

EPC: An Innovative Tool for Mega Project Construction**Abhishek Raj Singh¹, Dr. Sanjay Tiwari²****¹Dept. of Civil Engineering, Madhav Institute of Technology and Science, Gwalior,****Madhya Pradesh, India, 474005****²Assoc. Prof., Dept. of Civil Engineering, Madhav Institute of Technology and Science, Gwalior,****Madhya Pradesh, India, 474005;****Abstract**

It is undoubtedly true that the adoption of an appropriate project delivery method is positively related to the success of any construction project. As the construction industry expands rapidly, the need for a variety of contracting models increases simultaneously. Taking into account the dynamic nature of mega projects, more flexible & effective project delivery method is needed. So, as a method of project delivery, the Engineering, Procurement & Construction (EPC) approach accounts for an increasing proportion of mega project construction. The paper brought in contrast, the circumstances in which the approach would be suitable, the pros & cons of this project delivery method & the text also comes out with the future aspects of EPC.

Keywords: Construction, Contracts, Design, EPC, Procurement, Responsibility, Risk

INTRODUCTON

At present the construction industry is predominantly stuck with an innovative approach so-called EPC contracting. This approach satisfactorily being used for Mega Project Construction. The term Mega Project is generally adopted for the projects having costing more than 1 billion USD. Prior to the commissioning of Mega Projects many arrangements related to engineering/designing, material procurement & construction at site are to be made, which involves high potential risk. Thus to minimize risk, the owner/client prefers to use the innovative mode of project delivery i.e. through the EPC.

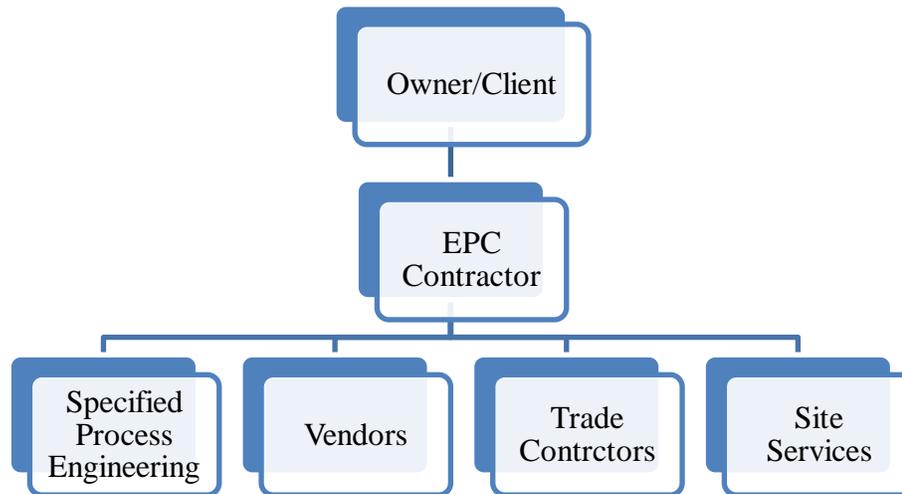
The research concentrated on listing out the factors that have accounted for the following:

- Why EPC
- Advantages & disadvantages
- Its future

EPC: An Overview

EPC is an acronym that stands for Engineering, Procurement & Construction. In this mode of construction the contractor agrees to deliver EPC services to the owner/client. In an EPC contract owner hires a contractor to provide all services, till the commissioning of the project. The EPC contracts are categorized under Integrated Engineering Contracts; as if the Lump-sum & Turnkey contracts are merged together to results into LSTK mode of contracting. In lump-sum contract, the contractor quote a single lump-sum figure. This lump-sum amount refers to the total sum of money for which the contractor agrees to build the required facility, accepting all responsibility for factor relating to the supply of raw material, uncertainties relating to construction hazards & many other(Kumar, 2011). And a turnkey contract is one “under which contractor is responsible for design & construction of the facility (PROJECT OFFICERS' GUIDEBOOK HOST COUNTRY CONTRACTING, 1992).So the LSTK mode or an EPC contract can be defined as a contract in which contractor bears full responsibility of designing, procuring material & constructing facility in a lump-sum amount to which contractor & the owner agreed upon. The diagram below shows a basic structure for an EPC delivery model. It should be noted that even where an EPC has the in-house engineering experience, it may still need to subcontract out design works where, for example, the facility requires specialist process engineering by a third party engineer(Cullen & Higgins, 2011).

Figure 1. Typical EPC Arrangement



(Phil & Nick, 2007)

Background

Prior to the 21st century the construction industry adopts the traditional approach for project delivery. But this mode was overtaken by an EPC system of project delivery. At present, many public & private projects are being performed on EPC basis. It is also one of the several delivery system used in public-private partnership projects & other financed infrastructure projects. EPC is an oldest approach that is now regarded as a new & an alternative delivery method. During ancient times in Egypt & Mesopotamia, the master builder was solely responsible for the design, arrangement to be made for raw material & construction of the entire project (Owusu. J. A & Ofosu. S. A, 2013). This system of project delivery has experienced steady growth in the past few years. In present scenario the practice of EPC projects is becoming a major management practice of large scale projects, especially for the developing Countries like China, Ghana, Iraq, Mongolia, Mozambique, India etc.

