

The Specifications of the E.P.C Turnkey Contracts in Major Project Management

Siamak Nouri*, Mostafa Jafari*, Majid Farahani*

Department of Industrial Engineering, Iran University of Science & Technology (IUST), Tehran-Iran
Noury@mail.iust.ac.ir

Department of Industrial Engineering, Iran University of Science & Technology (IUST), Tehran-Iran
Jafari@mail.iust.ac.ir

Petropars Ltd, No10, North Naft Ave., Mirdamad BLD, P.O Box: 15115/1547, Tehran –Iran
Farahani@ppars.com

Abstract

The application of the new project management structures and procedures is something inevitable in large industrial schemes such as oil & gas projects, power plants, and infrastructure schemes that technological plans affect apparently. The project managers are to exploit the latest scientific break-through in this field, and to rid themselves of the ineffective traditional methods so that they can utilize new procedures to accomplish their executive projects within a specific time and certain budget. What is quite tangible is the necessity of utilizing and ameliorating new procedures and structures of the project management due to the increasing trend of investment in large projects especially the oil; gas and petrochemical industries in order to achieve the social-economic development plan objectives. EPC Turnkey procedure is one of the new procedures of the project management and implementation. Although some specific restrictions are made for the owner in this method but the contractor is obliged to effectuate the entire project activities such as Engineering, Procurement, Construction, installation and start-up operations, ergo. Then the owner is released from the painstaking management responsibilities and the implementation of such projects that comprise such specialized and complex technological matters that are beyond the client's field of activities. Furthermore, engineering and construction stages will be performed harmoniously and integratively, ergo, it will be possible to commence executive tasks before the finalization of the design, consequently, the project period will be minimized. This article is a report of a research performed at the Master of Science level that deals with the necessities, straightened circumstances, and the strategies for utilization of EPC Turnkey method in major projects after analyzing various common contracts in developmental projects.

Keywords: Project Management, EPC Projects, Turnkey, Procurement, Design-Build contracts, Responsibility for the Process, Fast Track Construction

1. Introduction

When the owner intends to analyze the type of the project contract, must assess one's own capabilities and weaknesses (from the technical and management aspects). Contracts of any ilk can affect the allocation of responsibilities and needs of the owner to make coordination in project. The owner can make the contract price proportionately with the project risks by allocating the responsibilities appropriately.

The two chief aspects that the owner must take into account when adopting an appropriate procedure consist of allocation of the engineering responsibility and the allocation of the coordination responsibility.

The first step that the owner adopts is to identify the project designer. This factor changes the requirements and obligations of the owner into practical schemes. This factor may originate from the owner's internal organization, an independent consulting engineer or the contractor. Each person/contractor that performs a part of the design must have mastery over the project up to some extent so that can ensure the appropriate integration of the scheme and the maps.

The next step in decision-making is to allocate the coordination responsibility in the optimum manner. The design and performance factors ought to be harmonized in an appropriate manner so that one can rest assured of the effective project progress. This ilk of coordination comprises the management of the imported equipment/material and warehouses, the performance of the tasks by the owner's work force, and the subcontractors, the testing and supervision staff of the owner, or the associated owners. The owner himself, the contractor or any other third persons such as the management owner can make coordination. The owner is to take into account the quotation setting and payment methods in the contract.

Connoisseurs and specialists of the project management and contracts have presented a diverse classification manner in the developmental schemes management. Various contractual procedures and the features of each one have been expressed to clarify the EPC Turnkey procedure, and then some conclusions will be drawn with regard to the conditions ruling the developmental schemes management in major projects

2. Contracts types for executing the major projects

2-1- Various sorts of contracts as viewed from Joseph A. Huse attitude [1]:

- Design-Bid-Build
- Management Contracting
- Build-Operate-Transfer
- Design-Build and EPC Turnkey

2-2- Various types of contracts from P.D.V Marsh's attitude [2]:

- Traditional Client Coordinated
- Management Contracting
- Full Turnkey Contract
- Partial Turnkey contract

2-3- Various types of contracts from J G. Perry's attitude:

- Separate Design and Construction
- The Management Contract
- The Construction Management Contract
- The Design and Management Contract
- Fee Contracting
- EPC-Turnkey, Package Deal, Design and Build

A) Design-Bid-Build Contract / the traditional procedure / separate design & construction

This procedure is performed traditionally in the executive contracts. The owner assigns the designer to outline and delineate the project based on the owner's requirements so that can provide a collection of the required maps for the bid, tender and the task performance. There are some shortcomings, and potential defects concerning the performance-bidding-design contract form. For instance, the project accomplishment duration will lengthen because the design and performance stages are separate. Furthermore, the performed designs may not match the owner's technical capabilities, ergo; loan providers will not accept this procedure, when loans finance most of the project.

