



## Suitability of EPC Contracts in Public Sector Building Construction Projects

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**Abstract:** Large investments, public as well as the private, will be needed in various infrastructure sectors to meet the growing needs of the Indian economy. The public sector would continue to play an important role in building infrastructure and would need to ensure efficient and timely construction of projects within the agreed costs. The various departments and undertakings of the Central Government as well as the State Governments have been undertaking construction projects through the conventional item rate contracts where the Government provides the detailed design as well as the estimates of quantities for different items of work (Bill of Quantities). Payments to the Contractor are made on the basis of measurements of the work done in respect of each item. Experience shows that item rate contracts are prone to excessive time and cost overruns, besides recurrent disputes involving large claims. The reasons for the poor performance of item rate contract include inadequate project preparation and estimation coupled with allocation of several construction risks to the Government.(CIDC).EPC Contracts have long been used in infrastructure sector and proven to be cost and time effective. NITI Aayog in a statement in year 2016 said, all the public sector buildings above 100cr shall be procured via EPC Contracts. This study aims to find out the suitability of EPC contracts in public sector building projects based on certain parameters and success factors of EPC Contracts.

**Index Terms-** EPC Contract, FIDIC/NITI AAYOG, Risk management, Public-sector Buildings projects,

### I. INTRODUCTION

According to report published by EY, (Engineering, Procurement and Construction), Braving the headwinds in year (2017), sectors with high EPC dependencies are oil and Gas, Power EPC, Infrastructure construction having clientele base (Government-Private) approximately 80:20 while in case of Building sector projects it is 20:80. New procurement mechanisms are adopted by other sectors in construction trying to gap the challenges of cost and time. However, it would be necessary to understand the dynamics of construction sector to the adoption of these innovative changes. As per the order of NITI Aayog(2016) which suggests to adopt the EPC(Turnkey) Contract system in all projects worth more than 100 cr. and substitute item rate contract with EPC Contract where possible. The working mechanism in the sector reveals that the industry is categorically obsessed with traditional Procurement systems due to which most of the projects are facing cost and time overrun. (Smitha Yadav, 2016). As per report published by MoSPI in year (2019), as many as 345 infrastructure projects, each worth Rs 150 crore or more, have shown cost overruns to the tune of over Rs 3.28 lakh crore owing to delays and other reason. For many years now it seems that the most desired way for an Owner to procure a major construction project, particularly one being project financed, was via a fixed price, lump sum turnkey route; the so called engineering, procurement and construction contract ("EPC contract") (Phil Loots, 2007). Construction Industry Development Council (CIDC), with NITI Aayog in year (2017) had published General conditions of Contract for civil works on Engineering, Procurement and Construction for better understanding and implementation of EPC in construction sector. Nowadays, FIDIC forms of contract are intended to be suitable for projects being carried out around the world by all types of employers. (Klee, 2013). FIDIC publish different best practice documents including sample forms of contracts for works that are known for balanced risk allocation and efficient Claim management system. Using Standard forms have always been helpful in executing project timely. This paper aims to find out the suitability of EPC contract system in public sector building construction projects.

### II. NEED IDENTIFICATION AND PROBLEM STATEMENT

Contracts have evolved from item rate packages to lump-sum, fixed price, Fixed-time binding contracts. Slowly but steadily, **the onus of Project management has shifted from owner/Developer to the contractor**. There is a visible shift from owner-managed projects to EPC Contracts and **risk of time and cost overrun has been transferred to the contractor**, along with the responsibility of designing and procurement of material and construction. **This form of contract even protects the owner/developer from currency and interest rate/fluctuations.**

### III. OBJECTIVES

1. To understand the contracting strategies and risks/challenges involved in public sector building projects.
2. To identify the factors governing the suitability of EPC projects in public sector building construction projects.
3. To analyze the high/Less risk factors associated with EPC contracts in implementation in public sector building construction projects through expert opinion
4. To analyze the results of survey and further validate it on case study to find out the suitability of EPC Contracts in Public sector Building construction projects.

