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Pricing Policy in EPC Oil & Gas Projects

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***Abstract*—The essential parameters in pricing policy in each and every project are the detailed scope definition and the duration of the project. These parameters are officially stated by the client at the bidding stage.These information are the basis for pricing in the engineering, procurement and construction portions with respect to the services requested by the Client.The engineering estimation is extracted from the detailed scope of work in terms of required engineering man-hour, purchasing, cost and construction bill of quantity. The summation of EPC cost along with the contingency factors, escalation and organization overhead will end up to project pricing.The project pricing is a delicate issue and if it is accurately and precisely carried out, the cash-flow and organizational productivity will be improved and if something is disregarded in pricing, the organizational performance will adversely affected and end up to bankruptcy.At the bidding stage, the project charter is deeply reviewed by marketing/ estimation department and the detailed project scope in engineering, procurement and construction is extracted.**

***Index Terms*—Pricing Policy, EPC projects, Vendor.**

I. Introduction

Last few years, EPC (engineering, procurement and construction) projects in oil industry are extensively awarded to well-qualified contractors. This type of contracts have win-win aspects both for the client and contractor since the projects are accomplished faster, with lower price and better quality considering that the activities are carried out in all fast-track type and contractor is mainly responsible for each piece of the project.

In fact the pricing of the project is estimated at bidding stage by "estimator engineers" in marketing discipline based on the available information from the client side mainly the scope of work and time schedule. The pricing is allocated with respect to the essence of the different portions listed as follows:

A. Engineering:

The scope definition is elaborated by different engineering disciplines in terms of document / deliverable list and activities (e.g. vendor document review, 3D modeling). The elaborated document list is the basis for further procurement and construction works.

The next step is to dedicate the required man-hour for preparation / performing each deliverable / activity. The size and numbers of sheets for each document is the basis for estimation of required man-hour. Each company has its own figure however the data base of reputable companies is used by most of other companies. The same data base is applicable to the engineering activities. Briefly the output of pricing in engineering discipline is "man-hour".

B. Procurement:

The list of tagged equipment (such as pump, compressor, tank, vessel…) along with the quantity estimation of bulk material (such as cable, pipe, plate,…) are divided into different inquiry packages, these packages shall contain enough technical data (such as weight, dimension, length, …) and are the basis for estimation of required man-hour for procurement staffs in different groups (e.g. inspection, expediting, purchasing, transportation, contract,…).

The budget allocation for tagged items and bulk material is extracted from the company data base based on the actual price of the past projects of course the price is customized based on the equipment weight and dimension. Here the "procurement policy" is the most important factor affecting the total price of procurement. In fact major parameters as cost, time, quality, embargo, hot market, market depression, escalation, current economical and political situation, risk, potential of local market, knock-down condition are discussed in procurement policy to take the optimized solution for purchasing, then the project pricing is seriously affected implementing the above factors.

C. Construction:

The bill of quantity for different items extracted from the scope of work and estimator engineers (e.g. volume of concrete, weight of rebar, length of cables, weight of vessels,…) are the basis to estimate the required man-hour for construction activities (foreman, welder, fitter, labor, field engineer, supervisor,…). Also these are a couple of consumable items which are purchased by construction team (e.g. electrode, concrete, rebar, aggregates,…) and the same is included in project pricing. Also there might be special activities like "heavy lift" (installation of heavy equipment heavier than 100 tons) which are outsourced to qualified construction contractors and the same price is taken into consideration for project pricing.

With respect to item# 1 to 3 the project net price is obtained and then other factors such as contingency, escalation and over head are implemented and finally the project price is estimated in the bidding stage.

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On this paper for an EPC oil refinery project in Iran we focus on the procurement pricing only in mechanical items (pressure vessels) and three alternatives are deeply reviewed and final decision is taken based on the comprehensive facts and figures as illustrated in the next chapters.