B) Management Contracting (MC)

Management Contracting is a relatively new approach that concerns engaging an owner whose role is to make coordination and manage the project. The above owner is burdened with the task of time management, cost, and the quality control and concludes some contracts with subcontractors to achieve the tasks. The management contractor plays the role of the owner's manager in the traditional design-bid-build contracts. Thus, the management contractor relieves the owner of some the accountabilities and duties. According to this procedure:

The management contractor is paid by cost-plus fee method.

The executive tasks are usually classified into petite proportions and fierce competition occurs in the tender.

The design of each section that is being posed in the tender must have already been completed.

The designer ought to make up one's mind in numerous cases in the preliminary stages in this ilk of contracts as compared with the design-construction method.

C) Construction Management Contractes

According to this procedure, the executive manager is assigned for the task of the project management in accordance with the contract that signs directly with the owner and the executive manager ought to act within the predetermined time and cost. The owner concludes the entire contracts of other consultants and contractors.

D) Design and Management Contract

This approach is actually a type of management contract that has entrusted the owner with the responsibility of detailed engineering, ergo; it will bear the ensuing similarities with the Design and Construction Contracts.

- The owner will conclude only one contract.
- Design and execution management is performed in an integrative manner.
- The project implementation time will dwindle at the preliminary stages of design and performance
- The practical aspect of the designs escalates increasingly.

Nonetheless, the design and management contracts will have the ensuing differences with the Design-Build contracts.

- They are paid similar to the Management Contracts.

- The owner will control the procedure more than ever; however, will be liable for the technical tasks up to a minor degree.
- The relationship between the owner and the contractor concerns the most advanced technical professional expert designs.
- The design and management contractor does not perform any executive task and accepts fewer practical risks.
- Alterations occur in a simpler manner in such contracts and just negotiations can be held about the price modifications.

E) Fee Contracting:

The contractor will be accountable for the executive tasks, management services (primarily before the execution), provision of any design-related data or information or design input and occasionally the design process management. In these types of contracts:

- The payment will be compensated plus some wages as management fee.
- The owner opts out the designer and measurers.
- The total project budget will be specified during the engineering and construction tasks.
- Conclusion of the second-hand contracts is quite common in such procedures.

F) Build-Operate-Transfer (B.O.T) procedure

BOT contractual procedure consists of assigning the development and commissioning license of a governmental sector project to a company under the title of “Project Development Company” for a specific period. The above company will finance the project. Then it will take action to design and construct the facilities in question. Then it will exploit the factory and the related equipment and facilities in compliance with the duration reciprocally agreed in the contract and will return it to the government eventually. Hence, BOT is not an independent procedure for the executive contracts, rather it is considered as a method to finance the project. Such projects are becoming increasingly popular because of the two ensuing reasons: first , shortage of the governmental investment sources and second , the opinion that the private sector has a better management. Theoretically speaking, BOT scheme is able to pave the way for the implementation of the infrastructure projects at the least expenditures inflicted upon the government in the developing countries. Nonetheless, BOT projects inflict high expenditures and risks for the private sector.

G) Design-Build and EPC Turnkey

The EPC Turnkey method is also known as the package deal, design and construct, and clean-main and the owner is burdened with the responsibility of engineering, procurement & construction so that when the project is completed, the owner or client just turns the key in the lock hole to inaugurate the facilities commissioning. Ergo, the owner and his or her consultants will only participate in the tender process and supreme supervision of the contractor’s job. EPC Turnkey method is the utmost symbol of the entrusting the design and construction to the contractor. Hence, it is not necessary to specify whether the defect originates from improper design or weak construction. The

contractor is accountable for any defect or failing that occurs within the defined limits and scope.

The utilization of the EPC Turnkey method diminishes the owner’s accountability with regard to the engineering and construction process as compared with other contractual methods up to a drastic degree. Ergo, the owner merely manages the contract, reviews, and approves the designs based on the predetermined terms and provisions.

