are sequence, schedule or change sensitive and lack of flexibility for change can create adversarial relationships.

The following conditions suggest situations where this method may be optimal:

- Prior to inviting bids, sufficient time, funds and capable coordination are available to develop complete, clear and consistent working drawings and other bid documents; also, contract award will be followed by a realistic construction duration.

- At the time when the general contract and its subcontracts are all bid together, a firm contract scope can be detailed, limits of scope division defined and the project has a relative absence of uncontrollable risks.
- Changes after award should be limited and will not significantly affect the project schedule.
- The Consultant has the proven ability to administer the construction contract, including prompt resolution of disputes.

In the design-bid-build using separate (or multiple) bidding, the design team is first selected. Next, the design team creates bid packages for the required trades, for instance, heating and ventilation, electrical, mechanical, etc. Then bids are received from prospective prime contractors and awarded to the lowest, most responsible prime bidders [15].

Challenges and Problems

In both the private and public sectors, this method may face challenges in compressing the project schedule, if required, because fast-tracking of design and construction is not compatible with this delivery method. Actions, including realistic scheduling and bidder pre-qualification (only when special expertise is required) are recommended to minimize the above concerns.

Other problems to manage or avoid:

- Owners need to ensure that bid documents have few (if any) errors or omissions, to minimize cost, schedule and dispute impacts during the Project.
- A traditional approach may require a certain level of qualification (such as bonding), especially in the public sector, which has obligations to make bidding on building work widely available.
- The construction schedule may be compressed due to prior decisions being late. There may be insufficient time for design completion, with bids being invited prematurely in order to meet deadlines. It invites disruptive changes to defer part of the main design work until the bidding period or after contract award.
- Until the general contract is awarded, a “traditional” approach may involve construction expertise only through the Consultant. However, construction expertise can be obtained

sooner by retaining a construction advisor, and the Owner may value early collaboration of builders with design professionals in order to enhance the constructability of the project. This is best achieved as a concerted effort as opposed to an occasional request for advice about specific issues.

2.3.2. Design-Build (DB)

Design-Build has gained popularity in recent years in both the private and public sectors. The primary reason for this interest in Design-Build as a viable project delivery option is the owner's desire for a single source of responsibility for design and construction and the need to minimize time and cost growths due to disputes between parties. In the Design-Build approach to project delivery, the owner contracts with a single entity, the design-build entity, for both design and construction. The design-build entity can be led by an architect or a contractor and can consist of any number of people.

Design-Build Delivery is when a company or joint venture undertakes design documentation and construction of the whole project, and designer-builder teamwork is a main benefit. The primary differences between different delivery methods are in the method/timing of acquisition of design and construction, and the contractual relationships between the participants. Design-build is also used on a smaller scale under other project delivery methods, when a permanent system or piece of equipment is designed and built by the same company.

The first of the essential features of a design and build contract is that the employer approaches a contractor with a set of requirements defining what the employer wants. The contractor responds with proposals, which will include production as well as design work. The scale of design work included depends on the extent to which the employer has already commissioned such work from others. The contractor's design input varies from one contract to another, ranging from the mere detailing of a fairly comprehensive design to a full design process including proposals, sketch schemes and production information.

There will usually be some negotiation between the employer and the contractor, with the aim being to settle on an agreed set of contractor's proposals. These proposals will include the contract price, as well as the manner in which it has been calculated. Once the employer's

requirements and the contractor's proposals match, the contract can be executed and the contractor can implement the work. The contractor will be totally responsible for undertaking the design work outlined in the contractor's proposals, for fabricating the building, and for coordinating and integrating the entire process. This includes the appointment of consultants if the contractor does not have the necessary skills in-house. The employer may also choose to appoint consultants in order to monitor the various aspects of the work, but this is not always the case [19].

The contractual relationships in design and build offer some advantages over other methods of construction procurement. The most important advantage is that the contractor is responsible for everything. This 'single-point' responsibility is very attractive to clients, particularly those who may not be interested in trying to distinguish the difference between a design fault and a workmanship fault. This single point responsibility also means that the contractor is not relying on other firms (e.g. architects) for the execution of design or for the supply of information. By removing these blocks to effective communication, experience has shown that programs and budgets are more likely to be adhered to, and the speed of building is likely to be quicker [20].

A design-build contract is usually based on performance specifications often called Statement of Requirements, from which the Design-Builder defines the project to a detailed level. A firm-price contract is typically awarded at the end of the project development stage. Extended evaluation and negotiation is sometimes necessary, especially if designs are required from bidders for evaluation as part of contractor selection. The period for contract tender and award is placed between the design development and design documentation phases.

Each bidder needs to know that project funding is in place, and that the project will proceed to completion, before outlaying the substantial cost of preparing a bid. This is not compatible with the owner giving approval only for design documentation, and deferring construction approval until later. The owner should compensate unsuccessful proponents for their proposal submissions at a predetermined amount (honorarium). The owner, although compensating the unsuccessful parties for their proposal submissions, shall not be at liberty to use the design nor incorporate any part of an unsuccessful proponent's design into the project. Compensation covers only part of the

proposal preparation cost, and the design ideas and innovations remain the property of the proponent.

The following defining characteristics identify Design-Build:

1. Two prime players—owner and design-build entity
2. One contract—owner to design-build entity

Typical characteristics of the Design-Build approach include the following:

- ✓ Final design-builder selection may be based on any of the following: Direct Negotiation, Qualifications Based Selection, and Best Value: Fees or Total Project Cost, or Low Bid.
- ✓ Continuous execution of design and construction
- ✓ Overlapping phases—design and build
- ✓ Some construction-related decisions after the start of the project
- ✓ Overall project planning and scheduling by the design-build entity prior to mobilization (made possible by the single point of responsibility)

The advantages of using DB are single point of accountability for design and construction, fast track delivery because of construction begins before design is complete and project cost are defined early in the process. Figure 2.3. shows structure of Design -Build delivery method in which there is only one contractual relation between owner and design-builder after taking full responsibility design builder may sub contract with consultants or may use own force.

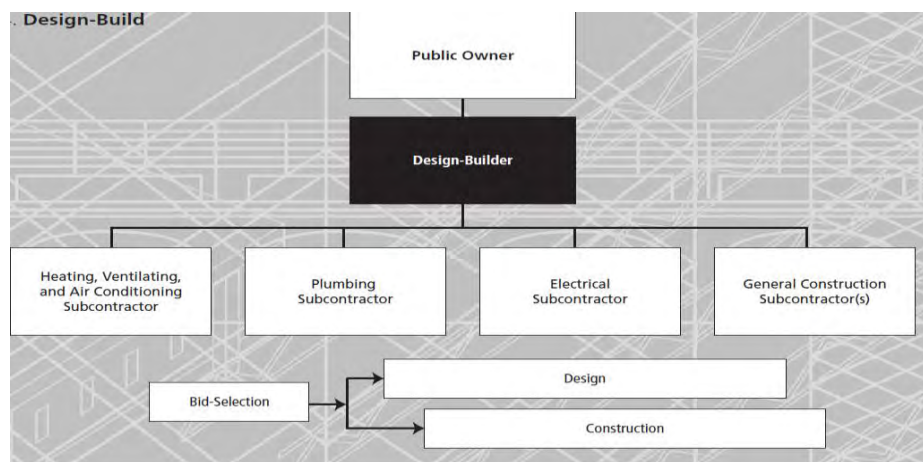


Figure 2.3. Design -Build structure [5]

Before determining if a project is suitable for Design-Build, an Owner should:

- be able to clearly and explicitly state his expectations – Statement of Requirements, end user needs and priorities for the project to all bidders;
- have (in house) or hire project management expertise and be prepared to commit these resources to the project;
- understand the Design-Build process, and fully understand the apportionment of risk between himself and the contractor;
- have the project financing in place and be prepared to award the contract within the tender/proposal validity period; and,

To be effective, the method requires:

- authority for contract award other than to the low-price bidder;
- firm performance specifications and a relative absence of uncontrollable risks at the time bids are invited;
- availability of design-build teams able to demonstrate financial capability, teamwork and who can assure quality requirements; and
- The Project Manager must be free to follow practices itemized above, as to make the required decisions that will maintain effective fast-tracking of design documentation and construction.

DB is getting wider acceptance in developed world and the method is being used and showing satisfactory result. Listed below are the testimonies of public officials about the method.

Paul Parsonneault, Construction Management Team Leader, Military Programs Branch, USACE

“There was no way possible to execute a historically large mission using the traditional delivery system. We determined that, in terms of the Army, the default delivery system is designed-build... Primarily because we can deliver more quickly, we can leverage the innovation of industry to provide us with the most cost effective solutions to our requirements.”

Jag R. Bhargava, Deputy Director, GSA

“With only four years between groundbreaking and full occupancy, we had to find a way of doing it. The only method I could think of was design-build on the new Census building.”

Pete Swift, Deputy Chief, Design and Construction Branch

“We at the Federal Bureau of Prison have been doing design-build since the FAR regulations changed. Our primary reasons back then were that we would eliminate a lot of the claims we were getting and we had a large workload. Over the years we have not had a claim on any design-build project we have done.”

Joseph Gott, Chief Engineer and Director of Capital Improvements, NAVFAC

“At NAVFAC, we do about 75 percent of new construction design build. The largest reason we select a project for the design-build delivery vehicle is the single point of accountability and responsibility. We have an A/E and a design-build constructor on the same team and have a contract with one company.” [21]

Though performance of DB projects in developed countries are satisfactory in order to get same performance in Ethiopia contractor's capacity need to develop both technically and financially. Both design and construction capacities should be developed by design build contractor rather than giving subcontract for design which is another agreement between design builder and consultants that may cause disagreements and delays though all responsibilities lie on design builder. In order to be successful on DB projects capacity building for local contractors should be done widely.

Disadvantages of DB

While the single point of contact can be easier, the checks and balances that exist between the architect and contractor are missing, which can create conflict between the owner and Design/Build firm. It can be difficult to assess whether the best price has been achieved, and since the process is somewhat sophisticated, the owner must have a clear idea of the requirements before firm selection.

Even if the owner has an independent A/E involved in oversight of the project, the A/E does not have as much insight into the design details. As such, with design-build, the owner will lose some control of the design process.

There is less competition. Not every company can put together an effective design-build team, and it may be more difficult to secure performance and payment bonds on this type of project. Even from the public procurement professional's perspective, the process involves best value approaches to solicitation development, evaluation and award not always familiar to construction management personnel.

Generally DB has the following disadvantages

- Reduces competition for construction services by excluding smaller firms unable to lead the larger projects most amenable to the design-build approach;
- Favors large national engineering and construction firms in competing for larger design-build contracts that are too big for smaller local or regional firms to pursue;
- Provides an opportunity for favoritism to enter into the contract award process by including non-price factors in the basis for selection;
- Undermines the inherent checks and balances between design and construction teams in the traditional delivery systems, with the design team no longer independent of the construction contractor;
- Strikes at the foundation of the traditional quality assurance/quality control roles through the combination of engineering and construction; and
- Increases project costs due to the elimination of the low bid contractor selection criteria.
- The D-B contractor has the incentive to complete projects faster and less expensively which can mean reduced quality of materials and workmanship.

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

Construction Management at-Risk (CM at-Risk) approaches involve a construction manager who takes on 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

preparation of cost models, 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 long-lead-time items, and coordination of construction activities. Construction Management at-Risk is designated as CM at-Risk, CMAR, CM@R, CMc, CM/GC and GC/CM.

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. The construction manager frequently provides a Guaranteed Maximum Price (GMP). CM at-Risk is sometimes referred to as CM/GC because the construction entity becomes a general contractor (GC) through the at-risk 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 safety performance of the project as a whole. Additionally, the construction manager can use his input and knowledge of the work to begin work earlier through phased design and construction schedules [12].

