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Cash Flow Multi-Criteria Analysis in Construction Projects

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Abstract

The tremendous economic challenges especially due by to the persistence of the financial crisis and the continuous decline of public investments in the last years have increased the financial risks faced by construction companies. With high capital expenditures and high level of competition in the market, the construction companies have to accept a large number of risks, which make them very vulnerable. In order to stay in the market, the construction companies often participate in tenders with prices increasingly smaller, making them vulnerable to the occurrence of unforeseen events that are inherent in any construction project. In the current political, economic, social and administrative situation, the most important vulnerability of the construction companies is the lack of liquidity at the level of the contracting authority, but especially at contractor level. This financial weakness leads to delays in the project implementation, in penalties for delay and lost opportunities, with direct effect on the health status of projects and organizations. Infrastructure construction projects are mainly base on FIDIC Conditions of Contract amended through special conditions by contracting authorities. This paper aims to examine the effect of conditions of contract relating to the financial relationship between the employer and the contractor and the influence that they have on the financial management exercised by contractor, providing them a practical tool for decision-making.

Keywords: Construction Project Cash Flow; FIDIC Conditions of Contract; Multi-Criterial Modelling; Project Financial Management

1. Introduction

Nowadays, the construction industry continues to face the effects of economic crisis. Even so, the actual funding systems are not encouraging the companies to improve their practices related to the project finance management. With high capital expenditures and high level of competition in the market, the construction companies have to accept a large number of risks, which make them very vulnerable. In order to stay in the market, the construction companies often participate in tenders with prices increasingly smaller, making them vulnerable to the occurrence of unforeseen events that are inherent in any construction project. In the last annual report ([1]), the president of FIDIC mentioned that "Unreasonable price competition in the awarding of engineering services is more frequent today than ever before".

In the current political, economic, social and administrative situation, the most important vulnerability of the construction companies is the lack of liquidity at the level of the contracting authority, but especially at contractor level. This financial weakness leads to delays in the project implementation, in penalties for delay and lost opportunities, with direct effect on the health status of projects and organizations. The financial aspects of construction projects have always been a major challenge for construction companies, especially in the current economic climate.

The type of contract that is the foundation of the relationship between the parties has significant effects on the strategy that the construction company will adopt to achieve the objectives of cost, duration and profit.

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2. Financial Contractual Aspects

The large investments from EU founds or state budged involved in the infrastructure construction projects requires balanced, accepted and tested type of contracts In such case, FIDIC Conditions of Contract amended by particular conditions are the most used contracts. According to the statutes, FIDIC (International Federation of Consulting Engineers) is a federation of member associations that represent the consulting engineering industry globally ([2]), aiming to enhance the image of consulting engineers and to be the authority on issues relating to business practice.

Developed over 50 years as global standards, the FIDIC contracts are recognized and applied in many types of projects. They describes all aspects that govern the relationship between the contracting authority and the contractor: general provisions and actors of the contract, material labor, equipment and machinery, execution period, longer runtime, reception and during the defects notification, measurement works, changes, payments, termination, force majeure, insurance and claims, disputes and arbitration. The financial aspects are dealt with in Clause 14 - Contract Price and payments, which sets out the sequence of events typical payments. FIDIC Red Book "*Conditions of Contract for Construction of buildings and engineering works designed by the beneficiary*" [3] defines the sequence of typical events of payments: at the end of each month of the reporting period, the Contractor submit the Statement and the supporting documents to the Engineer. After its verification, if the Statement is accepted, the Engineer will issue in maximum 28 days the Interim Payment Certificate. The Employer shall pay to the Contractor the amount certified within 56 days after the Engineer receives the Statement and supporting documents. The Employer will make the final payment within 56 days after the Engineer issue the Final Payment Certificate. If we take into consideration that the minimum time needed by the Contractor to prepare the Statement and supporting documents is 7 to 10 days, the first Interim Payment Certificate (IPC) will be issued at 65 days after the Date of Commencement. Considering that issuing the invoice by the Contractor is 7 days, the first payment will be done at 100 days after the Date of Commencement.

However, this sequence in time may be distort if the contracting authorities modify the related sub-clauses, leading into larger time intervals of payment. In such case, the contractor will be forced to support a greater financial effort in order to complete the works. There are also other reasons the payment may be delayed: the contractor is not enough well organized and prepared to submit in time the Statement and supporting documents and the Engineer may issue with delay the Interim Payment Certificate. Such events will cause an increasing financial pressure for the contractor reflected in his cash flow, without taking into account the risk events and uncertainties typical for construction projects.