Fig.1 illustrated the level one process of the main contractor in EPC project. The main contractor will do the entire owner requirements such as the engineering, procurement & construction of the project. The client satisfaction would be the result of this process.

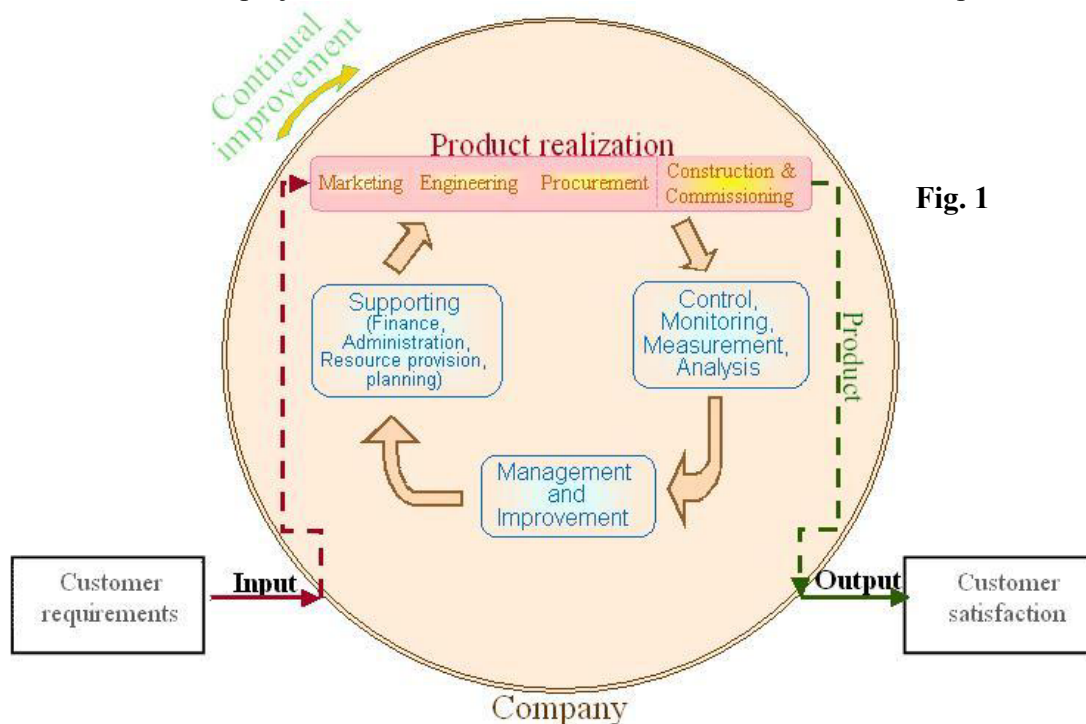
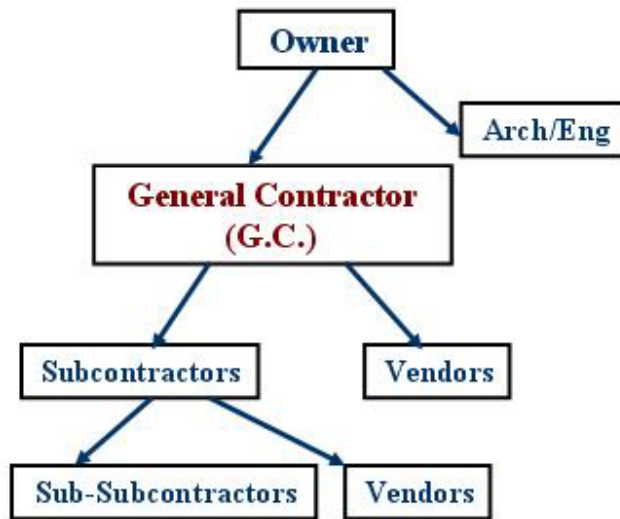


Fig. 1

When design responsibilities occur simultaneously with the construction, the total project completion duration will dwindle or “Fast Track” construction may occur. Furthermore, paving the way for economic design and construction can diminish project costs.

The bidding or tender stage is vitally important in the EPC Turnkey method. Here the owner ought to try the best and use plenty of sources to ensure the contractor’s capabilities and the quality of their suggested schemes. Likewise, the contractor must make enormous endeavors to provide his or her proposal and to ensure its pragmatism and the profitability of the proposed price. Usually the contractor that can execute the Engineer-Procure-Construct projects is named General Contractors (GC). The situation of G.C’s in EPC projects as shown in Fig.2 determines that the GC’s should use various vendors & subcontractors to execute the EPC projects.