The term “at-risk” is often a source of confusion. Sometimes it refers to the fact that the contractor holds the trade contracts and takes the performance risk for construction. In other contexts, the term is tied to the existence of a cost guarantee or GMP. Because the term “at-risk” has two distinct meanings, it is important to understand how it is being used in a particular situation. The eventual establishment of a guaranteed maximum price is typical of CM at-Risk project delivery.

When a GMP is used, the CM at-Risk approach is flexible as to when the construction price becomes fixed. As a result, the timing for agreeing to a GMP varies by project. Considerations of risk should include an evaluation of the amount of design information available, the amount of contingency included, and the owner’s willingness to share in the risk of cost overruns. [9]

The following defining characteristics identify CM at-Risk:

1. Three prime players—owner, architect, CM at-Risk
2. Two separate contracts—owner to architect and owner to CM at-Risk

3. Final provider selection based on Qualifications Based Selection or Best Value: Fees

Typical characteristics of the CM at-Risk approach include the following:

- ✓ Hiring of the CM at-Risk during the design phase
- ✓ Clear quality standards produced by the contract's prescriptive specifications
- ✓ Establishment of a guaranteed maximum price

Other characteristics that may be seen in the CM at-Risk approach include the following:

- ❖ Overlapping phases—design and build
- ❖ Preconstruction services offered by the architect, CM or contractor (such as constructability review, bid climate, and bid management)

The following circumstances favor construction management at risk Model:

- the design and construction teams are fully committed to their roles and to project coordination, and time is allowed for working through the learning processes;
- the Owner wants an optimal mix of cost minimization and early certainty that costs will be within budget;
- arrangement of timely provision of firm requirements, whether as performance specifications or in more detail;
- benefits are anticipated from availability and continuity of construction expertise, from the start of design documentation or sooner;
- project requirements and uncertainties are well understood when pricing is set; (absence of scope certainty = unreliable maximum); the later the GMP is fixed, the less likely are subsequent problems and disputes due to surprises;
- the owner's policies allow contract awards other than to low bidders [10].

Challenges and Problems

- Relationships and coordination among the Project Manager, design professional and builders are paramount, relying on good faith and mutual respect. This adds risk for the

builders as well as for the success of the method, generally. On the other hand, there is opportunity for mutual benefit from savings.

- Contracts are based on negotiation, and the Project Manager has to negotiate the second contract with the pre-selected contractor after the project is in progress. With professional estimating assistance, negotiations may have an objective basis, but the Owner does not have the advantage of competitive bidding.
- The Guaranteed Maximum Price contractor has incentive to identify design refinements to save construction costs and to work within the Owner's budget. However, the incentives usually do not apply to scope refinements that add costs in order to secure greater value for the Owner, so value management may be used to optimize the design and the use of funds [10].

The CM at-Risk makes a contract with trade contractors who perform their portion of the construction. These entities are contractually bound only to the CM at-Risk. It should be noted that there is no contractual relationship between the designer and the CM at-Risk. Figure 2.4. shows structure of Construction manager at risk which shows relationship between owner with designer and construction manager who held construction work and also have an input on design work .

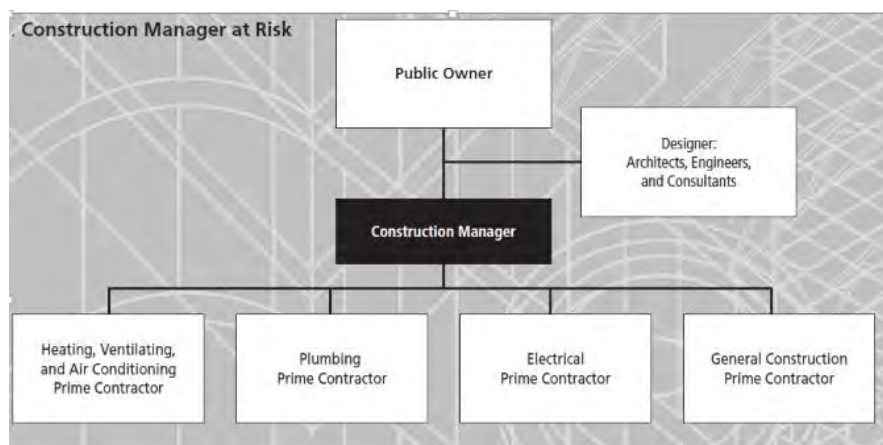


Figure 2.4. Construction manager at risk structure [5]

2.3. Project considerations

Several fundamental project considerations are directly impacted by the selected delivery method. These considerations include the need to adhere to a realistic budget, a schedule that

accurately presents the performance period, a responsive and efficient design process that leads to a quality set of documents, a thorough risk assessment followed by the proper allocation of risk by the owner, and a recognition of the level of expertise within the owner's organization or available to it.

According to AIA and ACA the main criteria for measuring the success of any project delivery method are cost, quality, time, safety and 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 [13].

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".

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 [15].

Unqualified 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. With a selection process based on best value or qualifications, this problem can be avoided. According to James David, Universities across the United States are beginning to select to use Design-Build (DB) as an alternate project delivery method over the traditional project delivery method of DBB to aid in reducing the cost, schedule, and change orders.

2.4. Selection of Project delivery methods

After knowing different types of delivery methods and its pros and cons an owner should consider the characteristics or features of the project so that best delivery method can be applied.

Selection of an appropriate procurement strategy is a key decision in terms of achieving client objectives, while inappropriate choice can be a factor in non-performance resulting into cost and time overrun and potential dispute. An owner has several areas of concern when embarking on a construction program or project. It is necessary to choose an overall project delivery and contracting strategy that effectively and efficiently delivers the project. [22]

According to Ademola Eyitope who research on critical selection criteria for project delivery method procurement systems are methods through which clients create the pre-conditions for the successful achievement of project objectives–time, cost and quality. The selected system under an appropriate contract type and control will help to avoid problems and attainment of these objectives. Any procurement strategy/method includes how risks are distributed, responsibilities are allocated, works are divided, compensations and payment are structured. However, the basic criteria for selecting suitable and appropriate procurement strategy by clients have been found to be undefined, cumbersome and often inappropriate in Nigeria. The emerging and increasing results such as economic loss, poor communication and coordination, disputes and acrimonies, delayed project delivery and poor quality projects have proved those decision rules abortive. There seem not to be standard or statutory guideline or regulations provision to comply in the choice of suitable Procurement strategy/Method. (22)

Selecting a procurement method is a daunting task for the client due to various factors governing a construction project. Stressing further that different clients have differing needs and requirements whereby construction projects vary so considerably, in every respect, that no single method of procurement can be suitable for every project.

Ademola 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 specifications

4. Completion Time

B. Project Business Case and Financing,

5. Availability /Funding Structure.

6. Number of competitors

7. Price Certainty and Market Structure

C Project Risk Management,

8. Controllable variation

9. Responsibility division and integration

10. Risk Sharing and Allocation,

D. Public Policy Requirement.

11. Specific Government Directive

12. Trend in client's familiarity

13. Political Reasons and Interference

Generally Ademola recommends specific government directive and Project Risk Sharing and Allocation are significant. The selection of project procurement strategy should necessitate robust analysis of project environment, in terms of policies, available resources, risk associated, technicality, and preferred contractual arrangements amongst all parties towards devising a method of project implementation and to achieving project goals of time, cost and quality.

Additionally from different literature reviews the following key considerations that should be considered during the selection of the project delivery method for a project will be discussed in detail.

1. Budget

Determining a realistic budget before design to evaluate project feasibility, to secure financing, to evaluate risk, and as a tool to choose from among alternative designs or site locations is a

primary need. Once the budget is determined, the owner requires that the project be completed at or near the established budget figure. Owners must decide how quickly they need to establish final project costs and with what risk level of exceeding this cost.

2. Design

Of foremost importance to the owner is that the desired facility function as envisioned while successfully fulfilling the needs of the owner and users. Therefore, the design team should be well qualified in the type of facility being designed. In addition, the owner must ensure that the program needs are clearly conveyed to the design team. Since the design of the facility must be buildable and design intent must be properly communicated, the owner requires that the design documents are constructible, complete, clear and coordinated. The documents should properly incorporate unique features of the site to include subsurface conditions, interfaces with adjoining properties, access, and other characteristics. Owners must decide how much control they need to have over the design elements of a project.

3. Schedule

The owner has similar needs in the area of scheduling. The dates of design commencement, construction completion and ultimately the operation of a new facility can be critical, either in terms of generating revenue from the facility, or in terms of providing needed functional space by a particular deadline.

Therefore, a realistic assessment of project duration and sequencing needs to be performed early in the planning process. The schedule must then be monitored and updated throughout the design, construction and pre-occupancy phases to achieve the desired goal. An owner must decide how critical it is to minimize schedule duration for a project.

4. Risk Assessment

In construction, issues of risk are closely tied to the status of the local construction market, on-site safety, the schedule and the budget. The owner requires an understanding of the risks involved in construction, and should make a conscientious decision regarding allocation of these risks among project participants, so that all areas of exposure are properly understood. In considering risk allocation, the owner should strive to assign risks to those parties that can best exercise control over those aspects. For example, it would typically be problematic to require that the contractor correct problems due to design errors or changes at no extra cost since a

contractor generally has little control over the cause or magnitude of such errors or changes. An owner must decide how much project risk they are comfortable in assuming.

5. Owner's Level of Expertise:

The owner's familiarity with the construction process and level of in-house management capability has a large influence over the amount of outside assistance required during the process, and may guide the owner in determining the appropriate project delivery method. An owner must make an assessment of its ability to properly perform under the various delivery methods.

2.5. Application of project delivery method in Ethiopia

It is convincing that public owner's primary goal in choosing a delivery method should be to ensure that the method will meet the project objectives and at the same time allow the project to be delivered on time and within budget. The choice should also consider the required project quality, safety, and owner's involvement during both design and construction periods. Contractor's capacity to discharge the contract responsibility should also be one of the criteria in adopting methods for project delivery.

The practice in Ethiopia, however, does not seem that these aspects are considered. Majority of the construction projects are delivered using the traditional design-bid-build method. Literatures disclosed that most of the public owners in the country even do not seem to know whether other options are there. Some public offices are unjustifiably reluctant to apply any method other than the one they are very familiar with. But, there are also experiences on the innovative delivery methods that justify no prohibitions on delivery method applications in Ethiopia.

For example, the Ethiopian Roads Authority (ERA) has attempted the design-build method for some fourteen (14) rural roads projects some years back. The Ethiopian Electric Power Corporation (EEPCCO) is also employing the design-build method. The Amhara National Regional State has also employed the DB method to deliver one road project successfully (Alemketema-Sekota road Project). The Oromia National Regional State is currently using Design Review and Construction Supervision Consultancy approach. This, itself, is a shift from the traditional DBB method.

All of the fourteen DB projects that ERA had awarded to the contractors were rural road projects intended to connect different rural towns in different parts of the country. None of the projects were completed at contract period. Maximum of 84% and minimum 27% of the work were completed at the end of contract period. Some of the major challenges and drawbacks were (18).

- 1) Lack of the required experience and expertise with the local contractors;
- 2) Client itself was not having the required experience for the DB delivery method;
- 3) Lack of well-established pre-contract planning;
- 4) Local contractors lacked proficient design staff (this is the case with most of the local contractors still)
- 5) Sometimes the local contractor's tendency to underbid the works;
- 6) Over-extension of contractors;
- 7) No clear guidelines for procurement of goods and services;
- 8) Financial incapability of local contractors, and;
- 9) Inadequate equipment;

Most of the above described challenges are due to problem on the project management. Hence for the future, this project management problem and the tendency of under bidding without properly analyzing their risks, the local contractors should observe, in advance, the real work which they will be executing. And, also, local contractors should build the capacity to exercise their rights to the contracts. They should claim when it should be claimed. It needs to be noted that international contractors are benefiting from such strategies.

