

Contracting Strategies in Large Engineering Projects¹

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ABSTRACT

Large engineering projects are increasing over time and representing a major area in the economic field. Thus a well fit relationship between the contractor and the owner is the key in order to allow a certain fluidity of these kind of projects. Despite the considerable development and improvement of the elaboration of the contacts, it is very important to know their types, application, and limitations. This paper aims to define and analyze the types of contacts involved in mega projects using the multi-attribute decision making. We can expect in the following stages of the paper the direct involvement of both the contractor and the owner with regards to the contracts. Besides, following the non-compensatory approach, attributes and criteria are set in order to choose the preferred contract for large engineering projects. In a nut shell, this paper might help to understand the use of contracts implicated in big projects and their importance to the owner and the contractor.

Key Words: Contracts, Large engineering projects, contracting strategies, Firm fixed price, cost reimbursement, unit price, incentives, project life cycle, development phase, implementation phase, contractor, owner, project participants.

INTRODUCTION

Nowadays, large engineering projects such as construction projects or the oil and gas industry represent an important percentage economically speaking in the worldwide societies. These kind of projects are huge, time consuming, and implicate an important capital investment. Thus, the contract between these large industries and the owner is critical since it specifies the obligations, the processes, and the risks. For instance, in the oil and gas field, the contractors play a foremost function in the development and the completion of such projects.

Large engineering projects are known as being massive and have a capital cost of millions of dollars. In other words, people that are investing in these projects are using their money and other recourses. Hence, these people can either be the owner who is investing his money to bring to life his ambitions and aspirations, the contractors or the subcontractors that will perform the

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project, the suppliers that will provide the project with the necessary raw materials and equipment, a sponsor that will finance the project, and many other organizations.

The people stated above will without any doubt form project teams in order to achieve specific targets and goals. As a result, the “contract” is introduced in order to get a corporative relationship between these people that have different conflicting interests in order to shape their behavior toward the project and the other participants.

The contract in general should express and demonstrate undoubtedly the financial, the legal, and the technical aspects of the project. For instance, a flight from city A to city B is a project. By acquiring the ticket flight, the passenger agrees on the terms and conditions which the airline is offering that may include the delays, the reservation, the failure to perform a service, the schedule change, and the loss of a baggage... In this case, both the passenger and the airline are participating in this project since they are both involved in the contract.

Any contract should be treated with a great concern as it is unique. Besides, every single contract should be dealt with from different perspectives: the owner, the market condition, and the contractor perspective.

The aim of this paper is to analyze the contracts that are involved in large engineering projects. Besides, this paper will also describe the contracting strategies used in these kinds of projects during the development and the implementation phases. Hence, this paper has as objective to enlighten about the use of contracts from the owner, the contractor, and the market condition perspectives.

In light of this we will be able to answer the following:

- 1) What are the contracting strategies used in large engineering projects?
- 2) What are the types of contracts involved?
- 3) What are the general detailed contracting strategies used by the owner and the contractor?

METHODOLOGY

This paper is using the Multi-Attribute Decision Making, also referred as MADM, which is a tool that evaluates several conflicting measures in a decision making. These criteria and measures can belong to any field; it could be daily life, a business, government, medicine scenarios... The paper will be using specifically the Dominance method and the non-compensatory approach which are types of the MADM. The dominance method and the non-compensatory approach are more accurate and suitable for this paper because they will compare subjective attributes. As stated, we want to clarify the types of contacts that are involved in large engineering projects. Using the dominance method and the non-compensatory approach, we will be able to do so.

Step 1- Problem Definition

Every single project is progressing during time following successive phases, thus it is important to be flexible of using contracts in each phase. For large engineering projects we can notice two main phases that are involved: the development and the implementation phase. The development phase takes around 2 to 3 years and up to 3% of the total project cost, so this phase is considered to be very critical. The implementation phase takes up to 5 years, and it contains all the engineering, procurement and construction details.

The appropriate type of contract choice is very important for both the contractor and the owner. Thus, each contract type has its own specification and administrative details. This paper will compare the relevant contract types for large engineering projects and analyze the most fitting one.

Step 2- Feasible Alternatives

In this case, we can notice three different types that are involved in large engineering projects such as the oil and gas or the construction sector.

Fixed Price:

In the fixed cost type of contract both the owner and the contractor agree on the cost when they sign the contract. Consequently, the cost is fixed and will not change during the project unless if it is necessary in some conditions. As a result, if the project cost goes outside the agreed price, then the contractor will pay the difference. To avoid any kind of issues related to the cost, the owner, in this case, is counseled to define lucidly the scope of the work.