Literature Review

Several studies relevant to the identification of factors resulting EPC project delivery method to be prominent among the mega construction firms was done & all reported factors were considered to establish a list of items for research. Michael E. Schneider (The International Construction Law Review, 1986) has explained the concept, liabilities, claims etc. of turnkey contracts. In the text, he provided the description of performance guarantees; which is a main element of an EPC contract. Owusu. J. A & Ofosu. S. A (2013) provided the factors on which a contractor is being hired by the owner. In an article published in TEXAS LAWYER's Energy Buzz by NatallieRegoli & Brian Polley (2014), listed the three key drivers for an owner in implementing any mega project were, Completion of project on time, As per specification & In budget. In a text it's mentioned that "turnkey project is the American version of design-build contract & commonly called Packed Deals" (Owusu. J. A & Ofosu. S. A, 2013) & as FIDIC has same conditions for EPC/ Turnkey contracts, so it deduces that the EPC can be called as advanced design-build.

Research Methodology

Comparison of case studies was the main source of data. The setting of the case study begins with the formulation of a research question. This paper is to provide an answer for “what factors contributes to EPC contracts dominance over other ways of contracting models.” This paper is case study based, the focus is directed to find the most popular & successful project delivery method among the existing contracting models in the construction industry. The case studies were assessed from the aspect of time variation, cost variation & quality. Lastly, overall satisfaction can be calculated as an indicator to aid discussion.

Result and Discussion

The case studies reveal unique results for every single project constructed through the EPC mode of contracting. The study aided in listing out the forms of contract used for delivering projects. The paper also comes out with the advantages and disadvantages of EPC delivering methods.

Table 1: Summary of Case Studies.

Background	Case Study 1	Case Study 2	Case Study 3
Type of Project	Thermal Power Plant	Government Polytechnic	Thermal Power Plant
Work Assigned	BTG (Boiler, Turbine, Generator) Area 3-units	Administrative Building & Workshop Building	BOP (Balance of Plant), Foundation of TG, Boiler, ESP, Coal Mill, Switchyard, NDCT, Wagon Tripler, Road Drain, FOPH, CW-RW Pump house, Reservoir, Mill, Main Building, Service Building, All mechanical stricture, electrical work Firefighting systems, etc.
Contracting Method	EPC	EPC	EPC
Total Land Area	30,000 sq.Km	20,234.28 sq.Mtr.	5127367 sq.Mtr.
Build up Floor Area	75,000 sq.Mtr.	4177.64 sq.Mtr.	2050946.80 sq.Mtr.
Lump-Sum Price	6897 Crores INR	1106.80 Lacs INR	1600 Crores INR
Year of Award	2009	2009	2010

This paper served the main purpose of finding out the factors like:

1.) Why EPC

There were many projects completed using various delivery methods in the construction industry, but the major drawbacks were 1) cost over-run & 2) time delay. To overcome these situations the construction industry merged lump-sum contract & turnkey contract, and the fusion resulted in an integrated form of contract EPC/LSTK contracts. This method of delivering projects differed from others, mainly in:

A.) Design Responsibility

Relating to design responsibility the contractor is solely responsible for designing. The Employer/Owner prepares its requirements in the form of specifications, for the sake of scope & other technical criteria, such as performance criteria often on a fitness for purpose basis.

B.) Contract Price Determination

In terms of contract price determination, there is generally as milestone based payments. In this mode the payments are made for the work conforming to the agreement & commensurate with the stages of completion of works.

C.) Contract Administration Approach

For Contract Administration, the Employer/Owner has to make their own arrangements. The owner hires consultants for monitoring the project. The consultants reduces the employer's involvement to the minimum during construction. This Employer's Agent hired to coordinate all processes on professional service agreement basis without direct responsibility for design & works.

D.) Risk Allocation

To distinguish the EPC from other traditional forms of project delivery, it is essential to understand the Risk Allocation. US department of Transportation defines it as "the goal of an optimal allocation of risk to minimize the total cost of risk on a project, not necessarily the costs to each party separately. Thus, it might sometimes seem as if one party is bearing more of the risk cost than the other party. However, if both owners & contractors take a long-term view & take into consideration the benefit of consistently applying an optimal method to themselves & for the rest of their industry, they will realize that over time optimizing risk allocation reduces everyone's cost & increases the competitiveness of all parties involved"(Lukas, 2013). Hence, in an EPC contract the risk is transferred from the owner to the contractor.