Fig. 2



The construction industry appears to be following other industries by reforming their vendors & subcontractors relations. Williams (1995) summarizes the direction of vendor's relations in the construction industry by stating: All the groups, engineering, procurement, construction, operations, and the vendors, must be integrated as one team. When the individual groups are all working together helping each other out,

recognizing and compensating for each other's weaknesses and highlighting and taking advantage of each other's strengths, then the team is united. When all of the team members feel that they will all succeed or fail together as a team, then a fast-track project is viable [3].

Each division of main GC responsibility for project completion (Engineering, Procurement & Construction) would be divided into some processes & disciplines like Fig.3 & the GC will complete the project by planning & controlling these processes that would be executed by vendors & subcontractors.

The owner may use the EPC Turnkey contract for a specific section of the project, which is known as the partial turnkey or semi-turnkey. In fact, the owner's responsibility escalates together with the task amount that performs on one's own or by having, other contractors and consultants perform them independently from the EPC contractor, ergo, the duties and coordination tasks of the EPC contractor will increase. This ilk of contract will guarantee the ensuing points.

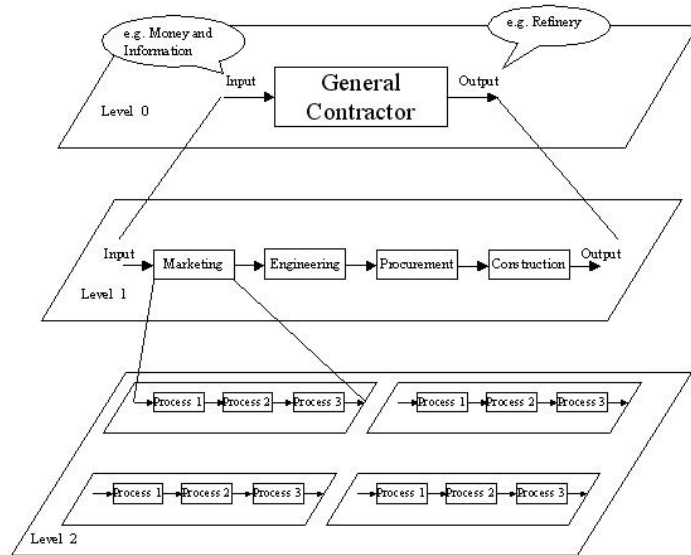


Fig. 3

In this method, the payments occur as lump sum or the unit price list.

- Complete technical clear specifications ought to be provided at the preliminary design stages.
- The owner specifies the technical and contractual requirements and obligations at the commencement stage.

- The owner often will adopt a minor stance in the discussions and negotiations that occur after the contract conclusion.
- Some measures have to be taken so that the expenditures of the designs performed by the contractor are taken into account at the bidding or tender stage too.
- The scope and the control procedure of the design tasks performed by the owner can cause disputes.
- The owner's requirements and obligations about the project start-up must be written down in the contract.

2-4- The decision-making criteria on the contract type selection

Here some criteria and factors that the owner must take into account about the selection of the contract type have been enumerated. Generally, the ensuing cases have to be ruminated over.

- The nationwide laws and regulations
- The investment procedure (financing)
- The size and complexity of the project and the owner's sources
- The required time for the project completion
- Considering the economic factors in design and commissioning expenses
- Ensuring the finalized expenditures of the project

2-4-1- The nationwide laws and regulations

The above factor will affect the owner's decisions to opt the contract strategy in the ensuing order:

Accentuating the final price of the projects concerning, the budget that will lead the owner to procedures bearing fixed lump sum prices.

Sometimes the EPC Turnkey method is practically impossible in the developing countries because the executive tasks are assigned to the local contractors and it is extremely difficult for the contractor to bear responsibility of such contracts.

The traditional method coordinated by the owner will be appropriate in case the tasks are assigned contractually at the presence of various contractors and the engineering department of the owner or the consultant engineering companies perform the design tasks.

2-4-2- The investment procedure (financing)

When the owner is to finance the project, can opt out the most appropriate method. Otherwise, loaners and suppliers of the project can affect the selection of the contractual method in accordance with the procedure predetermined for the project financing, based on one of the ensuing manners.

