# Principles of Construction Cost Assessment During Preparation for Tender

[1]*Evgenij Smirnov* and [2]*Igor Fedoseev*

[1]St. Petersburg State University of Architecture and Civil Engineering,
Vtoraja Krasnoarmejskaja ul. 4, St. Petersburg, 190005, Russia
[2]Saint Petersburg State University of Economics, Prilukskaja ul. 3, St. Petersburg, 191002, Russia

**Abstract:** Construction cost assessment during bid preparation is the most tedious and responsible stage. Evaluators have to take into account a multitude of various factors affecting construction cost. They include the following in case of the conventional construction pattern: the chosen methods and technologies of facility construction; options of construction provision with machinery and mechanisms, labour and material resources; conditions of payment for executed works and supplied resources, which affect the formation of financial flows during construction. The construction schedule illustrates the time association of all construction processes and is the basis for determination of the actual volume of the required resources and funds at each time point. Given the many-sidedness of the arising problems, construction cost assessment should be conducted based on the following principles: construction schedule optimization; accounting of market cost of resources; generating the best plan of construction resource provision; cost minimization and financial flow optimization; risk accounting; project approach. Using these principles during assessment of facility construction cost within the framework of bid preparation allows increasing its competitive ability according to the main winner choice criteria-construction cost and periods.

**Key words:** Construction cost assessment · Schedule · Tender principles · Bid · Competitive ability · Financial flow · Risks · Cost · Construction periods

## INTRODUCTION

Winning the tender for construction of buildings and structures is based on selection of options of bid cost minimization, reduction of construction periods while ensuring the required work quality. Thereat, construction cost assessment during bid preparation is the most tedious and responsible stage. Calculation inaccuracies distort the construction cost and, consequently, the bid price, causing negative consequences for the contractor:

- if construction cost is overestimated, the bidder's bid will not be competitive and will be rejected;
- underestimated bid price in case of winning the labour contract will cause the tender winner's losses.

Therefore, it is essential to predict the future costs as accurately as possible and correctly determine the construction cost which underlies the bid price.

Many researchers devoted their papers to issues of construction cost assessment during preparation for tender [1]. For instance, A. Akintoye and E. Fitzgerald, reviewing the current practice of construction cost assessment in Great Britain, state the main issues such as the evaluators' having no practical knowledge about the construction process; lack of time for accurate assessment; absence of full data in tender documentation; dispersion of resource prices, including prices of subcontract works.

S. Cui suggests determination of the cost of contractor's facility construction during preparation for tender based on the strategy matrix [2]. The columns of this matrix give the initial conditions; the lines correspond to the selected strategies. The matrix cells give the anticipated results at the given initial data corresponding to the selected strategy. The suggested method is aimed at determining the option of the facility construction strategy, allowing for minimization of losses in case of

**Corresponding Author:** Evgenij Smirnov, St. Petersburg State University of Architecture and Civil Engineering,
Vtoraja Krasnoarmejskaja ul. 4, St. Petersburg, 190005, Russia.
Tel: +7(812)3165311.

various deviations from the planned conditions on the one hand and maximizing contractor's profit-on the other hand.

R.F. Aziz, when assessing the construction cost during preparation for tender, lays special emphasis on the modelling of financial flows, i.e. determination of contractor's incomes and expenses during facility construction [3]. This approach allows optimizing the use of resources, thus reducing the construction cost and periods.

S.J. Rajpatty, while emphasizing the important role of the evaluator of facility construction cost at any contracting organization in modern conditions, points out subjectivity and creative nature of assessment process [4]. This is related to the fact that evaluators have to take into account a multitude of various factors affecting construction cost. The author gives such factors as environmental requirements, new efficient construction methods, periods and peculiarities of material and structure delivery, conditions of payment for works and settlements with suppliers, inflation developments, change in the value of money, etc.

Agreeing with the suggestions and arguments of the said researchers on the whole, let us try and answer the question: what must underlie the contractor's construction cost assessment during preparation for tender?