II. Pricing Policy in Procurement of Mechanical Items (Pressure Vessels)

A. Problem Description

The aim of project pricing policy is to minimize the project price in order to be the winner of the bid. This is an extensive area of knowledge and shall be carried out with special care with estimator engineers. Actually the engineering, procurement and construction have their own policy to minimize the cost. For instance in engineering works the main concern is to outsource the job or to do it by ourselves. In construction the main concern is splitting the job among the qualified construction contractors in terms of area or activities, i.e. hiring construction contractor for piping, electrical, instrumentation activities or hiring construction contractors for each and every units such as process, utility or offsite.

On this paper the area of concern is the procurement phase where generally 50% of total project price is involved and it is why it is an important task in bidding stage. It is a vast area of knowledge and there are a couple of scenarios to minimize the project pricing. One of the important disciplines in terms of budgeting in oil refinery projects is "mechanical" consisting of static equipment such as pressure vessels, towers, heat exchangers. To purchase the pressure vessels three alternatives are presented on this paper and the best which can fit into project requirements is chosen.

B. Method (fuzzy ELECTRE full ranking method)

Having reached the alternatives' evaluations through a fuzzy is a phase of the decision-making process. In this paper, we utilize fuzzy ELECTRE III, as a fuzzy-based MCDM method for dealing with the uncertainties in the problem. It has been applied in past to various types of decision-making situations. ELECTRE III requires an input of criteria evaluations for the alternatives, called decision matrix, preference information, expressed as weights, thresholds, and other parameters. The alternatives' performances can usually be determined with ''certain accuracy" and the imperfect knowledge about the evaluations can be taken into account when defining the thresholds for the model. The ELECTRE III method is based on the outranking relation between pairs of actions is formed. This results in an outranking matrix. (Figueira, Mousseau, & Roy, 2005; Qahri Saremi & Montazer, 2007; Roy, 1990).

Let have the following notations:

1) $F = \{g_1, \ldots, g_i, \ldots, g_n\}$ is the set or family of criteria.
2) J: denotes the set of criteria indices.
3) $A = \{a_1, \ldots, a_i, \ldots, a_m\}$ is the set of actions (alternatives).
4) $q = \{q_1, \ldots, q_i, \ldots, q_n\}$ is the weight factor.
5) $g_j(a_i)$ is the evaluation of criterion g_j for action a_j. Let define the following comprehensive binary relational operators, to compare two alternatives, a & b, as follows:

- Q is the weak preference relation, that is aQb denotes the relation ''a is weakly preferred over b", which means hesitation between indifference and preference.
- S is the outranking relation, that is aSb denotes that ''a is at least as good as b".

The thresholds of the ELECTRE III model are denoted as follows:

- q_j is the indifference threshold for the criterion g_j.
- p_j is the preference threshold for the criterion g_j.

These thresholds can be constant and also variable (directly or inversely) along the scale of each criterion. The construction of an outranking relation requires the definition of a credibility index for the outranking relation aSb; q(a,b) denotes such an index. It is defined using both a comprehensive concordance index, c(a, b). For computing the partial concordance indices, we first define sets for two coalitions of criteria (assuming that all the criteria are to be maximized) (Tervonen, 2004).

- Concerning the coalition of criteria in which aSb:

$$JS = \{j \in J : gj(b) - gj(a) <= qj(gj(a))\} \quad (1)$$

- Concerning the coalition of criteria in which aQb

$$JQ = \{j \in J : qj(gj(a)) < gj(b) - gj(a) <= pj(gj(a))\} \quad (2)$$

Using these two sets, we can compute the partial concordance indices cj(a,b), as follows:

- if $j \in J^S \rightarrow cj(a,b) = 1$ (3)

- if $j \epsilon J^Q \rightarrow$

$$cj(a,b) = pj(gj(a) - (gj(b) - gj(a)) / pj(gj(a) - qj(gj(a)) \quad (4)$$

- Otherwise-$\rightarrow cj(a,b) = 0$ (5)

Thus cj(a,b) decreases linearly from 1 to 0.

III. Case Study

At bidding stage in an EPC oil refinery project in Iran in detailed stage the pricing policy was precisely carried out by a consortium consisting of three companies (two Iranian companies and one Chinese company) and finally this consortium was the winner of the bid and consequently the project was awarded to them in September 2006. The basic design of this project had been developed by a Japanese company so far. The procurement pricing in mechanical items (pressure vessels) is taken as a sample for this study and we will demonstrate that the decision taken at bidding stage was quite compatible with an analytical method presented in the next steps.