It is the only experience in innovative delivery method in Ethiopia but it is not the regulation that has been the impediment to the application of the innovative methods. Rather, capacity of local contractor's that has been the hindrance. Local contractors are facing problems of fulfilling requirement of DB projects as most of DB projects are financed by donors who require high technical and financial capacity. So, technical and financial capacity of contractors should be improved. Design builders should improve their construction and design capability. Due to lack

of design capability contractor who engage in DB contracts usually sub contract the design part which induce another contract. As number of contracts increase complexity will increase even though design builder take full responsibility from owner. Also contractors need to exercise their contractual rights and make themselves familiar with the delivery system.

Even though the DB project delivery method was practiced some twenty years back and suspended for a short trial, ERA organize DB directorate in 2009 and lots of projects are being delivered through DB delivery method which become good experience for the construction industry. After its establishment DB directorate make contracts for 27 DB projects from which 11 projects are completed.

2.6. Findings of different literatures

Lema Mosissa conducted a research on Alternative Project Delivery Methods for Public Constructions in Oromia Region. According to this study alternative project delivery method is in need due to time and cost overrun, burden on owner and quality maintenance. The first priority of consideration in using alternative delivery methods is given to reduction of project time then cost certainty and the third one is reducing owner burden, ensuring quality become the least in criterion.

In contradiction from international study results discussed below, Lema's study revealed that DBB method meets project schedule more effectively than DB and CM-at-Risk. And DBB also take the leading position in cost minimization. The respondents believe the separation of design team from construction entity creates a system of *checks and balances*, unlike the case with other methods.

Lema's research showed that the 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. And CM-at-risk method is mentioned to be effective in ensuring a quality project (both functional and esthetic). This is because, as the respondents mentioned, highly experienced construction management professionals are involved who can give constructability, material quality, value engineering, and cost control inputs both at the design and actual construction stages. Moreover, he quoted that as

the Construction Manager at Risk assumes most of the project risks, he/she willingly tends to execute the project within the specified standard care.

Administrative burden to the public owner according to the study is reduced if CM-at-Risk is used; the other better choice is DB method then comes DBB and finally CM-Fee method [18].

According to Mekonnen who perform his research on “effectiveness of DB and DBB projects” DB projects were associated with shorter overall project time than conventional system DBB. It is also reckoned that reduction of the overall project period is attributed to the system’s ability to overlap the design and construction phases. It is observed also that cost and completion time is firmer under the Design and Build procurement method. This means the client knows his total financial commitment in the early stage of the project; the contractor does not introduce any changes throughout the project. Because there is no provision for bill of quantities, adequate arrangements for evaluating any changes on the price or on cost basis can be carried out earlier by including in the contract. In most of DB procurement form, the final cost does not exceed the project budget, because as it is the fixed fee the calculated risks and the cost variations are absorbed by the contractor. In this respect, Design and Build certainly presents a better chance of the client obtaining his completed building within budget.

Also results of his study clearly indicate that the choice of project delivery method affects project performance. Significant difference in the project performance was found between innovative project delivery system and traditional DBB contracting methods. For example, the average time growth for DB was approximately 31.6 % of the time growth of the traditional DBB project delivery method. Individual project factor, however, can have a dominant effect on project outcome. One of the major topics of interest of his research was the analysis for the effectiveness of DBB vs. DB project delivery systems.

According to the study owners prefer 100% DB project delivery system while 90% of the contractors prefer DB project delivery system. The most common reason owner’s selected DB as a project delivery method was schedule. Schedule is clearly a major motivator for owners. The researcher also indicated that time overrun for DBB projects is 28.2 % while the corresponding time overrun for DB projects is only 8.9%. Owners are clearly seeing schedule as a significant incentive for using DB delivery system. As schedule were the most important criteria for

choosing to use DB. Controlling cost growth is also of paramount importance to owners as they endeavor to manage scarce public resources for capital projects. Also Mekonnen found projects using DBB reflect a 32.6 % growth in contract amount. In the same manner the DB projects result in a 0.28% contract amount increment.

Damon Scott on his thesis entitled *The Owner's level of effort in design-build contracts*, concluded owner organizations are turning to DB delivery systems in order to control schedule growth and costs on projects while lowering the amount of in-house resources needed for management. And when matched with appropriate project characteristics DB method is capable of speeding delivery and lowering project costs [12].

According to Valerie Rose Riecke on her article with a title of *Public Construction Contracting: Choosing the Right Project-Delivery Method*, experts in USA consider the construction-manager-at risk and design-build methods to be the best for controlling costs, reducing construction time, improving quality, and decreasing the administrative burden. The study were done by distributing a questionnaire to construction industry experts including academicians, architects, engineers, construction managers, general contractors, legislators, local and state officials in North Carolina, and prime contractors.

In her study *Valerie* compared different delivery methods by using four considerations. Her study shows which delivery method is best suited to Control Project Costs, Meet the Project Schedule, Ensure a Quality Project and to Reduce the Administrative Burden. Construction-manager-at-risk method is the most effective in controlling project cost according to her study. Seventy-three percent of the experts responded that costs are always met and usually reduced because the construction manager assumes the financial risk associated with any profit or loss. If the budget is exceeded, the construction manager must work without charge to arrive at the guaranteed maximum price. Experts also ranked this method high because the construction manager is involved in all project phases. The design-build method also is effective in controlling project costs, although not as effective as the construction-manager-at-risk method. Half of the respondents believe costs are always met and usually reduced. The rest responded that costs typically are met. Experts ranked this method high because there are not as many

change orders or as many claims stemming from errors and omissions in the design documents [24].

According to the study, the design build method is the most effective in meeting or accelerating the project schedule. Sixty-four percent of experts responded that schedules are always met and usually accelerated, and 36 percent reported that schedules are typically met. Experts responded favorably to this method because phased construction can occur. Using this approach, the design builder can avoid scheduling delays by identifying long lead times early. Little distinction is observed with regard to quality. Experts indicated that public owners have the greatest chance for a quality project using construction manager at risk followed by DB. With regard to burden reduction DB called for the least involvement, thus providing the greatest reduction of administrative burden. It was followed by construction manager at risk. Design-bid-build using single-prime bidding ranked a close third and separate-prime bidding ranked last.

On his study Fernane JD 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 (16).

Design and build forums were prepared by Bennett apothecary and Robinson on 1996 in University of reading in UK. The forum posted a comprehensive survey to a selected sample of owner agents to collect performance data in terms of cost, schedule and quality. Interviews were conducted with 150 clients and project team members on a selected group of 35 projects. These interviews were conducted to evaluate the accuracy of collected data and to identify differences in project performance. 332 projects were analyzed. 156 used design-build approaches and 156 used traditional DBB. According to the finding from the forum DB has listed advantages than DBB: [20]

- a greater chance of finishing within 5% of budget
- a higher possibility of achieving specified quality
- a 12% improvement in construction speed

- a 30% improvement in project delivery speed
- a 13% reduction in unit cost
- more certainty in finishing on time

Konchar Summarizes the results of a national study comparing the cost, schedule and quality attributes of 351 projects delivered using the three predominant U.S project delivery systems: DBB, DB and construction management at risk. From his analysis regardless of facility type, the types of contracts used or the experience of team members, the unit cost of DB projects was 6.1% less than the unit cost of projects built using DBB and 4.5% less than projects built under the construction management at risk delivery system. The unit cost of projects using construction management at risk was 1.6% less than that of DBB projects.

Similarly, DB projects, on average, were 12% faster than DBB projects and 7% faster than construction management at risk projects in terms of construction speed. The construction speed of projects using construction management at risk was 5.8% faster than that of DBB projects. And considering the project delivery speed the analysis revealed DB projects were found to have a delivery speed 33.5% faster than DBB projects and 23.5% faster than construction management at risk projects. Delivery speed of projects using construction management at risk was 13.3% faster than that of DBB projects. [26]

Pockock and Liu(1996) conducted a study using 209 military projects in US. These projects were divided between traditional (DBB) methods and DB delivery system. In contrary to popular opinions the projects studied showed slightly lower performance on DB projects in terms of cost and schedule growth when compared to DBB projects. [12]

Roth (1995) also studied the performance of DB contracts in the military. His research studied child care facilities built by the navy and included six DB and six DBB of similar size and scope. This sample of projects showed less cost growth for DB (6.51% to 11.36%) and lower cost per square foot than for DBB. These results differ considerably from Pockock and Liuwork [27].

According to Linda researcher at Golden Gate University, DB project delivery method outperforms DBB in terms of cost growth and time growth. This project delivery tool has proved to deliver a project on time and within budget. A project delivery system that combines the

construction and design function within a single entity enhances project efficiency. The DB method should be used if the project is a viable candidate. This researcher recommends that renovation projects not be used as DB projects unless the contractors are allowed to do destructive inspection. Every contractor interviewed stated that renovation projects were not good candidates for DB since the contractors did not know what was hidden under roofs, walls, floorings, etc. These projects do not allow for design creativity, which is a strong suit in DB [14].

A Thesis at University of Nevada, Las Vegas on ‘Comparison of design-build and design-bid-build performance of public university projects summarizes samples of 42 DB projects and 42 DBB projects on newly constructed buildings. The total cost growth data showed that DB projects had a lower total cost growth and the results also showed that the mean design and construction schedule growth and the mean total schedule growth of DB projects were significantly lower than that of DBB projects [16].

2.7. Summary of literature review and gap identification

Generally almost all research works show significant influence of project delivery method used on project performance especially on time and cost overrun. Developed countries are applying DB and CM@R widely and there is better performance of projects which are delivered through innovative delivery method.

Almost in all literature findings it is showed that DB projects out shine with regard to cost saving while most of the researches also agrees with minimum cost growth in DB projects than DBB. The reason for cost minimization in DB projects is, there are not as many change orders or as many claims stemming from errors and omissions in the design documents. This is due to both design and construction responsibilities are to the design builder and any cost increase during construction phase will be absorbed by contractor as the contract is fixed fee contract. Project time is also minimized by using DB this is due to phased construction can occur that is construction can occur before completion of design. Also using this approach, the design builder can avoid scheduling delays by identifying long lead times early. Generally due to involvement of builder in design stages, there are minimum errors or omissions of design which eliminate additional cost and time caused by design problem.

Little distinction is observed in the findings with regard to quality achievement. Almost all researches reflect the same finding on burden reduction that DB projects reduce maximum burden from owner as responsibilities are taken by one party, design builder. As number of contract minimize burden to administer those contracts also decreases and there will be no disagreement with regard to responsibility assignments. There for DB projects outshine in better project performance than DBB.

But most of Ethiopian constructions are being delivered using traditional delivery method which is DBB and projects are facing significant cost and time overrun that is affecting the country's economy. Though there is good start at ERA who establishes DB directorate and shifting some of recent contracts to DB delivery system, there is very few experience of applying innovative delivery method in public constructions. Even though previous researches in Ethiopian construction industry shows better performance of DB projects than 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. In order to identify the level of usage of innovative delivery methods and its performance with regard to timely and costly completion different research methodologies have been used as discussed in next chapter.

CHAPTER THREE

METHODOLOGY

3.1. Research design

In this research both qualitative and quantitative methods are used. It is qualitative because it assesses a problem by taking professionals' opinions, views and perceptions on projects that are not being delivered with time and budget scheduled. It is also quantitative because it tries to measure the problem by investigating facts and tries to establish relationships using statistical tools.

The research strategy adopted is exploratory and descriptive type. The research was initiated to identify problems and attempts to find present challenges, factors of challenges and remedial measures in road projects that are facing time and cost overrun so it is exploratory. On the other hand it is also descriptive because it tries to describe the overall practice of project delivery through different delivery methods. It was attempted to collect data from the relevant source professionals from ERA, consultants and contractors.