### IV. RESEARCH METHODOLOGY

To address the research questions or meet the research objectives, the following research steps are proposed-

Step 1–Understanding the trend in public sector buildings, the relationship amongst the Contracting strategy and procurement method, peculiarities and success factors of EPC Contracts and Risks in building sector.

Step 2–Understanding the parameters of EPC Contracts and risks associated with EPC parameters (in form of questionnaire)

Step 3 - Further Developing the survey methodology including aim, objective, target group of survey and floating the questionnaire amongst various experts working on EPC Contracts to analyse High/Moderate/Low Risk profile parameter of EPC Contracts.

Step 4 - Analyzing the survey and validating the survey result through a case study on Public sector building construction project on EPC Contracts to assess the suitability of EPC Contracts in public sector building construction projects.

### V. LITERATURE REVIEW

#### 5.1 Trend in Public sector buildings

Large investments, public as well as the private, will be needed in various infrastructure sectors to meet the growing needs of the Indian economy. The public sector would continue to play an important role in building infrastructure and would need to ensure efficient and timely construction of projects within the agreed costs. (Construction Industry Development Council, 2017).

The various departments and undertakings of the Central Government as well as the State Governments have been undertaking construction projects through the conventional item rate contracts where the Government provides the detailed design as well as the estimates of quantities for different items of work (Bill of Quantities). Payments to the Contractor are made on the basis of measurements of the work done in respect of each item. Experience shows that item rate contracts are prone to excessive time and cost overruns, besides recurrent disputes involving large claims. The reasons for the poor performance of item rate contract include inadequate project preparation and estimation coupled with allocation of several construction risks to the Government.

#### 5.2 About EPC

Step-1: Owner contracts with EPC Contractor to design and construct a project.

Step-2 Owner's Statement of Requirements/Performance Specification/Output Specification can be prepared by Owner, Owner's Consultant.

Step-3: Owner or Owner's Consultant administers contract.

Step-4: EPC Contractor is responsible for: Design, preparation of Engineering drawings, procurement, construction, testing, commissioning and Meeting Owner's Requirements

Source (Helmut Johannsen (Nov, 2017), EPC Contracts)

EPC is the widely used acronym for the project delivery method known as Engineering-Procurement-Construction. It has much in common with design-build, including single source responsibility for design and construction, fixed price contracts, and broad assumption by the contractor of the risks of cost, schedule and performance. (Haskell, 2017)

The key clauses in any construction contract are those which impact on: Time, Cost, and Quality. The same is true of EPC contracts. However, EPC contracts tend to deal with issues with greater sophistication than other types of construction contracts. This is because, as mentioned above, an EPC contract is designed to satisfy the lenders' requirements for bankability (McNair, 2011). **EPC contracts provide for:**

- A single point of responsibility
- A fixed contract prices
- A fixed completion date
- Performance guarantees
- Caps on liability.
- Security
- Performance specification

Although Engineer, Procure, Construct EPC contracting can potentially save millions of dollars up front, as well as dollars paid in change orders while construction proceeds, design-build/EPC contracting may not be the silver bullet for construction that design-build/EPC contractors perceive it to be. (Galloway, 2009).

### 5.3 Peculiarities & success factors of EPC contracts:

- 1 Front End Engineering Design
- 2 Base concept/Schematic design
- 3 Statement of Owner requirement vs Detail specifications
- 4 Role of owner consultant
- 5 Design requirement and issues
- 6 Procurement process
- 7 Quality requirements
- 8 Contract schedule issues
- 9 Performance tests
- 10 Contractual Obligations:
  - 10.1 Termination for default
  - 10.2 Performance security
  - 10.3 Third party requirements
  - 10.4 Force majeure
  - 10.5 Change in law
  - 10.6 Commissioning requirements
  - 10.7 Insurance
  - 10.8 Extension of Time

Critical success factors (CSF) for large EPC projects are those that are most influential to the budget, time schedule and quality of the finished asset.