There are three different alternatives for purchasing the pressure vessels each has its own advantages/disadvantages

identified in this study:

1) The equipment technical data sheets elaborated in basic design to be included in inquiry package by consortium and the inquiry to be launched to foreign vendors. Further activities listed as follows to be prepared by the foreign vendor (offshore supply):
   a) Preparation of mechanical fabrication drawings
   b) Procurement of raw material
   c) Fabrication of the pressure vessels
2) In the detailed design stage the engineering drawings to be extracted from the technical data sheets available in basic design and to be included in inquiry package by consortium. Also the required raw material to be estimated and purchased by consortium from Europe market (offshore supply) and to be delivered to the local vendor workshop. Here the main tasks to be carried out by the vendor are listed as follows:
   - Preparation of mechanical fabrication drawings
   - Fabrication of pressure vessels
3) In the detailed design stage the engineering drawings to be extracted from the technical data sheets available in basic design and to be included in inquiry package by consortium and the inquiry to be launched to local vendors. Further activities listed as follows to be prepared by the local vendor:
   - Preparation of mechanical fabrication drawings
   - Procurement of raw material
   - Fabrication of the pressure vessels

To evaluate the above mentioned alternatives, there are a couple of criteria listed as follows:

1) Price
2) Delivery time
3) Quality
4) Risk

Based on the project time schedule the "wanted values" along with the feedback from the vendors are summarized on the table Table 1.

The below remarks are needful for better understanding of the Table 1content:

1) The weight factor dedicated for each criterion is extracted from past experiences and also experts' opinions.
2) For alternative #i and alternative #iii the consolidated price including engineering, procurement and construction quoted by the vendors is included.
3) For alternative #ii the cost of raw material procurement by consortium is segregated and the cost of fabrication is individually presented as quoted by the vendor.
4) Wherever is applicable, the delivery of raw material and fabricated vessel are specified.
5) The quality outranking is taken by interview from the experts and past project experiences.
6) The risk is mainly applicable to embargo for foreign vendors considering the political situation and the same is applicable to bankruptcy for local vendors.

The wanted values are basically extracted from the project master schedule for delivery time and dedicated budget for the price.

TABLE. 1 WANTED VALUE

Alternative	Price q=7 (1)	Delivery time q=5 (0.71)	Quality q=3 (0.43)	Risk q=2 (0.26)	Price match	Delivery time match	Quality match	Risk match
i	5723	18	3	3	0.61	0.2	1	0.5
	Normalized 0.78	0.9	1	1				
ii	760 (raw material) + 2451 (fabrication)	16 (raw material) +4 (fabrication)	2	3	0.78	0	0.67	0.5
	Normalized 0.44	1	0.67	1				
iii	7308	16	1	2	0.23	0.4	0.33	1
	Normalized 1	0.8	0.33	0.67				
Wanted Value	4130	10	3	2	-	-	-	-
	Normalized 0.56	0.5	1	0.67				

IV. RESULTS ANALYSIS

Table 2 presents the matrix of concordance index for three alternatives.

TABLE. 2 MATRIX OF CONCORDANCE INDEX

Alternative	i	ii	iii
i	1.00	1.00	1.00
ii	1.00	1.00	1.00
iii	0.44	0.77	1.00

The above figures show the pair-wise comparison of the alternatives. In another words it shows that:

- Alternative #iii is not preferred to alternative #i as well as alternative #ii and consequently in our evaluation alternative #iii will be out.
- Alternative #i and alternative #ii are in the same level of preference and of course alternative #i is slightly better than alternative #ii with comparison to the wanted values.

V. CONCLUSION

Based on the above comprehensive case study, it is clear that both alternative #i and alternative #ii are taken as an action plan for procurement of pressure vessels in detailed design stage and the relevant cost is implemented in the project pricing policy. The split of work between local procurement (alternative #ii) and offshore supply (alternative #i) is basically decided with respect to the constrains in our local market outlined in the company past projects lessons learned.

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