The methodologies applied are: literatures were surveyed, problems were identified, data and information sources were determined, on the basis of the data and information sources the research instruments were decided, data collection methods were designed, the required data were collected and analyzed and draw conclusion from the result of data analysis and forward recommendations. The surveyed reference materials include: researches and journals related to project delivery method, guide lines text books, hand book and internet exploration etc.

3.2. Data source and sampling

Collection of data from different stake holder professionals: owner (ERA), consultants and contractors who has contract with ERA, were done by the designed methods of data collection technique that is questionnaires and case study.

The research data was collected based on the stepping points found in the literature review. The samples for questionnaires were drawn from professionals at ERA, contractors & consultant offices. Professionals from ERA were selected from both DB and DBB directorate at different positions. Construction and consulting offices that have contractual agreement with ERA that have experience on both delivery methods were selected that means purposive sampling is used

and also professionals were included from different sectors and at different positions. Sample projects for case study are selected from projects that are completed after 2010 by ERA. Due to smaller number of projects delivered by DB, samples projects were taken from recently completed projects which have required information.

55 questionnaires were distributed; for professionals from contractor, consultant and owner side at different positions from which 46 is collected. Figure.3.1. shows number of distributed and collected questioner. Also six projects from both DB and DBB are considered for case study. Numbers of projects from DBB were screened but only three of them that can provide the required information were selected. But due to scarcity of completed projects by DB, recently completed projects at hand are used.

Professionals from	Distributed questioner	Responded questioner	Return rate %
client	15	12	80.0%
consultant	15	14	93.0%
contractor	15	11	73.3%
professionals	10	9	90.0%
total	55	46	83.6

Table 3.1 Distributed and responded questioner

3.3. Data collection

The data collection approach adopted for conducting this research includes both primary and secondary sources. Questionnaire and case studies provide the primary data for this study while the secondary data sources include journals, articles, researches, hand books and internet sources on related topics. These different methods of data collection have been used in order that the data or information obtained from one can be supplemented by the others.

3.3.1. Questionnaire

Questionnaire provides firsthand information for the subject matter of a research as it is focused on issues which further serves as a survey to understand the main concerns and attitudes of

respondents towards the problems. In this study, questionnaire was distributed to selected representatives of owner, consultant, contractor and professionals.

In this research Questionnaires used to assess professional opinion, observation and attitude towards different project delivery methods. In the questionnaire it is aimed to assess level of awareness of professionals on innovative project delivery method, how they perceive the effect of delivery method on project performance, how they relate project performance and delivery method, the challenges they are facing through different delivery method and identifying their opinion on the need of innovative delivery method.

3.3.2. Case Study

Six projects, three from DB and three from DBB were analyzed in order to identify the performance, challenges and remedial measures for both delivery methods. Samples were taken from projects that are completed and can serve the purpose of the research. As DB delivery method is being employed recently in ERA it is hard to get enough samples so three projects completed recently and data at hand is analyzed. Also in order to make good comparison three DBB projects are analyzed.

3.4. Limitation of research methodology

In this research work it is tried to assess current project delivery method being used in ERA. Identifying the reason for delay and cost overrun in DB and DBB projects and proposing alternative approach that could improve performance of projects are the main goal of this thesis.

Maximum effort is utilized in order to get information and data from relevant sources that could achieve research goals. Though it was challenging to get full data and response from questioner, it is hard tried to organize the data at hand and collect necessary information from the responses.

Major limitations were:

1. Scarcity of local researches performed on related topic, so majority of references for comparison of performance resulted in DB and DBB were international researches and articles

2. Number of projects performed by DB project delivery method is very small and finding completed one was very challenging as ERA start applying this method recently.
3. Professionals are bored and busy to response questionnaire on time and fully. Some responses were very late that hinder early completion of the research and also some responses were not complete that jeopardize reliability of the research so some responses were rejected
4. Data for case study were hard finding. It was so though to find organized data of selected projects due to bad archive habit of completed projects in ERA. Also finding responsible person for these projects was so challenging.

CHAPTER FOUR

ANALYSIS OF FINDINGS AND DISCUSSION

4.1. Overview

This thesis tries to analyze performance of projects through different delivery methods by mainly focusing on time and cost performance of DB and DBB projects and to identify the challenges and remedial measures that need to be taken. And this chapter deals with analysis of data collected through questionnaire and case study in combination with literature review.

Mainly the questionnaire focuses on opinion of professionals on different delivery methods and their experience on performance of delivery methods with regard to cost, time and quality. Also the questionnaire tries to assess professionals view in the need of innovative delivery method.

In case study 6 completed projects were analyzed by mainly focusing on timely and costly completion of projects that helps to compare which delivery method perform better. Also the causes for delay and cost overrun, if any are assessed. The performance of each projects are discussed. Claims and other challenges and its solving mechanisms are also discussed that will help to forward recommendation that can overcome time and cost overrun in both DB and DBB.

4.2. Questionnaire Analysis

Total of 46 responses from questionnaire were analyzed and majority of respondents believe that project delivery method used affects project performance. In correspondence with local and international experience half of the responses indicate cost as the major performance criterion that is influenced by applied PDM. Timely completion comes second with 33% vote and there is no significant difference with regard to quality maintenance by altering project delivery method according to the responses.

Whereas according to Lema the first priority of consideration in using different delivery methods is given to reduction of project time then cost certainty and the third one is reducing owner burden and the last one is ensuring quality.

Damon Scott on his thesis entitled The Owner's level of effort in design-build contracts, concluded owner organizations are turning to DB delivery systems in order to control schedule

growth and costs on projects while lowering the amount of in-house resources needed for management.

Generally the analysis from the questionnaire and output of other literature's show that project delivery method has greater influence on project cost and time. Though the priority given differs, it is agreed that cost and time of the project will be affected. Quality of a project can be maintained in different delivery methods different findings have different view on the method that helps to maintain better quality. In this questionnaire response and Lema's study quality is best maintained in DBB where as in international studies like Valerie and Damon as an example, DB is preferable in maintaining quality. But still there is no significant difference in usage of innovative or traditional method with regard to quality maintenance.

Most of the respondents have been working on innovative project delivery system (73%), the rest 27 % either don't use or don't know any method other than DBB. They believe that innovative project delivery system is not being applied widely in the country and the reasons according to respondent's priority are lack of experience, legal provision hindering the application and then need to use usual method adopted and finally comes lack of awareness on innovative delivery methods.

In developed countries like USA alternative delivery methods are being used widely in recent years. Though there were provisions that hindered application of DB and CM@R in USA it is being changed. As an example Valerie in her article indicates "Historically, North Carolina's laws restricted public owners to using a project delivery method called design-bid-build using separate-prime bidding but in 2001 the North Carolina General Assembly added two options for project delivery: design-bid-build using single-prime bidding and construction manager at risk. The North Carolina statutes also include a special provision that allows the State Building Commission to approve alternative contracting techniques. The most commonly approved method is design-build."

Alternative delivery methods are being used widely in developed countries. As an approval one can see number of researches that is done by taking large number of samples. From this huge number of samples one can assume the presence of more projects that are being delivered

through innovative delivery methods. As an indication one can refer researches conducted by different scholars. Konchar Summarizes the results of 351 projects delivered using the three predominant U.S project delivery systems: DBB, DB and construction management at risk. Pockock and Liu(1996) conducted a study using 209 military projects delivered through (DBB) methods and DB delivery system. And also a Thesis at University of Nevada, Las Vegas summarizes samples of 42 DB projects and 42 DBB projects on newly constructed buildings and in reading design and build forum analyses of 156 used design-build approaches and 156 used traditional DBB in US were presented.

In selection on PDM there should be considerations that can help in achieving project objectives. Professionals were asked which criteria should be consider in selecting appropriate delivery method, according to their response project time followed by cost get the priority. Risk minimization, level of expertise on the owner side and quality needed also listed as a criterion according to their priority.

Majority of the respondents in the questionnaire exercise both traditional and innovative delivery method. From their experience 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 and minimized clients burden and risk on comparison to DBB. Though DB performs better in timely completion, 42% reveals the existence of time overrun in DB projects too. Half of the responses show quality maintenance in DB. Figure 4.1 shows comparison graph on timely and costly completion of projects delivered through DB and DBB, according to the response.

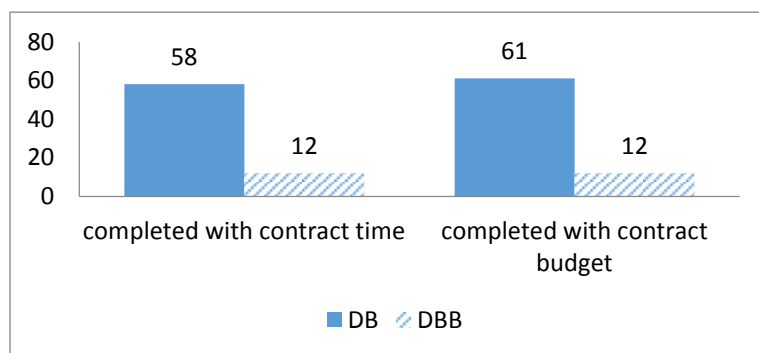


Figure 4.1 Comparison on time and cost growth on DB and DBB projects

According to Konchar the unit cost of DB projects was 6.1% less than the unit cost of projects built using DBB and 4.5% less than projects built under the construction management at risk delivery system. The unit cost of projects using construction management at risk was 1.6% less than that of DBB projects and similarly considering the project delivery speed the Konchar's analysis revealed DB projects were found to have a delivery speed 33.5% faster than DBB projects and 23.5% faster than DBB projects and 23.5% faster than construction management at risk projects. The delivery speed of projects using construction management at risk was 13.3% faster than that of DBB projects.

According to the research at Design and build form in which 332 projects are analyzed it is found that DB has advantages over DBB as tabulated below

- a greater chance of finishing within 5% of budget and
- a higher possibility of achieving specified quality
- a 12% improvement in construction speed
- a 30% improvement in project delivery speed
- a 13% reduction in unit cost
- more certainty in finishing on time

Pockock and Liu studied in contrary to above mentioned popular opinions, the projects studied showed slightly lower performance on DB projects in terms of cost and schedule growth when compared to DBB projects.

According to a thesis by Linda N. Allen on 'comparison of DB and DBB as a project delivery method' total cost growth data showed that DB projects had a lower total cost growth and the results also showed that the mean design and construction schedule growth and the mean total schedule growth of DB projects were significantly lower than that of DBB projects. And DBB get higher vote than DB on quality maintenance 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.

In Lema's research it is showed that the DBB method is effective to maintain a quality construction project. CM-at-risk method is also effective in ensuring a quality project (both

functional and esthetic). This is because, according to lema's finding highly experienced construction management professionals are involved both at the design and actual construction stages.

Whereas according to design and build forums there is a higher possibility of achieving specified quality in DB projects than DBB also Valerie in her article disclose forty percent of experts responded that functional and aesthetic goals are always met using single-prime bidding, construction manager at risk, or design-build. Twenty-seven percent thought that using DBB is best. Overall, 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 the questionnaire response burden and risk reduction to owner is much higher in DB. 85% of the respondents reported using DB will minimize burden and risk from owner and only 15% believe using DBB will be best. As it can be seen from Figure 4.2. 31 % of professionals believe 1/4th of risk will be minimized and another 31% says half risk will be minimized the rest 38% believe more than half of the risk is minimized by using DB than DBB.