If an international agency provides a loan, it will naturally tend to conclude a contract for the engineering, procurement & construction operations separately. The loan-providing agency permits the EPC Turnkey contract in exceptional cases that the special processes that have to be implemented exist in the project or factory.

If the project is a finance one, the loan giver is willing to conclude an EPC Turnkey contract because this method will decrease the risks involving any extra expenses and one can lay assured that the project will be commercially exploited at the determined date.

2-4-3- The project size and complexity and the owner's sources

The project size and complexity will affect the owner's decisions to select the contract procedure, because of the required qualitative and quantitative management and technical sources and the related experiences that the owner may possess.

Provided that the project has been simplified or minimized as compared with the owner's current sources, the traditional method coordinated by the owner is preferable.

On the contrary, if the project is huge and complex with regard to the owner's sources, the EPC Turnkey method or the management contract procedure will be appropriate.

Anyway, the owner either must have the required sources to opt out the proper contractor or can use the consultants to provide a project summary to assess the received proposals.

2-4-4- The required time for the project accomplishment

In projects, whose objectives consist of profit increase or cost saving the amount of time that can be saved in EPC Turnkey contract or the management contract must be compared with the traditional method.

The time saving quantity can be collated with the cost saving quantity of the traditional methods (and it can be classified into tiny sections) and appropriate decision can be adopted. When we need facilities to save time in a particular date, time saving will play a vital role in this regard.

In our case study, every one day delay in phase 1 of the south pars gas field development project in Iran will cause disadvantage of 1.5 million US\$.As a result selecting the EPC procedure for executing this project was too commendatory

2-4-5- Considering the economic factors in design and commissioning expenditures

When the consultants or the owner's engineering department makes designs independently, the schemes will be conservative, upstream, and non-economical.

One solution is to entitle the owner to combine design and construction so that they can present their own proposals based on their own designs in bidding and tenders. The owners are increasingly utilizing the consulting engineers to make designs at the stage of presenting proposals based on the EPC Turnkey contracts in recent years. Ergo, the consultants have adopted more economic policies as compared to the previous years. Nonetheless, we should not ignore its negative effect upon the commissioning and maintenance expenses. Generally, the owner must make endeavors to keep the project expenditures as low as he or she can and must certify that commissioning and maintenance charges including the spare parts required during the useful life span of the project have been evaluated and taken into account.

2-4-6- Ensuring the final project costs:

When the owner is thoroughly aware of himself or he requests and no essential alterations occur consequently due to the requirements or obligations, then he can avail himself of a EPC Turnkey lump sum contract because in this way the complete responsibilities and risks are transferred to the contractor. In addition, the owner's engineers will have the least time amount to make alterations, and no extra charges will be inflicted.

3. EPC Turnkey contract features:

Now that the status of each one of the contractual procedures and decision-making criteria have been specified for the implementation of the developmental projects, we will examine and analyze the specifications of the EPC Turnkey contracts.

3-1- Generalities

Most of the major projects all over the world are implemented as EPC contracts. Such contracts are being put forward increasingly in the developmental schemes and an independent legal person bears responsibility of the project performance and design. It can be a company on its own or a combination of several companies collaborating with each other (Joint Venture). The General Contractor that takes measures to implement the EPC projects, should not necessarily have the entire design and construction facilities on its own. A GC may assign a second hand contractor to make design and engineering tasks or an engineering company may perform the construction tasks as a second-hand contract by means of a qualified contractor experienced in executive tasks.

Some of the Design-Build contracts are also named EPC Turnkey contracts. According to such contracts, the contractor must not only bears responsibility for the project design and construction but also must ensure the owner that the established project will act in compliance with his or her needs and wishes and will be ready for commissioning. The Turnkey phrase originates from the fact that the owner will turn a key to inaugurate the project and it will commence to function successfully afterwards.

The EPC method is different from the method in which separate contractors make design and construction, as regards the client. One difference is that the contractor guarantees the design, procure & construct of the entire task in the design and construction aspects but in the second mode, the executive contractor is accountable for the proper work trend, and the designer is only liable to observe the technical specifications based on standards and does not bear any guaranty responsibility for the whole task. The second important difference is that in the second mode the designer is professionally interested in reporting the predicaments of the contractor and the executive group for the client. However, the above willingness is vice versa in the EPC procedure, ergo, the contractor who is accountable to perform the tasks is not willing to inform the owner of the executive predicaments and obstacles. The steps of work with the responsibilities based on above explanations in major projects have shown in Fig 4.