3. Practices in managing financial risks in the construction projects

Several studies were run on the construction project financial management practices, in relation to the contracting clauses, revealing the associated risks. In 2015, KPMG ran a global survey for the construction sector [4] focusing on the project management practices (planning, risk management, controls and governance, project performance and collaboration between the owner and contractor). The survey reveals that for 72% of awarding contracts cases, full competitive tenders took place. Despite some concerns about a lack of flexibility, the traditional design-bid-build approach remains one of the two most popular project delivery strategies, enabling the owner to work with various suppliers for different aspects of the project. One of the biggest concerns expressed by the survey participants is the accuracy of the estimated costs before committing to the project. The contingency model (for example, 10 percent model) is not useful in many cases to cover the risks. The type of contract which is the base of the relationship between the parties have significant effects on the strategy the construction company will take in order to achieve it purposes in terms of cost, duration and profit. The survey also reveals that most of the companies develop financial projections methods based on the deterministic estimation of project financial performance.

In [5], a practical cash flow analysis model is proposed, that can be applied by the construction companies mainly when decisions about portfolio structure are taken. The proposed model allows construction companies to predict not only when, but mostly what amount of money should be borrowed or obtain from internal or external sources and when and what amount of money should be return. Due to the high amount of money needed to perform the projects, it become reasonable to say that construction companies need a specialized bank and not commercial one, which will supports their financial needs.

4. Multi-criteria decision models for managing the construction projects

Most of the construction companies develop financial projections based on estimated financial performance of the projects, considering some basic assumptions, regarding the time frame (the financial projections cover the project implementation period plus three-five years after the project's completion), capital outlays and financing

costs (they include any up-front and ongoing capital needs during the reference period), revenues associated with the project, expenses, capital structure. Net present value (NPV) and internal rate of return (IRR) are two of the most frequently used indicators for measuring the estimated financial performance of a project. When a project has a positive NPV, the project is financially appealing. If a project has a negative NPV, there is an expected negative cash flow or the project won't generate enough cash to cover inflation and the targeted return. IRR is the discount rate required to achieve a NPV of zero. The higher a project's IRR is, the more attractive the project is financially. Other indicators are used to complement the NPV and IRR, such as: payback period, weighted average cost of capital, terminal value. In [6] several key performance indicators for organizational structures in construction and real estate management were proposed. The traditional scheduling models were enriched ([7], [8]) in order for serve better to the project financial projections in a probabilistic approach. The semi-probabilistic simulation methods, mainly the Three Scenario Approach ([9], [10]) and the probabilistic ones ([11]) become more popular.

The complexity of the construction projects environment make very difficult to evaluate them using models with only one single parameter. Most of the models applied for assisting the financial decisions in the construction projects ([12], [13], [14]) are using multiple criteria, such as: economical conditions, market share, market prices, type of project, type of contract, project duration, the time allocated to prepare the tender, the company financial "health", the need to win the tender, the available resources, the estimated price, the available technologies and so on.

5. A proposed approach of multi-criteria analysis

Due to the adverse economic conditions, the contractor decisions are based taking into account his financial capacity to support the project, in direct relation with the incomes. The proposed model consider that different type of construction projects lead to specific shape patterns of the contract price distributed on time. The aim of analysis is to quantify the contractor potential financial effort due to the variation of several parameters: project duration, the date of commencement, the time interval for the invoice payment and the date of issuing of the Statement and supporting documents.

Three real projects of road construction, based on FIDIC Red Book Contract clauses were analyze. The first project represents the rehabilitation of a section of national road length of 38.27 Km, the second project aimed the establishment of a by-pass (76.25 km in length) and the third one dealt with the consolidation of a section of national road length of 7.2 Km. A number of 174 cash different cash flow patterns were developed and analyzed.

The contract price monthly distribution for each project is presented in figure 1, 2 and 3.

