

MULTICRITERIA VERBAL ANALYSIS FOR CONSTRUCTION CONTRACTS

Leonas Ustinovichius¹, Arunas Barvidas¹, Andzelika Vishnevskaja¹, Ilya V. Ashikhmin²

¹*Vilnius Gediminas Technical University,
Department of Construction Technology and Management,
Saulėtekio al. 11, Vilnius, Lithuania*

²*Institute for System Analysis, Russian Academy of Sciences, Moscow, Russia
E-mail: ¹leonasu@st.vgtu.lt*

Abstract: In this paper, aims to analyze the construction contracts and to determine their effectiveness by verbal methods. Contractors of international construction projects are often faced with complicated situations working in the conditions of uncertainty in construction. One of the potential risk factors is associated with the requirements of contract conditions. A simple quantitative method for evaluating the requirements defined in specifications of the contract is presented. One of the major aspects is project or contract management. Project developers need various models of managing large and complex projects. The suggested method for evaluating contract effectiveness may be widely applied at one of the stages of project management. A case study of practical use of verbal methods is presented.

Keywords: verbal decision analysis, multi-criteria choice problem, criteria preference-independence, transitivity, consistency control.

1. Introduction

The problems associated with construction contracts are widely discussed in the scientific literature. In one of the papers (Richardson, 1993) contracts describing the relationships with the providers of logistic services are analysed as insurance and dispute prevention means.

The paper (Ginevičius *et al.*, 2001) analyses the standards and conditions of contracts which are of special importance in making contracts in the construction industry in European countries. It focuses on the need for project managers to review their strategies against possible commercial developments over the expected project lifetime. The new-style institution of civil engineering contract may provide flexibility, clarity, simplicity and an emphasis on good project management.

Contractors of international construction projects are often faced with the situation of uncertainty working in the field of construction (Bubshait *et al.*, 1994). The specifications of contracts and their requirements make a potential source of risk. The paper presents a simple quantitative method for evaluating technical specifications of a construction contract. This method is based on 11 attributes, including clarity, conciseness, completeness, internal and external consistency, practicality, fairness, effect on quality, cost, schedule, and safety. This procedure can also be used to assess the risk level associated with contract conditions.

Contractual relationships are mainly based on confrontational situations (Zaghoul *et al.*, 2003) that reflect the level of trust (or mistrust) in the contract documents. This determines the relationships among contractors. This paper presents some of the results of a survey conducted across the Canadian and North American construction industry. It should be obvious that trust and constructing methods are related and this relationship is of vital importance to effective project management and contract administration. Trust relationship between the contracting parties provides some opportunities for developing a better risk allocation mechanism and contracting strategies, as well as for significant saving in the annual bill for construction.

The paper (Chen *et al.*, 2003) discusses methods of determining contract price and risks. However, an algorithm for cost estimation is not provided there. An emphasis is placed on the standard requirements to cost estimation in getting the insurance policy from an insurance company.

Project management embraces the development of contract to be signed by employer and one or more contractors. Economic success of both parties largely depends on the contract developed, which also determines the behaviour of managers seeking to increase profit and protect themselves from losses (Branconi *et al.*, 2004). Taking into account the significance of contract, top managers of both parties

should be involved in contract development and negotiation. However, in the literature on the problem, contract is considered to be a technical aspect of project development, which should be a responsibility of project managers and lawyers. In the paper considered, eight key criteria of contract evaluation to be analysed by top managers in developing contracts for large projects are described. Thus, top managers developing contract conditions should pay special attention to these eight criteria.

The need for various management models is increasing among project managers. Some authors believe that in developing project management methods the investigation of both project success and critical success factors should be made.

2. The analysis of construction contracts.

Based on the analysis of the available engineering contracts and practical experience, key criteria for economic evaluation of a business deal may be identified. These are the parameters to be clearly defined in the contract. They should reflect the main conditions of the contract (e.g. technical specifications and warranties, cost, schedule of payment, etc.) and define general obligations and responsibilities of the parties involved (securities, damage claims and liability limits, etc.).

A brief description of each set of evaluation criteria is presented in Table 1. The key issues to be included in the contract are defined in this table. Then, every set of criteria will be described in detail. Risk assessment should include eight evaluation criteria for major projects exposed to higher risks. Highly risky projects should be considered more carefully. Risky projects may be classified (through risk identification and evaluation), depending on the relevant criteria.

Contract definitions are: specifications, project price (quality of cost estimates); work schedule; terms and conditions of payment; performance guarantees (for defects); warranties; liability limits; securities.

The evaluation criteria are associated with Williamson's transaction costs theory extended by Jarillo (1988). The present investigation is based on Jarillo's concepts of 'classic market' and 'strategic network' of partners. The latter, however, requires the continuous collaboration and relationships. Usually, projects do not meet these conditions because the collaboration is over when the project is completed and is not likely to be continued in the future.