The essence of tender and assurance of contractor's winner was vividly depicted by the Great Russian writer Leo Tolstoy in his micro short story "How the Muzhik Removed the Stone", written in 1875:

"There was a huge stone on the square in a certain town. The stone took much room and hindered driving about the town. Engineers were called and asked how the stone could be removed and how much it will cost. An engineer said the stone had to be broken into pieces by using gunpowder and then moved away and that would cost 8000 roubles; another suggested bringing a large roller under the stone to remove it and that would cost 6000 roubles. And one muzhik said: "I'll remove the stone for 100 roubles". They asked him how he would do it. He replied: "I'll dig out a large hole beside the stone; I'll spread the ground about the square, dump the stone in the hole and level it with ground". The muzhik did so, he was paid 100 roubles and another 100 roubles for the contrivance" [5].

In this case, the tender was won by the bidder's work technology allowing for achieving the final result with the minimum expenses.

## MATERIALS AND METHODS

The research involved the methods of system approach, abstraction, methods of logical and comparative analysis and synthesis, economic and statistical handling of data, organizational design and economic and mathematical modelling.

**The Main Part:** To ensure calculation accuracy while minimizing the construction cost in order to make the bid competitive, the authors recommend the contractor to determine construction cost following the principles given below.

**Optimizing Construction Schedule:** The time parameters of construction process determine its fulfilment in time and overall duration, basing on the maximum overlapping, rhythm and flow of certain operations or a complex of operations. The main time parameters are the process deadlines, shift arrangement, duration of certain operations. The adopted solutions and contractor's selected technologies are recorded in the model-work time schedule. Construction cost should be determined based on the optimal work time schedule, ensuring facility construction within the minimum periods at the minimum costs. From the financial viewpoint, the optimal facility construction schedule will be the one corresponding to the financial flow of contractor's incomes and expenses requiring no attraction of the own current assets or bank credits.

**Generating the Optimal Plan of Construction Resource Provision:** The construction schedule illustrates the time association of all construction processes and is the basis for determination of the actual volume of the required resources and funds at each time point of facility construction. The schedule is used by the group of qualified specialists from different departments of the construction contractor to elaborate the schedules of the needed resources. This is the basis for elaboration of resource supply schedules with account of the creation of the necessary stocks at the facility warehouse. Resource supply schedules allow for calculating the procurement costs. Provision of facility construction with the necessary materials and structures should be planned while minimizing the combined transport and storage costs with account of the rational scopes and reliability of supplies ensuring the rhythm of facility construction. Supply reliability is the system's capacity to ensure the attaining of the basic goal as regards the timeliness of

supplies of the planned products in the given scope and nomenclature. Quantitative measure of reliability is the probability of attaining the required supply parameters (scope, nomenclature, deadlines). Reliability of material support of construction operations is the system's capacity to assure complete and uninterrupted material support of construction works. Quantitative measure of reliability is the probability of deficit-free work.

**Accounting of Market Cost of Resources:** It is necessary to predict the future expenses on facility construction as accurately as possible based on the market price of resources (average for the industry or region), taking into consideration changes in local prices caused by possible inflation developments [6]. When determining the value of resource appreciation, it is needed to study the option of price correction during construction, specified by the customer in the contract terms, which is part of tender documentation [7, 8]. If the customer does not correct the contract price during construction under the contract terms, the potential contractor will assume all risks of resource appreciation.

**Cost Minimization and Financial Flow Optimization:** It is needed to determine options of construction work technologies from the viewpoint of assurance of the required labour productivity and work quality at the minimum costs. While determining the expedient level of work mechanization, it is needed to consider and calculate the costs by three options of construction facility provision with machinery and mechanisms assuring the required productivity and work quality [9]:

- Using own machinery and mechanisms with account of their transportation to the construction site, assembly, removal and operating costs;

- Lease of construction equipment at the lessor's prices at the construction site;
- Special procurement of construction equipment for construction of the tender facility with its possible sale after completion of the labour contract.

Cost minimization involves the modelling of the financial flow, representing an overlapping of two graphs,-those of contractor's incomes and expenses arising during facility construction. The income graph is made up of the advance payment and payments for certain work stages in accordance with the terms of customer's payment for works outlines in tender documentation. The expense graph is drawn by summing up all the direct costs and overhead costs with account of the terms of payments to resource suppliers and workers' salary. Fig. 1 shows the financial flow graph for facility construction.