- Project Finance Risk Analysis
- Contract structuring

Success of both the two factor depends upon quality of Pre-FEED/FEED Study which normally takes an year to plan.

Front-end engineering and design (FEED) plays a critical role in preparing EPC projects for success. More than simply providing a project cost estimate, FEED comprises a thorough project scope, complete project budget, total cost of ownership, implementation timeline and initial risk assessment.

“Poor planning estimates and missed deadlines are among the largest contributors to project failure, according to Insights and Trends, PwC’s 2012 Global Project Management Survey of participants in 38 countries”

Source: (McKinsey & Company, 2018, Success factors of EPC contracts) & (Rockwell Automation: Front end engineering and design)

As per EY, EPC World-Braving the headwinds,2017, which defines the various project risks associated in different stages of Project lifecycle:

Table 1: Risks in Buildings sector

Risks	Pre-tender Stage	Post-tender Stage	Execution Stage
Political risks	Political stability of the country; change in government	Delay in approvals and land acquisition	
Environmental risks		Environmental approvals	Unfavorable climatic condition
Technical risks	Insufficient preliminary research on scope, resource availability, technology requirement leading to inaccurate time and cost estimation	Design changes/inadequacies; Resource Availability; Site conditions	Unfamiliarity with topography/Terrain; resettlement and rehabilitation; Utility shifting
Financial risks	Cost estimates and financing assumptions	Liquidity and credit shortage	Foreign exchange and interest rate fluctuation
Market risks		Economic Downturn	Delay in payments from client; unavailability of resources
Contractual/legal risks	Unfamiliarity with local laws	Unfamiliarity with the local laws and regulations; limited say in contract negotiations	Unfamiliarity with the local laws, tax and regulations
Force majeure risks			Risks associated with external hazards, including storms, floods, earthquakes, vandalism, Civil unrest

## 5.4 EPC Bidding Process

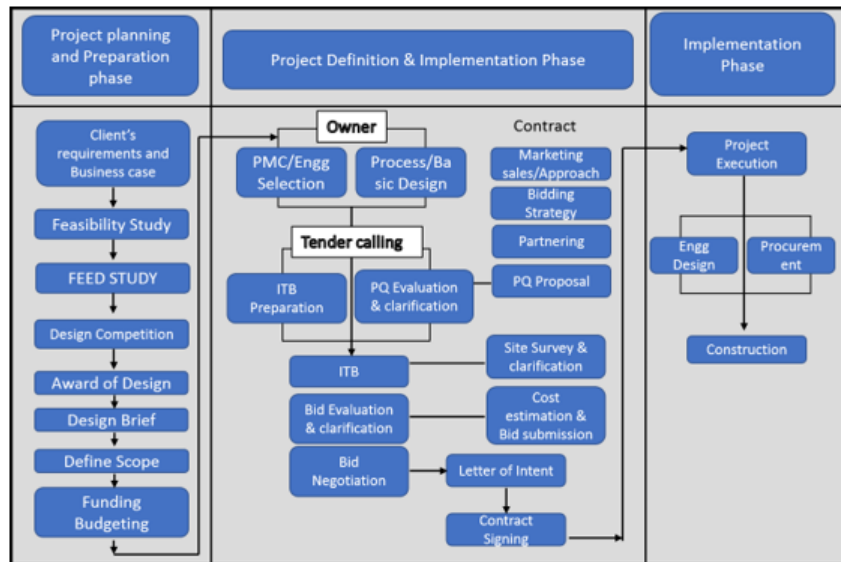


Figure1: EPC Bidding process

Source: Author

## 5.5 Front End Engineering Design:

Proper front-end engineering and design lay the groundwork for well-engineered, on-time and on-budget projects. Poor upfront planning in the form of unanswered questions, a lack of detailed requirements and ambiguous support from management can lead to significant changes during a project's execution and can easily result in the project going over budget and past schedule. PwC global survey in year 2012 of project management leaders identified that the top four factors that contribute to poor project performance are:

- Poor estimates/missed deadlines
- Lack of executive sponsorship
- Poorly defined goals/objectives
- Change(s) in scope mid-project

These factors reinforce why a front-end engineering and design approach (FEED) is so vital to preparing a capital building project for success. FEED is the basic engineering that follows a conceptual design or feasibility study and is used as the basis for the detailed engineering phase. For a successful FEED Study:

### FEED is more than a cost estimate

Some organizations minimize their up-front engineering investments, either because they don't see the value in FEED or because of time or cost restraints. Skipping or minimizing this step, though, can limit their ability to accurately define project scopes, result in decisions that are based on assumptions and lead to price estimates that are made in haste – all of which can actually increase costs in the long run. In short, those involved in capital building projects should remember that FEED is project design that leads to a project cost – not the other way around.

Early stakeholder involvement is important

Good FEED requires support and involvement from a cross-functional team within an organization. This should include the engineering, finance, operations, regulatory and facility-management teams.

## 5.6 Base concept/Schematic design:

“Base Concept” generally consists of Schematic Design prepared by Owner. The advantage of providing base concept is that **it facilitates** good understanding of performance specifications and **owner general expectations of design**. On the other hand, the disadvantage of providing base concept is that **it may limit innovation**.

## 5.7 Statement of owner's requirement vs Detailed design:

Statement of Owner's Requirements can vary from statement of outcome required, to performance-based specification, to detailed specification, or any combination thereof. Consequences of failure to meet performance requirements must be addressed.

- Performance measures and/or tests or other requirements that will demonstrate performance requirements are met
- Detailed specs but only where something truly is critical to Owner.

## 5.8 Role of owner consultant

Benefit and Risk: Owner's Consultant is essential to protect Owner if EPC Contractor's consultant is on a fixed price with limited scope, does not provide field services, or doesn't fully take into account future life-cycle issues.



### 5.9 Design requirement and issues

The EPC agreement specifies the dates on which different sections of the project land will be handed over to the Contractor. It defines the scope of the project with precision and predictability to enable the Contractor to determine its costs and obligations. It also lays down a ceiling of 10 percent of contract price to cater for any changes in the scope of the project, the cost of which the Authority shall bear.

The Contractor shall carry out survey and investigations and also develop designs and drawings in conformity with the specifications and standards laid down in the Agreement. It will get these checked by a proof consultant and a safety consultant who are to be appointed with the approval of the Authority. The design and drawings would be reviewed by the Authority's engineer to ensure that they conform to the scope of the project as well as the prescribed standards and specifications. The EPC agreement also stipulates provisions for quality control and assurance.

A provision has been made for damages which the Contractor shall pay to the Authority for not achieving the prescribed milestones. The Authority will pay bonus to the Contractor for completion of the project before the scheduled completion date.

## VI. SURVEY ANALYSIS AND FINDINGS

### 6.1 Aim of Survey

The aim of this survey is to find out High risk /Less risk parameters associated with their implementation in public sector building construction projects in EPC Contracts.

### 6.2 Methodology of Survey

There are total 8 parameters listed in "Details of questionnaire" below that can define the success of EPC Projects, out of which FEED Study, Scope definition and achieving Functionality through specifications, plays major role in success of EPC projects. Since Building sector is also design and functionality oriented and if these three parameters are working fine on building construction project, the contract form can be said to be "suitable".

The Survey include experts with designation preferably PMC, Architects, Public sector Officials, Contractors worked/Working on EPC Contracts building projects, and academicians with knowledge on EPC Contracts. The number of respondents shall be 25-30nos.