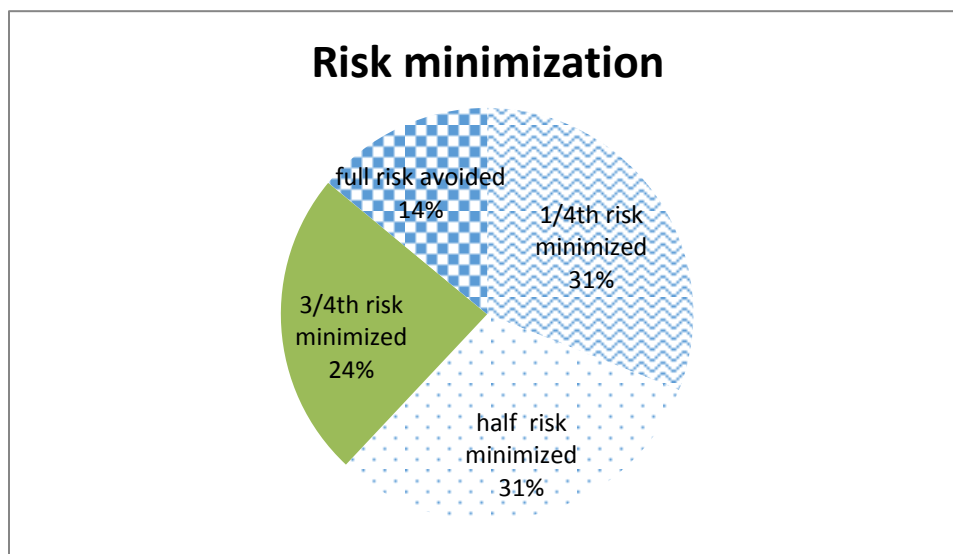


Figure 4.2 Percentage of responses on different risk minimization level on DB projects

In Lema's analysis administrative burden to the public owner according to the study is reduced if CM-at-Risk is used, the other better choice is the DB method. The respondents thought that the final choice in this respect to be the DBB. Valerie's study indicated that design-build called for the least involvement, thus providing the greatest reduction of administrative burden. It was followed by construction manager at risk. Design-bid-build using single-prime bidding ranked a close third and separate-prime bidding ranked last.

In general, the results indicate that administrative burden increases with the number of contracts. The design build method benefits public owner by involving only one contract. There is only one line of communication for the owner.

Overall, this analysis and studies reveals that DB performs better with regard to timely and with budget completion also almost all studies reviewed and the analysis shares the same stand with regard to burden reduction that DB is preferable than DBB. Most of the findings are in favor of DBB With regard to Quality maintenance by mentioning advantage of increased number of parties with different perspective and one can identify others party error and corrections can be taken.

According to questionnaire response it would be better to entertain DB for complex and shorter time projects with a need of minimized risk. Around 80% of respondents can't judge either cost or time overrun is frequently happening because they believe both are worst and happen in similar frequency. Variations are the main reasons for cost and time overrun. Also right of way issues, contractor's financial and technical capacity, delays in design and design approval and weather conditions are mentioned as reasons for cost and time overrun. DBB is more exposed to variations than DB as a response from the questioner. Among the reasons for variation in DBB, quantity increase took the priority and also design changes are major cause of variation on DBB. Whereas change in employer requirement mostly change in control point and right off way cases are the major cause of variation in DB.

In projects with frequent variations there are also frequent claims. As it can be seen from Figure 4.3 and figure 4.4 claim is mostly entertained in DBB than in DB. 78% of respondents agree that

time claim is more frequent in DBB and 84% of them suggest DBB is more exposed to cost claims than DB.

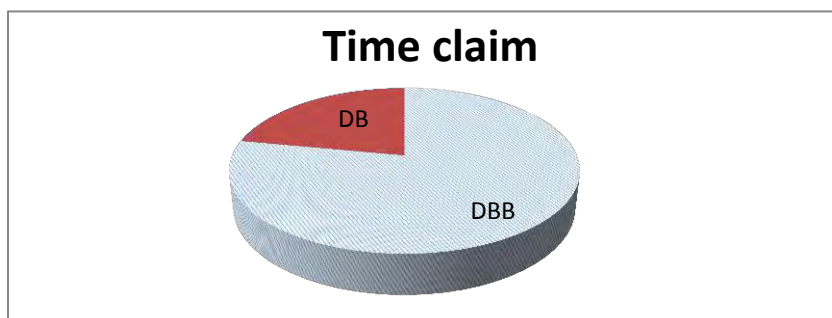


Figure 4.3 Frequency of time claim in DB and DBB

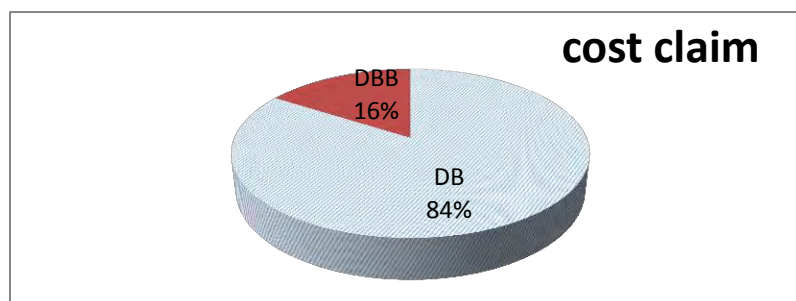


Figure 4.4 Frequency of cost claim in DB and DBB

In order to overcome the time and cost overruns the industry is facing, 88% of respondents recommends application of innovative delivery system in Ethiopia and the rest believe there is no need for the innovative systems rather working on problems of the usual method (traditional one) will be a solution.

From the supportive of innovative method 92% believe it is especially needed for road projects, 78 % for water projects and 67% for buildings also. Half of them think all type of construction need to apply innovative project delivery method, by expecting cost and time minimization, quality maintenance and burden reduction. Most of the professional in the survey think up to 50% burden reduction in DB in comparison to DBB.

Generally according to questioner result DB projects perform better with regard to timely and costly completion of projects. It is observed that maximum burden can be minimized by using

DB whereas; DBB perform better in quality maintenance. It is also observed that DBB projects are more exposed to variation and claims which leads to time and cost overrun.

4.3. Case Study

In this part of the thesis, projects delivered through DB and DBB will be analyzed and comparisons on the two delivery methods will be held in conformity with questioner. Weak spot of both DB and DBB will be studied and recommendations will be given. Though both DB and DBB projects face time and cost overrun, it is seen from the questionnaire analysis that DBB projects are more exposed to time and cost overrun, and variations are the main reason. The frequent reasons for variations according to the questionnaire are quantity increase and design change. In order to know the extent of these factors on time and cost overrun, Claim and variations in sampled projects will be analyzed. So that it will be easier to identify the main causes of delay and cost overrun in each delivery method accordingly recommendations will be given for adjustments measures.

4.3.1 Gore-Gambella Road (DBB)

Gore-Gambella Road upgrading project is located in the Western part of Ethiopia in Oromia and Gambella Regional states with a total project length of 143.3km. It is part of the major trunk road that connects western part of the country with the central part via Addis - Jimma - Gambella road.



Figure 4.5 Map showing Gore Gambella road (source: - Central Statistical Agency)

On 21st December 2006, ERA has signed a construction agreement with the Contractor, Consolidated Contractors Company (KUWAIT) W.L.L for the construction works of the road. The original cost of the civil works contract is ETB 817,570,809.78 inclusive of VAT 15%. However, due the variation of the original BOQ, the initial cost has been changed.

The Construction Contract commenced on March 1, 2007. The Original Contract Completion date was February 28, 2010; the project time to be 3 years, whereas, the revised one was July 15, 2011 as a consequence of Approved Extension of Time, 501 calendar days.

The original value of the ‘_Consultancy Contract’ was ETB 2,579,100 and USD 639,875.00. However, due to granted two ‘-Extension of Times’ (through Supplementary Agreements #1 and #2) , the revised Contract amount was ETB 13,209,263.79 and USD 439,176.00 up to August 15, 2011. Cost and time growths are presented on table 4.1. and 4.2 respectively.

	Contractual period	Actual completion period	Time growth
Construction service	1095	1596	45.75%

Table 4.1 Contractual and Actual Contract Period

	Contract amount (ETB)	Executed amount(ETB)	Cost growth
Construction service	817,570,809.78	1,005,000,000	22.9%
Consultancy service	11,153,425	19,094,222.19	71.12%
Total	828,724,234.7	1,024,094,222.19	23.6%

Table 4.2 Original and Executed Contract price

The cost increase is not only from construction service, due to time extension consultancy service cost is also increased. From the above Table it can be seen that cost overrun in this project is almost 23.6% of the original contract amount these is due to the effects of to-date

approved claims , Various Orders , 15% VAT, new legislation (Sur Tax), ceiling Price escalation and Baro Bridge maintenance and around 46% time overrun. Also there is increase in contract amount for consultancy service due to extension of time which is additional cost for the owner.

Due to interdependence between time and cost overruns; there are additional costs only because of extended time like increase in foreign currency exchange rate, compensation claims for the idle machineries and man power and additional cost for consultants. These price increases also affects the ceiling for price adjustment which is determined to be 20% of the contract amount in this specific project, which allow additional price adjustment for amended contract amount.

Seven variations are the main causes of time and cost overrun. The variations and claims will be discussed and the factors with major influence and high frequency will be identified.

A. Summary of Claims

In order to identify which of the causes happen frequently it is better to categorize the claims under this project.

1. Claims due to design changes
2. Right of way
3. Economic and legislation issues in the country
4. lack of detail study before design
5. Late payment

The claims in this project are categorized in to five causes from which design change is the major one. Replacement of consulting company who make a design by new one causes these changes because the new consulting firm revises the designs. In order to overcome such replacements there should be screening method which can identify capable firms with sufficient experience in design so that design can be done through detail studies following design procedures and standards.

The absence of detailed study before design and bidding stage also leads to claim and delay, lack of sub base material that is assumed to be found around the project route and rejection of sub base material is an example. It is worth mentioned that late payments has great effect for additional cost and delays. Also ROW, economic and legislation cases affect timely completion of the project and cause additional cost in this project.

B. Variations

- Variation Order No.1 Change of the pavement type from DBST to asphalt concrete
Because of the terrain types and the average annual rainfall
Amounts of the two sections receive (it costs 45,674,645.85 ETB)
- Variation Order No.2:- Changing the joint coupling from reinforced concrete to
Cement-sand mortar of 1:2
- Variation Order No.3 Provision of 2 additional Type-C houses for the Engineer
- Variation Order No.4 line shift at km70-71
- Variation Order No.5 Replacement of existing box culvert C-120 at km76+906 with
New one
- Variation Order No.6 Revision of Guidepost Schedule
- Variation Order No.7 Revision of Road marking

Variation type				
	Due to design change	ETB in 10 ⁶	Due to ROW	ETB in 10 ⁶
1	From DBST to AC	45.67	Late handover of camp site	22.78
2	Construction of box culverts	0.553	Late handover of quarry site	35.133
3	Revision of guide post schedule	1.236		
4	Revision of road marking	0.635		
	Total	48.09		57.913

Table 4.3 Major variation

Majority of variations are due to ROW issue and design changes which are costing the employer millions of ETB as mentioned above even though there were price escalations and quantity increases that contribute for cost overruns. Generally in this project cost overrun due to design

change can be overcome by taking good care during design stage or transferring all the design risks to the contractor by using DB project delivery method.

4.3.2. Wacha - Maji (DBB)

This project road is portion of the country's road network, which is collector that turns out left from Jimma - Mizan Teferi trunk road. The design is done by an international consultant, called Gannet Fleming in association with a local consultant, PANAF consult. The review of detailed design and tender document preparation were done by SABA Engineering. The contractor is china international water & Electric Corporation (CWE). The project is commenced at September 25th 2007 and completed at June 10 2012 with total project length of 174.278km.