Experienced derived from EPC Turnkey contracts indicate the ensuing advantages.

- The executive group will participate actively during the design process, and most often results in an economic and frugal scheme

I.D	STEPS of WORK	RESPONSIBILITIES
1	↓ Basic Design	Design Group(DG)
2	↓ Detail Design	GC
3	↓ Procurement	GC+ DG
4	↓ Transportation	GC
5	↓ Construction	GC+ Sub.Con.
6	↓ Commisioning	Client+GC+DG

Fig. 4

- The design and construction staffs can easily communicate, consequently, the total project duration will be minimized, and the engineering concepts can easily be changed into practical plans.
- The owner will be more satisfied because one specific contractor is responsible for the entire tasks and will not be forced to spend his or her time to settle the claims originating from the designer and contractor's discrepancies.

3-2- Outstanding features of the EPC Turnkey contracts

Two significant factors ought to be taken into account on such contracts:

- The first one is the contractor's responsibility for the process.
- The second is the type of the financial agreements, (whether the payments are lump sum or other methods are being utilized),

3-2-1- The contractor's responsibility on the system process

One of the essential factors that determines the philosophy and relations of the EPC contracts is to allocate responsibilities of the system process between the owner and the contractor. The process of a major project can be so specialized and complex that the owner team's expertise level may be much higher than the contractor's engineering team. Ergo, the owner will be accountable to start-up the system process. In this case, the contractor does not make any basic designs and will commence the task from the detailed design stage.

In the second case, the system process design is within the contractor's expertise field and may be the sole wielder of such technology or knowledge. Ergo, the contractor performs the task from the preliminary stages and will be responsible for the process function, start-up, and the system commissioning guaranty. Ergo, the EPC Turnkey contract will be logical due to the contractor's high expertise. Based on the EPC project life cycle[6] that has shown in Fig. 5, the general contractor will be at the helm of project design and construction, start-up, qualitative and quantitative operation guaranteed during a specific period. In such contracts, it is often necessary that the contractor train and educate the owner's personnel so that they can operate the project when it is completed.

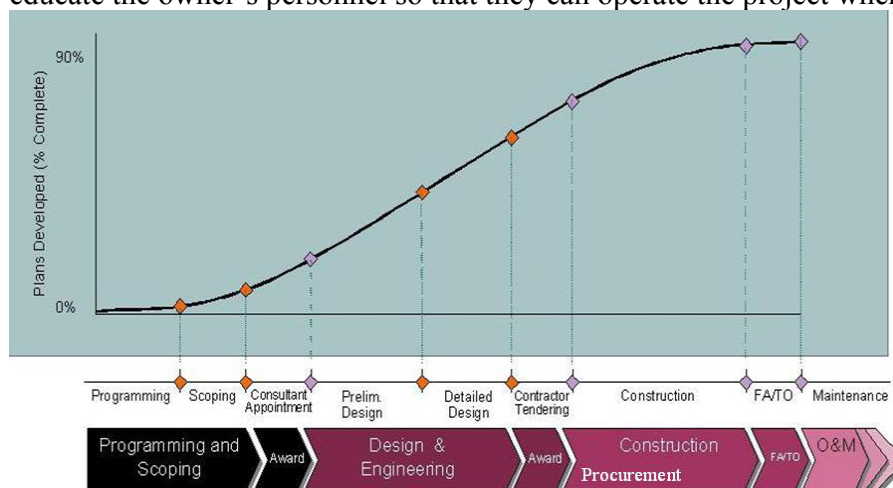


Fig. 5

The project process functional responsibility can be divided or jointly shouldered. The owner may be only at the helm of the appropriate chemical formula provision or the theoretic system process and the contractor designs different type of equipment and their

relations so that the above process is set into effect. Generally speaking, the less distinct the owner's and the contractor's responsibilities are, the harder it will be to settle the claims based on the contractual items when they occur.

The contractor's accountability in the project process function will affect the nature of his relations with the owner and other subcontractors. For instance, when a contractor is not in charge of such cases, prefers to view the project from the aspect of the time quantity that the staffs dedicate to the project, and tries to minimize its own risks in other aspects.

Ergo, when an engineering company is requested to design and construct a major project, it prefers to conclude an engineering-procurement-construction contract separately so that minor executive subcontractors will not be legally bound in this case.

When the contractor is at the helm of guaranteeing system process function, in fact the price that accepts for the project implementation will embody some of the risk factors too.