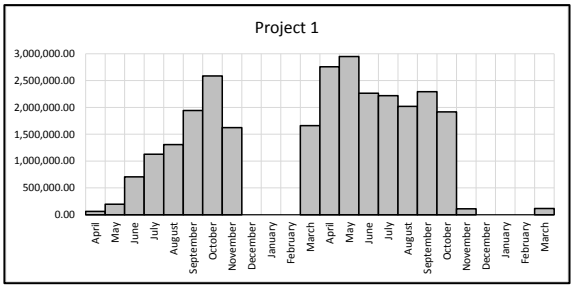

Figure 1 Contract price monthly distribution for Project 1

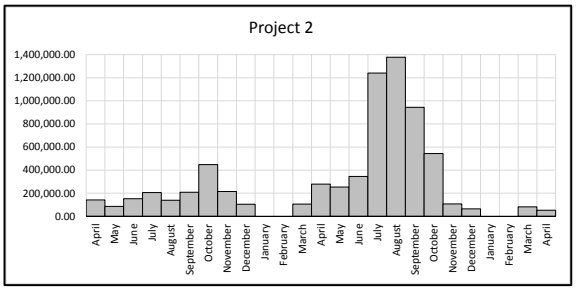

Figure 2 Contract price monthly distribution for Project 2

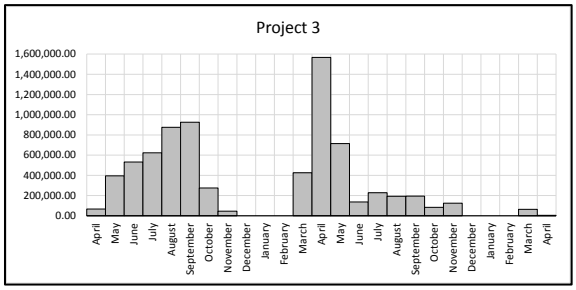

Figure 3 Contract price monthly distribution for Project 3

The following computation hypotheses were considered in the cash flow analyze:

- The payments will be made considering only the General Conditions of Contract;
- The effect of the advance payment and the guaranty for the advance payment was not taken into account;
- The depreciation, the bank taxes and commission were not taken into account;
- The Statement and supporting documents are prepared by the Contractor monthly, or for minimum 5% from the Contract Price.

In the cash flow analyze, the following parameter's variation were took into account:

- Construction project duration considering for one project the following durations: 16, 18, 20, 22 and 24 months;
- The date of commencement; the project schedule was develop so that the date of commencement of work to correspond the months from March to October;
- The time interval for the invoice payment considering the following payment terms: at 30 days, at 60 days and 90 days;
- The date of issuing of the Statement and supporting documents. Two cases were considered for the date of issuing the Statement: at 10 days and at 35 days after the reporting period

The project cash flow is consisted on the contractor costs with labor, materials, equipment and transport, other direct costs and overhead, profit and incomes from the payments, according with contractual clauses.

During the analyze we established the peak of the cash flow and its weight from the contract price for each scenario, identifying the best and the worst situation for each type of project.

5.1. *The influence of project duration*

The study of the influence of project duration was made on Project 3 – road consolidation of a section of 7.200 km of a National Road, considering the variation of duration between 16 to 24 months. The project cash flow was developed taking into account the payment of invoices on 30, 60 and 90 days, and the Statement and supporting documents are issued at 35 days after the reporting period. Considering that the date of commencement vary from March to October, there were retained the maximum and minimum weights of the peak of cash flow. As results, we obtained the domain of cash flow peak weight from the contract price considering the variation of duration (figure 4).

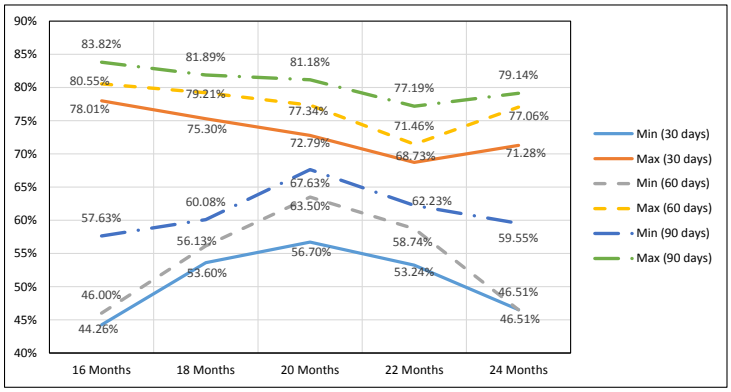

Figure 4 The variation of cash flow peak weight from the contract price for different project durations

Analyzing the results, we can find that for this type of construction project, the minimum weight of cash flow peak is obtained for 24 months duration, due to the distribution of the contract price on a higher duration. For this duration, the cash flow peak weight from the contract price vary from 46.5% to 79% depending on the date of commencement and the interval for payment. The contractor financial effort will be as higher as the delay of payment will be higher.

5.2. *The influence of date of commencement*

In order to emphasize the influence of the date of commencement on the contractor financial support, several hypothesis were took into consideration:

- All three projects have the duration of 24 months;
- The Statements and the supporting documents are submitted at 35 days;
- The payments is made at 30, 60 and 90 days.

In the case of Project 1 - rehabilitation of a section of 38.27 km of a National Road, the cash flow peak weight from the contract price vary from 41% to 69% depending the date of commencement and the interval for payment (figure 5). The best dates of commencement are in March and April, while the worst are in August, September and October.