	Contractual	Actual	Cost and time growth
Days	1277	1724	35%
ETB	775,621,616.40	1,306,039,296.91	68%

Table 4.4 Contractual and Actual period and price with percentage increase

These 68% increase in cost and 35% increase in time are mainly caused due to three claims, four variations and 351,932,171.12 ETB price adjustment. These claims and variations are discussed below to identify the main cause of time and cost overrun in this project.

A. Claims

1. Claim for EOT due to works delayed by inclement weather condition prevailed during dry season has been resolved by granting 57 calendar days of EOT for the contractor.
2. Claim for EOT and prolongation cost due to substantial increase in cut to spoil quantity has also been resolved amicably by granting 584 calendar days of EOT and ETB 28,717,656.82 as a compensation of the prolongation cost for the contractor.
3. The contractor requested for a new rate to be determined for rock (hard) excavation due to substantial increase in quantity. With due consultation with the employer, the engineer determined an additional rate of 9.75ETB/m³ on the rock excavation quantity beyond the BOQ quantity. Accordingly the contractor has been compensated with amount of ETB 3,027,429.06.

B. Variations

1. Extension of Maji town section by additional 560m with estimated cost of 5,883,053.47

2. Centerline shifting for sections with estimated cost of ETB 4,669,749.76
3. Centerline shifting for another section with estimated cost of ETB 4,218,216.3
4. Construction of two slab culverts with estimated cost of ETB 2,521,798

Variation type				
	Due to design change	ETB in 10 ⁶	Due to quantity increase	ETB in 10 ⁶
1	Extension of road section	5.883	Increase in cut	28.72
2	Center line shifting	8.887		
3	Additional box culvert	2.52		
	total	17.29		28.72

Table 4.5 Major variation

Bad weather condition, excessive quantity increase and unit rate changes are the main claims that cost around 33 million ETB. All the variations due to changes from the original design, center line shifting could have been avoided if detail survey investigation were held and also two culverts could be budgeted if the drainage systems were carefully studied.

It is to be noted that, in addition to the above mentioned formally issued variations, several other informal variations have been made in the project work that incur significant increase in quantity and cost. Though there are variations and claims in this project the main contributor for cost overrun is price adjustment. That is caused due to extended time otherwise the effect of inflation would be minimized and price adjustment could have been removed.

4.3.3 Hawusewa- Abala-Irebt (DBB)

Hawusewa- Abala-Irebt is contract one of Afdera-Abala road project which is found in northern part of Ethiopia with road length of 94.192km. The task for the pre-qualification of contractors and evaluation of bids for civil works was carried out by ERA. The contractor was Jiangxi Zhongmei Engineering construction Co Ltd and ICT-ICTE-Omega consulting engineering was consultant.

Ensuring that the road is constructed within the contract price and time for completion allowed under the contract or any agreed amendment were one of the listed objective of consultant in this project, were as it can be seen from the table 4.6 that the executed amount is more than double price of contact amount. And the project took more than three years beyond the contract time

	Contract_amount	Executed amount	Cost growth
Construction service	451,790,275.11	1,073,970,883.53	137.7%
Consultancy service	11,309,330	16,922,069.45	49.6%

Table 4.6 Contractual Versus actual cost for consultancy and construction

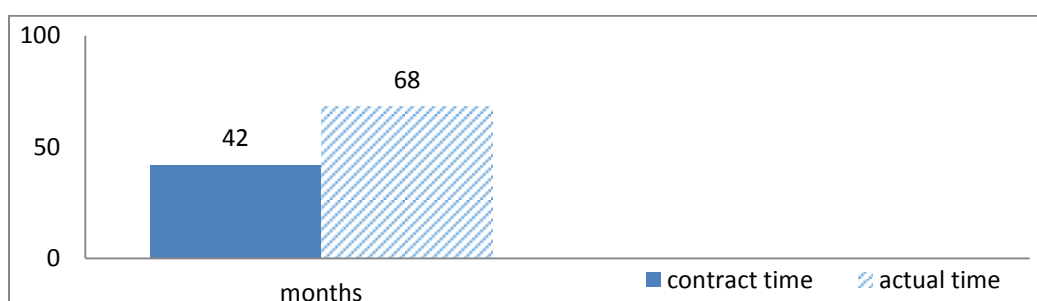


Figure 4.6 Contractual Versus actual time

Causes of time and cost overrun

1. The quantum of earth work quantities in cut and fill increased due to improper geometric design and survey error. The increased earthwork quantum which incurred EOT and cost overrun due to the above reasons could have been managed at the right time with the employer by checking properly the survey control points and distributing observed errors before starting of construction site work.
2. The quantum of minor and major structures increased due to lack of proper and consistent site investigation for cross drainage during design stage and lack of applying detail design procedure.
3. The quantum of protection works increased due to lack of proper handling the design for protection works and the number of major structures on the project road increased to 12 from 3 as provided in the original design.
4. The quantum of protection works increased beyond the limit of road construction activities. Due to the situation of Abala town at the foot hill of a range of high mountains, the supervision consultant had to change drainage design and also provide additional slab

culverts. These situation could have been considered in the first contract if through study were held before design, so that there will not be cost and time overruns beyond the schedule.

5. The quantum of pavement layers increased due to poor geometric design and improper site investigation
6. The contractor is not well familiar with road works. The works done were not systematic and in a programmed way, resulting in inadequate utilization of manpower and resources.

As it can be seen from the above causes most of variations are due to design problem which occurs by not giving enough time and lack of detail studies.

Generally there are lots of variations which are approved and claims for time and money compensations in this project. Almost all of the variations are due to design change and errors that causes extension of time. Table 4.7 shows list of approved variations and table 4.9 shows EOT to create image on how projects are being affected by lack of detail design.

VO No	Description	Amount (ETB)
1	Realignment of sections, Additional drainage structures, bridges, change and design of 3 original bridges and retaining walls at selected location	123,721,187.58
2	Supply of two type A vehicle	7,095,380.52
3	Advance camp for Engineer	3,278,121.00
4	Provision of steel pipe culvert for irrigation	19,828,80.80
5	Protection work for downstream	1,249,584.58
6	New rate for extra items (missed items)	128,224,112.54
7	G.I. pipe for irrigation at bridge crossing	378.605.43
8	Protection in Abala town	5,796,349.68
9	Wireless communication system	2,937,657.00
10	Geo-Technical investigation of 9 Bridges	1,042,404.00
11	Shifting of center line due to land slide	2,510,000.00

12	Increment of pavement thickness in sub base and Base course layers	9,000,000.00
13	Quantity increment due to second design review (increase in masonry quantum, new items and increased in earth work quantum	65,770,000.00
Total		350,624,796.90

Table 4.7 Variations

Variation type				
	Due to design change	ETB in 10 ⁶	Due to quantity increase	ETB in 10 ⁶
1	Realignment of sections and design change in drainage structure	123.72	Quantity increase	128.224
2	Provision of steel pipe culvert	128.224		
3	Shifting center line	2.52		
4	Change in pavement thickness	9		
	total	263.46		128.224

Table 4.8 Major design and quantity variation

Item no	EOT granted	Justification
EOT 01	372	Variation order 02
EOT 02	335	Delay due to discrepancy of survey control point
EOT 03	223	Increased quantum of work
EOT 04	126	Increased quantum of work
Total Date extended		1056

Table 4.9 EOT

The proactive approach is the key factor for successful and timely completion of any project. Regular interaction between the contractor, consultant and the employer is necessary, the works not done according to specification results in repetition of activities. It is wastage of time and money for redoing the work. In the absence of effective planning, skilled personnel and works without technical specification causes failure in the project by causing money and time loss.

4.3.4. Hargele – Dolobay – Dolo odo (DB)

Hargele-km 60+000 Road is located in Somalia regional state, Afdera zone which is the first phase of Hargele-Dolobay-Dolo Odo Road project. The road starts at a station of 000+000 from Hargele town and terminates at 58.674km. Hargele-Dolobay-Dolo Odo (Contract 1:- Hargele-km 60+000) Road project was intended to be completed in 1095 calendar days including 3 months of mobilization period but completed by 731 calendar days. Enyi General Business plc, Enyi construction is the design builder and Transport construction design Share Company is the consultant for the project. The project is funded by Federal Democratic Republic of Ethiopia.

The Design builder has planned 82.159% of the contract amount during the completion of the project and the actual accomplishment of the design builder was 100% of the contract amount while the elapsed time was 77.90% of the contract time during the completion of the project. As it is indicated above the design builder had recorded 22.1% ahead of schedule.



Figure 4.7 Map showing Hargele – Dolobay – Dolo odo (source: - Central Statistical Agency)

As it can be seen on figure 4.8 contractual completion time is much greater than actual completion time and Actual project amount exceeds contractual amount only due to price adjustment there is no any additional cost incurred due to changes or variations

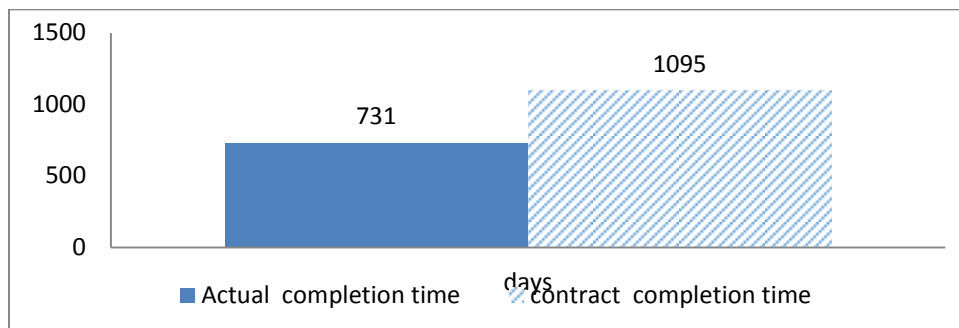


Figure 4.8 Contract Versus actual time

Though the project is completed ahead of time there were problems in the project in which most of it was machinery failures and rainfall cases. Also there were design delay for part of the road but these cases except rain were contractor's responsibility, so the design builder solved the problems encountered within the reasonable time for completion of the project. As a result the project is completed ahead of seven months from the original completion time of the project.

During construction period the right of way obstruction was identified and removed timely within the route corridor. And the contractor identified and conducted quality requirement tests and requested the possession of quarry site in the construction period. Following that the consultant notifies ERA to assign right of way agent to settle during the construction period and the matter solved without any delay. These cooperation and fast responses on right of way cases contributes for the earlier completion of the project.

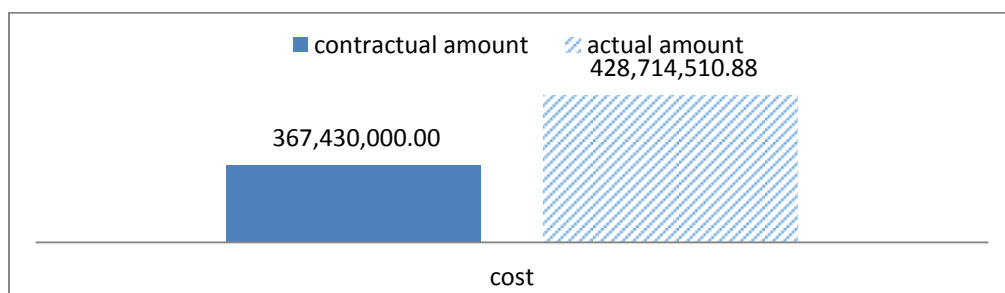


Figure 4.9 Contract Versus executed amount

There were claims and disputes raised. The claims were for unexpected rain in November, delay in approval of working drawing and late payment certificate. Though none of the claims are approved this type of claim is frequent and it might be the cause of delay in other projects. The dispute raised was due to disagreement in determination of price escalation of reinforcement bar it was solved after a year by approval of the client for the proposal of rate by claim expert.