### 6.3 Suitability Parameter:

There are total 14 questions out of which 6 can be answered in Yes/No/Yes with modifications only and rest 8 are range specific. Range can be between 1-2, 3, 3-5. The description of 1-5 have been provided with every range specific question.

The parameter can be said to become High Risk event/Less risk event, if response is:

Above 3 = Less risk event (If more than 50% respondent marks to above 3, it means particular parameter is working fine in public sector building projects).

Less than 3 = High risk event (If more than 50% respondent marks to less than 3 it means particular parameter is not working fine in public sector building projects and may bring risks during the implementation of EPC process).

Equals to 3 = Moderate risk event.

The parameter can be said to be suitable if more than 50% respondents' answers is above 3.

### 6.4 Sample Conclusion:

If most (above 60%) of the respondents have given their responses as above 3, so it can be said that these parameters are less risky during the implementation phase of EPC process in public sector building projects because of well-defined FEED Study, clear scope definition etc. and from their experience EPC may be suitable for public sector building projects. For further validation the result shall be cross checked with case studies to find out the exact status of public sector EPC projects in terms of feasibility, overruns, mitigation measures etc.

Table 2: Detail of Questionnaire:

S No	Risk Group	Questions	Analysis	Suitability
1	Pre-FEED/FEED Study	To what extent, should the end user involve (in case of complex buildings like Hospitals) in preparation of Feasibilities studies in EPC Contracts in Public Sector Building construction projects?	1: 20% 2: 40% 3: 60% 4: 80% 5: 100%	Above 3
		FEED study is very crucial stage in EPC projects, on a scale of 1-5 how much its importance is being considered in <b>public sector building projects</b> ?	1: Not considered 2: Considered Less 3: Moderate 4: High 5: Very High	Above 3
		What is the level of completeness of FEED Study in public sector building projects in EPC Contracts?	1: 20% (Incomplete-Lack of Pre-Feed Study) 2: 40% (Ambiguous) 3: 60% (Moderate) 4: 80% (Good: Need one-time clarifications from owner) 5: 100% (Excellent-Fully complete and easy to understand and implement)	Above 3
		Who carries out the FEED Study in Public sector Building Projects?	<ul style="list-style-type: none"> <li>• FEED Experts</li> <li>• Owners' team</li> <li>• Others</li> </ul>	
2	Base concept/Schematic Design (Scope Definition)	On a scale of 1-5, How well the scope is the defined in EPC Contracts?  (Intent: Incomplete/unclear Scope definition due to insufficient feasibility study leads to delays and disputes in construction)	1: 20% (Incomplete-because of incomplete feasibility study) 2: 40% (Ambiguous- Requirements are not clear) 3: 60% (Moderate) 4: 80% (Scope is clear, but require one-time modification to make it fit for purpose) 5: 100% (Scope is clear and well defined in terms of owners' requirements and needs no modification)	Above 3
3	Statement of owner's requirement vs Detailed design: (Functionality)	On a scale of 1-5, How clearly are the specifications and details of the project have been specified by the client?  (Intent: Inadequate specification and detailing due to unclear scope definition and FEED Study leads to dispute during construction)	1: 20% (Incomplete) 2: 40% (Ambiguous- Specifications and details are not matching) 3: 60% (Moderate) 4: 80% (Specs are clear, but require one-time modification to make it fit for purpose) 5: 100% (Specs are clear and well defined in terms of owners' requirements and needs no modification)	Above 3
4	Quality Requirements	In EPC Contracts the client has to submit only Architectural drawings, to what extent does the quality of Architectural drawing deliverable improved?	1: No improvement- Same as other contracts i.e. More revisions and slow decisions. 2: Slightly Improved- More revisions and fast decision 3: Moderate=Less revisions and fast decisions. 4: Highly improved- Very few one-time modifications. 5: Excellent- (Require No changes)	Above 3