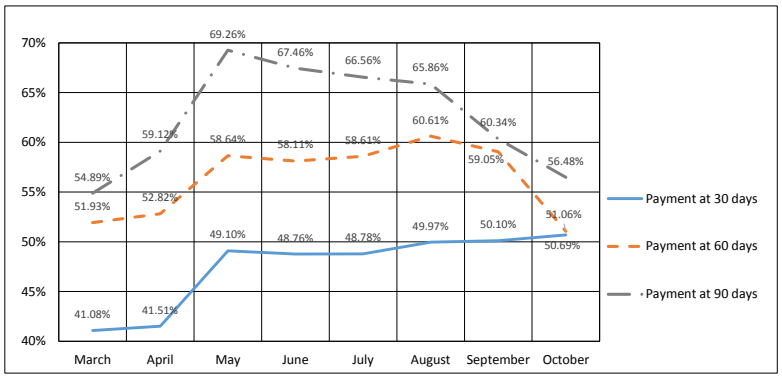

Figure 5 The variation of cash flow peak weight from the contract price for Project 1

For the Project 2 - the construction of a by-pass of 7.625 km, the cash flow peak weight from the contract price vary from 50% to 70% depending the date of commencement and the interval for payment (figure 6). The best date of commencement is in July, while the worst is in April.

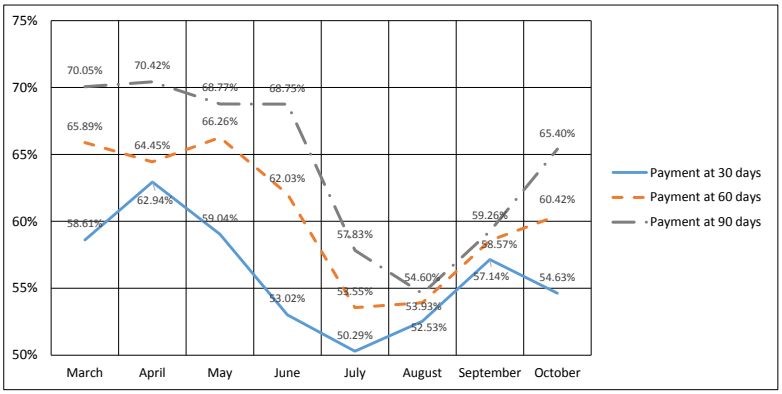

Figure 6 The variation of cash flow peak weight from the contract price for Project 2

In the case of Project 3 - the consolidation of a section of 7.200 km of a National Road, the cash flow peak weight from the contract price vary from 39% to 63% depending the date of commencement and the interval for payment (figure 7). The best dates of commencement are in April, May and September, while the worst are in March, July and October.

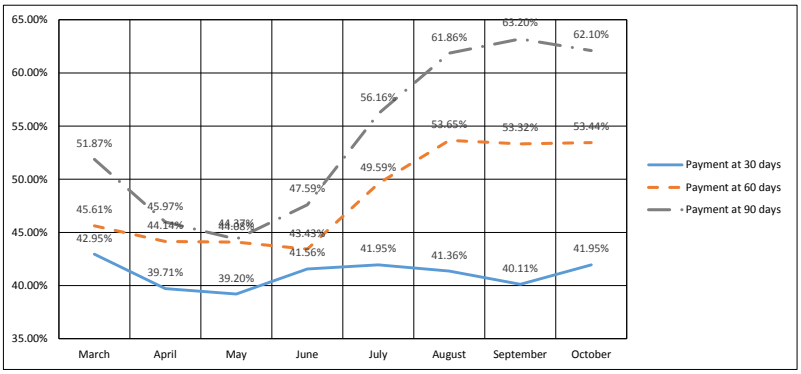

Figure 7 The variation of cash flow peak weight from the contract price for Project 3

5.3. *The influence of the time interval for the invoice payment*

Considering the same set of conditions, the contractor financial effort vary for the payment at 30 days between 44% - 71%, between 54% - 77% for the payment at 60 days, and between 64% - 79% the payment at 90 days, depending the type of project.

5.4. *The influence of the date of issuing of the Statement*

Although the timely issue of the Statement and supporting documents is in the interest of contractor, in practice it appears that this is not enough organized and prepared to develop the necessary documents. Issuing as soon as possible the Statement and supporting documents can reduce the contractor effort between 2% - 12% from the contract price, depending on the type of project and time interval for the invoice payment.

6. Conclusions

The results of this study suggest that different factors that can influence decisions both in the bid-tender stage, but especially in the implementation phase of infrastructure projects should be carefully considered by the construction companies. The specificity of works and applied technologies, the sequence of activities and resources involved, all are affecting the contract price distribution and is leading to major imbalances in the share of cash flow of the contract price. The construction companies have to adapt the terms of the contract by special conditions, along with the duration of the works, the time for invoice payment, the date of commencement and the time interval of issuance of Statements. The ideal conditions and homogeneous envisaged by the general contracting clauses required a significant effort of analyzing and understanding the dynamics problems of a financial nature faced by contractors after signing the contract without accounts but risk events and uncertainties that characterize fully these project categories. For this reason, the application of multi-criteria decision models can support the construction companies in managing better their projects.

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