Generally the project is completed ahead of time and the problems encountered were solved without any delay. The process of designing and construction proceed accordingly though there were design delays and late approval for part of the road it didn't cause any idle resource and the revised master schedule helps to maintain the track. There were clearly defined employers requirement and also excellent performance of contractors in both design and construction. Also smooth communication between owner and contractor helps to maintain cost and time of the project.

4.3.5. Agulae – Shaigube – Berahile (DB)

The road Agulae – Shaigube - Berahile is located in the northern part of Ethiopian in Tigray and Afar regional states. It connects Dallol depression with the main highway of Mekele – Wukro Road. ERA entered an agreement on August 3, 2010 with Defense Construction Enterprise at a cost of ETB 969,916,753.17, including ETB 69,000,000 provisional sum, to design and build the road in 1095cal.days. Supervision of the project's design and build work done by Eng. Zewdie Eskinder & Co. Plc. as employer's representative



Figure4.10. Map showing AGULAE – SHAIGUBE – BERAHILE (source: - Central Statistical Agency)

Time elapsed including mobilization period is 1694 Calendar days or 198.5% of the Contract time. The Contractor started permanent work activities on February 11, 2011 even though he scheduled to start the permanent works on December 1, 2010 after 70 days of delay. This delay was caused mainly by the delay in Design work, Mobilization of Equipment and Instruments, and the delay in the construction of the Employer's Representative Camp and Laboratory.

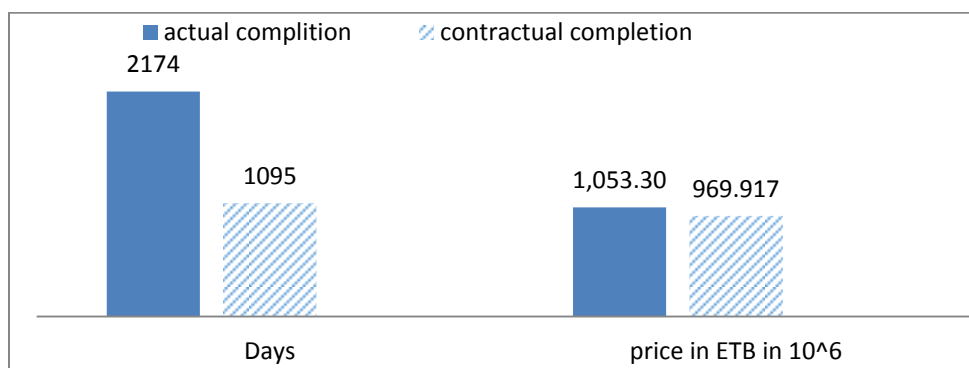


Figure 4.11. Contract Vs actual completions

According to the contract, the time for the design work shall not exceed six months from commencement. However, the Contractor was doing the design, investigation and survey works up to almost end of the project.

Regarding cost of the project, there was no additional work or amendment on the contract so, except price adjustments there were no additional cost incurred but the extension of time causes for the increment of the cost by contributing for price escalation which would be removed if the project ends at time. There would be lesser effect of inflation and faster construction operation, which in a commercial context, produces an earlier return on the capital invested if projects can end according to contract time.

A. Claims

The contractor submit his claim for the consultant for the delay in removal of electrical pole, after reviewing the document the consultant send his decision to the owner for the approval and time claim was granted to the contractor with the contractor's undertaking not to claim for cost

The contractor submitted intent to claim regarding delay in the approval of Alignment within the escarpment section and the contractor collectively requested a total of 217 calendar days

pursuant but only 99 calendar days were granted, As the contractor didn't mobilize man power & equipment in excess of available activities, and also didn't keep any record of idle time. Therefore the contractor has given undertaking not to claim for cost.

The contractor also presented his claim For the change of multiple cell box culvert to bridges and 138 calendar days were granted

- ✓ There were no amendment and variation in this project.

4.3.6 Abala – Shaigube (DB)

Abala-Shaigube road project is located in north part of regional state of Afar with a length of 63km. SUR construction took the Design and construction contract to complete the work within 2.5 years by commencing the work at 29th July 2010 so that contract completion day to be 14th January 2013 but it is completed at 31st January 2014 which is 382 days beyond the contract.

	Contractual	Actual	Cost and time Growth
Days	894	1276	42.7%
ETB	707,955,759.00	993,553,375.57	68%

Table 4.10 Time and cost growth in Abala – Shaigube

The contractor spent

- ✓ More than six months to commence the employer's representative camp construction
- ✓ More than seven months to get approval of the design works for the first stretch
- ✓ More than seven months to commence and execute permanent works
- ✓ More than nine months to submit finalized hydrology report that suit the existing site condition
- ✓ More than eleven months to submit a single final report of topography design report

Generally the contractor has delayed in design, mobilization of resources and commencing the actual works.

A. Claims

#1. Under this claim event the contractor has requested time extension of 265 days for completion of the work owing to delay in approval of the route alignment in Abala town however the employer only approved 14 days of EOT in the first claim but it was reclaimed for revision.

#2. Under this claim the contractor requested 199 days for completion of the works in to the alleged delay in the removal of obstructions within Abala town section

In this project contractor's capability is in question due to contract failure to proceed with schedule starting from design, mobilization and commencement. There is no variation and dispute in this project that means there is no additional cost other than price adjustments. But 139 days of EOT has been approved for the second claim which contributes for increase of price adjustment.

4.4 .Comparison on DB Vs DBB

Table 4.11. and table 4.12 below shows percentage increases from contract amount on time and cost in DB and DBB projects assessed above in order to indicate which delivery method has greater time and cost overrun so that recommendation and corrective measures can be given.

Delivery method	Project name	Distance	Surface type	Contract amount	Executed amount	Percentage increase	Percentage increase for DB and DBB
DBB	Gore Gambella	143.4km	DBST	817,570,809.78	1,005,000,000	22.9%	76.2%
	Wach - Maji	175km	AC	775,621,616.40	1,306,039,296.91	68%	
	Hawsusewa- Abala - Irebti	94.192km	AC	451,790,275.11	1,073,970,883.53	137.7%	
DB	Hargele- Dolobay-dolo odo	58.674 km	Gravel	367,430,000	428,714,510.88	16.68%	31.09%
	Agulae- shaigube-	74.92 km	AC	969,916,753.17	1,053,300,000	8.6%	

	berahile						
	Abala-shaigube	57.145 Km	AC	707,955,759.00	993,553,375.57	68%	

Table 4.11 Cost overrun comparison on DB Vs DBB

Delivery method	Project name	Contractual days	Actual days	%age increase	Mean percentage increase for DB and DBB
DBB	Gore Gambella	1095	1569	45.75%	47.55%
	Wach - maji	1277	1724	35%	
	Hawsusewa-Abala - Irebti	1260	2040	61.9%	
DB	Hargele-Dolobay-dolo odo	1095	731	Ends before contract time	47.07%
	Agulae-shaigube-berahile	1095	2174	98.5%	
	Abala-shaigube	894	1276	42.7%	

Table 4.12. Time overrun comparison on DB Vs DBB

Delivery Method	Project name	Cost per KM	Average Cost/KM (ETB)
DBB	Gore Gambella	7,008,368.20	8,624,461.00
	Wach – maji	7,463,081.70	
	Hawsusewa-Abala - Irebti	11,401,933.11	

DB	Hargele-Dolobay-dolo odo	7,306,720.37	12,917,416.24
	Agulae-shaigube-berahile	14,058,996.26	
	Abala-shaigube	17,386,532.08	

Table 4.13 unit cost comparisons on DB Vs DBB

It can be seen that unit cost of projects per Km is higher in DB projects than DBB. This justifies DB projects got higher cost but the cost is defined early before starting the project and the variations and additional works are minimum. The risks of uncertainties are all absorbed by DB contractor so, usually cost of DB projects is higher which is aimed to compensate the uncertainties. But generally DB projects perform better with regard to costly completion of projects while compared to contract amount. From the above table 4.11 it can be seen cost is highly increased in DBB (76% increase) from contract amount. In most of DBB projects additional works, variations, design changes, ROW and price adjustments are the main causes for cost and time overruns.

Delivery type	Projects	Variation due to design change	Km	Variation per Km	Average variation
DBB	Gore Gambela	48,090,000	143.4km	335,355.65	1,077,069.49
	Wacha Maji	17,290,000	175km	98,800.00	
	Hawsusewa- Abala - Irebti	263,460,000	94.192km	2,797,052.8	
DB	There is no Variation				

Table 4.14 Variation Due to design change

There is around one million ETB design variation on each Km in DBB projects. But there is no variation in DB projects. The above mentioned 8.624 million ETB cost per Km in DBB is

including this variation, though there are lots of variation in DBB projects cost of a road per Km is higher in DB than DBB. So the only benefit in DB with regard to cost is its early determination of project cost.

In DB projects analyzed above there is no additional cost except price adjustments. The system by itself transfer all the risks of additional work and design change issues to the design builder, so all additional costs if any will be covered by the contractor but as it can be seen from the above projects price adjustment contribute millions of ETB above the contract amount which contribute for the 36% increase. But there are time overrun in most of DB projects too that contribute to magnified price adjustments.

The above table 4.12 shows delays both in DBB and DB projects are almost similar but Hargele-Dolobay-dolo odo project shows that there is a chance to complete a project before intended time. additional works, variations, design changes, ROW, works omitted during design stage or due to lack of detail design, quantity increase in earth work and alignment changes are the major causes of delay in DBB projects. Whereas late submission of design and late approval, ROW issues, late mobilization and commencement of the work and lack of experience on local contractor are the main causes of delay in DB projects.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

In this chapter conclusions will be drawn from the analysis and recommendation will be forwarded. According to the findings conclusions on applicability and performance of DB and DBB delivery methods, challenges observed and favorable conditions to apply are drawn. Also remedial measures that will overcome time and cost overruns and challenges observed will be recommended.

5.1. Conclusion

Every project is limited by time and budget. In order to serve its purpose constructions need to be delivered within specified time. Infrastructures have to give its intended service at the right time and also in countries like Ethiopia who invest its scarce capital on construction, completion of a project within allocated budget is main concern. But most of projects in the country are facing time and cost growth.

Though there are lots of reasons for the above mentioned problems this study aims to suggest better project delivery method that can overcome or minimize time and cost overruns and by identifying the problems faced through DB and DBB, remedial measures for better applicability are developed.

1. Initial cost of a road project per KM is higher in DB than DBB. Due to the unforeseen risk in DB projects cost is higher in DB.
2. Time and Cost growths from contract amount are higher in DBB projects than in DB. Also owner's burden is highly reduced in DB than DBB. 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 sacrificing quality.
3. It is found that cost is the major criterion that is affected more by delivery method used. Lower influence is observed on time growth for different delivery method and time overruns in both methods have opportunities to be improved if right remedial measure is applied. Delays hinder provision of service at right time and also contribute for increase

in project cost and incur additional cost for consultancy service for extended time. In addition to its effect on cost growth delays also cause late response of capital invested on construction which is also loss for the owner.

4. There is a greater chance of finishing a project: with budget, improved construction speed and improved projects delivery speed if DB is used. It is generally concluded that it would be better to entertain DB for complex, defined budget and shorter time projects with a need of minimized risk.
5. Main reasons for time and cost growth in DBB projects are design change, change orders and quantity increase. Also ROW, late payment and weather conditions are causes for delay in DBB. DB projects are facing time overrun due to ROW, delay in designs and its approval, late payment and contractor's incapability. From case study result it is found that majority of cost growths are due to price adjustment, also change in employer requirement contributes for the growth.
6. DBB is more exposed to variations than DB according to the result found from the survey. In projects with frequent variations there are also frequent claims. Both time and cost claims are mostly entertained in DBB than in DB.
7. Being well-known delivery method, simple procurement process, defined scope and lowest price accepted are some of the advantages of DBB. And it is good for simple, uncomplicated projects that are not schedule-driven and not subject to change. Longer schedule for linear process, no design input from contractor, not well suited for complicated projects are some of the problems of DBB.
8. The advantages of using DB generates from: 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.

