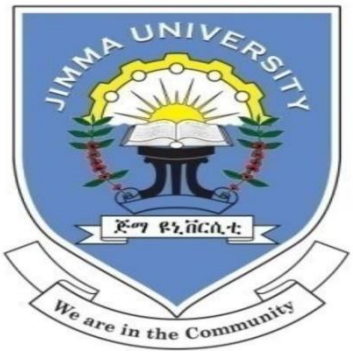

JIMMA INSTITUTE OF TECHNOLOGY
SCHOOL OF GRADUATE STUDIES
FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING
CONSTRUCTION ENGINEERING AND MANAGEMENT CHAIR

"ASSESSMENT OF THE EFFECTIVENESS OF DESIGN-BID-BUILD AND DESIGN-BUILD DELIVERY METHOD IN INDUSTRIAL PARKS DEVELOPMENT PROJECTS IN ETHIOPIA"

A Thesis submitted to school of graduate Studies Jimma University, Jimma Institute of Technology. Faculty of Civil and Environmental engineering in partial Fulfillment of the requirements for the degree of Master of Science in construction Engineering and management.

By

Tesfaye Likisa

August, 2020

Jimma,Ethiopia.

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Advisor: Eng. ALEMU MOSISA (Assistant Professor)

Co-Advisor: Eng.ABAY LEGESSE(PhD Candidate)

August, 2020

Jimma,Ethiopia

DECLARATION

I declare that this research entitled **"**Assessment of the Effectiveness of Design-Bid-Build and Design-Bid Delivery systems in Industrial Parks Development Projects in Ethiopia "is my original work and has not been submitted as requirement for the award of any degree in Jimma University or elsewhere.

Tesfaye Likisa	_____	_____
NAME	SIGNATURE	DATE

As research Advisor, I hereby certify that I have read and evaluated this thesis paper prepared under my guidance Eng Alemu Mosisa (Ass. Professor) entitled **"**ASSESSMENT OF THE EFFECTIVENESS OF DESIGN-BID vs DESIGN-BID-BUILD DELIVERY METHOD IN INDUSTRIAL PARKS DEVELOPMENT PROJECTS IN ETHIOPIA" and recommend and would be accepted as a fulfilling requirement for the degree Master of Science in Construction Engineering and Management.

Advisor: Engr. Alemu Mosisa (Ass. Professor)	_____	_____
NAME	SIGNATURE	DATE

Co-Advisor: Engr.Abay Legesse (PHD Candidate)	_____	_____
NAME	SIGNATURE	DATE

ABSTRACT

Success or failure of any project is greatly influenced by the performance of cost, time and quality. The performance of each project may differ with the type of project delivery system used. Therefore, performance of projects under each delivery system should be considered in making the decision to select suitable procurement system. In Ethiopia Industrial Parks Development Corporation, Design-Bid- Build and Design-Build are the two dominant project delivery systems used. As various study shows, construction projects in Ethiopia experience cost overruns, completed far behind schedule and are of low quality due to inappropriate project delivery method selection.

Therefore the aim of this study is to assess the effectiveness and overall evaluation of Design-Bid-Build and Design-Build project delivery systems in industrial park projects in Ethiopia.

First factors which used to select Project delivery system, main causes for time and cost growth and factors which affect quality of the project were identified intensively from extensive literatures. In addition, other local factors (context to our country) have been added as recommended by experts and according to the researcher's own experience in implementing construction projects. Then data were collected from Industrial Parks Development Corporation archive, desk study, and interview & by questionnaire from clients, consultants, contractor's Representative. Both primary and secondary data collection procedures were conducted. The research method used was quantitative non experimental method. Quantitative analysis was done by descriptive statistics and Relative importance Index (RII) technique was applied for ranking of critical factors.

Accordingly, the factors used to choose appropriate Project delivery system are ranked using relative importance index (RII). The result shows top four factors used to select Design-Bid- Build are; Size and complexity of the project; Urgency of completing the project, Available budget for the project and Project design/ innovation. Whereas for Design-Build top four factors: Size and complexity of the project, Urgency of completing the project, Available budget for the project and Time. The main causes for time overrun (schedule growth) of design-bid-build projects are ***(top three factors)*** *: -Right of way problem, inadequate planning, Contract scope change, Whereas the main cause of schedule growth for Design-Build project delivery system are* ***(top three factors):*** *-Right of way problem, inadequate planning and contract scope change modification. Similarly, the main causes for cost overrun (cost growth) of design- bid- build projects was additional works; time delay, inadequate pre-planning, take the top three causes for cost growth which is similar to Design-Build project delivery system. In addition, material, machinery and labor cost increment is the main cause of cost growth for Design-Build project delivery system.*

The research result shows also design- build system outperformed design-bid- build in terms of time and cost growth. The result and overall evaluation of this research is therefore encouraging(recommend) and very helpful for Industrial Parks Development Corporation to shift its Project Delivery Method from Design-Bid- Build to Design-Build so that by reducing main factors of cost and time growth identified for Design-Build project delivery method in this thesis.

Key words: DBB, DB, IPDC, Project Delivery Method*.*

ACKNOWLEDGMENTS

First of all, my special thanks go to the Almighty God. Then, I would like to express my deepest gratitude to Ethiopian Roads Authority for sponsoring this scholarship program.

As well, I want to present my deepest gratitude to my Main advisors, Eng. Alemu Mosisa (Assistant Professor) & Co-Advisor Eng. Abay Legesse (PhD candidate) for their consistent support, guides and encouragement.

Also, I would like to thank Jimma University, Institute of Technology & Faculty of Civil and Environmental Engineering for allowing me to pursue post graduate studies for my professional advancement.

Finally, I am deeply grateful to all who have given assistance in obtaining the required information, data and also who have helped me in filling the questionnaires and give me their precious time for interview.

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ABBREVIATION

AIP	Adama Industrial Park
BDIP	Bahir Dar Industrial Park
BLIP	Bole Lemi Industrial Park
CETP	Chemical Effluent Plant
CMR	Construction Management at Risk
CPD	Causes of Project Delay
DB	Design-Build
DBB	Design-Bid-build
DBIP	Debre Brihan Industrial park
ETB	Ethiopian Birr
GTP	Growth and Transformation plan
HIP	Hawasa Industrial park
IP	Industrial Parks
IPDC	Industrial Parks Developments Corporation
JIP	Jimma Industrial park
KIP	Komboch Industrial park
KLIP	Kilinto Industrial Park
MIP	Mekele Industrial park
PDM	Project Delivery Method
PDS	Project Delivery System
STP	Sewage Treatment Plant
UNIDO	United Nations industrial Development Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of study

Industrial parks are one of the most important factors supporting positive economy development with high economy turnover and high employment (Gebeyehu, 2017.) by attracting investment in the manufacturing sector.

Since the 1960s, an increasing number of countries have embarked on the road to promote industrialization and economic restructuring through industrial parks. For developing countries like Ethiopia, industrial parks can maximize resource integration for limited production factors within a certain spatial scope. By attracting labor and capital-intensive domestic and foreign investment in manufacturing and service industries, industrial parks can not only increase job opportunities, wages and skills of local workers. Furthermore, they can also establish links to global value chains through participating in international competition, technology transfer, foreign exchange and making full use of comparative advantages to promote the upgrading of industrial structure, and constantly improve the country's position in the international division of labor. Currently, the industrial park economy has become a global trend and contributes in our country's economic growth (Zhang *et al*, 2018).

Industrial parks development in Ethiopia was established through proclamation No.886/2015 as one of the public enterprises. It becomes an engine of rapid industrialization that nurture manufacturing industries, accelerate economic transformation, promote and attract both domestic and foreign investors. The goal of industrial parks is necessary to accelerate the economic transformation and development of the country through the establishment of industrial parks in strategic location to promote and attract productive domestic and foreign direct investment there by upgrading industries and generate employment opportunities. (IPDC Regulation, 326/2014).

Generally industrial parks development is started in recent years in our country. No further research is conducted on this topic area and it needs further studies to add knowledge or fill the gap and recommend which delivery sub system is more important and effective for the organization.

1.2 Statement of the Problem

On today's world there is variety of project delivery methods for project developer on the market. Among them design bid build, design build, turnkey, design build operate transfer, construction management at free and construction management at a risk are mostly used. But there is lack of experience and knowledge gap, lack of Legal and regulatory ability to use various innovative project delivery systems by project owners.

Generally, construction projects in Ethiopia experience cost overruns, completed far behind schedule and are of low quality as various studies shows. It is not uncommon to read and hear about determination of contractor's employment due to nonperformance and poor-quality work man ship. 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 to 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 (*Tariku, 2016*).

As literatures show absence of proper project delivery system is one of the reasons for long delay and cost increment on many projects. (Asaminew ,2013).Study conducted by (Mosisa,2006) in Ethiopia, Oromia regional state ,There are cases in which improper selection of project delivery method can be cited as the main causes of contract disruption and then claims.

Clients are incurring cost overruns of between 60 – 180%) (Exclusive of inflation) and time overruns of 12 – 24 months on construction projects in Ghana today (Ameyaw, 2009)

Adopting the most appropriate PDS is a process that entails detailed analysis of multiple criteria and situations and does not follow a "one size fits all" approach .The present body of knowledge concerning project delivery systems imply that the type of delivery system applied in a project has a direct impact on the outcome of the project (pooyan, 2012).

Therefore it better to identify the root cause of improper selection of project delivery system, cost overrun, time overrun and quality deviation and propose the alternative solution in the case of IPDC.

The objective of this research is also to evaluate the performance of projects completed and on progress through DBB and DB methods and compare their performance, (based on time, cost and quality) & identify the existing problems and to recommend feasible alternative delivery method in the context of IPDC.

1.3 Research questions

i. What are the factors used to select the sub-delivery system (DBB vs. DB) for the successful completion of industrial parks development projects in Ethiopia?
ii. What are the performance of DB and DBB in industrial parks development projects in Ethiopia.
iii. Under what circumstances does DBB or DB delivery system effective in industrial parks development projects in Ethiopia?

1.4 General objective

The general objective of the study is to assess the effectiveness of design-bid and design-bid-build delivery system in industrial parks development projects performance in Ethiopia.

1.5 Specific objectives

1. To investigate the factors used to select the sub-delivery system in industrial parks development projects.
2. To evaluate the cost, time and quality performance of the traditional design-bid-build and the design and build Delivery methods in industrial development projects in industrial parks development project
3. Provide an overall evaluation of DBB and DB and finally recommend better project delivery method in industrial development projects in Ethiopia.

1.6 Scope and limitation of study

The research will focus on completed and on progress projects since the establishment of industrial parks development in Ethiopia. It also mainly focuses on the assessment of the effectiveness and implications of DB project delivery versus the traditional DBB project delivery in terms of selected project characteristics and relevant/measurable performance criteria based on the data collected from

industrial parks development projects. Project performance inspect carefully in this study is limited to the settled costs, and schedule measures of the projects reported and not include time and cost for pre planning and feasibility studies of the projects. The limitation in this study is the number of DBB projects which are limited in the industry parks development. In comparison to DBB delivery method the DB project delivery method has somewhat better available data and greater in number. Therefore, the findings of this study are influenced by the insufficiency of data and no of the DBB project delivery method. In spite of the fact that the DB delivery method is recently adopted to industrial parks development projects, as much as possible it is better to evaluate the data available at hand. Therefore, care should be taken to interpret the results of this study for other types of projects.

1.7 Significant of the study

Due to recent establishment of the industrial park's development projects in Ethiopia no further study or research is conducted on the area. And it opens doors further for other researchers and fill gaps for IPDC, contractors, and consulting firms who engaged on Industrial construction projects. In addition, the significance or merit of this study lies in making a contribution to the understanding of the importance of appropriate project delivery systems, as there seem to be some linkage between project delivery method and cost and time overruns and the project performance.

CHAPTER TWO

LITERATURE REVIEW

2.1.General

2.1.1 Origin of industrial Parks

Industrial Estate is the combination of two words –first, Industrial which means consisting and pertaining similar types of industries or it also concerns to those employed in labor, especially in manual labor, and their wages, duties, and rights, and second, estate which means a landed property usually of considerable size to be used and developed for specific purpose.

Thus, industrial estate means an area specially designed and developed for the establishment of manufacturing units with all necessary facilities. (https://shodhganga.inflibnet.ac.in/bitstream/). The concept of industrial park can be dated back to the industrial revolution of the 18th century during which countries formed industrial areas to facilitate industrialization. (*Weldesilassie et.al*.2017). Various definition of industrial park have been made through different time since the evolution of industrial parks (also known as industrial state, trading state).

2.1.2 Special features of industrial parks

Before embarking on describing various delivery methods, it is important to note the features of industrial parks projects that distinguish them from other industry projects because these features may have an effect on the selection of project delivery system.

During field visit and review of documents the industrial parks developed by IPDC have complex infrastructures and buildings. IPDC has its own standards for design which was adopted from international standards and Employer's requirements. Therefore,

DB contractor is expected to come up with a proposal that consider 15 years or less payback period (excluding business and commercial facilities in the calculation) for calculating the total project cost without compromising functionality of buildings and infrastructure for the intended purpose.

The park includes infrastructures like roads with different topology design, storm water drainage, sewage treatment plant (STP), central effluent plant (CETP), water supply, power and telecommunications and buildings like factory sheds with different size (3000 m2-11,000m2), commercial and administration building, main gate (the industrial parks are bonded park, with CCTV camera so that customs will take place in a single location at entrance and exit). The entire compound has artificial lightening system covering the entire perimeter following fence, for roads road lightening and traffic lightings are included inside it.

2.1.3 Purpose of industrial parks in Ethiopia

Industrial park development corporation is a public enterprise which is established through proclamation (proclamation no 886/2015) to accelerate the economic transformation and development of the country through the establishment of industrial parks in strategic location to promote and attract productive domestic and foreign direct investment thereby upgrading industries and generate employment opportunity.

2.1.4 Current status profile and future industrial parks in Ethiopia

Several Industrial parks are being developed throughout the country (Regional State, private owned) Current Federal industry park corporation development (IPDC)’s detail information is summarized in the following table.in addition IPDC has three industry parks which is on planning stage (Samara, Aysha & Asosa).

Table 2-1 current status of industrial parks in Ethiopia (Source http://www.ipdc.gov.et/index.php/en/industrial-parks)

Name of Industry park	Adress (Region, Woreda, Sub-city)	Eligible Sector	Amount of land in hectare	Total Number of shades	Type and Number of Sheds				Status of IP	Remark
					11000 m^2	**5500 m^2**	**3000 m^2**	**Other types in m^2**		
Bole lemi –I	Addis Ababa	Apparel & textile	172	20	10	10	-	-	Operational	**Fully occupied**
Bole lemi –II	Addis Ababa	Apparel & textile	181	2 sheds & Serviced land	1	1	-	-	Ready for sublease	-97.25/ha leasable Serviced land available
Kilinto	Addis Ababa	Pharmaceutical Hub	279	Serviced land					Ready for sublease	146.8/ha leasable Serviced land available
Hawassa Phase- I, Cycle -I	Hawassa	Textile & Garment		37	12	22	-	3 special sheds (39,680 **m^2**)	operational	**Fully occupied**
Hawassa Phase- I, Cycle -II	Hawassa	Textile & Garment	140	15	5	10	-	-	operational	**Fully occupied**
Adama	Adama	Machinery, Apparel & Garment,	120	19	6	9	4	-	operational	**Fully occupied**
Dire-Dawa	Dire-Dawa	Garment, Apparel, and Textile	150	15	5	6	4	-	operational	11 sheds available

Name of Industry park	Adress (Region, Woreda, Sub-city)	Eligible Sector	Amount of land in hectare	Total Number of shades	Type and Number of Sheds				Status of IP	Remark
					11000 m^2	**5500 m^2**	**3000 m^2**	**Other types in m^2**		
Mekelle	Mekelle	Apparel & Textile	75	15	5	6	4	-	operational	4 sheds available
Kombolcha	Kombolcha	Apparel & Textile	75	9	2	7	-	-	operational	**Fully occupied**
Jimma	Jimma	Apparel & Textile	75	9	-	4	5	-	operational	**Fully occupied**
Bahir-Dar	Bahir-Dar	Apparel & Garment	75	8	-	8	-	-	operational	**Fully occupied**
Debre-Birhan	Debre-Berhan	Apparel & Garment	100	8	-	8	-	-	operational	3 Sheds available
ICT	Addis Ababa	IT manufacturing, Business process outsourcing and IT enabling service	200	Buildings for rent and Service land					Operational	Ready for rent and sublease

2.2. Project Delivery Method

Contract or 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 a Construction Project. The project delivery systems also categorized according to their performance Force Account Method (When the project owners engage themselves to undertake the project & believe that there is a comparative advantage in cost, time & quality); Contract Method (When the project owners outsource it).