The conventional construction period is 7 months; bid price is 100 conventional monetary units. The advance payment equals 10% of the bid price and is 10 conventional monetary units. The graph shows that there is shortage of funds during the first three months, i.e. contractor's expenses will exceed its incomes during facility construction. The exceedance is shaded on the graph.

The contractor may cover the funds deficit by means of its own current assets, if such are available in the sufficient amount, or use a bank credit, increasing the bid price and , consequently, reducing its competitive ability.

Other options for covering the funds deficit are possible; they will not increase the bid price and are based on methods of financial flow optimization:
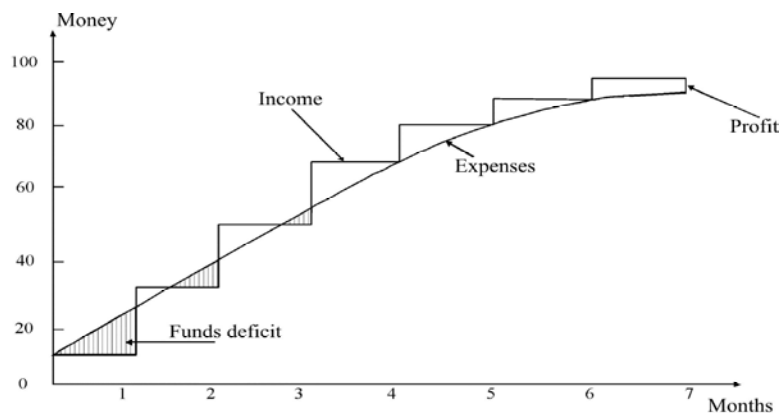


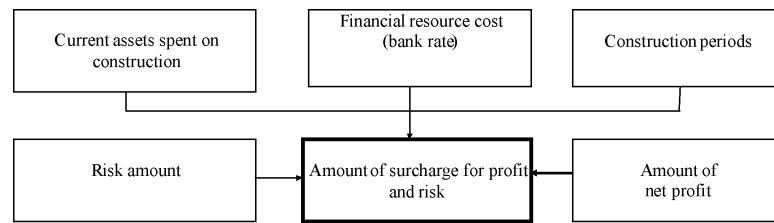Fig. 1. Financial flow graph (income and expense prediction)

Fig. 2. Factors affecting the amount of surcharge for income and risk during bid price calculation

- Artificial increase of rates for certain work kinds at the initial construction stage while reducing them at the construction end. Thereat, the balance of increase and decrease should be so that the overall bid price is unchanged. It will allow for artificial increase of the amount of funds, paid in advance by the customer, without reducing the bid's competitive ability, because the construction price and periods will not change;
- Correction of material supply schedules to minimize the scope of each supply while increasing their frequency, thus improving the financial flow by means of reduction of the one-time payment to suppliers. Thereat, work rhythm must be ensured by creating the minimum amount of material reserves at the facility warehouse;
- Schedule correction as regards the possible shifting of expensive and material-intensive works from the funds deficit "area" to the surplus "areas". If the desired results are not achieved, all the three methods can be used at the same time.

**Risk Accounting:** It is necessary to take into account the risks, the losses due to which can exceed the amount of planned profit from completion of the tender facility construction contract. The planned profit amount depends on the amount of own current assets spent on construction and the compensation for the risk of their loss. When calculating the construction cost, the potential contractor should take into account a multitude of other risks caused by the absence of full information in tender documentation, possible errors in work scope calculation, incorrect prediction of resource cost change etc. [10].

The basic factors affecting selection the amount of surcharge for income and risk during calculation of the price of the bid for construction contract are given in Fig. 2.

**Project Approach:** During preparation for tender, it is advisable to form a team for construction cost assessment, including specialists from all departments (including operating personnel), whose activity affects

construction cost, periods and quality and in case of winning, entrust this team to manage and perform facility construction while assuring the parameters determined by them. This principle will allow increasing the responsibility of specialists involved in bid preparation.

**CONCLUSIONS**

In authors' opinion, using the aforesaid principles during resource provision planning and determination of facility construction cost during tender bid preparation will assure the optimal method of facility construction management with the maximum efficient use of resources. This is the key factor to ensure tender bid's competitive ability. Moreover, if the labour contract is awarded, the contractors will need to implement the already elaborated facility construction plans, including the plans for its provision with all types of resources having the given cost parameters.

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