It is found from the questionnaire that majority of professionals have awareness about alternative delivery method though their applicability in the country is very low, and the reasons mentioned are lack of experience, the need to use usual method, ignorance and lack of knowledge of

Authorized persons or leaders of organization who has power to determine project delivery method.

5.2 Recommendation

Due to the fact that projects are facing time and cost overrun, remedial measures should be taken in order to save time and budget of the country. Professionals and every participating party should work hard to have better performance of projects. In order to get better performance of projects the following points should be given due consideration

- Objective of project should be identified before selection of project delivery method so that proper selection will be held that helps for achievement of the project
- In selection of PDM project time, cost, need of risk minimization and level of experts on the owner side should be considered
- Professionals and authorized persons who have the power to determine delivery method should update themselves to the recent and effective PDM that have greater performance on international experience
- Organizations need to consider DB as an alternative way to deliver projects rather than sticking on traditional method that is DBB
- Guidelines that shows advantage, drawbacks, favorable conditions, challenges and characteristics of different delivery method should be prepared in order to ease selection by owner
- during construction period the right of way obstruction should be identified and quarry sites should be requested earlier after conducting quality requirement tests for possession and there should be permanently assigned ROW expert to settle these issues

Specifically in order to find better output from DB projects the following points should be considered

- In order to minimize the unforeseen risks and its related cost explicit study should be performed before determining the rate so that magnified budget for the risk can be minimized
- The owner should be able to clearly and explicitly state his expectations – Statement of Requirements, end user needs and priorities for the project to all bidders

- There should be best merging of design and build section who can provide designs within specified time and that can deliver constructions without delay
- Employer representative should have strong communication with design builder and follow design provisions for approval and early approval should be given
- Owner should have (in house) or hire project management expertise and be prepared to commit these resources to the project
- There should be clear understanding on Design-Build process, and fully understand the apportionment of risk between himself and the contractor
- There should be authority for contract award other than to the low-price bidder
- Decisions should maintain effective fast-tracking of design documentation and construction
- In order to overcome quality problem in DB there should be strict follow-ups on design approval
- International experiences should be shared
- Further depth study with enough number of sample projects should be done.

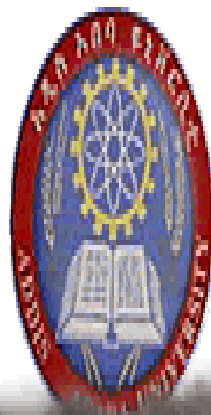
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Master's Thesis Proposal

Project delivery systems and their effects on cost and time overrun on ERA projects

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ABSTRACT

This study will assess available project delivery methods in ERA projects and its effect on time and cost overrun. Most of projects in Ethiopia are facing time and cost overrun. Though the reasons are diversified there are cases in which inappropriate delivery methods can be considered as the cause. Before the project procurement is held identification of project objective and careful selection of project delivery method should be done so that time and cost of the project which are some of the objectives can be achieved.

Studying application of different delivery methods, discover results experienced in different delivery methods and its relationship with time & cost overrun are the main purpose of this thesis so that correction measures and recommendation will be suggested.

This topic is selected because time and cost overruns are always observed in public construction and alternative delivery methods are not being applied. Most of construction projects in the country are procured through Design bid build (DBB) method without checking whether it will help to achieve project objective or not. The root cause for not considering alternative delivery method will be checked through interviews and desk study. Also case studies will be performed to identify correlation between different methods and timely and costly completion of a project.

INTRODUCTION

There are generally two ways of accomplishing construction projects: 1) construction by contracts, and 2) 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. (1)

In accomplishing the project by contract, different Project Delivery System will be used in which 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. (2)

Project delivery methods can be the traditional one which is Design-Bid-Build DBB or innovative delivery systems such as, Design-Build (D-B), Design .Build- Operate (D-B-O), Construction Management (CM At Free & At Risk) etc

Construction of a large facility takes a long time and usually involves a large capital investment. Cost overruns, delays and other problems tend to be proportionally huge. Cost is one of the primary measures of a project's success. This is true, especially for public projects in developing countries like Ethiopia, because public construction projects in these countries are executed with scarce financial resources. In construction projects the common criteria for project success are generally considered to be cost, time and quality.

This research will cover different project delivery methods and its effect on timely and with budget completion of the project in ERA projects. The main purpose of this research is to assess the applicability of different project delivery method and its effect on timely and costly completion of the project.

The study will address time and cost overrun cases in different delivery system so that the relationship will be studied. After analyzing different cases of delivery systems and its effect of time and cost overrun, better applicability of delivery system will be suggested. Also by knowing the relationship measures will be suggested to overcome the problem.

STATEMENT OF THE PROBLEM

Though there are lots of project delivery methods, traditional way which is DBB is mostly used in Ethiopia which might not fit for all projects. Every project has its own nature or characteristic which needs different treatment to meet its goal but using already adopted method for all projects will lead to failure to meet project objectives or will not fit to the project situation.

Projects are facing time and cost overrun. Abebe and Girmay indicated that claims, in some projects, in Ethiopian construction sector have been observed reaching up to 200-300% of the project cost. (3) Also according to lemma most projects in oromia region shows up to 80% time overrun. (1)

There are cases in which improper selection of project delivery method can be cited as one of the main causes of contract disruption and then claims. Unless care full attention is given to the selection of project delivery system it will affect project time certainty, cost, quality and owner's interest and administrative burden.

Project finishing on time and absence of cost overruns are considered the most important factors of successful projects, which help to decrease problems for all parties and give new chances to construct other related projects. Most construction projects are exposed to delay to the extent that it may extend to the double period of time specified for that project, causing loss of project's profit, increasing cost and leading to technical and managerial problems between project's parties. Cost overruns is also considered another a big problem.

So, it is the interest of this research work to assess the existing situation in ERA and to identify the relationship between project delivery system and time and cost overrun, and to suggest better

way of applying different project delivery method so that it will ensure timely and costly completion of the project.

LITERATURE REVIEW

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. (2)

When the project owners engage themselves to undertake the project, it is called a force account delivery system. Such a system is often promoted if the Project Owners believe that there is a comparative advantage in cost, time & quality. But Most of the project delivery methods/systems are found under the category of outsourcing. The following are some of them.

- ✓ Design-Bid-Build (D-B-B);
- ✓ Design-Build (D-B);
- ✓ Construction Management (CM At Free & At Risk);
- ✓ Design .Build- Operate (D-B-O);
- ✓ Design-Build-Operate-Maintain (D-B-O-M);
- ✓ Design-Build-Finance-Operate (D-B-F-O);
- ✓ Full Delivery or Program Management;
- ✓ Build-Own-Operate (B-O-T);
- ✓ Build Own Operate Transfer(B-O-O-T); (2)

Globally, innovative project delivery methods, where a contractor offers broader service packages, are increasingly used in the infrastructure sector. Nevertheless, completion of a construction project on time, within budget, and in a form that meets the owner's needs most effectively is one of the pitfalls in Oromia/Ethiopian construction industry.

One method to avoid these pitfalls is to put together a team of people whose skills match the type of projects envisioned and who have a proven record of delivering such projects. Before this team is put together, the owner should decide how the members will interact with both the owner organization and with each other-deciding on the project delivery method. (1)

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.

Hence, there should be understanding of the importance of appropriate project procurement methods, as there seem to be some linkage between project delivery method and cost and time overruns and industry under-performance.

Time overruns is defined as the time increased to complete the project after planned date which caused by internal and external factors surrounded the project. Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase," or "budget overrun. (4)

Changes to the base contract occur almost in every construction project. These changes can result from the owners adding additional scope of work differing site conditions, errors or omissions in the contract documents, delays by the owner, unpredicted conditions, constructive change and /or acceleration. Construction projects frequently suffer from delays and are usually completed within a period longer than what is agreed upon by the contracting parties. Substantial financial claims can arise from those circumstances; and consequently clients and contractors often argue about the causes of and liability for the delay circumference. (5)

In the developed world, the excessive use of the DBB method has given reasons to investigate innovative project delivery methods. Although a proliferation of construction projects delivery methods are available, there is still considerable confusion about their application and use.

Clarification of their differences is critical to understanding how they can best be utilized to enhance the project procurement process and leverage in-house expertise and project funding. Based on literature reviews, the primary reason why innovative project delivery methods are selected by public-works owners is to shorten the duration on specific projects by merging the design and construction processes. Quality, cost effectiveness, and a single point of responsibility are also cited as reasons to pursue these innovative methods.

OBJECTIVE OF THE STUDY

The objectives of this research are:-

- ❖ Assessing effect of project delivery methods on time and cost overrun
- ❖ Identifying favorable conditions to apply alternative delivery methods and pointing merit and demerit of delivery methods
- ❖ Recommending better project delivery method by making comparison on cost and time performance of DB and DBB projects.

RESEARCH METHODS

The following methods will be employed to achieve the objectives of this research:

- **Reviewing literatures on project delivery methods and related cost and time overrun**
Available project delivery methods in the country specially in ERA will be assessed through literatures and time and cost overrun cases will be reviewed in relation to the methods.
- **Questionnaire**
Questionnaire will be distributed for different professionals to assess their opinions on project delivery methods.
- **Selecting & Analyzing sample case studies**
Case studies in ERA with for DB and DBB project delivery methods will be done to see the correlation between project delivery method and time and cost achievement.
- **Based on the analysis to be made using the above surveys, questionnaire and case studies conclusion and recommendations will be derived.**

WORK SCHEDULE

The thesis work is going to take six month starting from December 2014 to May 2015. The whole work schedule is shown below:

Item No.	Description of Activities	Duration (Weeks)	2014	2015				
			December	January	February	March	April	May
1	Literature review	4						
2	Preparation Of Interview Questions	2						
3	Data Collection through interview and case study	5						
4	Data Analysis and interpretation	3						
5	Discussion of results and findings	4						
6	Preparation and submission of draft thesis	3						

7	Preparation and submission of the final thesis	3							
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BUDGET

The total cost of the project is estimated to be **14,800.00** birr based on the activity plan. The detail cost breakdowns are listed as follows:

ACTIVITIES	UNIT	QUANTITY	UNIT PRICE (BIRR)	TOTAL PRICE (BIRR)
Photo copying	pcs	2,000	0.75	1500
Stationary materials	Ls	1	2000	2000
Secretarial services	Ls	1	1000	1000
Personnel for collection of questionnaires	Ls	3	1000	3000
Printing service cost	pcs	1	1500	1500
Transportation	Ls	1	2,000	2000
Communication (telephone cost) & internet servies	Ls	1	2500	2500
EVDO apparatus	pcs	1	1000	1000
Flash disk 8GB	pcs	1	300	300
Total Cost				14,800

REFERENCES

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3. Abebe, D., and Girmay, K. (2003). Claims in International Construction Projects in Ethiopia, ZEDE, Journal of EEA, Vol. 20, pp 1-24.
4. Jomah Mohammed Al-Najjar, (2008) Factors Influencing Time and Cost Overruns on Construction Projects in the Gaza Strip
5. Anwar M. Omar, (2007) delay claims management in construction, Gulf project management magazine September

SIGNED DECLARATION SHEET

I the undersigned, declared that this thesis is my original work and has not been presented for a degree in any university and that all sources of materials used for the thesis have been duly acknowledged.

Title of the thesis:

–Project delivery systems and their effects on cost and time overrun on ERA projects”

Name: Rahel Tariku

Place: Addis Ababa, Ethiopia

Signature: _____ Date: _____

This thesis has been submitted for examination with my approval as university advisor:

Name: Prof. Dr.–Ing. Abebe Dinku

Signature: _____ Date: _____