A project delivery system has been defined as the set of "relationships, roles and responsibilities of project team members and the sequence of activities required" for the deployment of a capital project (Sanvido and Konchar, 1998).

The project delivery method defines the acquisition process, relationships, roles and responsibilities of the project team and the sequence of events to deliver the facility. Depending on what project delivery method is chosen as the acquisition process, roles and responsibilities of team members and the sequence of activities is different (Linda N. Allen, 2001).

Study conducted on Innovative Project Delivery Methods for Infrastructure-An International Perspective (Pakkala, 2002) categorized contract method of project delivery system as (segmentation, integration & financing) listed below, **these are:**

- **Integrated Process Delivery Methods**

  Design-Build-Operate; (D-B-O)

  Design-Build-Operate-Maintain; (D-B-O-M)

  Design-Build-Finance-Operate; (D-B-F-O)

- **Segmented Delivery Methods**

  Design-Bid-Build; (D-B-B)

  Design-Build; (D-B)

  Construction Management ;(CM)

  Pure Operations & Maintenance (O&M)

- **External Financing Methods**

  Design-Build-Finance-Operate ;(D-B-F-O)

  Build-Own-Operate ;(B-O-O)

  Build-Own-Operate-Transfer; (B-O-O-T)

Design-build (DB) and design-bid-build (DBB) are two principal project delivery systems used in many countries .In our countries also Federal road construction and industrial parks developments projects in Ethiopia are the two public enterprise which used the two type of delivery methods. Since the establishment of Industrial parks development projects in Ethiopia has two main project delivery system (PDS) DB and DBB. Most of PDS used in IPDC are DB. Each project is unique and the owner's objectives change from project to projects. Thus, owners should evaluate their objectives carefully and then study the effectiveness of each method in achieving their specific objectives before deciding on the most appropriate delivery method. (El-Sagah, 2008).

2.2.1. Design-Bid-Build (DBB)

Design-bid-build (D-B-B) is a method of project delivery that involves the owner or agency contracting different entities for design and construction. After Project Owners did prepare the Basic Planning that identifies construction project programs, they call upon the participation of Design and/or Supervision Consultants. This Consultant will carry out the design together with the necessary tender documents which will be the basis for tendering to select Contractors.

There are three distinct steps to the design-bid-build method of delivery: the actual design processes, the process of bidding out projects and the construction processes. The design phase involves working with an architect or engineer in order to design a feasible plan that can be taken to contractors during the bidding process. (*De Leon, 2017\).*

The bid phase, also known as the tender phase, involves either "open" or "select" bidding. Open bidding is open to all contractors, while select bidding is only open to certain pre-selected contractors. Bids are analyzed by the general contractor and the architect. There are numerous subcontractors required for every job; that's why an experienced general contractor is your best friend. We find the highest quality contractors and work with them again and again. As a result, of the relationships we've developed, we score discounted rates that are passed onto you

The construction phase is when the actual project is underway and all of the appropriate subcontractors are busy working on their particular tasks. It is all of these sub-contractors that bring the project to life. The general contractor works as a go-between for subcontractors and owners, ensuring projects are on track and in budget every step of the way. They are in charge of resolving any issues that arise and keeping the project owner up to date with progress reports, pictures, etc.

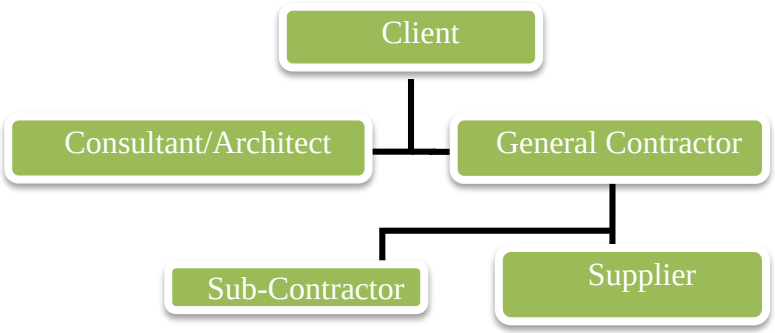


Figure 2.1 Contractual relationship for DBB projects (single prime bidding)

Also (pooyan,2012) classify design bid and build as Design-Bid-Build Using Single-Prime Bidding (As shown on fig. 2.1) & Design-Bid-Build Using Multi Prime Bidding as clearly shown on figure fig 2.3..

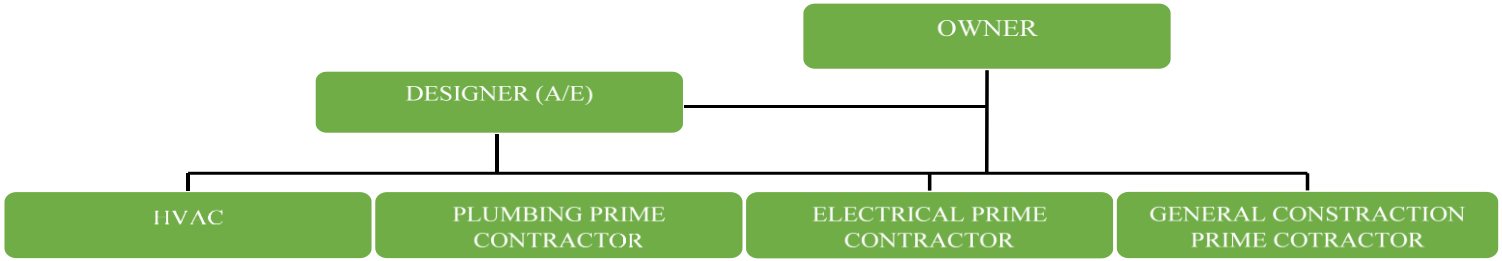


Figure 2.2 Design -bid-build project delivery method using multi –prime bidding

The following defining characteristics identify Design-Bid-Build

- Three linear phases: design, bid and build.
- Three prime players: owner, designer and contractor.
- Two separate contracts: owner to designer and owner to contractor.
- Owner warrants the sufficiency of the plans and specs to the contractor:
- The contractor is responsible to build the project as designed.
- The designer is responsible to design to the professional standard of care.
- Owner is responsible for any "gaps" between the plans and specs and the owner's requirements for performance.

Some of the advantages and disadvantages of design bid and build are listed below but it may not include all the known, but highlights the main points for a clearer understanding of this delivery method's strengths and weaknesses.

Advantage to Design-Bid-Build

- Provides ample options to the owner of the project because you'll have a lot of bids to choose from.
- Helps ensure all bidding contractors are treated fairly
- Open competition;
- Distinct roles are clear;
- Owner flexibility;
- Easy to tender
- Long History of Acceptance.

Disadvantages

- No “fast-tracking” process available”
- Budgets may or may not be met...architects are not always current on pricing market(s)
- Low bidder may not understand project goals, objectives and criteria
- Owner has no control or in put on sub-contractors
- Process puts Owner as issue resolution agent if architectural documents and construction conflict
- No cost savings sharing
- Relationships can be adversarial.
- Innovation not optimized;
- Usually cost overruns;
- Disputes between parties;
- Client retains risks;
- Usually low bid-incentive for change orders;
- Owner responsible for errors & omissions

2.2.2. Design-Build (D-B)

Design-Build (D-B) is simply a project delivery method in which the Owner/Client selects an organization that will complete both the design and construction under one agreement. Upon completion, the Owner is then responsible for operations and maintenance of the project. The Owner is also responsible for all the financing aspects. .(Pekka Pakkala,2002).

In this arrangement both the design & construction liability rests with the Contractor. The purpose of the design-bid process is to reduce risks to the owner of the property by assigning all responsibilities to one single entity. It may also help meet shorter deadlines because you can overlap the design and construction process. *(Perils Construction.Inc. posted by Admin April 17, 2017. 2121 Ponce De Leon Blvd).*

According to the Design-Build Institute of America, the lead position on the project may be assigned to a general contractor, designer, developer, or as a joint effort. Whomever is in charge selects and follows up with the appropriate subcontractors for all elements of the job, from start to finish. A 2011 study found the design-build project delivery method was used by approximately 40% of non-residential construction projects in the US, which represented a 10% increase from 2010. Popularity continues to increase, but some projects with more complicated components still prefer the design-bid-build process *(De Leon, 2017)*

The following defining characteristics identify Design-Build (DB)

Integrated process: overlapped design and construction – typically fast tracked.
Two prime players: owner and design-build entity.
One contract – owner to design-builder with single point of responsibility.

The design-builder is responsible to design and construct the project to meet the performance standards set forth by the owner in the contract (employer's requirement).

With respect to any prescriptive designs or specifications, the design-builder is responsible for discovering any inconsistency between the prescriptive requirements and the performance standards and the owner remains responsible for the cost to reconcile the inconsistent standards**.**

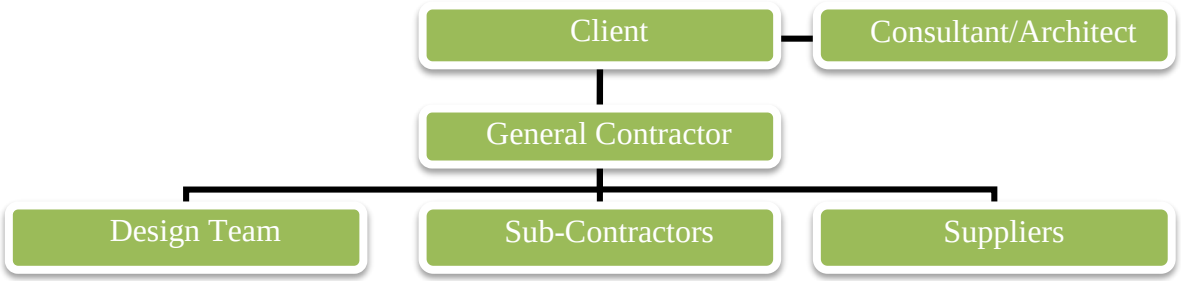


Figure 2.3 Contractual relationship (project organization structure) of DB projects

Some of the advantages and disadvantages of design-bid-build and design-build are listed below but it may not include all the known, but highlights the main points for a clearer understanding of this delivery method's strengths and weaknesses.

Benefits to Design- Build

- Single source responsibility both for design & construction;
- Integrating design & construction;
- Reduction in administration;
- Innovation;
- Cost savings;
- Constructability optimized;
- Most risks transferred to the design-builder;
- Usually GMP (guaranteed maximum price);
- A much quicker process that takes less time and tends to stay on budget better than design-bid-build projects.
- Reduced risk to the owner of the property because potential conflicts between the owner, architects and contractors are eliminated.
- The owner of the property is free from serious legal and managerial positions.
- Many of the costs and stresses associated with interior office build outs are taken on by the design-build team as opposed to the owner.

Disadvantages

- Owner has limited involvement
- Difficult to establish criteria for selection of D/B team
- Design is complete at GMP
- Process may not bring best designer and best builder together for owner
- Quality control is responsibility of D/B team, no checks and balances
- Limiting competition;
- High tendering costs;
- New method & unfamiliarity;
- Client needs quicker decision making;
- Clients bringing design requirements(30%)(reduces design innovation)

2.2.3. Construction Management: CM

Under Construction Management the Owner contracts separately, but somewhat simultaneously, with a design consultant and with a firm whose primary expertise is construction (the Construction Manager). The owner procures the management services of the Construction Manager (in most cases a general contracting construction firm) early in the design phase. Construction Management should not be confused with Project Management. Project Management implies a much broader set of responsibilities than Construction Management. Project Management is the overall management by, or on behalf of, the Owner of all aspects of a project from its inception through design, construction & use. CM is of two types: CM at Free/as Agent & CM at Risk/as Constructor. This distinction determines the contractual approach to CM.

2.2.3.a Construction Management - At Risk Advisor (CM - At Risk)

In this scenario the Owner/Client has one agreement with the Construction Manager, who then manages the contracts with the Design Consultant and the General Contractor. CM-At Risk assumes much of the risks of the project, which differentiates this model from CM-Agency and DBB, where the Owner maintains the risk. Again, the Owner is responsible for operations and maintenance of the project as well as the financing aspects *(Pakkala, 2002).*

Further, CMR in contrast to DB brings general contractor on board to the design process at early stage, where their inputs can benefit the project. CMR has added advantages over other PDS, in term of schedule compression, quality, innovation, cost certainty and elimination of adversarial relationship through excellent teaming (Jaffery Ali & Riaz, 2013).

Construction Management at Risk (CMR) features or characteristics'

Three linear phases: design, bid, build or may be fast tracked.
Three prime players: owner, designer and CM-constructor.
Two separate contracts: owner to CM-constructor and owner to designer.
Owner warrants the sufficiency of the plans and specs to the CM-Constructor:
Owner is responsible for the "details" of design.
Owner is liable for any "gaps" between the plans and specs and the owner's requirements for performance.
Hiring of the CM at-Risk during the design phase.
Overlapping phases—design and build & Contract format may be lump sum or GMP.

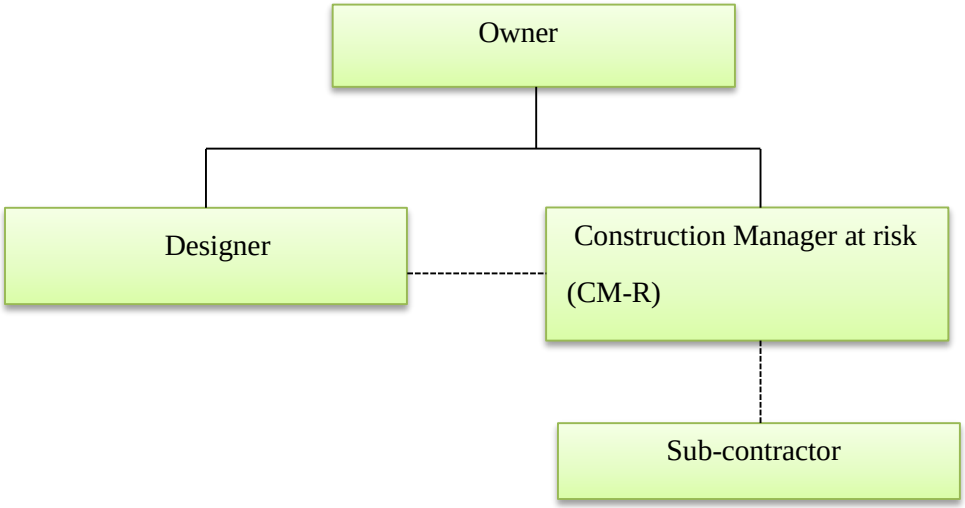


Figure 2.4 Construction manager at risk project delivery system

A**dvantages CM at Risk may include but not limited to:**

- Good for clients with insufficient staff;
- Owner flexibility;
- Responsible for time & cost overrun;
- Holds & manages the trade contractors;
- Constructability design review;
- Same legal position as a General Contractor;
- Provides a GMP;
- Works closely as a teaming effort & encouraging partnering & trust

Disadvantages CM at Risk may include but not limited to:

- Duplication of administration & additional paperwork;
- More paper work for the client;
- Some duplication of administration;
- Fast tracking difficult to control with designer & CM
- Sometimes difficult to manage all phased packages with costs, changes & schedules

2.2.3.b Construction Manager (CM) as Free/Agent

This is a form of CM under which the Construction Manager acts as an agent of and advisor to, the Owner. The *Owner enters* in to multiple trade contracts with the trade contractors & suppliers. The Construction Manager is retained on a fee for services basis & acts on the Owner's behalf in managing & coordinating the trade contracts in the best interests of the Owner. The Owner retains all of the contracting risks inherent in each of the trade contracts. It essentially involves the Owner acting as its own general contractor, with the assistance of a Construction Manager. This form of CM is sometimes also referred to as the "CM as Advisor" or "owner contacted form of CM" A**dvantages**

CM at free may include but not limited to:

- Provides a managing & administering for all phases of a project;
- Treats planning, design, construction as an integrated tasks;
- Some costs & schedule control**;**

Disadvantages CM at free may include but not limited to;

- No contractual relationship with trade contractors;
- No contractual responsibility for outcomes of a project;
- Client retains the risks;

2.2. Criteria for Selection of Project delivery systems

Selecting the appropriate project delivery method is a key decision that has to be made in the early phases of the project. There are many delivery methods that can be used on any project. The decision is usually based on certain factors of importance to the owner. The effectiveness of the delivery methods vary according to the factors. Owners must rank their objectives and choose the method that maximizes the effectiveness in achieving the project objectives(El-Sayegh, 2003) & ignoring the significance of these factors can lead to substantial problems, disputes and litigation among the project stakeholders; especially when owners face difficulties in identifying these factors (El-Sayegh, 2008).