Table 1. Major contract provisions and their effect on contract management.

Criteria	The effect of contract form on management	
	Positive	Negative
Specifications	Concentrated on key criteria	Too detailed
Price	Reasonable	Not beneficial for contractor
Terms of payment	Favourable for contractor	Unfavourable for contractor
Schedule	Rational delay time	High coverage of losses
Performance guarantees	Concentrated on key criteria	Too detailed
Warranties	Rather limited	All including
Liability	Not high with respect to contract price	High with respect to contract price
Securities	Not broad with respect to contract price	Broad with respect to contract price

Jarillo (1988) and Heimer (1985) further developed Williamson's theory of transaction costs by considering varying requirements (i.e. of the clients or regulations), instability of expenses (i.e. cost factors or technical defects) and the control problems of contract execution. To solve these problems, the authors suggest that some 'hierarchical' elements, relating to a key management structure, dispute settlements and standard management procedures, incentives, etc. be included in contracts.

It can be shown that well-known procedures and methods improve the standards, dispute settlements and management of contracts. However, the evaluation criteria may differ, depending on a particular project.

The experience of the authors of the present research shows that a set of properly selected project evaluation criteria can help avoid strong negative effects of the most critical factors in 80 % of cases. If some actions or procedures do not satisfy the above-mentioned criteria, it may greatly affect project execution which, in this case, can hardly be successful. However, if some other requirements are not satis-

fied, the project is not likely to fail. Therefore, it may be recommended to managers to pay special attention to the described issues.

2.1. Description of the economic impact on the contract deal

General conditions include adequate and complete description of work when technical and commercial aspects are balanced. The client defines the work to be done under project which actually determines its long-term profit.

Price (cost estimates) embraces such issues as price stability and the assessment of expenses. In fact, price should be in agreement with the standards required by technical specifications, including the stability of expenses. The client should avoid offering the lowest bid in all cases.

Terms of payment define a schedule of partial pay determining how ready cash obtained by the contractor covers the expenses in the course of project execution.

Schedule fixes the dates of feasible work completion (especially in the middle and the end of the process), which should not be altered. The influence of the expenses caused by delays on the levels of liquidated damages is also described.

Guarantees of project execution refer to satisfying the requirements to plant performance according to specified technological parameters. The conditions of satisfying these technological requirements and those for the levels of liquidated damages in the case of deviation from the specified parameters are defined.

Warranties (warranty period) define payments for defect remedying or replacement of faulty equipment. Compensation for unsatisfactory services may also be provided.

Liability limit defines the highest limit of contractor's liability. Liquidated damages levels and warranties protect the employer, while contract liability limit protects the contractor.

Insurance (deposits, securities, bonds, etc.) determines how the contractor guarantees project execution to the employer and how the employer ensures payment for the contractor's work.

Six key levers (evaluation criteria) make a basis for performing these procedures. The contract defines the behaviour of the contracting parties because, first, the project does not provide for continuous relationships which could discipline people. Second, the turnover of employees is a common practice. Therefore, the contract defines the scope of work as well as standards of behaviour and trust in others as well as project execution. The validity, realism, completeness and coherence of a business venture are the main features evoking confidence and contributing to success of the project.

2.2. Evaluation criteria and contract form selection

Let us consider how three main types of contract including fixed price, cost reimbursable and mixed contracts may be evaluated by the suggested criteria. According to *LSTK (Lump sum turn key)*, all objectives may be incorporated in a single contract with the highest risk and liabilities allocation and minimized number of interfaces.

All *EPCM (Engineering Procurement and Construction Management)* contracts are complicated, with the risk of subcontractor not defined. Due to irregular supply, some technological lines cannot be installed. Only highly experienced contractors can avoid these problems. Since the risks of subcontractor are not defined in *EPCM* contract, the value of some *LSTK* contracts is decreased by about 20 – 30 %. *EPCM* contract becomes very complicated when signed directly by. Besides, multiple interfaces may cause misunderstandings. Due to irregular supply, some technological lines cannot be installed.

LSTK contracts are not so complex because of a smaller number of interfaces. This allows for parallel consideration, negotiations and decision-making. The limits of the project under *LSTK* contract are clearly defined. When the project is very substantial, multilateral contracts are unavoidable.

Some additional hierarchical contract issues include:

- a) contract efficiency factors. These are regulatory and financial conditions ensuring project finance when the work is commenced by the contractor;
- b) taking over a building on completion of construction. The conditions of taking over the responsibility for the completed project by the employer and dismissal of the contractor;
- c) insurance. This concerns the external risks and liability of the 3rd party;
- d) the right of the 3rd party for intellectual property. It is a definition of risks associated with 3rd party patents and their violation;

- e) events of force majors. Liabilities in the case of events beyond a party's control, i.e. war, disasters, natural calamities, etc. are described;
- f) duration of work. Cost reimbursement after the completion of project suitable for the client;
- g) taxes. Allocation of tax and legislative risks;
- h) applicable law. Knowledge of legislative aspects of contract coming into force;
- i) dispute resolution/arbitration. Dispute settlement by various mechanisms including more drastic measures (after a certain period of time).