3-2-2- The nature and the ilk of the financial agreements

Financial agreements are the second outstanding feature of such contracts. The payment method will affect the contract so intensely. There are two common methods in the major project implementation, which are as ensues: cost-plus and lump sum. Here their applications in EPC projects have been examined. In addition, another combination method is known as cost-plus along with the guaranteed target cost level and it includes most of the advantages of the both methods from the owner's attitude. Ergo, when the expenditures exceed the predetermined amount, the contractual relation will change into lump sum, thus, the payments will be disbursed as percentages of the work progressed. However, in cases that there are no dangers of expenditures exceeding the guaranteed limits, and then the target guaranteed cost rule would not apply and the contract will proceed in accordance with a sheer cost-plus one.

As for the EPC Turnkey contracts that are signed or concluded before the engineering tasks have commenced or before the proceeding of the engineering task, it is not reasonable to set the payment method as lump sum or target cost, because the construction cost will be based on guesses.

3-3- The reasons why the EPC projects are attractive for the contractors

- The contractor can rest assured of the fast-track performance of tasks and receiving the due payments punctually because of the fast nature of such projects.
- The specifications of the EPC contracts are in a way that they will not depend upon the timetable and activities of others.
- The contractor can freely opt out the executive techniques and equipment.

Nonetheless, the last case is not considered as a disadvantage for the contractor because although a contractor may reduce the quality aspect by choosing cheap low quality facilities, knows what type of facilities can surely perform the tasks. If the equipment does not work properly and accurately, the contractor bears responsibility for not receiving the last payment & also the 10 % Good Performance Guarantee (G.P.G) and the risk of losing future job opportunities.

4. Conclusions

There are contractors all over the world who are quite adept and skilled in the entire executive engineering aspects. What matters for the owner is to exploit the contractor's

skill and experiences in projects so that it can improve the project speed and frugality. The contractor encounters plenty of questions when intends to set the owner's requirements into effect. For instance, diverse comments on technical specifications and other sources, which are, included the standards, engineering experiences, and suchlike. Ergo, the owner must ensure at the detailed design stage that the contractor has not swerved from his or her duty and has not lowered the project standards.

The project implementation must essentially be based upon the logical comments on the tender documents, fundamental designs, technical specifications, standard engineering experiences that the contractor has performed in other projects, the utilized codes and standards, so the contractor sets them into effect based on one's own skill and experiences.

When the owner and his consultants adopt the EPC Turnkey method, they have trusted the contractor's experiences and skills. Ergo, it is not necessary to interfere in the contractor's duties or examine the contractors' proposals after long procrastinations if the general contractor does not swerve from his or her duties. The above case applies especially if the owner's requirements have been fulfilled, and the tasks have proceeded in accordance with the international engineering experiences and the related construction and equipment have been supplied through the manufacturers and sources.

Time is very valuable in the application and the legal matters of the EPC contracts. Both the owner and the general contractor must observe the commitments. Ergo, standard contracts are concluded with the impression that the only important matters in each stage of the task whether design or engineering is to discuss the facilities purchase, goods provision, and installation and no procrastination should occur while the project is being performed.

Generally, the EPC contracts have to be managed different from traditional contracts and the general contractors must precede the tasks as they accept risks in this regard except the cases where safety concern occur. As this practice has become quite common all over the world, we should not allow the EPC contracts to be changed into tools for trying engineering trial and errors because in this way they may lead to results far from what has been contemplated as the contractor's scope of activity and duties.

References:

- [1] Hues Joseph A. Understanding and negotiating EPC Turnkey contracts, London, 1997
- [2] Marsh P.D.V. Contracting for Engineering and Construction Projects, England, 1995
- [3] Williams, Gareth Vaughan, (1995) "Fast Track Pros and Cons: Considerations for Industrial Projects," Journal of Management in Engineering, Vol. 11, September/October, pp. 24-32.
- [4] Friedlander Mark C. A primer on Industrial D/B Construction Contracts, 2000
- [5] The technical assistant of Iran's planning and management organization, the criteria published with regard to the technical executive system of the developmental plans until the end of 1379, the explication for the provision of major industrial schemes, 1380
- [6] Al Samman, Bassam, the First Project Management Driven Organizations Conference, Beirut, 2004
- [7] Kvaerner Procedures for South Pars Gas Field Development-Phase1, Petropars Ltd , Iran , 2003