The proper selection of a project delivery system (PDS) is considered one of the primary determinants of project success as it influences the subsequent relationships among project stakeholders. (khalafallah & Fahim,2018).

The criteria used for selecting (or evaluating) the appropriate method(s) among the alternative delivery methods were: *project time certainty, controlling project cost, ensuring project quality, and reduction of owner's administrative burden. (*Lema *2006).*

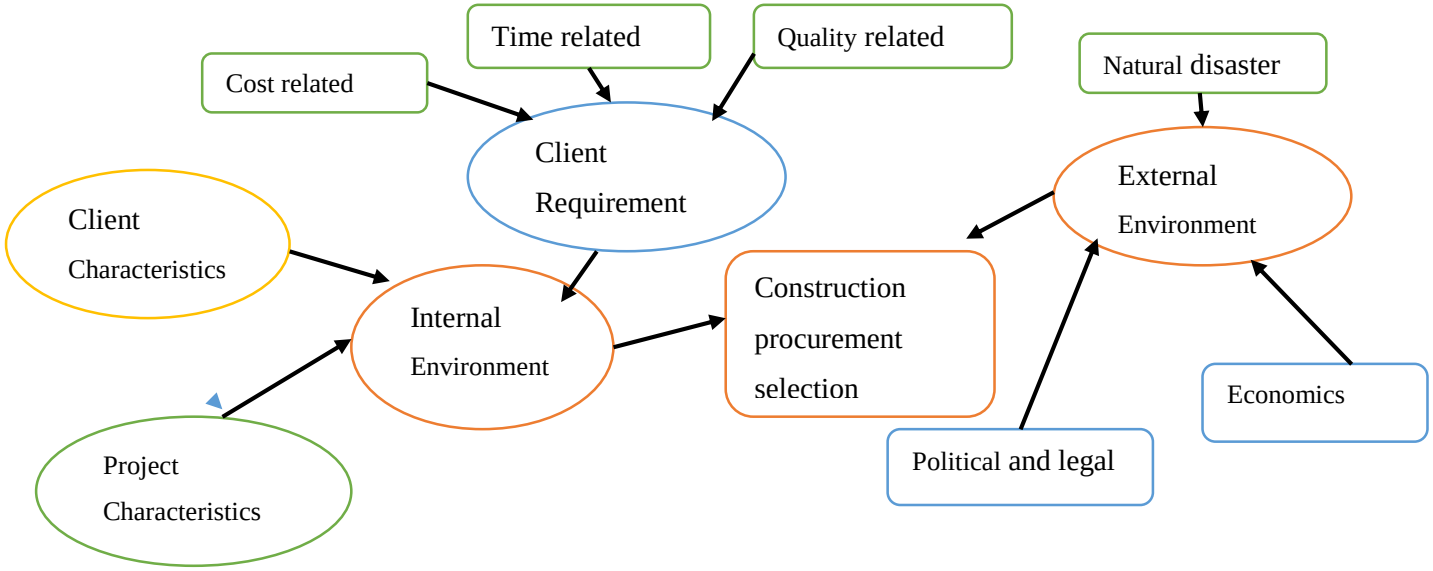
Research conducted by (Asaminew, 2013) on Federal road projects in Ethiopia, he identified major factors which used to select project delivery systems are: project size, Project complexity, Employers Requirement and risk considerations, Budget (source and availability), Design, Schedule, risk Assessment, owners' level of expertise.

The delivery method selected should help the owner to achieve their project goals and objectives in an efficient and cost-effective way. A comprehensive study should include all the available PDMs and all the qualitative and quantitative characteristics of the project that may be influenced by the delivery method option (Kamran Ghavamifar, 2009).

A research conducted by Muneeb Riaz & Syed Raza Ali Jaffery,2013) on Investigating selection methods for construction project delivery systems based on professionals' perspective in Qatar, after reviewing from Existing Literatures and identifying categorize into four major pertinent factors for the selection of project delivery system 1. **Project Characteristics (**cost overrun, schedule delay, project size, risk allocation, responsibility, project design or innovation, Coordination/communication, owners goal, owner control, owner staff capability, Owner PDS experience, Third party Agreements, Owner staff involvement) 2. **Regulatory issues (**Competitive bidding, Local laws) 3.**Life cycle issues (**Maintenance, Life cycle cost, sustainability) 4. **Other issues (**Construction claims/dispute, Adversarial relationships

According to Ratnasabapathy (*et al.*, 2006) the factors for selection of appropriate project delivery system classified into internal and external factors as shown on fig 2. Below.

The figure shows how the factors relate and interrelate with each other. It explains how the task involved in selecting the right Procurement Method can be extremely complex and difficult to unravel.



Source: Ratnasabapathy *et al.*, 2006

Figure 2.5 Factor Affecting Selection of Procurement Method

After intensive literature review the factors used to select appropriate project delivery systems are classified and defined in the following table.

Table 2-2 Factor affecting Selection of project delivery Method

S No	Influencing Factors	Defined /Explanation of Factors
A	**Project characteristics**	
1	Size and complexity of the project;	If Project size is to large, the nature and complexity make confusion for client it is critical to select appropriate project delivery system at initial planning phase which reduce risk for project owner.
2	Available budget for the project;	It is important for project owner to determine the available Budget for the project and contingency if the budget is Over planned one. Owners must decide how quickly they need to establish final project costs and with what risk level Of exceeding this cost.
3	Sources of funding for the project;	Sometimes Source of funding is important consideration for project owners the donors may want to check Project proposal or want to supervise the project implementation up to the end.
4	Ensuring project Quality	Meeting the customer's expectations, or 'compliance With customer's specification May be apriority for the owner. so the owner need involvement in ensuring the quality Of project. the PDS determines the level of involvement Of project owner which affect the quality of project.

S No	Influencing Factors	Defined /Explanation of Factors
5	Time	Time is one important among project performance. The project may completed within Short period or schedule growth. Schedule growth will come or born other un expected risks such as claim and disputes.so in order to avoid such risks and Meet owners goal careful selection of PDS is critical.
6	Urgency of completing the project	The urgency of completing a specific project may be political decision, or may be payback period of the project. Which delivery system answer it is important.
7	controlling project cost	This issue includes several aspects of project cost, such as ability to handle budget restrictions, early and precise cost estimation, and consistent control of project costs
8	Project design/ innovation	The complexity and innovation in the design is critical if the Technology is new and client has no experience for design And construction.
9	Risks associated with the system	Clients transfer of risk/allocation to others
10	Third party agreement	Flexibility for input to design and construction of third Party agreement. This issue concerns each delivery method's impact on facilitating agreements with third parties. political entities, utilities, railroads, and so forth—involved in the progress of the project

S No	Influencing Factors	Defined /Explanation of Factors
11	Capability and creativity of the project owner's;	Owner experience in using specific PDS and. its internal Capability, in choosing different types of PDS is important for project success.
B	**Owner characteristics**	
12	reduction of owner's administrative burden	Which delivery system reduce administrative burden needs carful selection.it is directly connected to the no of owner staff involvement, budget allocation for administration and time required to administer it.
13	Owners goals	A clear and concise definition of project goals not only assists with selecting an appropriate Project delivery method, it also provides a clear measure for project success and clear directions for the construction manager or design-builder in completing the project. So to Meet employer's requirement proper selection of project delivery system is important.
14	Owner control	If Clients desire of high degree of control on schedule. Cost and quality of the project each PDS has its own advantage and dis advantage.
15	Owner staff involvement	If Clients desire of substantial or minimum use of its own staff The type of delivery system used determine the frequency And no of owner staff involvement.
16	Owner Project Delivery System (PDS) experience.	Client experience of using a specific project delivery system

S No	Influencing Factors	Defined /Explanation of Factors
C	**Life cycle issues**	
17	Life cycle cost (Project life cycle cost is critical factor)	The effects of project delivery methods extend to the operation and maintenance phase It is related to the quality of the project, the quality starts from design stage to construction. the level of owner in participating in design and supervision also Affected by types of project delivery System which directly affect life of the project Each delivery system has its own opportunities and effect.
18	Maintenance (Ease in maintenance is critical to Clients)	Maintainability is affected by the choice of delivery method in two different areas: level of quality and ease of maintenance.
D	**Others**	
19	Legal and regulatory ability to use various innovative project delivery systems	During choice of project delivery method, it is important to consider in relation to public policy and regulatory issues such as existing laws, mandated social programs, labor unions, and other factors that establish the legal environment in which a project must be delivered. State and local codes may have their own restrictions.
20	Construction claims/dispute	Clients desire minimum claims and disputes. a delivery method can reduce the number of construction claims, that Delivery method is a favorable choice, and if it increases the possibility of construction claims, it is an unfavorable choice.

2.3.Selection of project delivery system & project performance

Success of construction projects depends mainly on success of performance. The selection of project procurement method has a great impact on project performance (time. cost and quality). (Cheung et al, 2004) identified project performance categories such as people, cost, time, quality, safety and health, environment, client satisfaction, and communication.

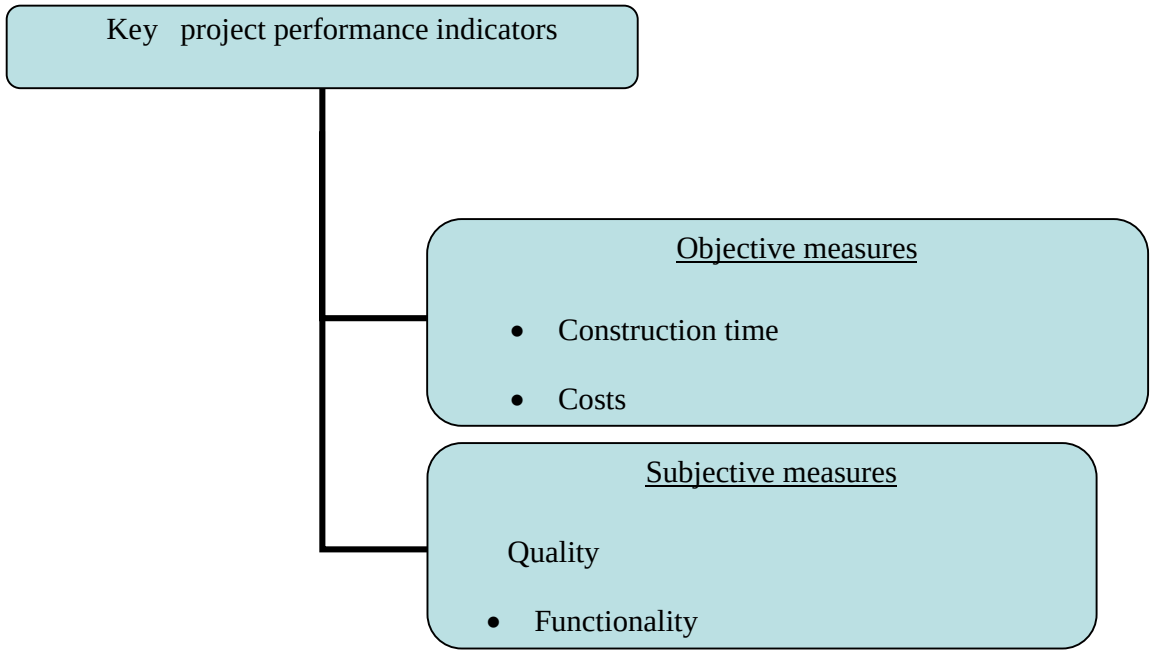


Figure 2.6 Key Performance Indicators for Project Success (Chan & Chan, 2004)

Traditionally, a project is considered to have achieved a high level of performance if it is delivered at the right time, right price and good quality level. (Ghadamsi, 2016). These criteria have been described as the iron triangle of project performance. Fig. 2.8 below shows the iron triangle as adopted by (Atkinson, 1999).

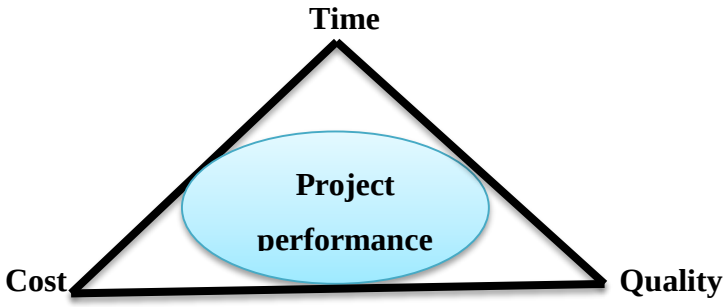


Figure 2.7 Project Performance Criteria Trade-Off Triangle: (Source: Atkinson, 1999)

Study and Analysis of Factors Affecting the Performance of the Construction Projects conducted (Alias et.al, 2015) listed the most important performance indicator of any construction industry as below no 1-9.

1. Cost
2. Time
3. Quality
4. Productivity
5. Client Satisfaction
6. Community Satisfaction
7. Health and Safety
8. Innovation and Learning
9. Environment

(Collins, 1996) also point out in the area of project management that, the schedule, cost and quality achievement is also referred to as the iron triangle. Out of these three aspects, it is the achievement of schedule and cost compliances that the project management is attending to most of the time.