Cost Reimbursable (Cost-Plus):

In this type of contact both the owner and the contractor will agree on a specific cost that will include the labor cost, the material cost, the subcontractors cost, the equipment cost... without forgetting the profit, the contingency, and the risks fees that could be either fixed or not. The most important thing in this type of contract is trust between both parties.

Unit price:

In this type of contract, the cost is not known until the achievement of the project. As a matter of fact, it is very significant to measure the quantities and the amount of work that is achieved during time and steadily.

As a result, this paper will consider 4 alternatives:

- ✓ Firm fixed price
- ✓ Fixed price plus incentive fee
- ✓ Cost reimbursement (Cost Plus)
- ✓ Unit price

Step 3- Development of the Outcomes of the Alternatives

To conduct the Dominance analysis, we need to consider, in order to select the suitable contract for large engineering businesses, some criteria that will match the needs and the expectations that we are looking for.

- ✓ Predictability of Cost
- ✓ Performance
- ✓ Time of delivery
- ✓ The use
- ✓ Meeting milestones
- ✓ Share of risk

Step 4- Selection of the Criteria

To select our criteria, we will use the dominance approach as a first analysis. In this case, we will consider and assume that all our attributes are proportionately and equally important.

Attributes	FFP vs FPIF	FFP Vs CR	FFP Vs Unit price	FPIF Vs CR	Unit price Vs FPIF	CR Vs Unit price
Predictability of Cost	Better	Equal	Worse	Worse	Better	Equal
Performance	Better	Better	Worse	Worse	Better	Equal
Time delivery	Better	Better	Worse	Worse	Better	Worse
The use	Better	Better	Worse	Equal	Better	Equal
Meeting milestones	Equal	Worse	Equal	Worse	Better	Equal
Share of risk	Equal	Equal	Worse	Worse	Better	Better
Dominance	Yes	Maybe	No	No	Yes	Maybe

Figure 1: Dominance Analysis By author

Firm Fixed Price

It is also known by the lump-sum contract. The firm fixed price contract in general fix the total price of the project. It may also add some incentives for early realization, or liquidated damages for late closure. The firm fixed price contract is preferred in large engineering projects when the scope is well designed and the schedule is determined. In this type of contract, the contractor has the choice between lowering the cost or making it higher according to the cost of materials and equipment. Besides, he also can adopt to avoid bidding to prevent high risk FFP contracts.

Application:

- Large engineering project such as construction.
- Clear scope and schedule.
- Authorized cost and known pricing records.
- Eliminating conceivable divergence and controlling the level of effort.

Suitability:

- The contractor has the command to assign the personnel.

Limitations:

- The price is not adjusted no matter what was the contractor performance costs.
- The financial risk is assigned fully to the contractor.
- Low risk on the owner.

Fixed Price Plus Incentive Fee

The fixed price plus incentive fee is a type of contract where the contractor lowers the cost of production as possible. In this manner, the contractor is making cost savings due to his effective way of management, purchasing, and fulfilling the completion time. In this case, the contract specifies a target cost, and at the closure of the project the incentive bonus is determined.

Application:

- The contract has to cover the target cost, the ceiling price, and the profit.
- The elements that can be subject to incentives are the cost, quality, time of delivery, and performance.

Suitability:

- Development and production.

Limitations:

- Suitable and appropriate accounting system for the contractor.
- The adjustment of fees is made when the accomplishment of the contract.

Cost reimbursement (Cost-Plus)

In this type of contracts, the contractor is reimbursed for the actual work he is taking care of and adding to it the additional profit.

Application:

- Used in construction and emergency projects.

Suitability:

- Meet the government needs respecting the expected costs.

Limitations:

- The risk is higher to the government.
- The final cost of the project is not determined until the end.
- Review with the contractors who are asserting an expenditure.

Unit price

The unit price contract is another type of contracts frequently used by large engineering projects, federal agencies and builders. This type of contract is set during the bidding process. At this stage, the owner requests the price for the foremost items. By providing the cost, the owner can easily modify the scope according to the agreements he had made during the improvement of the project.

Application:

- Definition and approximation of the quantities used.
- The contractor can bid following the work units.
- The final cost is unknown at the initiation phase.

Suitability:

- Possible early start.

Limitations:

- High risk on the owner while dealing with the total quantity.
- High risk on the contractor while dealing with the fixed unit price.

Step 5: Analysis and Comparison of the Alternatives

Using the non-compensatory approach – Disjunctive reasoning:

By using the non-compensatory approach, we will first do a comparison of the attributes that we have chosen as alternatives in order to select the most important one.