E.) Performance Guarantee

The performance guarantees undertaken by the contractor are based on certain assumptions with respect to the quality of raw materials used & the operating conditions, such as climatic conditions, availability & regularity in supply of utilities etc. Difficulties occur when the assumptions & the conditions prevailing mismatches/differs. A failure to meet contractual performance guarantees is often sanctioned by liquidated damages reflecting the degree by which guarantees have been missed.

2.) Advantages & Disadvantages

As similar to an unbiased coin, every project delivery method has its advantages & disadvantages separately for owners and contractors & sometimes competitively for both.

The advantages of the EPC mode of delivery are as follows:

- Single point responsibility
- Opportunity for innovation & faster project delivery
- Efficiency (design & construction expertise together)
- “Fitness for purposes” through performance specification
- No real alternative for proprietary technology
- The contractor bears the risk of integrating design & performance of all packages
- Streamlined contractor/consultant interface
- Fewer changes
- Implementation of changes often simplified
- Often a reduction of claims (or number of claims)
- Increased flexibility to address changing conditions
- Reduced administrative burden for the owner
- Improved risk management for owner

The disadvantages of this mode of project delivery can be listed as:

- Loss of control and reduced owner involvement in design
- Cost of risks and contingencies can result in substantial risk premium
- Environmental/Regularity processes
- The contractor has an incentive to provide minimum compliant standard to decrease cost
- Limited pool of qualified EPC-contractors
- QA/QC largely in the contractor’s hands
- Disputes tend to be larger & more complex
- Management of long term risks

3.) Its Future

Since the starting of 21st Century showed the popularity of the EPC project delivery method so its dominance could be foreseen in the upcoming years too, as the construction industry is expanding enormously. Presently, the construction industry is in need of a project delivery method which can fulfil the owner’s requirement, in budget & on time. EPC serves the purpose better, than any other contracting model; so its dominance can be expected in the construction industry for a long term.

Apart from advantages & disadvantages, the owner’s perspective to favor EPC are summarized as:

- “One-off” project
- Low risk tolerance
- Marginal project
- No internal resources
- Need for overall performance guarantee
- The owner has limited expertise
- Single point responsibility

Forms of contract used for EPC

The study revealed that, the construction industry had enormous growth in past few decades. So taking the future need in concern the (FIDIC) provided a standard form of contract in 1999 for EPC model of project delivery. "The Silver Book (1999)" provides conditions of contracts for EPC/ Turnkey projects, enlightening that in early 21st Century EPC mode prominence resulted in need of some standard forms to monitor the conditions of the contract. The FIDIC describes EPC projects as the contracts where one entity takes total responsibility for the design & execution of an engineering project to provide a fully equipped facility, ready for operation. Similarly the Institution of Civil Engineers (ICE) analyzed the need for the forms to monitor the EPC projects proposes "ICE conditions of contract design & construct 2nd Edition: July 2004". This contract also held the contractors responsible for all aspects of design & construction. Furthermore, many organizations developed the forms, providing conditions of contract, such as Institute of Chemical Engineers (IChemE) introduced IChemE (Red) form of contract- Lump Sum Contracts. This form of contract provides conditions for the payment to the contractors on the Lump Sum basis, similar to the EPC. The Joint Contract Tribunal (JCT) also produces a standard form of contract as "MW2005 Agreement for Minor Building Works". Considering the necessity of providing conditions to the EPC/LSTK mode of project delivery, the Government contracts also play a vital role in monitoring the conditions for the various contracts. The International Chamber of Commerce (ICC) & The Liasion Group of the European Mechanical, Electrical, Electronic & Metalwork Industries (ORGALIME) issued new standard contracts, named as ICC model Major Project Turnkey Contract & the ORGALIME Turnkey Contract for Industrial Work respectively, to regulate conditions in Turnkey contracting or Packaged Deals.

Conclusion

The factors indicating the reasons behind the dominance of EPC project delivery method in the construction industry were extracted through the synthesis of the study/research carried out. These factors also formed the basis for EPC project evaluation. From the case study analysis results, three of the factors were found to be critical in explaining EPC dominance. Specifically, single point responsibility, risk transfer and performance guarantee are important to bring about the successful outcome from the EPC mode of contracting. All of these factors highlight that EPC project success rest on the commitment and efforts input from all parties to the project.

Results from this study have shown some interesting findings about EPC projects, which has resulted in its dominance. This research provides greater insight into the key factors/criteria relationships that may impact the decision of choosing project delivery method & provide clients and contractors an understanding of, 'on what basis should a project delivery method be adopted'.

Information from the research can benefit both the education & practice of project management. In practice, the results can assist the selection of best project delivery method, identification of, the development in other forms of contracting and in forecasting of performance & success of the project delivery method adopted, before the project commences. In education, the results can be used to design the content of management education programs for project managers running EPC projects.

This research provides a lot about the EPC project delivery method, but more research should be conducted to further explore the EPC till intuit.

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