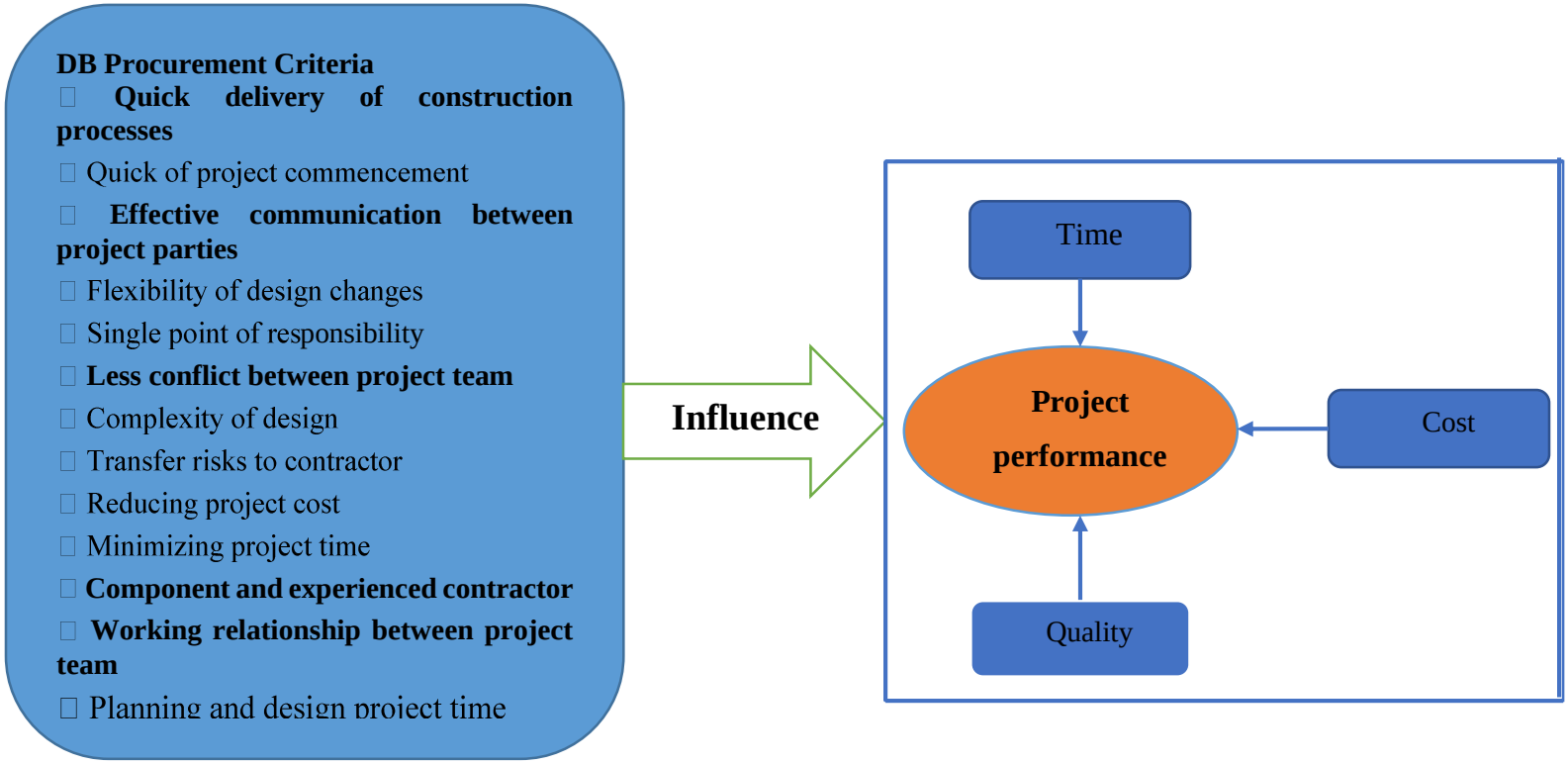


Figure 2.8 Conceptual Framework of Construction Procurement Influence on Project Performance

Source Ghadamsi, 2016.

(Ghadamsi,2016) after reviewing intensive literature review develop Conceptual Framework Of Construction how selection of Procurement Influence On Project Performance, As indicated in Fig. 4, below the independent variables of the study are represented by DB procurement selection criteria, whilst project performance outcomes (time, cost and quality) form the dependent variables Cheung et al (2004) remarked seven main key indicators for performance which are: time, cost, quality, client satisfaction, client changes, business performance, and safety and health. (Pheng and Chuan, 2006) stated that project performance can be determined by two common sets of indicators. The first set is related to the owner, users, stakeholders and the general public which are the groups of people who will look at project performance from the macro viewpoint. The second are the developer, a non-operator, and the contractor which are the groups of people who will look at project performance from the micro viewpoint.

2.4. Factors which affect project time performance

(Ogunlana, Promkuntong & Jearkjirm, 1996) investigated 12 high-rise buildings and categorized their findings into client/consultant related, contractor-related and external causes for time delays.

Factors influencing construction time and cost overruns on high-rise projects in Indonesia, (Kaming et al., 1997) found that ‘design changes’, ‘materials shortage’ and ‘inadequate planning’ were the most significant contributors to time delays on construction projects.

Similarly (Sambasivan & Soon, 2007) categorized their findings into client, contractor and consultant categories.Ten most important causes were: (1) contractor’s improper planning, (2) contractor’s poor site management, (3) inadequate contractor experience, (4) inadequate client’s finance and payments for completed work, (5) problems with subcontractors, (6) shortage in material, (7) labor supply, (8) equipment availability and failure, (9) lack of communication between parties, and (10) mistakes during the construction stage.

Increase in material cost, inaccurate materials estimation and underestimating of project costs among others are the most significant cost factors while the most significant time factors include

unexpected site condition, increase in project scope, lack of timely progress payment and inadequate planning. (odedirian et al.,2012) Study conducted by Serdar Durdyev & M.Reza Hosseineini (2018) on Causes of delays on construction projects. The purpose of this paper is to present a systematic review of studies on CPD published between1985 and 2018. Accordingly, the findings reveal that researchers from developing countries have contributed the most to identifying the causes of CPD. A total of 149 causes of CPD were identified in a thorough review of 97 selected studies. Weather/climate conditions, poor communication, lack of coordination and conflicts between stakeholders, ineffective or improper planning, material shortages, financial problems, payment delays, equipment/plant shortage, and lack of experience/qualification/competence among project stakeholders, labor shortages and poor site management were identified as the ten most common CPDs.

Factors that related to owner's responsibility

- Financial problem (delayed payments, financial difficulties, and economic problems)
- lack of coordination with contractors
- Slow decision making
- Contract scope change/modification
- Right of way problem (client unable to clear construction site on time)
- Inadequate planning
- Lack of coordination with local authorities

Factors that related to contractor's responsibility

- Lack of experience
- poor site management
- Lack of machinery and equipment on market
- Delay in delivery of materials to site
- Shortage of materials on site
- lack of subcontractor’s skills

- coordination problems with others;
- financial problems
- Shortage and low productivity of labor

Factors that related to consultant's responsibility

- Lack of experience on the part of the consultant's site staff.
- Poor supervision and slowness to give instruction
- incomplete documents
- absence on site & delayed and slow supervision in making decisions

Factors that related to external factors

- Adverse weather condition
- Poor site condition (unforeseen ground condition)
- Lack of materials, equipment and tools on the market
- Poor economic conditions (currency, inflation rate, etc.);
- changes in laws and regulations;

2.5.Factors which affect project Cost performance

Studied the performance of transportation infrastructure projects in Nigeria and concluded that 'material price fluctuations', 'inaccurate estimates', 'project delays' and 'additional work' contributed most to cost overruns. In a fourth study on construction projects in Nigeria by (Elinwa & Buba, 1994), it was found that 'cost of materials', 'fraudulent practices' and 'fluctuations in materials prices' had the most significant impact on project costs.

The above causes of cost growth or cost overrun can be summarized as:

- Additional works;
- Time delay (client and contractor);
- Material, machinery and labor cost increment;
- Inaccuracy of material take-off and estimation;

- Inadequate pre-planning and fraudulent practices.

2.6.Factors which affect project Quality performance

Quality can be described as meeting specifications and approved standard agreed by stakeholders. (Collins, 1996) describes quality as the world's oldest documented profession. Quality professionals use a number of definitions to define project quality. Quality in its simplest form can be defined as: 'meeting the customer's expectations,' or 'compliance with customer's specification.' No matter what definition we follow for quality, it becomes very complex when we try to put it into actual practice. For a user, quality is nothing but satisfaction with the appearance, performances, and reliability of the project for a given price range.

Enchase et al,2019 a research conducted on Factors affecting the performance of Construction projects in the Gaza Strip identified factors which affect quality of the project and rank from highest to lowest respectively as (Conformance to specification, Unavailability of competent staff, Quality of equipment and raw materials, Quality assessment system in organization and Quality training/meeting). Construction Quality from Different Perspective are discussed below;

2.7.1 Client's Perspective on Quality

The majority of research work in this area indicates the clients' main concern boils down to 'value for money' and 'fit for the purpose'. However, these objectives are rather broad in definition and encompass a vast variety of factors. Because of the subjectivity associated with these definitions, their objective assessment is very difficult. Below an outline definition is provided.

- Value for Money: Basically, value for money means the best available for the client, for a given money. This is a measure of how well the product is and the level of satisfaction it creates. Different roads have different characteristics; however, it may be possible to use statistical techniques in order to develop a quantified method for measuring value for money.
- Fit for Purpose: This parameter, from client's point of view, is a reflection of the degree to which the product satisfies his requirements as defined, as early as, the briefing phase.

2.7.2 Constructor's Perspective on Quality

The prime concern of the constructors is 'client's satisfaction'.

- Client's Satisfaction: How pleased the client is with the final product is a matter of concern to the constructor. This can be divided into subjective and measurable parameters. Therefore, perception of the client about the subjective parameters, such as design features and finishing, is a matter of concern to the constructor.

2.7.3 Third Party Perspective

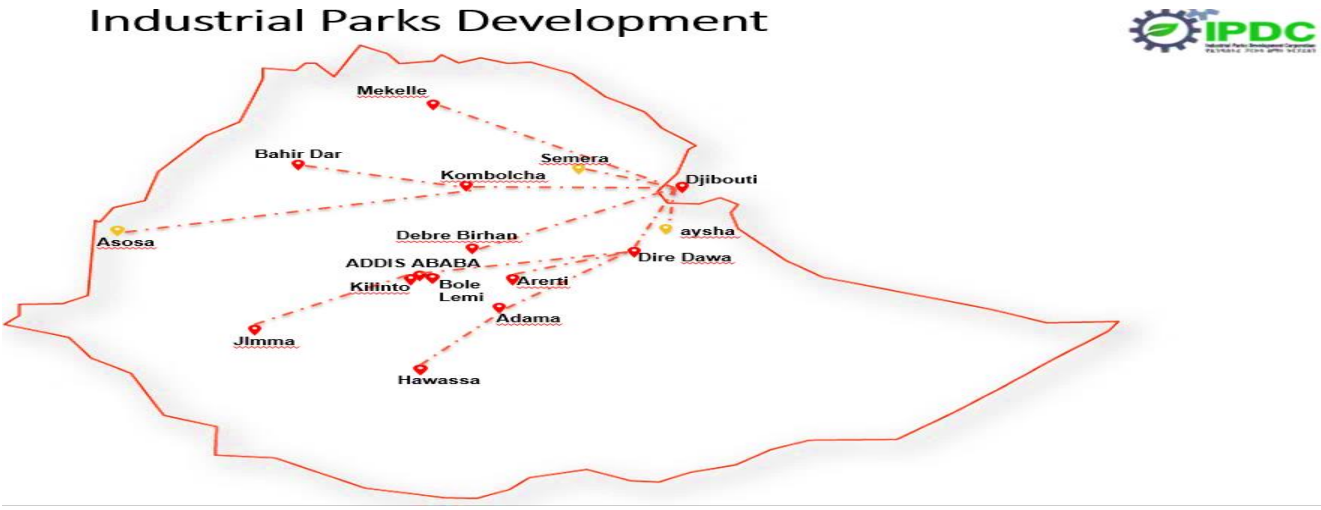
Normally, the third parties in the construction industry consist of quality assurance companies or local authorities. The standards adopted by the third parties often measure 'fit for the purpose' and 'material quality level' (Oliver 1991)

CHAPTER THREE

RESEARCH METHOD

3.1.Study Area

The study covers all completed and on progress of design -bid- build and design bid of industrial parks Development Corporation to assess the effectiveness of DB and DBB. The branch industrial parks are distributed across the country as shown on fig below.



Source industrial parks development corporation

Figure 3.1 Current and future Industrial parks in Ethiopia

3.2.Research Design

The research design follows descriptive survey, desk study, desk study was chosen as one of the instruments to assess the practices from relevant studies, reports and documents. Besides, the research instruments use questionnaire, Interview and document reviews. Hence the research design used for this research is quantitative and descriptive survey to compare the effectiveness of project delivery system.

3.3.Population and Sampling Method/Technique

Sampling technique is method of selecting a subset of population which represent the whole population. Among the different sampling techniques, the researcher employed simple random sampling. For simple random sampling, every member of the population have an equal chance of being selected.

Based on the project delivery framework, questionnaire, desk study and interview were developed to organize and analyze project data known to impact project performance. The study population was drawn from industrial parks development projects In Ethiopia, from owners, contractors and consulting offices that have exposure to both DBB and DB or one of the two project delivery systems. Thus, the researcher considered 54 respondents in the sample using (1) from 120 eligible elementary units.

The industrial parks considered were:

Jimma Industrial park (JIP)

Debre Brihan Industry Park (DBIP)

Mekele Industrial park (MIP)

Hawasa Industrial park (HIP)

Komboch Industrial park (KIP)

Bahir Dar Industrial Park (BDIP)

Adama Industrial Park (AIP)

Dire Dawa industry park (DDIP)

Bole lemi industrial park (BLIP)

Kilinto Industrial park (KLIP)

3.4.Sample size determination

Targeting population will be in line with the objectives of the assessment on the effectiveness of Design build and Design bid build and The Sampling frame will be designed from the list of participants in Ethiopian industrial parks development projects. It illustrates as below.

- Contractors
- Consultants
- Clients

Determining the sample size is key on the overall statistical process. To determine the sample size, use the equal proportion for positive and negative response.

p = $q = 0.5$, Where p and q are sample proportions. (Half of respondents are Familiar with DBB PDM and the other half of respondents are Familiar with DB PDM).

- $d = 0.1, N = 120$
- $n_0 = \frac{\left(z\alpha_{/2}\right)^2 pq}{d^2}$,
- If ${n_0}/{N} \leq 5\%$, then take $n = n_0$
- If ${n_0}/{N} > 5\%$, then take $n = \frac{n_0}{1+{n_0}/{N}}$, (sample size Determination Formula)
- Where $\alpha = 5\%$ is the accuracy level of significance usually. As a result $z\alpha_{/2} = 1.96$.
- N=Total number of members.
- d=degree of accuracy designed (marginal error).
- For this study the researcher decided to take $d = 10\%$. So :-
- $n_0 = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.1)^2} = 96.04$, $\frac{96.04}{120} \approx 0.80 \gg 0.05$ Therefore, $n = \frac{96.04}{1+{96.04}/{120}} = 53.34568 \approx 54 \; ------(1)$
- Add 10% of 54 for nonresponse
- $n = 54 + 54 * 0.1 = 59.4 \approx 60$

Table 3-1 Respondent Distribution and Response Percentage

Respondent Category	Questionnaire Distributed	Questionnaire Collected	Response %
Owner Representative	28	25	89.29
Consultant Representative	15	14	93.33
Contractor Representative	17	15	88.24
Total	60	54	90.29

The respondents included in the survey comprised of a total of 60 people, out of which 28 from owner, 15 consulting office, 17 from Contractor.

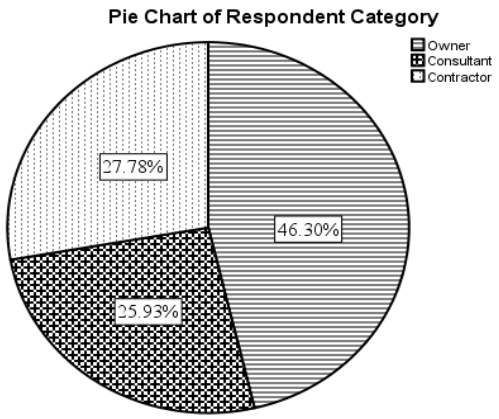


Figure 3.2 Percentages and Types of respondent Category

Table 3-2 Cross tabulation of industrial park and questioner Distributed

Name of industry park	Owner		Consultant		Contractor	
	Site	Head Office	Site	Head Office	Site	Head Office
Hawassa phase 1						
Hawassa phase 1+	2	1	1	1	1	1
Adama	2	1	0	1	1	1
Mekele	1	1	1	1	1	1
Kombolcha	1	1	1	0	1	1
Dire dawa	2	2	1	1	1	0
Jimma	3	1	0	1	1	1
Kilinto	1	2	0	1	1	1
Bole Lemi II	1	1	1	0	0	1
Debre Birhan	2	1	0	1	1	1
Bahir Dar	1	1	1	1	1	1
Sub total	**28**		**15**		**17**	
Grand total	60					

The questioners was distributed both for site and head quarter for owners, consultant and contractors. Since each project has a representative at industrial parks Development Corporation at Head office level, Consulting office at head quarter and contractors at headquarters. The cross tabulation was made based on the no of workers available for owner, consultant and contractor.