3. Practice of DSS UniComBOS for determining the effectiveness of construction contracts

Strategic economic and political decision-making and research planning are referred to non-structured problems. Since the essential characteristics of such problems are qualitative, they can hardly be used in the analysis. On the other hand, the quantitative models are not sufficiently reliable.

Non-structured problems have the following common characteristics. They are unique decision-making problems, i.e. every time a DM (*decision-maker*) is faced with an unknown problem or the one having new features compared with the previously considered case. These problems are associated with the uncertainty of the alternatives to be evaluated, caused by the lack of information for making a decision. The evaluation of the alternatives is of qualitative nature, being usually expressed verbally (in statements). Very often, experts cannot measure qualitative variables against an absolute scale where the level of quality does not depend on the alternatives. When the uncertainty is high, experts can only compare the alternatives qualitatively, based on particular criteria. Experts first use the extended verbal evaluation, making then the comparisons in terms of 'better-worse'; 'nearly equal'.

The following aspects of behaviour are evaluated by verbal methods of decision-making (Korhonen *et al.*, 1997; Larichev, 1992; 2000):

- Qualitative measurements allow for an adequate description of an unstructured problem.
- Formulation of final decision making rules according to data processing principles of humans and allow for explaining the methods psychologically.
- The procedures used to screen the conflicting data ensure the reliability of the information obtained, allowing a DM to formulate the final rules.

The suggested method is needed to arrange a number of alternatives according to the DM preferences. First, the preferences are stated based on qualitative parameters and then a logical scheme for comparing the alternatives is developed. The criteria are considered against the scales with the estimates expressed verbally by statements. A survey may be conducted to elicit the DM preferences and to eliminate the dependence of the criteria. Some special procedures are suggested to identify and eliminate the criteria dependence, which makes the use of the obtained information more effective.

To evaluate the effectiveness of construction contracts, a classification consisting of evaluation criteria and final decisions should be developed. For this purpose, the data from Table 1 (i.e. major goals of a business deal and their influence on the forms of contract) are applied to the model of the first *FIDIC* construction investment project. A verbal DSS (*decision support system*) UniComBOS (Ashikhmin *et al.*, 2003) is taken from the Internet <http://iva.isa.ru>.

In determining the effectiveness of construction contracts, the following factors are taken into consideration: technical specifications, costs, terms of payment, performance guarantees, insurance costs and liability limit.

Every criterion is assigned an estimate, e.g. large, average and small. Entering the estimates, a matrix (3x7) is constructed and the evaluation Table 2 is obtained. When all the criteria are entered, the contracts of three various forms will be evaluated.

The comparisons are made in the following way: the system displays two alternative sets of estimates upon some criteria and a DM gives his/her preferences between these sets. The system allows four variants to be considered:

A comparison of construction contracts of three forms by the DSS UniComBOS yielded the results (Fig. 1) according to which the second form of contract (incentive contract) was found to be better than the first form (fixed price contract), while the alternative № 3 (cost reimbursable contract) was rated third.

Table 2. Available contract alternatives

Alternatives (A)	Criteria (C)						
	Technical specifications	Price of estimates	Terms of payment	Schedule	Performance guarantees	Warranties	Limit of liability
	1	2	3	4	5	6	7
Fixed-price contract	Highest consistency	Suitable for contractor	Fixed in advance	Rational delay time	Very important	High	High
Incentive contract	Well defined	Suitable for contractor	Not fixed	Rational delay time	Important	Intermediate	Intermediate
EPCM	Not defined clearly	Not suitable for contractor	Not fixed	Inadmissible delay time	Important	Low	Low