6	Overall	Which of the following parameter still needs to be workout in detail more for successful implementation of EPC Contracts in Building Sector?	<ul style="list-style-type: none"> <li>• Pre-FEED/FEED Study</li> <li>• Base concept</li> <li>• Project specifications (Functionality)</li> <li>• Quality parameter</li> <li>• Others (Specify)</li> </ul>	Answer can be more than 1 also.
7	Role of owner consultant	Is/Should there be role of client's Architect after award of tender?	Yes/No/Maybe	
8	Design requirement (Feasibility/Design Basis report)	Was the Design Basis Report completed and approved before tendering?	Yes/No	
		Does all the statutory approvals have been taken before execution of construction phase?	Yes/No	
		Is it possible for owner to Request for change in design during Engineering and Construction phase of EPC contracts?	Yes/No/Yes with Terms and conditions	
9	Overall	Does EPC Contract help in mitigating cost, time overrun?	<ul style="list-style-type: none"> <li>• Yes, Both of them</li> <li>• None of them</li> <li>• Time only</li> <li>• Cost only</li> </ul>	
		As the building sector is design and Functionality oriented, which contract form would you recommend for Public Sector Building projects like Hospitals, Schools and other high functionality driven buildings?	EPC/DB/DBB	

## VII. SURVEY CONCLUSION

From the responses of experts engaged in various Public sector buildings projects on EPC mode, it has been seen that completeness of "FEED study" and "statutory approvals" are high risk parameters in public sector building projects on EPC contracts, while "clear project specification" is a moderate risk parameter. The preferred choice of contract form is EPC Contract form as compare to DB and DBB but on the other hand it has also been observed that EPC contracts do helps in mitigating cost overrun factor but it may not be able to mitigate time overrun because of unforeseen circumstances or unmaintained risk register in FEED Study. Hence From expert opinion, choice of contracts in public sector building projects is:

EPC > DB > DBB

To further validate the suitability of EPC Contracts, the parameters and other contractual obligations shall be discussed through case studies to bring out the exact status of EPC Contracts.

## VIII. CASE STUDY

To further validate the result of expert opinion, a case study of a Public sector project being constructed on EPC Contracts have been opted to find the suitability of EPC Contracts in public sector building construction project. The duration of project was 6months+ 2 years + 2 years. First 6 months was for planning and taking approvals (Engineering phase). Next 2 years was allocated for construction phase and next 2 years was allocated for Defect liability period and maintenance of project. It was found that the project is more than 1 year behind schedule because of the following reasons:

### 8.1 Project Issues:

Table 3: Project issues involved in case study.

Sr. no	Issue Description
1	Delay in Tree cutting Approval.
2	Change in Layout Plan in order to retain trees
3	Shortage of Funds

1. All the statutory approvals have been taken except Tree cutting permission (which was in scope of contractor) during the time allocated for taking statutory approvals i.e 6 months from date of award of contract. There are about 349 existing trees at site out of which 109 to be cut. Initial Design consists of 2 basement + stilt + 8 storeys. The design has been revised i.e. Stilt+ 8 storeys in order to reduce the no of trees to be cut. All the approvals were taken again as per new design and it took again 6 months in getting those approvals done.
2. The project has faced "shortage of funds" issues due to which the project is running behind schedule (more than 1 year).

## IX. CONCLUSION

From the Expert opinion survey and the case study it can be seen that taking statutory approvals and shortage of funds from clients contribute to major time delay issues in public sector EPC Contracts. Reasons of delay are “Delay in taking statutory approval”, & “Shortage of funds”. Since the maximum percentage of risks are transferred to contractors’ side in EPC Contracts, it should be the duty of client to be clear and specific towards his design and contractual requirements. Delay in taking statutory approvals and shortage of funds are among the most common reasons of time, cost overrun in most of the building construction projects regardless of procurement method being adopted. Because of fixed design, fixed cost parameters, EPC Contracts are found to be suitable for public sector projects provided that all the approvals have been taken before commencement of construction work.

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