Table 3-3 Cross tabulation of Industrial park and respondent category

Name of industry park	Owner		Consultant		Contractor	
	Site	Head Office	Site	Head Office	Site	Head Office
Hawassa phase 1						
Hawassa phase 1+	1	1	1	1	1	1
Adama	2	1	0	1	0	1
Mekele	1	1	1	1	1	1
Kombolcha	1	1	1	0	1	1
Dire dawa	2	2	1	1	1	0
Jimma	1	1	0	1	1	1
Kilinto	1	2	0	1	1	1
Bole Lemi II	1	1	1	0	0	1
Debre Birhan	2	1	0	1	1	0
Bahir Dar	1	1	1	0	1	1
Sub total	**25**		**14**		**15**	
Grand total	54					

Based on Questioners distributed the no of questioners distributed and collected was shown the above table 3.3 from each category. Respondent Distribution and Response Percentage was also shown on table 3.1 above.28 questioners distributed for owners 25 of them response correctly and neatly, similarly a total of questioners distributed for consultant both for site and head office 14 of them correctly responded and none of it was rejected. 17 questioners distributed for contractors at site and head office a total of 15 responded.

3.5. Study variables

3.5.1. Dependent variables

The dependent variable which is associated with in the research title "Assessment of the effectiveness of design-bid -BUILD and design-bid delivery method in industrial parks development projects in Ethiopia", among the performance indicating factors key elements of any industry:(Alias et.al, 2015).

- Time
- Cost (allocated budget)
- Quality
- Safety and Health
- Productivity
- Employer Satisfaction
- Innovation and Learning
- Community satisfaction

3.5.2. Independent variables

The independent variable represents the input or cause of the output. The independent variable associated with this study is project delivery system.

- Design build project delivery system & Design bid build project delivery system.

3.6. Data collection procedure

First, a total no of industrial parks across the country was identified from Web page of IPDC. Then questioner was developed after intensive literature review to answer the specific objectives of the research. A total of DBB and DB projects of IPDC was included except private developer and ICT parks for the sake of time and cost. The questionnaires' prepared in the form of qualitative and quantitative for data collection. The first questioner part includes project characteristics and factors

that affect time growth, cost growth and factors which affect quality of the project which answer Descriptive (qualitatively) the objective of the research. The second part of Questioner include Quantitative which answers specific objective two which include project contract, such as original contract sum, final contract sum, original contract period, projects commencement date, practical completion date, extension of time granted and official hold-up and other necessary information.

E-mail and telephone dialogue were developed to increase the consistency of the data collection effort and maintain the professional image throughout the survey.

The data collection was made through:

- Data collection from archive
- Questionnaire
- Interview

3.7. Data processing and Analyzing.

After the raw data have been collected, the data was carefully analyzed through quantitative and qualitative data analysis method.

The data processing operation include,

Editing:-examining the collected raw data to detect errors and omissions

Classification: - Arranging data in groups as DBB & DB.

Finally analyzing data through qualitative and quantitative data analysis by using excel and SPSS.

Qualitative data analysis including ranking of factors that affect time, cost and quality through Relative Importance Index. The RII was computed as (Cheung et al. 2004; Ugwu and Haupt, 2007; Enshassi and Mohamed, 2009; Alias et al, 2015):

$$\mathbf{RII = \Sigma W / (A \times N), (0 \leq index \leq 1)},$$

Where W is the weight given to each factor by the respondents and ranges from 1 to 5; A – the highest Weight (that is 5 in this case) N – the total number of respondents (where "1" is "very poor" and "5" is "very high").

Whereas quantitative data analysis includes cost and schedule growth.

Cost Growth (%) = [(Final Project Cost (ETB) – Original Contract Cost (ETB))/Original Contract Cost (ETB)] * 100

Schedule Growth (%) = [(Final contract period (days)-Original Contract Period (days))/original contract period (days)] *100

3.8. Ethical Consideration

The data was collected by obeying ethical consideration. A supportive letter was written to concerned organization for the researcher to collect data from construction Engineering and management chair and the data is used only for academic purpose.

Saunders et al. (2009) states that respondents and participants during research data collection should participate on the basis of informed consent. Since the study was conducted only for academic purpose there were no conflicts between the researcher and the respective project stakeholders.

3.9. Data Quality Assurance

Several methods were used to reduce potential areas of bias. These helped to reduce respondent bias, and bias introduced by the research team. The data are independent. Design build and design bid build projects data are totally independent.

- **Respondent Bias**

Respondent bias represented the level of subjectivity which entered an individual's response. This research study collected projects contractual data like commencement date, intended completion date, actual completion date, accepted contract amount, final project cost, and schedule values which represent valid objective data. However, other data regarding as employer, contractor, and consultants on the project also collected.

- **Research Team Bias**

Training sessions, standard data collection activities and the proximity of the research team members to this research helped also to improve consistency and avoid research team bias.

After data collection process, the data were checked for completeness and any incomplete or misinformation was corrected by checking the source data. The data obtained from questioners were properly analyzed using different statistical methods and computer software's like Microsoft excel and SPSS v20. All the obtained data were recorded and collected in due care that it was reliable and accurate.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. General Back Ground

In this chapter the data collected is analyzed and presented in a different form by combining with literature review. A questionnaire survey was designed aiming to get the opinion and understanding from the experienced respondents regarding to the construction performance in IPDC. The questionnaire consists of two main sections. The first included the characteristics and backgrounds of the participants and companies who contributed to the survey. Such questions were: Type of organization, typical of projects of organization, job title of the respondents, years of experience of the respondents, number of projects executed by the respondents in the last five years in industrial parks projects and value of executed projects in the last five years. The second section included the factors that may have considerable impact on performance in the construction industry. The total number of factors considered is 58 grouped into seven categories.

These are:

- project delivery method factors-20
- Time related factors - 25 factors.
- Cost related factors - 6 factors
- Quality related factors - 7 factors

Total of 60 questionnaires were distributed among them 45 (75 %) were for design build projects and the remaining 25 % were for design bid build projects. From the total questionnaires responded, consultants or supervisors were 14 (25%), contractors were 15 (28.33%) and clients were 25 (46.67%). The sampling considers almost all concerned body involved in the projects execution except those didn’t back the questionnaire.

Of the 60 questionnaires distributed, 54 (90.27%) responses were received. of 54 received response 41(75.93 %) were from design build projects and the rest 13 (24.07%) were from design bid build projects. Responses were received form eleven projects. Of the 54 returned questionnaires, 25 (46.3%) were from clients, 15 (27.78%) from contractors and 14 (25.93%) from consultants or supervisors (table 3.1 & 3.2).

4.2.Factors that affect selection of project delivery system

Before project owner select specific project delivery system it is best to identify the factors that can affect the project. The factors may vary from one project to another project since each project has unique characteristics. After intensive literature review the factors may be categorized into four groups' i.e. project characteristics, owner characteristics, life cycle issues and other issues as described on table 4.2 After Analyzing & Ranking the data collected the main factors that project owner consider for DBB delivery system are (**top four factors**): - Size and complexity of the project; Urgency of completing the project, Available budget for the project & Project design/ innovation, Whereas for DB delivery system the project owner should consider (**top four factors**): - Size and complexity of the project, Urgency of completing the project, Available budget for the project & Time.

Table 4-1 Factors causes used to choose DBB or DB project delivery method

Category	Factors causes used to choose project Delivery Method	DBB		DB	
		RII	Rank	RII	Rank
1	Size and Complexity of the project	0.88	2.5	0.88	1.5
2	Urgency of completing the project	0.88	2.5	0.88	1.5
3	Available budget for the project	0.88	2.5	0.84	3.5
4	Project Design Innovation	0.88	2.5	-	-
5	Time	-	-	0.84	3.5

(Riaz and Ali Jaffery, 2013). A research conducted on Investigating selection methods for construction project delivery systems based on professionals' perspective in Qatar after reviewing existing Literature and ranking pertinent factors for selection of project delivery system the result

shows **top three** are Cost overrun (Project completion within budget and cost),Schedule delay (Project schedule compression) and project size/nature.

It is obvious that characteristics vary from project-to-project and depends on the project owner and stake holders. Deciding which PDM to adapt is a challenging task due to variety of available options and diversity of project/client needs and objectives. (hosseni et.al,2016).

Beside each delivery system has its own advantage and dis advantage it is better for the owner if apply a multi criteria decision making technique is the best solution for the selection of project delivery system. (Pooyan, 2012).

4.3.Factors that affect schedule growth

Time is one critical that measures project performance which all stakeholders of a project carefully consider. It also measures the success and failure of project. Time is one of a natural resource and it is also considered as a money. Project Delay because cost overrun, claims etc. This delay in time cannot come from one party in construction industry. After review of literature cause of delay or time growth is categorized into 1. Delay that arise due to owner's responsibility 2. Delay that come from consultant responsibility 3. Delay that come from contractor responsibility 4. Delay that come from beyond control of parties (usually natural and manmade).Ranking the results obtained from the questionnaire of time overruns (delay) For DBB & DB Projects are presented in the table 4.3 below. As per the respondent The main causes for time overrun (delay) of design –bid- build (DBB) projects are**(top three factors)** : -Right of way problem, inadequate planning, Contract scope change, Whereas the main cause of schedule growth for DB project delivery system are**(top three factors):** -Right of way problem, inadequate planning and contract scope change modification.

The causes of schedule growth arise from all participant or parties of the project and may differ from one project to another. (Kikwasi ,2012) indicate seven highly ranked causes of delay or time growth as design changes, delays in payment to contractors, information delays, funding problems, poor project management, compensation issues/right of problem and disagreement on the valuation of work done.

Research conducted by (Elina & Mangvwat, 2001) time –overrun factors in Nigerian construction industry top three pertinent factors for schedule growth are:-

- Mode of financing and payment for completed works (94%)
- Improper planning (80%)
- Underestimation of time/duration of projects (79%)
- Frequent changes in materials and designs (79%)

Table 4-2 Factors for delayed of DBB & DB project delivery method

Causes(factors) for time (schedule) growth in industrial parks project	DBB		DB	
	RII	Rank	RII	Rank
Right of way problem	0.86	1	0.82	1
Inadequate planning	0.77	2	0.7	2.5
Contract scope change/modification	0.75	3	0.7	2.5

4.4.Factors that affect cost growth

Cost overruns (cost growth) is presented in the bottom table. As per the respondent the main causes for cost overrun (cost growth) of design bid build (DBB) projects was additional works; time delay, inadequate pre-planning, take the top three causes for cost growth which is similar to DB project delivery system. Also, material, machinery and labor cost increment is also main cause in DB delivery system. Cost overrun is described as the ratio of the change in the original contract amount to the original contract award amount. Causes of cost overrun may varies from project to project since every project is unique.Ahady.et.al (2017) study conducted on causes of cost overrun in construction industries in developing countries, as it has been found that all the factors are not similar to every project in developing countries though some of them are common such as poor management, fluctuation of material prices inaccurate material estimates and financial status of the contractor.

The most important causes of cost overrun were found to be inflation or increase in the cost of construction materials, poor planning and coordination, change orders due to enhancement required by clients, excess quantity during construction. (Nega, 2008)

Table 4-3 Factors for cost growth of DBB & DB project delivery method

No.	Causes for Cost growth in industrial parks projects	DBB		DB	
		RII	Rank	RII	Rank
1	Additional works;	0.8	1	0.74	1
2	Time delay (client and contractor)	0.78	2	0.73	2
3	Material, machinery and labor cost increment	0.62	5	0.63	3.5
4	Inaccuracy of material take-off and estimation	0.65	4	0.58	5
5	Inadequate pre-planning	0.75	3	0.63	3.5
6	Fraudulent practices	0.58	6	0.53	6

4.5.Factors that affect project quality

As described in table below main factors that measure quality in DBB projects are: - Fit for the purpose, Conformance to standard, Quality assurance of materials and equipment used for construction, Project with good service quality & satisfactory durability. Whereas main factors which influence quality in DB projects are: - Fit for the purpose, Project with good service quality, Satisfactory durability, Conformance to standard & Quality assurance of materials and equipment used for construction.

Table 4-4 Factors which Measures Project quality of DBB and DB delivery methods

No	Factors which Measures Project quality	DBB		DB	
		RII	Rank	RII	Rank
1	Pleasing to look;(aesthetic value)	0.8	6.5	0.76	6
2	Project with good service quality;	0.83	4.5	0.8	2.5
3	Free from defects on completion;	0.8	6.5	0.69	7
4	Fit for the purpose	0.89	1.5	0.86	1
5	Satisfactory durability	0.83	4.5	0.8	2.5
6	Conformance to standard (product made exactly like designer and employers' requirement)	0.89	1.5	0.79	4
7	Quality assurance of materials and equipment used for construction	0.86	3	0.78	5

4.6. Cost and Time overrun of Selected DBB Projects.

Some sample projects of DBB projects are presented, as given in Table 4.5 to assess the status of the currently under construction industrial projects implemented in the industrial parks development corporation construction projects. The table has been used to show the associated time and cost overruns, as per the sampled projects.

Table 4-5 Original and Revised Contract Price and Contract Period of Sampled DBB Contracts.

NO	Name of industry park (IP)	Size (HA)	Original Contract Price	Revised Contract Price	Original Contract Period	Revised Contract Period including EOT
		HA	ETB(Million)	ETB(Million)	(Days)	(Days)
1	Kilinto	279	5,728,195,245.43	6,465,417,766.35	365	1094
2	Bole Lemi II	171.4	3,522,404,883.60	3,704,327,072.23	365	1094

Source: -FDRE, Industrial Parks Development Corporation Head Quarter.

Original Contract Price: - the cost initially estimated at the time of bid award (Contract Amount)

Revised Contract Price: - is the revised amount of money at the time of this research.

Original Contract Period: - Estimated project duration at the time of bid award (Contract Duration).

Revised Contract Period: - Contract period including EOT granted.

ETB: - Ethiopian Birr currency.

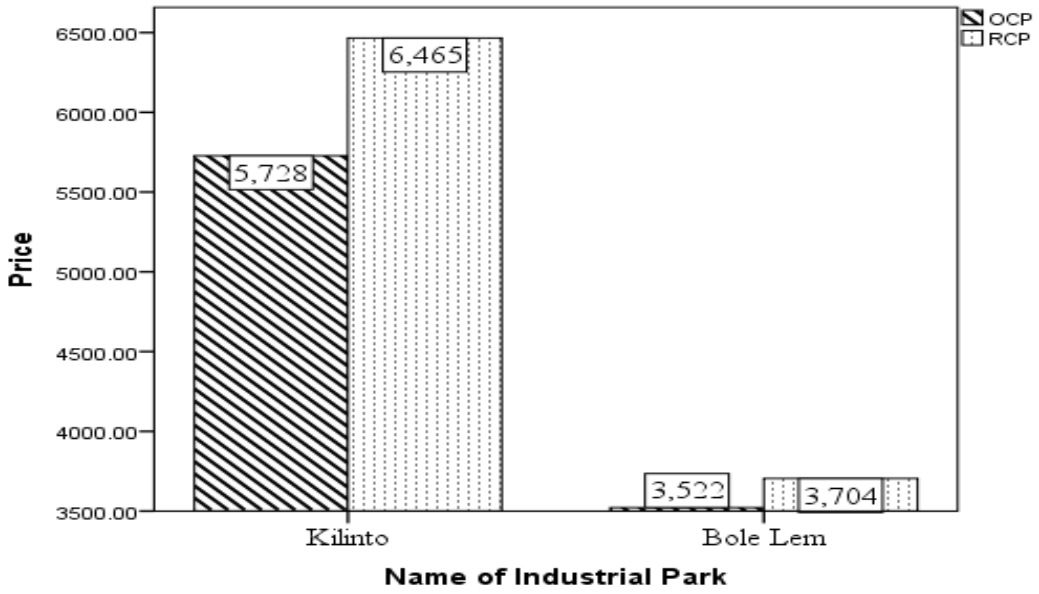


Figure 4.1 original and revised contract price of DBB projects

The total percentage of contract amount increment of the above D-B-B projects have been collected and arranged in the table below to show the significance of the contract amount cost overrun whose mean value is 9.02 %. The Contract price cost increment and its respective percentages are presented in Table 4.6.