<i>Attributes</i>	Predictability of Cost	Performance	Time delivery	The use	Meeting milestones	Share of risk	Overall importance
<i>Predictability of Cost</i>	-	1	1	1	1	1	5
<i>Performance</i>	0	-	1	1	0	1	3
<i>Time delivery</i>	1	0	-	0	0	0	3
<i>The use</i>	0	0	0	-	0	0	1
<i>Meeting milestones</i>	0	1	0	0	-	1	2
<i>Share of risk</i>	1	1	1	1	0	-	4

Figure 2 Comparison of attributes using non-compensatory approach By author

The table above shows that the most important attribute to consider while dealing with contracts is the predictability of the cost and the risks.

In this phase, a comparison is made in order to rate each type of the contracts and assess them to know if they correspond to the criteria.

<i>Attributes</i>	Importance	FPP	FPPIF	CR Cost plus	Unit price
<i>Predictability of Cost</i>	5	5	2	2	1
<i>Performance</i>	3	4	3	3	4
<i>Time delivery</i>	3	4	2	3	4
<i>The use</i>	1	2	1	1	2
<i>Meeting milestones</i>	2	1	1	1	2
<i>Share of risk</i>	4	1	1	4	5

Figure 3: Criteria vs Alternative Solutions By author

Calculating the weighting of each attribute using the following formula, we get:

$$\text{The weighting of each attribute} = \frac{\text{The Importance of each attribute} \times \text{The alternative solution}}{\text{criteria}}$$

<i>Attributes</i>	FPP (Weighted)	FPPIF (Weighted)	CR Cost plus (Weighted)	Unit price (Weighted)
<i>Predictability of Cost</i>	25	10	10	5
<i>Performance</i>	12	9	9	12
<i>Time delivery</i>	12	6	9	12
<i>The use</i>	2	1	1	2
<i>Meeting milestones</i>	2	2	2	4
<i>Share of risk</i>	4	4	8	20
<i>Total</i>	57	26	29	55

Figure 4: Relative Weighting of each Attribute By author

Step 6: Selection of the Preferred Alternative

After comparing the alternatives with the criteria, and computing the relative weighting of each attribute, we can notice that the contracts that get the highest score are the firm fixed price contract and the unit price. Thus, according to the MADM approach, the preferred contracts for large engineering projects are these two types of contracts.

<i>Rank</i>	<i>Contract</i>	<i>Score</i>
1	<i>FFP</i>	57
2	<i>Unit Price</i>	55
3	<i>CR Cost plus</i>	29
4	<i>FPPIF</i>	26

Figure 5: Rank of the contracts By author

Step7: Performance Monitoring and the Post Evaluation of Results

The aim of the following analysis is to compare different types of contracts and assess their feasibility and suitability for large engineering projects. After performing the MADM approach and comparing the types of contracts with the attributes suggested, we can conclude that for these attributes the Firm fixed price contract and the unit price are the most suitable contracts for large engineering projects. Still, each project is unique, and the change of the attributes and the criteria that we have chosen can lead to the change of the type of contract. For instance, a lot of factors could have also been taken into consideration such as the delivery method, the risk premium, the ceiling price... which leads to the alteration of the preferred type of contract.

Besides, there are three types of contracting strategies. In the first strategy, the owner basically requests a competitive bidding in order to start his development phase. In this stage, the contractor is recommended to provide a basic design package. Later, the owner will request another time a competitive bidding in order to initiate the implementation phase that will comprise the procurement, the construction, and detailed engineering. Then comes the second strategy, in this strategy the owner holds the packages of two contractors for the development phase. Only one of them should win the bid. In the third strategy, the contractor chosen will realize the two phases that are the development and the implementation phase. In this case, the contractor will provide the owner with basic design packages, then both of them will negotiate in order to start the implementation phase. If the owner could not get to his expectations, then he should look for another competitive bidding. We can notice that the strategies share some similarities. Still, the first one deals with different contractors, the second with two, and the third with one.

CONCLUSIONS

The scope of this paper is to answer the following questions:

1. What are the contracting strategies used in large engineering projects?
2. What are the types of contracts involved?
3. What are the general detailed contracting strategies used by the owner and the contractor?

Along this paper, we could analyze the contract types involved in large engineering projects using the multi-attribute decision making, also called MADM. After assessing the attributes and choosing the contract types, we noticed that the contracts that are involved in these types of projects are the firm fixed price and the unit price contracts. Yet, the attributes are subject to change which lead to the change of the type of the contract. Besides, they are different types of contracts that can be involved in large engineering projects such as the cost reimbursable, the fixed price plus incentive fee, the EPCM contracts ... Nevertheless, the selection of the best contract will depend on different aspects such as the owner, the contractor, the scope and the requirements of the project during the three different phases that are the development and the implementation phases.

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