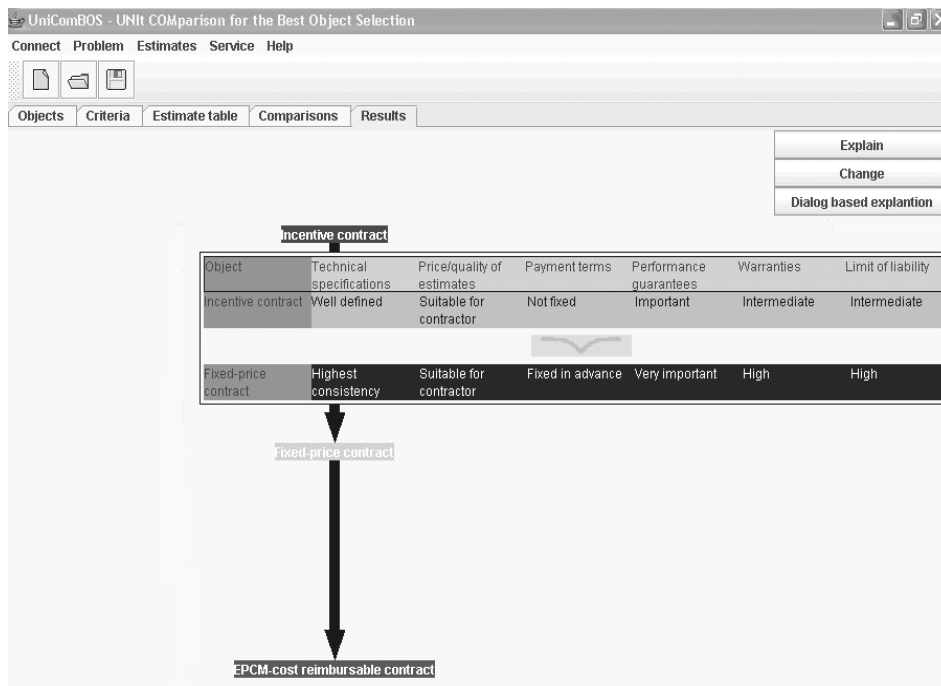


Fig. 1. Results of comparative assessment of alternatives

4. Conclusions

Ample literature on project management has been reviewed. However, scarce data on the key issues to be incorporated in the contracts of major engineering projects have been found. Six key criteria for contract evaluation have been developed based on the analysis of engineering projects performed by the largest international enterprises. They include technical specifications, price (precise cost estimates), terms of payment, performance guarantees, insurance costs and liability limits. The logic clarity and fairness of these factors help to determine project performance, providing the basis for a well-managed project.

The analysis has shown that LSTK concept gives the priority to responsibility and the reduced number of interfaces. Therefore, according to the suggested evaluation criteria, this type of contract is most suitable in the construction industry.

DSS UniComBOS is designed to discrete multi-criteria choice problems on the base of a DM’s preferences. The correctness of procedure implemented in it for preference elicitation has been proved with psychological studies. The Rule of combining relations has good resolution, thus it is possible to choose the only best alternative in the most cases. Qualitative information on preferences of each participant allows obtaining elements of their opinion uniformity.

References

- Ashikhmin, I. V.; Furems, E. M.; Larichev, O. I.; Roizenon, G. V. 2003. Decision Support System UniComBOS to Discreet Multi-Criteria Choice Problems. *DSS in the Uncertainty of the Internet Age*, The Karol Adamiecki University of Economics, Poland, Katowice, 111–121.
- Branconi, von Ch.; Loch, Ch. H. 2004. Contracting for major projects: eight business levers for top management, *International Journal of Project Management* 22: 119–130.
- Bubshait, A.; Almohawis, S. 1994. Evaluating the general conditions of a construction contract, *International Journal of Project Management* 12(3): 133–136.
- Chen, W. T.; Shr, J. F. 2003. A method to determine minimum contract bids for incentive highway projects, *International Journal of Project Management* 21: 601–615.
- Ginevičius, R.; Podviezko, V. 2001. Complex evaluation of economical-social development of Lithuanian regions, *Statyba* [Journal of Civil Engineering and Management] 7(4): 304–309.
- Furems, E. M.; Gnedenko, L. S. 1992. Interactive procedure for non-transitivity revealing and correcting under pairwise comparisons, *Information Systems and Operations Research* 4(1): 118–126.
- Heimer, C. A.; Stinchcombe, A. L. 1985. *Organization theory and project management*. Oslo: Norwegian University.
- Jarillo, J. C. 1988. On strategic networks, *Strategic Management Journal* 9: 31–41.
- Korhonen, P.; Larichev O. I.; Moshkovich, H.; Mechitov, A.; Wallenius, J. 1997. Choice behavior in a computer-aided multiattribute decision task, *Journal of Multi-criteria Decision Analysis* 6: 233–246.
- Larichev, O. I. 1992. Cognitive validity in design of decision-aiding techniques, *Journal of Multi-criteria Decision Analysis* 1(3): 127–138.
- Larichev, O. I. 2000. *Theory and Methods in Decision Making, as well as Chronography of Events in Magic Countries*. Moscow, 182–183 (in Russian).
- Luce, R. D.; Raiffa, H. 1989. *Games and Decisions: Introduction and critical survey*. Dover Pub. (reproduction from first edition of 1957).
- Richardson, H. L. 1993. Contracts build relationships, *Transportation & Distribution* 34(11): 53–58.
- Zaghloul, R.; Hartman, F. 2003. Construction contracts: the cost of mistrust, *International Journal of Project Management* 21: 419–424.