Table 4-6 original and revised contract price of DBB projects

No	Name of industry park (IP)	Size (HA)	Original Contract Price	Revised Contract Price	increase in contract price	Percentage Increment in Contract Price
		HA	ETB(Million)	ETB(Million)	ETB	%
1	Kilinto	279	5,728,195,245.43	6,465,417,766.35	737,222,520.92	12.87
2	Bole Lemi II	171.4	3,522,404,883.60	3,704,327,072.23	181,922,188.63	5.16
Mean						9.02

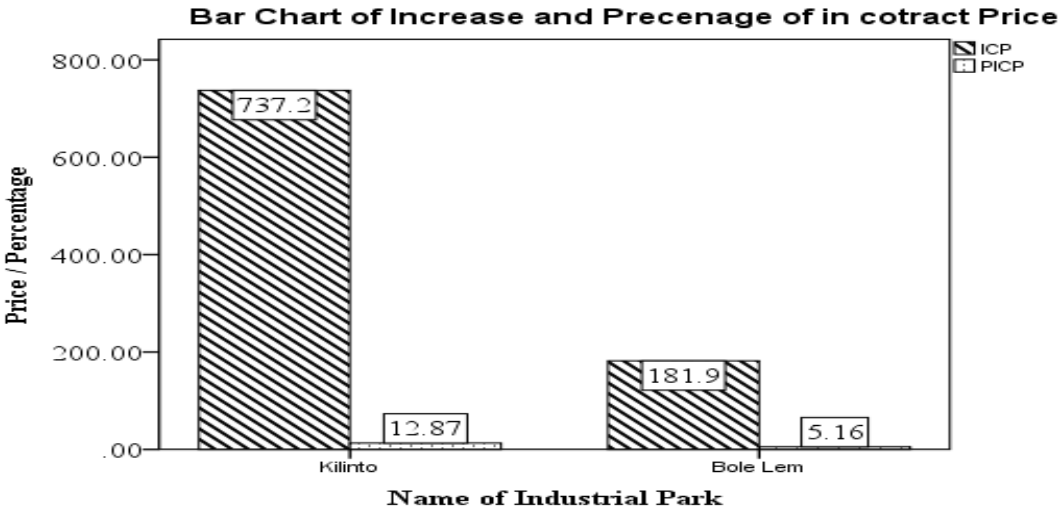


Figure 4.2 Increment in contract price and percentage of increase in contract Price

The increasing days of the total contract period and its percentage of increment of the D-B-B projects is shown in table 4.7 below to show the significance of the contract period overrun. The Contract period or schedule overrun and its respective percentages are presented in

Table 4-7 Increment in Contract Period of Sampled DBB Contracts

No	Name of industry park (IP)	Size (HA)	Original Contract Period	Revised Contract period	increase in contract period	Percentage Increment in Contract period
		HA	(Days)	(Days)	ETB	%
1	Kilinto	279	365	1094	729.00	200
2	Bole Lemi II	171.4	365	1094	729.00	200
Mean						**200**

The above Tables signifies that the budget and time overruns range from 5.16 % to 12.87 % of the initial costs with mean value of 9.02% and 200 % of the initially estimated cost & time respectively. It can be seen that the mean time overrun itself is high as the mean cost overrun. From tables Table 4.6 and Table 4.7 it can be seen that, on average, there is about 9.02 % cost increment beyond the initially estimated budget and about 200 % time overrun. From the above tables one can conclude

that the construction work on the industrial parks development corporation (IPDC) have not been running as per the durations and the budgets estimated before the commencement of the actual construction in IPDC.

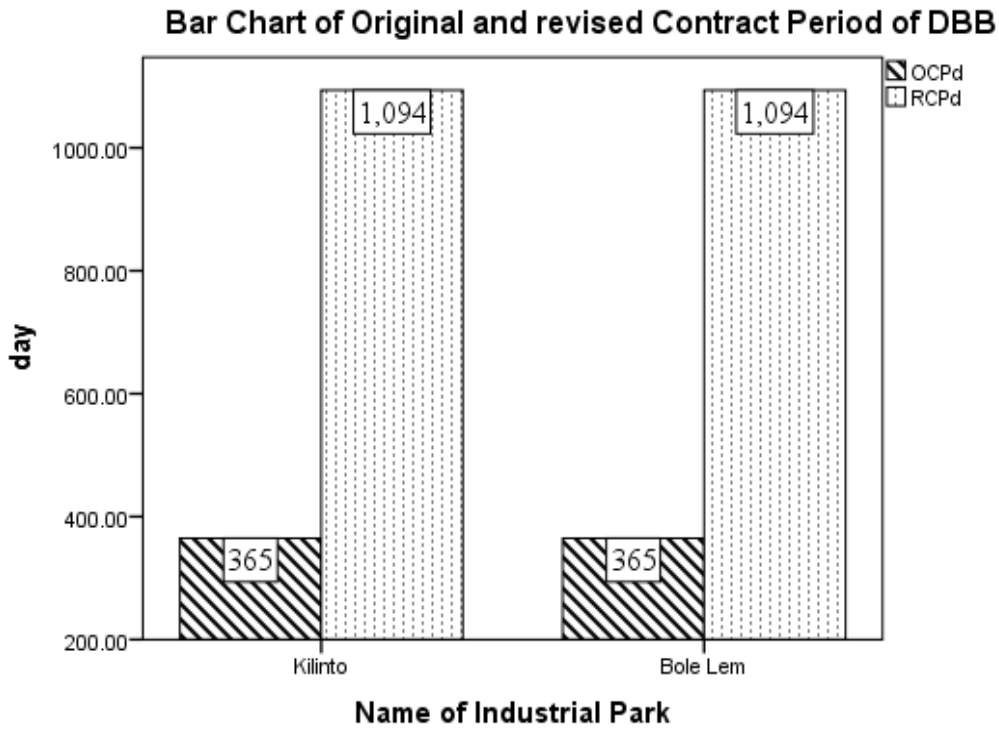


Figure 4.3 Original and Revised Contract Period of DBB

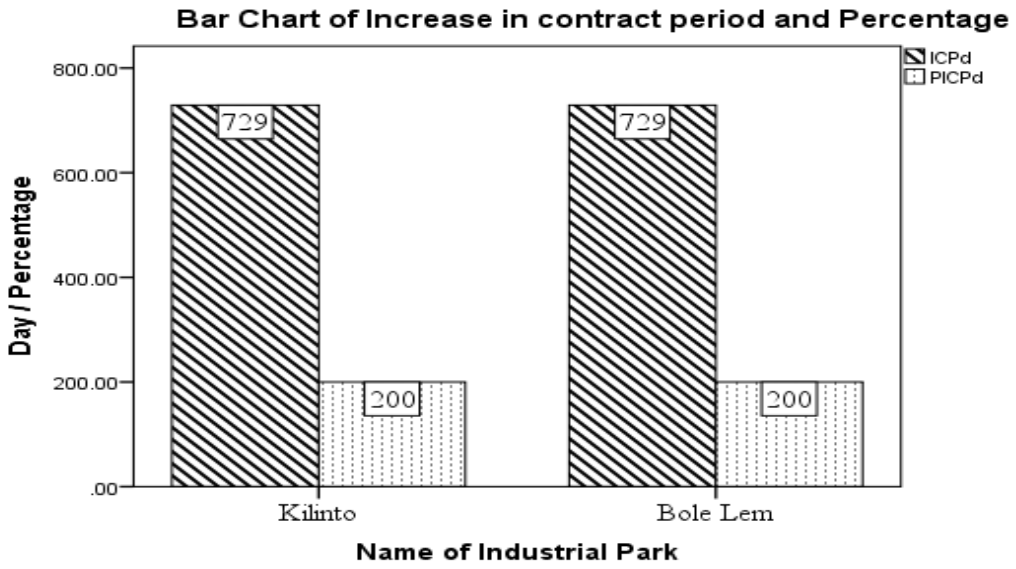


Figure 4.4 Increase in contract Period & Percentage of sampled DBB

4.7. Cost and Time overrun of Selected DB Projects

The sampled DB projects shown in Table 4.8 are selected from the DB projects that are currently under construction. The projects are selected from DB federal road construction projects. The table has been used to show the associated time and cost overruns, as per the sampled projects.

Table 4-8 Original and Revised Contract Price and Period of Sampled DB Contracts

No	Name of industry park (IP)	Size (HA) HA	Original Contract Price $(Million)	Revised Contract Price $(dollar)	Original Contract Period (Days)	Provisional acceptance date (Days)
1	Hawassa phase 1	130	246,085,867.81	291,730,039.79	270	468
2	Hawassa phase 1+	10	83,762,397.00	69,238,021.14	212	541
3	Adama	150	150,249,496.00	150,249,646.00	270	883
4	Mekele	75	99,267,236.00	105,959,568.00	270	552
5	Kombolcha	75	93,933,543.00	93,933,543.00	270	673
6	Dire dawa	150	159,332,390.00	159,332,390.00	270	1095
7	Jimma	75	70,634,716.90	71,934,757.32	270	789
8	Debre Birhan	75	86,108,732.26	86,108,732.26	270	637
9	Bahir Dar	75	63,425,672.36	63,425,672.36	270	773

Source: -FDRE, Industrial Parks Development Corporation Head Office, Contract administration, design and supervision
Directorate

Original Contract Price: - the cost initially estimated at the time of bid award (Contract Amount

Revised Contract Price: - is the revised amount of money at the time of this research

Original Contract Period: estimated project duration at the time of bid award (Contract Duration).

Revised Contract Period: - Contract period including EOT granted.

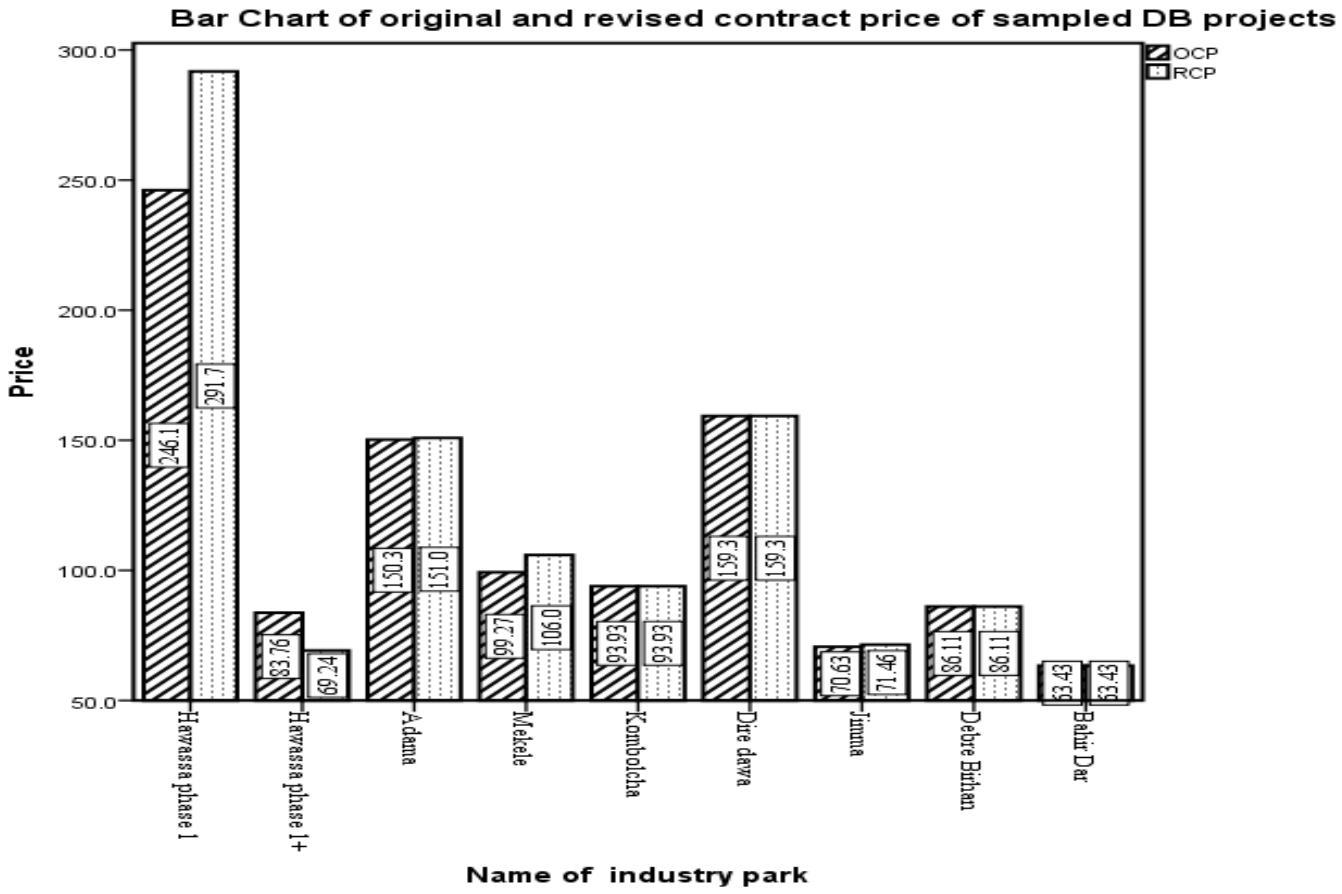


Figure 4.5 Original & Revised contract price of sampled DB project

As per the survey data gathered for those 9 DB projects the results of the research indicated that projects delivered using the DB project delivery system approach performed less increment in the contract price than those delivered through the DBB delivery systems. As it is indicated in the Table 4.9 below the percentage of the increment in the contract price is from 0% up to a maximum of 1.06% which is very small when it is compared against the previously described DBB project delivery system.

Table 4-9 Increment in Contract amount of Sampled DB Projects

No	Name of industry park (IP)	Size (HA)	Original Contract Price	Revised Contract Price	Increase in Contract Price	Percentage Increment in Contract Price %
		HA	$(Million)(dollar)	$(dollar)	$(dollar)	$(dollar)
1	Hawassa phase 1	130	246,085,867.81	291,730,039.79	45,644,171.98	18.55
2	Hawassa phase 1+	10	83,762,397.00	69,238,021.14	(14,524,375.86)	-17.34
3	Adama	150	150,249,496.00	150,946,770.00	697,274.00	0.46
4	Mekele	75	99,267,236.00	105,959,568.00	6,692,332.00	6.74
5	Kombolcha	75	93,933,543.00	93,933,543.00	-	0.00
6	Dire dawa	150	159,332,390.00	159,332,390.00	-	0.00
7	Jimma	75	70,634,716.90	71,459,727.28	825,010.38	1.17
8	Debre Birhan	75	86,108,732.26	86,108,732.26	0	0.00
9	Bahir Dar	75	63,425,672.36	63,425,672.36	0	0.00
mean						1.06

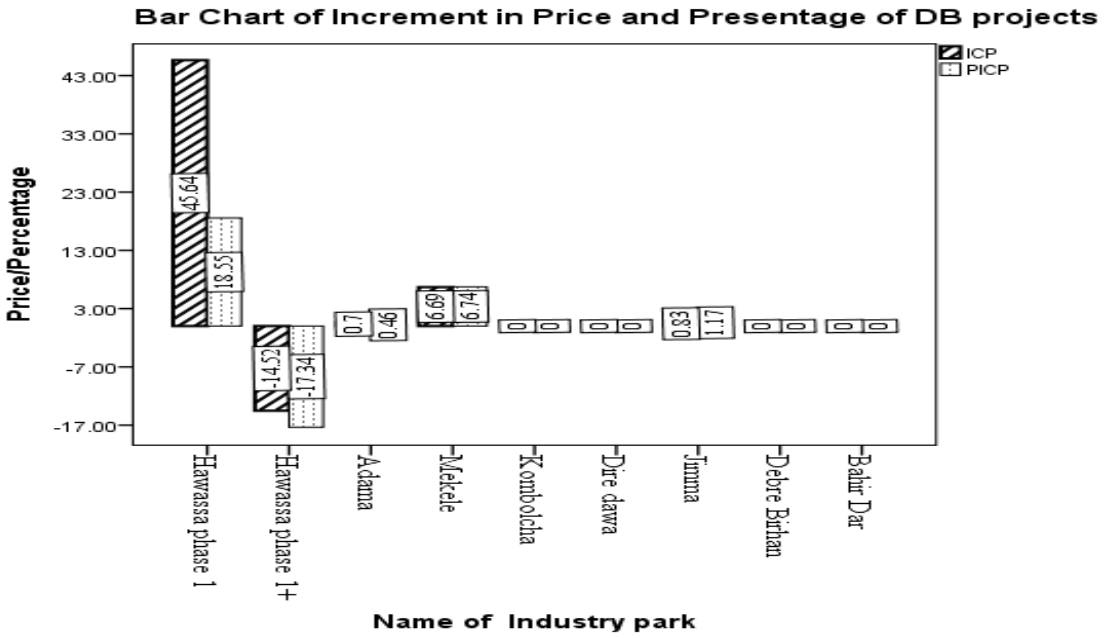


Figure 4.6 increment in contract price and percentage increase in contract price

The survey highlights that significant number of the sampled DB projects were associated with shorter overall project time than conventional system. It is also reckoned that the reduction of the overall project period is attributed to the system's ability to overlap the design and construction passes.

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. As it is seen in table 4.9 and table 4.10, in most of DB procurement form, the final cost does not exceed the project budget, because as it is the fixed fee they calculate 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, because as it is fixed fee the cost variation is absorbed by the contractor.

Table 4-10 Increment in Contract Period of Sampled DB Projects

No	Name of industry park (IP)	Size (HA)	Original Contract Period	Revised Contract period	increase in contract period	Percentage Increment in Contract period
		HA	Days	days	(Days)	(Days)
1	Hawassa phase 1	130	270	468	198	73.3
2	Hawassa phase 1+	10	212	541	329	155.2
3	Adama	150	270	883	613	227.0
4	Mekele	75	270	552	282	104.4
5	Kombolcha	75	270	673	403	149.3
6	Dire dawa	150	270	1095	825	305.6
7	Jimma	75	270	789	519	192.2
8	Debre Brihan	75	270	637	367	135.9
9	Bahir Dar	75	270	773	503	186.3
mean						169.9

The above Tables signifies that the budget and time overruns range from -17.34 % to 18.55 % of the initial costs with mean value of 1.06 % and from 73.3 % to 305.6 % of the initially estimated time with mean value of 169.9 % respectively.

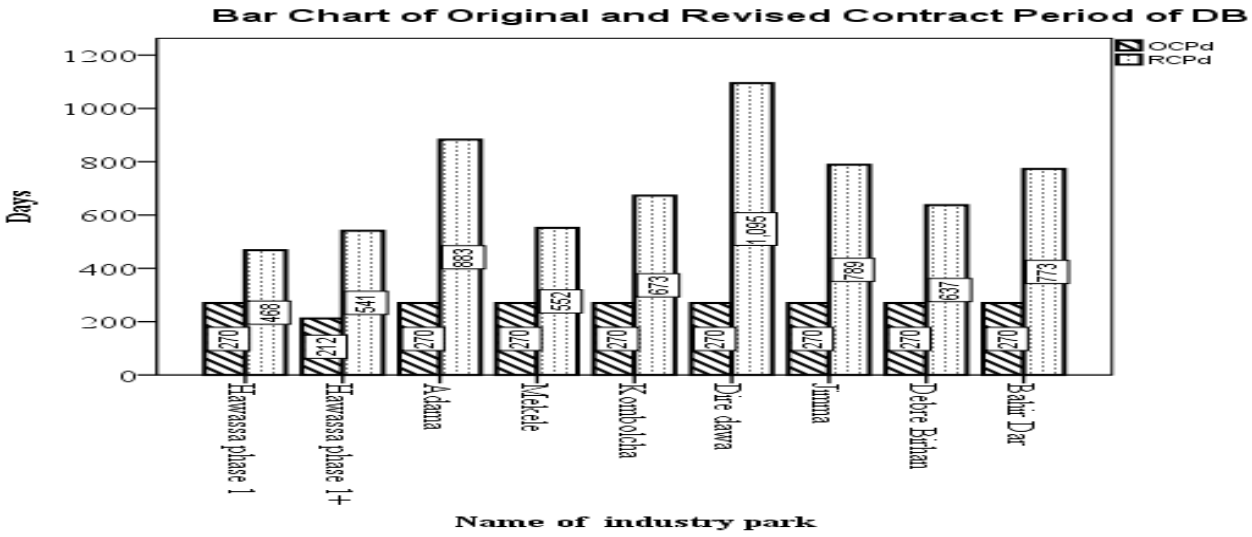


Figure 4.7 Original and Revised Contract Period

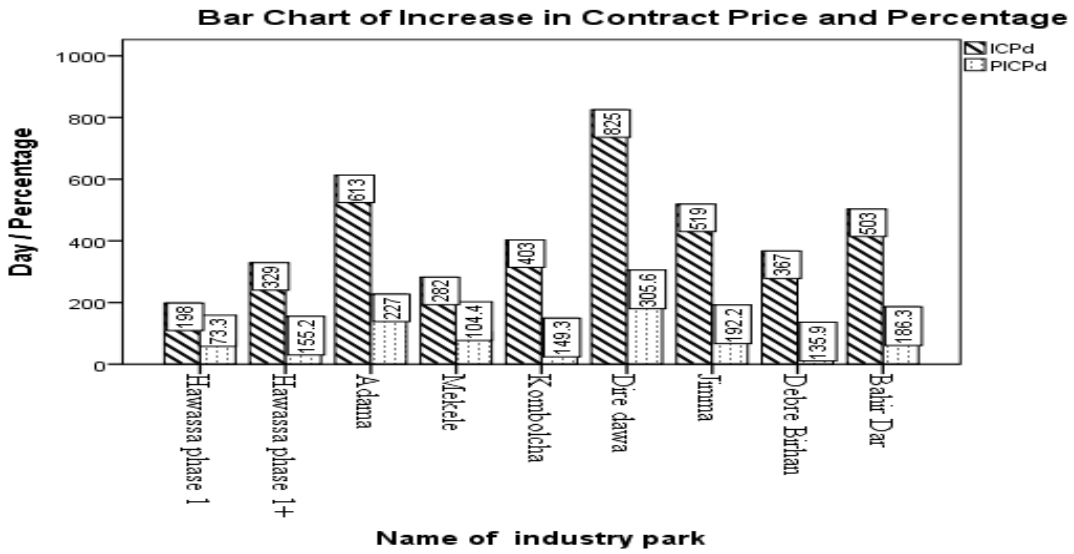


Figure 4.8 Increase In contract Price & percentage increase in contract price.

- **Other literature Findings**

Mark Konchar & Victor Sanvido(1998).research on Comparison of U.S. Project Delivery Systems," the researchers shows DB delivery method is outperformed than DBB ,that means DB is 6.1% lower in unit cost,12% faster in construction speed,33.5% faster in delivery speed,5.2% less cost growth,11.4% less schedule growth.

S. Ratnasabapathy and R. Rameezdeen (2002).research conducted on Performance Assessment of Commercial Projects in Sri Lanka the results indicate that DB projects show best performance in terms of cost and time, at the same time quality is achieved in DBB Projects. In addition, this study concludes that performance of a project is not only depended on the selection of appropriate procurement system, but also influenced by the capability of the contractor as well as the quality of all inputs including proper design and management.

Edaakie et.al (2015) carried out a comparative analysis of traditional and design & build methods of procurement in the Nigerian construction industry on total of 100 building projects of 50 projects DBB and the remaining 50 projects DB. The research revealed that, The factors affecting the performance of procurement methods were also assessed under which the complexity of design, capital cost of project and adequacy of contractor resources were identified as the most important factors affecting the performance of traditional procurement method. For the design & build procurement method the most important factors identified were financial risk, alterations to design and involvement of non-contractual parties. It was also discovered that project completion at estimated cost, project completion at estimated time are the most important criteria for selection of traditional procurement method while in the design & build method, project completion at estimated time, project completion at estimated cost, nature of project and quality assurance were the major selection criteria. In terms of project performance, design & build procurement method was discovered to perform better in terms of cost and time than the traditional method implying that projects under the design & build procurement method are usually completed within the estimated contract sum and duration and lower level of cost and time overruns are conceded. In our country a

research conducted on Ethiopian road authority by Asaminew(2013) & Tariku (2016) the result of both researchers shows DB projects more outperformed in terms of time and cost. That means schedule growth and time growth are less in DB project delivery system.

4.8. Overall Evaluation of the Respondents

The questioner was designed on the general profile of respondent in experience (in general and in particular in company), field of specialization and respondent position in accompany as table 4. Below shows it.

51(94.4%) of the respondents are familiar with both project delivery system (DB &DBB).

This shows the respondents easily compare the performance and others related factors within the two-project delivery system.

Table 4-11 response in experience, field of specialization, and position in a company.

Respondents in experience			Respondent in Field of specialization			Respondents position in a company		
Years	No of respondents	Percentage (%)	Field of specialization	No of respondents	Percentage (%)	Position	No of respondents	Percentage (%)
1-5	8	14.8	Architect	4	7.4	Consultant	14	25.9
6-10	26	48.1	Structural Eng	7	13	Contractor	14	25.9
11-15	18	33.3	Sanitary Eng.	6	11.1	Project manager	3	5.6
>15	2	3.7	Electrical Eng.	5	9.3	Site supervisor	8	14.8
-	-	-	Civil Eng.	31	57.4	Sub-contractors	7	13
-	-	-	others	1	1.9	others	8	14.8
Total	54	100	-	54	100	-	54	100

All of the project considered in this study are new construction as confirmed during desk study and all the interviewees confirmed it also same. Since IPDC was established through regulation 326/2014 through council of minister. All the projects are new and recent.

Table 4-12 Design Risk, speed of delivery & project schedule.

Design risk minimized			**Speed of delivery fast**		**project schedule is efficiently utilized**	
Category	No of respondents	Percentage (%)	No of respondents	Percentage (%)	No of respondents	Percentage (%)
DBB	18	33.3	8	14.8	14	25.9
DB	35	64.8	44	81.5	37	68.5
I don't know	1	1.9	2	3.7	3	5.6
Total	54	100	54	100	54	100

As shown on table 4.12 above Design Risk, speed of delivery & project schedule are better in DB project delivery system.

Another way of this study (research design) used are structured interview questions which help the interviewee put their idea freely and write any missing factors or cases which was not incorporated in questioner.

Both DBB and DB respondents requested their opinion to explain with regard to their specific project and compere both project delivery system in terms of project performance and to state if any other causes.

Accordingly, both respondents view and opinion are summarized and listed for both project delivery methods

4.10.1. DBB Respondents Evaluation

Causes of Delay

- Under estimation of the project duration
- Design Changes
- Client changing design and requirement for some works
- Missed design components during the design time
- Variation works/additional work

- Political Decision
- ROW
- Design error
- Poor contract administration
- Inadequate planning.

Causes of cost over run

- Design changes
- Variation order
- Underestimation of the BOQ quantity
- Missed items
- Additional Works

Quality (performance specification) deviation

- Poor material delivery from the contractors
- Poor supervision from the consultant
- Poor quality control system
- Lack of both consultant and client experience
- Incomplete technical specification
- Approval of design without client representatives
- Deviation due to functionality and conformance
- Change of materials due to client interest like transformer RMU from CCF to VVV

Causes of change order (variation)

- Clients requirement change
- Aesthetic Purpose changes
- Poor feasibility study
- Missing of important items in BOQ (bill of quantities)

- Esthetic value
- Investor request
- Unforeseen ground condition
- Scope change

Effectiveness of DBB VS DB

- DBB retain control of design
- DBB is good to determine the cost beforehand, Employers know exactly what it costs to deliver a project
- DBB is good to define the scope, to give a clear instruction to contractor and consultant
- The disadvantage in DBB, the final cost changes due to variation and miss-calculation of the BOQ
- DBB is time consuming. The designing period, the bidding period, and everything its time consuming.
- DB is often the fastest delivery system
- In DB owner not retains the control of the design
- IN DB there is a tighter control of budget
- DBB and DB project delivery systems have their advantage and disadvantage. Choosing from the two-delivery system depends on the project scope, time and budget.
- DBB is better if when scope, type and specification of the project is clearly defined or known.

4.10.2. DB Respondents Evaluation

Causes of Delay

- Right of way issue, delay in design approval process, construction material shortage, delay in importing construction materials, daily workers shortage, delay in other stake holders work like EEU, EEP, Ethio-telecom, poor project management, poor feasibility study
- Underestimation of original contract period, political instability

Causes of cost over run

Additional works, design change, missed works during design approval, investor's additional requirement

Quality (performance specification) deviation

- Poor supervision, poor material approval process.
- Due to short period of construction period, it is difficult to keep specification especially for asphalt work

Causes of change order (variation)

- Investor's additional requirements and physical site condition
- Client additional requirement

Effectiveness of DBB VS DB

- If it is supervised properly and the designs are approved attentively, DB type contract delivery system is effective for complex projects and projects, which are new to the country**.**
- DB type of project delivery method experienced less cost and less schedule growth minimize administrative burden and risks from project owner so that widely accepted throughout the world.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

The aim and main objective of the research, is to assess and evaluate the effectiveness of project delivery system for industrial parks development Projects in Ethiopia using the traditional delivery method (DBB) versus the innovative project delivery (DB) method in order to determine which delivery method is the best approach to meet the needs of industrial parks development Projects in Ethiopia and to make recommendations based on the findings. The following conclusions and recommendations are, therefore, presented in line with the specific objectives designed to meet the main objective.

5.1. Conclusion

- For DBB project delivery system the main factors (top four) that the project owners consider are: - size and complexity of the project; Urgency of completing the project, Available budget for the project and Project design/ innovation**.**
- For DB project delivery system, the main factors (top four) that the project owners consider are: - Size and complexity of the project, Urgency of completing the project, Available budget for the project and Time.
- The main causes for time overrun (schedule growth) of design –bid- build (DBB) projects are(top three factors) owners should have to consider are : -Right of way problem, inadequate planning, Contract scope change, Whereas the main cause of schedule growth for DB project delivery system are**(top three factors):** -Right of way problem, inadequate planning and contract scope change modification.
- Similarly, the main causes for cost overrun (cost growth) of design bid build (DBB) projects was additional works; time delay, inadequate pre-planning, take the top three causes for cost growth which is similar to DB project delivery system. Also, material, machinery and labor cost increment is also main cause in DB delivery system.

- The results showed that the mean Cost Growth of DB projects are significantly lower than that of DBB projects. The data also showed that DBB projects had also a higher Construction Cost Growth.

In relation to the general evaluation, the DB project delivery system is evaluated to be more effective for the industrial parks development projects in Ethiopia.

- The total Cost Growth is lower in DB projects than in DBB projects for industrial parks development projects in Ethiopia the mean values of the cost growth for DBB and DB projects are 9.02 and 1.06 respectively.

- The Total Schedule Growth is significantly lower in DB projects than in DBB for industrial parks development projects in Ethiopia. The mean values of the schedule growth for DBB and DB projects are 200% and 170% respectively

- Assessment in terms of overall performance (DBB vs. DB) shows there is significant difference was found in appraising the cost growth, schedule growth and other indicators in terms of quality

- 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 transportation of construction materials to site and weather condition.

5.2.Recommendation

- Design build project delivery system is still new in Ethiopian construction industry. Therefore, from the research output the industrial parks development corporation are recommended to use DB system than DBB system from the point of time and cost growth factors.
- Industrial parks development clients also recommended to develop an effective project management system or tools to decrease excessive time and cost growth and avoid quality problems. Contract document must be interpreted and implemented document. As we observed from research out put there is an increase in contract period for both DBB and DB delivery system. But for most of the projects there is no approved extension of time (EOT). Which shows poor project management system and lack of responsibilities among the parties.
- The research recommended to IPDC and other clients to establish some standards on determination of actual project completion & intended completion date by considering factor like topography, weather, project size & complexity, internal and external factors and others for each project.
- Research also recommended to the clients to compare other performance factors like safety and health, Environmental and community related factors (Problems with adjacent Community, Neighbors and site conditions problems), productivity, employer satisfaction, innovation and learning, community satisfaction, environment impact assessment
- Finally, it is suggested that training programs should be developed to educate client's and consulting firm's Engineers, and other decision makers of IPDC on the benefits and boundaries of all project delivery methods, and their proper utilization for successful implementation and utilization of project delivery systems.in case of DB projects where client staff is less involvement.it is difficult to control qualities(design & construction) since architect and engineer works on behalf of contractor. So, the client and its representative should be proactive to control the qualities.

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APPENDIX A

Master's Thesis Data Collection Questionnaires

Dear Respondents:

I would like to thank you in advance for the time and effort involved in your participation in this research. This questionnaire is prepared to obtain information from key informants. The information is required for the academic research entitled "the effectiveness of Design-Bid and Design-Bid-Build Delivery Method in Industrial Parks Development Projects in Ethiopia", which is being conducted as partial fulfillment of MSc. in Construction Engineering and Management. The main objective of the research is to assess the effectiveness of project delivery Method in industrial parks project in Ethiopia. This questionnaire guide is divided into two sections; General profile of the respondent and project characteristics

If not, enough space is provided for the brief questions, please feel free to attach extra sheets to the document. In the questions, I ask for detailed information on project characteristics and performance. Please do what you can to assemble this information as fully as possible. Your detailed responses will allow me to understand to what extent these project characteristics and performance measurements have influence in the effectiveness of project delivery Method in industrial parks project in Ethiopia. The confidentiality of the participants on this questionnaire will be maintained. This interview data will not be placed in any place except for educational and research purpose. The identity of person who provided all this information will remain anonymous. The data obtained during this interview will not be linked in any way to participants' names.

Please return this questionnaire by hand, via email or by mail to the following address:

Tesfaye Likisa

Cell phone: 0913423448/0944122125

Jimma University, IOT, Civil Engineering Department

Post Graduate Student, Construction Engineering & Management Stream

Jimma, Ethiopia

General Profile of the Respondent, Organization & Project Characteristics

I. General Profile of the Respondent

1. Positions: _____

2. Organizations (optional): _____

3. Addresses: (optional) _____

4. Are you Familiar with project delivery method? A. Yes B. No C.Both

5. If yes please specify it (all applicable) A. DBB B. DB C. if other specify it_____

6. How long **you** have worked in construction industry?

A. 1-5 Year B. 6-10 Year C. 11-15 Year

D. above 15-year E. I have no any work experience

7. What is your field of specialization?

A. Architect C. sanitary

B. structural Eng. D. electrical Eng.

E. Others, please specify……

8. Your position in company?

A. Consultant (Designer) C. Contractor (Builder)

B. Sub- Consultant E. Site Supervisor

D. Project Manager F. Sub-Contractor

G. Others, please specify……

II. General Profile of the Organization and project characteristics.

1. From your experience, in what type of project delivery method design risks are better minimized?

A. Design-Bid-Build

B. Design-Build

C.I do not know

2. By outsourcing the design work in which of project delivery system do you think that speed of delivery maintained better?

A. Design-Bid-Build B. Design-Build C.I do not know

3. In which type of project delivery system do you believe that project schedule is efficiently utilized?

A. Design-Bid-Build

B. Design-Build

C.I do not know

4. Describe the nature of this project.

A. New Construction B. Maintenance C. other specify

III: Questionnaire

Instrument-B (ranking time, quality cost growth and selection of Project Delivery System factors/causes)

The purpose of this survey is to rank the factors to choice/select appropriate project delivery system, causes of time growth (delay), cost growth and measures factors which affect quality.

In the following survey you are kindly asked to circle the appropriate point you think reasonably from (1-5). Only for the bottom four tables.

1= very poor 2= poor 3= medium 4= high 5= very high

DB = design build DBB = design bid build

A. Factors used to choose/select appropriate project Delivery Method

No.	Project type-DBB or DB choice (circle) one of it	Please circle on the appropriate point (only one)				
	Factors causes used to choose project Delivery Method	1	2	3	4	5
	Project characteristics					
1	Size and complexity of the project;	1	2	3	4	5
2	Available budget for the project;	1	2	3	4	5
3	Sources of funding for the project;	1	2	3	4	5
4	Ensuring project Quality	1	2	3	4	5
5	Time	1	2	3	4	5
6	Urgency of completing the project	1	2	3	4	5
7	controlling project cost	1	2	3	4	5
8	Project design/ innovation (The complexity and innovation in the design is critical)	1	2	3	4	5
9	Risks associated with the system (Clients transfer of risk/allocation to others)	1	2	3	4	5
10	Third party agreement (flexibility for input to design and construction of third-party agreement).	1	2	3	4	5
11	Capability and creativity of the project owner's;	1	2	3	4	5
	Owner characteristics					
12	reduction of owner’s administrative burden	1	2	3	4	5
13	Owners goals (meeting employers’ requirement)	1	2	3	4	5
14	Owner control (Clients desire of high degree of control)	1	2	3	4	5
15	Owner staff involvement (Clients desire of substantial or minimum use of its own staff)	1	2	3	4	5

16	Owner PDS experience Client experience of using a specific PDS –project delivery system)	1	2	3	4	5
	Life cycle issues					
17	Life cycle cost (Project life cycle cost is critical factor)	1	2	3	4	5
18	Maintenance (Ease in maintenance is critical to Clients)	1	2	3	4	5
	Others					
19	Legal and regulatory ability to use various innovative project delivery systems	1	2	3	4	5
20	Construction claims/dispute (Clients desire minimum claims and disputes)	1	2	3	4	5

B. Factors which affect time (schedule) growth

No.	Project type- DB or DBB circle one of it	Please circle on the appropriate point (only one)				
	Causes(factors) for time (schedule) growth in industrial parks project	1	2	3	4	5
	The factors that related to owner's responsibility					
1	Financial problem (delayed payments, financial difficulties, and economic problems)	1	2	3	4	5
2	lack of coordination with contractors	1	2	3	4	5
3	Slow decision making	1	2	3	4	5
4	Contract scope change/modification	1	2	3	4	5
5	Right of way problem (client unable to clear construction site on time)	1	2	3	4	5

6	Inadequate planning	1	2	3	4	5
7	Lack of coordination with local authorities	1	2	3	4	5
	factors that related to contractor's responsibility					
8	Lack of experience	1	2	3	4	5
9	poor site management	1	2	3	4	5
10	Lack of machinery and equipment on market	1	2	3	4	5
11	Delay in delivery of materials to site	1	2	3	4	5
12	Shortage of materials on site	1	2	3	4	5
13	lack of subcontractor’s skills	1	2	3	4	5
14	coordination problems with others;	1	2	3	4	5
15	financial problems	1	2	3	4	5
16	Shortage and low productivity of labor	1	2	3	4	5
	The factors that related to consultant's responsibility					
21	Lack of experience on the part of the consultant’s site staff.	1	2	3	4	5
22	Poor supervision and slowness to give instruction	1	2	3	4	5
23	incomplete documents	1	2	3	4	5
24	absence on site	1	2	3	4	5
25	delayed and slow supervision in making decisions	1	2	3	4	5
	Factors that related to external factors					
26	Adverse weather condition	1	2	3	4	5
27	Poor site condition (unforeseen ground condition)	1	2	3	4	5
28	Lack of materials, equipment and tools on the market	1	2	3	4	5
29	Poor economic conditions (currency, inflation rate, etc.);	1	2	3	4	5
30	changes in laws and regulations;	1	2	3	4	5

C. Factors which affect cost growth

No.	**Project type-DB or DBB circle one of it**	Please circle on the appropriate point (only one)				
	Causes for Cost growth in industrial parks projects	1	2	3	4	5
1	Additional works;	1	2	3	4	5
2	Time delay (client and contractor)	1	2	3	4	5
3	Material, machinery and labor cost increment	1	2	3	4	5
4	Inaccuracy of material take-off and estimation	1	2	3	4	5
5	Inadequate pre-planning	1	2	3	4	5
6	Fraudulent practices	1	2	3	4	5

D. Factors which Measures Project quality

No.	**Project type-DB or DBB circle one of it**	Please circle on the appropriate point (only one)				
	Factors which Measures Project quality	1	2	3	4	5
1	Pleasing to look;(aesthetic value)	1	2	3	4	5
2	Project with good service quality;	1	2	3	4	5
3	Free from defects on completion;	1	2	3	4	5
4	Fit for the purpose	1	2	3	4	5
5	Satisfactory durability	1	2	3	4	5
6	Conformance to standard (product made exactly like designer and employers' requirement)	1	2	3	4	5
7	Quality assurance of materials and equipment used for construction	1	2	3	4	5

IV: Interview Questions (Case analysis)

1.Causes of Delay

……

……

……

2.Causes of cost over run (if exist)

……

……

……

3. Quality (performance specification) deviation

……

……

……..

4. Causes of change order (variation if exist)

……

……

5. Effectiveness of DBB VS DB

……

……

6. Your conclusion and recommendation:

……

……

APPENDIX B

DEFINITION AND EVOLUTION OF INDUSTRIAL PARKS

1.1 The following definitions has given to industrial parks at different times.

According to (Blonde-Henriksen, 1982) is defined an industrial park is a tract of land set aside for industrial purposes under the private management and control of the developer or investors. An industrial park is defined as an area reserved for industrial development which is usually located close to the transportation environment, mainly in case where more types of transportation are used. (Vidová1, 2010).

Wikipedia, the free encyclopedia defines an industrial park as “An industrial park (also known as **industrial estate**, trading estate) is an area zoned and planned for the purpose of **industrial development**. An industrial park can be thought of as a more "heavyweight" version of a business park or office park, which has offices and light industry, rather than heavy industry”. (https://en.wikipedia.org/wiki/Industrial_park).

According to UNIDO’s definition “An industrial park is defined as a tract of land developed and subdivided into plots according to a comprehensive plan with or without built-up (advance) factories, sometimes with common facilities and sometimes without them, for the use of a group of industrialists”. (UNIDO, 1997, p.10)

“Industrial park” means an area with distinct boundary designated by the appropriate organ to develop comprehensive, integrated, multiple or selected functions of industries, based on a planned fulfillment of infrastructure and various services such as road ,electric power and water, one stop shop and have special incentive schemes, with abroad view to achieving planned and systematic, development of industries, mitigation of impacts of pollution on environment and human being and development of urban centers, and includes especial economic zones, technology parks ,export processing zone, free trade zones and the like designated by the investment Board;(“ Industrial parks proclamation, No.886/2015”)

1.2 Evolution of industrial parks

Industrial parks have not evolved in steady progression. As new uses have been accommodated, some uses commonly included in earlier parks have been excluded. For example, heavy industry, once part of early planned industrial districts, is seldom provided for in the newest industrial parks. At the same time, however, new facilities such as offices, services areas, shopping centers, and recreational facilities are being added to enhance the convenience of the planned industrial for neighborhood tenants and investors. (Bonde-Henriksen, 1982).

The cornerstone of industrial parks can be found in Great Britain, which is a country, where factory production spread and where first industrial zones were founded. These were set up by multiple production units; the first factories arose somewhat accidentally, however, their later occurrence represents an organized deed that followed certain idea of urban planning and regional concept. The first industrial park, Trafford Park, was established by a company named Ship canal and Docks near Manchester in 1896. (Vidová1, 2010).

APPENDIX C

Category	Factors causes used to choose project Delivery Method	DBB		DB	
		RII	Rank	RII	Rank
Project characteristics	Size and complexity of the project;	0.88	2.5	0.88	1.5
	Available budget for the project;	0.88	2.5	0.84	3.5
	Sources of funding for the project;	0.83	5.5	0.81	5
	Ensuring project Quality	0.78	11	0.77	9
	Time	0.75	14	0.84	3.5
	Urgency of completing the project	0.88	2.5	0.88	1.5
	controlling project cost	0.8	9	0.74	12
	Project design/ innovation	0.88	2.5	0.79	8

Category	Factors causes used to choose project Delivery Method	DBB		DB	
		RII	Rank	RII	Rank
	Risks associated with the system	0.82	7.5	0.75	11
	Third party agreement	0.65	19	0.63	16.5
	Capability and creativity of the project owner's;	0.75	14	0.62	19
owner characteristics	reduction of owner's administrative burden	0.66	18	0.8	6.5
	Owners goals	0.75	14	0.8	6.5
	Owner control	0.78	11	0.64	15
	Owner staff involvement	0.83	5.5	0.66	13
	Owner PDS experience Client experience of using a specific PDS –project delivery system)	0.78	11	0.62	19
Life cycle issues	Life cycle cost (Project life cycle cost is critical factor)	0.72	16.5	0.76	10
	Maintenance (Ease in maintenance is critical to Clients)	0.82	7.5	0.63	16.5
Others	Legal and regulatory ability to use various innovative project delivery systems	0.72	16.5	0.62	19

APPENDIX D

	Causes(factors) for time (schedule) growth in industrial parks project	DBB		DB	
		RII	Rank	RII	Rank
Factor that related to owner's responsibility	Financial problem	0.71	7	0.69	4
	lack of coordination with contractors	0.74	4.5	0.62	11.5
	Slow decision making	0.74	4.5	0.62	11.5
	Contract scope change/modification	0.75	3	0.7	2.5
	Right of way problem	0.86	1	0.82	1

	Causes(factors) for time (schedule) growth in industrial parks project	DBB		DB	
		RII	Rank	RII	Rank
	Inadequate planning	0.77	2	0.7	2.5
	Lack of coordination with local authorities	0.71	7	0.63	9
factors that related to contractor's responsibility	Lack of experience	0.58	21.5	0.53	24.5
	poor site management	0.65	21.5	0.6	14.5
	Lack of machinery and equipment on market	0.62	15.5	0.53	24.5
	Delay in delivery of materials to site	0.58	21.5	0.6	14.5
	Shortage of materials on site	0.54	24	0.56	21.5
	lack of subcontractor’s skills	0.58	21.5	0.58	17
	coordination problems with others;	0.51	26	0.57	19.5
	financial problems	0.66	10.5	0.56	21.5
	Shortage and low productivity of labor	0.6	18.5	0.58	17
The factors that related to consultant's responsibility	Lack of experience on the part of the consultant’s site staff.	0.66	10.5	0.66	5.5
	Poor supervision and slowness to give instruction	0.62	15.5	0.66	14.5
	incomplete documents	0.71	7	0.6	7
	absence on site	0.63	13	0.62	11.5
	delayed and slow supervision in making decisions	0.68	9	0.64	8
Factors that related to external factors	Adverse weather condition	0.62	15.5	0.62	11.5
	Poor site condition (unforeseen ground condition)	0.6	18.5	0.55	23
	Lack of materials, equipment and tools on the market	0.58	21.5	0.58	17
	Poor economic conditions (currency, inflation rate, etc.);	0.62	15.5	0.65	7
	Changes in law and regulations	0.52	25	0.53	24.5

APPENDEX E

INDUSTRIAL PARKS DEVELOPMENT CORPORATION PROJECTS

HAWASA INDUSTRIAL PARK

MEKELE INDUSTRIAL PARK

KOMBOLCHA INDUSTRIAL PARK

ADAMA INDUSTRIAL PARK

JIMMA INDUSTRIAL PARK

DIRE DAWA INDUSTRIAL PARK

BOLE LEMI INDUSTRIAL PARK

KILINTO INDUSTRIAL PARK

BAHIR DAR INDUSTRIAL PARK

DEBRE BIRIHAN INDUSTRIAL PARK