Systemic integrated approach to evaluating the resource potential of a construction company as a bidder

A.A. Lapidus¹, I.L. Abramov¹

¹Federal State Budget Educational Institution of Higher Education, Moscow State University of Civil Engineering (National Research University), Russia

ivan2193@yandex.ru

Abstract: In the last few decades, the Russian construction market has seen competition grow fierce among contractors. All of the market players strive to surpass their competitors, while the clients face a serious task of organizing the bidding procedures in keeping with internal regulations and in line with the federal law on procurement. This paper suggests a mathematical model which uses the systemic integrated approach to evaluate the resource potential of a construction company participating in the procurement process. To this effect, research of international procurement experience has been conducted and its findings have enabled the authors to outline and assess the key factors shaping the behavior of the suggested model. As a result of the research, recommendations have been developed for an efficient systemic integrated evaluation of the resource potential of a construction company in order to improve the quality of procurement processes in the construction sector.

1. Foreword

As a result of social and economic transformations in Russia after 1993, the domestic real estate market entered a rapid growth phase as confirmed by the Rating Agency of Building Complex (RABC): as of June, 2016, there were about 153,000 construction organizations in the country recorded in self-regulated organization registers. Shortage of orders experienced by numerous construction firms and caused by an economic recession in the previous years plunged the primary housing market into a deepest crisis: according to RABC, in the first half of 2016 only, more than 1,500 Russian construction companies went bankrupt, or twice as many as in the same period of the previous year. In this connection, Russia’s market has been witnessing a growing competition in the recent decades. Each company is striving for success and superiority over its competitors, while customers are facing the challenge of organizing the bidding procedures pursuant to their regulations, in strict compliance with the requirements of federal laws.

The following types of works and services are procured through bidding:

- Construction, reconstruction and capital repair of industrial facilities, buildings and structures of various purposes;
- Design, engineering survey, structural design and other works;
- Supply of materials and equipment packages;
- Managerial, supervisory and consulting services.

Against the background of healthy competition, there are growing requirements to bidders wishing to take part in construction projects, new laws are developed and modified, and bidding regulations are systematized and optimized [1].
The term “tender” has been borrowed by Russia’s market from the world practice characterized by long-standing and clear-cut bidding regulations and procedures [2, 3]. For instance, in the European Union countries, procurement by tender is regulated by Directive 2014/24/EC of the European Parliament and of the Council of 26 February 2014 on public procurement that repeals Directive 2004/18/EC. Article 58 of the said Directive sets forth the basic criteria for selection of economic operators: a) suitability to pursue the professional activity, b) economic and financial standing, and c) technical and professional ability. According to Article 69 of the said Directive, Contracting authorities shall require economic operators to explain the price or costs proposed in the tender where tenders appear to be abnormally low in relation to the works, supplies or services [2,3]. Important prerequisites for an efficient and dynamic production development in the construction industry include priority setting, as well as the elaboration of a new strategy for accomplishment of the assigned tasks, setting shared objectives, and, accordingly, development of integrated solutions [4,5].

Special normative legal documents have been developed for the introduction of a tender system in the Russian Federation [6,7]. Moreover, it became possible now to hold tenders using electronic platforms [8] that simplify many procedures; however, for Russia this is a relatively new practice bound to be modified in the future.

2. The purpose of this article
The purpose of this article is to develop a systemic integrated mathematical model [9] for evaluating the resource potential of a construction company and make recommendations and proposals on improving the quality of tenders with a view of selecting the best bidder. With this purpose in mind, the following tasks have been solved:

- Review of international tender experience in so far as it relates to the selection criteria for contracting suppliers;
- Review of the key factors affecting the determination of a quality resource potential of a construction firm;
- Development of a mathematical model for a systemic integrated approach to the determination of a resource potential of a construction firm participating in the tender.

3. Research findings
Development of theoretical recommendations on improving the quality of tenders for the purpose of selecting the best bidder.

One of the most important and urgent challenges of construction tenders is analyzing the conjunction of all factors allowing for an objective assessment of a bidder’s resources. This challenge can be tackled differently depending on the customer’s priorities and requirements to the bidder that may include experience, the quality of previous projects, the lowest price or the shortest completion period.

Let us consider the price factor and three blocks of factors characterizing any construction firm: “availability of equipment, machinery and duly qualified and specialized personnel”, “the firm’s experience with similar projects”, and “the firm’s financial standing and investment concentration level”.

The price is a prime factor of contractor selection. However, appropriateness of a choice based on the price consideration only is open to debate. The National Builders Association has regularly cited examples of electronic tenders, where due to unrestrained dumping efforts the initial maximum price of a contract was reduced manifold resulting in subsequent inconformity with the construction
project’s real costs. Thus the world practice provides for contractor selection to be based first of all on the assessment and consideration of the contractor’s resource potential, experience and goodwill, and only after that of its bid.

In this connection, the list of main factors that characterize the resource potential of a construction firm as a potential contractor can be reduced to three items and graphically presented as follows:

![Block diagram of factors affecting the assessment indicator of a construction firm](image)

**Figure 1.** Block diagram of factors affecting the assessment indicator of a construction firm

### 4. Method

The resource potential [9, 10] of a construction firm participating in a tender can be mathematically assessed using a multifactor system modelling technique [11-13].

This technique involves an assessment of significance of each FAR (factor affecting the result).

#### 4.1. Availability of equipment, machinery and duly qualified and specialized personnel

- Availability of skilled personnel in this organization (FAR=+1);
- Absence of skilled personnel in this organization (FAR=-1);
- Availability of facilities: offices (+1), warehouses (+1), vehicle fleet (+1), concrete plants (+1) \(\sum \text{FAR}=+4\);

---

1 The register of factors is formed pursuant to particular features of the future project. See. Figure 1.
• Absence of facilities: offices (-1), warehouses (-1), vehicle fleet (-1), concrete plants (-1) ($\sum$ FAR=-4);
• Availability of specialized construction machinery and equipment: tower and crawler cranes (+1), concrete pumps (+1), mobile cement stations (+1) ($\sum$ FAR=+3);
• Absence of specialized construction machinery and equipment: tower and crawler cranes (-1), concrete pumps (-1), mobile cement stations (-1) ($\sum$ FAR=-3);
• Availability of road machinery and equipment: excavators (+1), bulldozers (+1), graders (+1), rollers (+1) ($\sum$ FAR=+4);
• Absence of road machinery and equipment: excavators (-1), bulldozers (-1), graders (-1), rollers (-1) ($\sum$ FAR=-4);
• Availability of means of transportation: dump trucks (+1), low bed trucks (+1), concrete mixer trucks (+1) ($\sum$ FAR=+3);
• Absence of means of transportation: dump trucks (-1), low bed trucks (-1), concrete mixer trucks (-1) ($\sum$ FAR=-3);
• Availability of formworks and scaffolds (FAR=+1);
• Absence of formworks and scaffolds (FAR=-1).

4.2. Experience with similar projects
• Confirmed record of over three years of the company’s operations in the construction market (+1), record of participation in tenders in the last three years года (+1), tenders awarded in the last three years (+2) – the best score ($\sum$ FAR=+4);
• Absence of confirmed record of over three years of the company’s operations in the construction market (-1), record of participation in tenders in the last three years года (-1), tenders awarded in the last three years (-2) – the worst score ($\sum$ FAR=-4);
• Completed similar projects (+7) with customer feedback (+2) – score ($\sum$ FAR=+9);
• Absence of completed similar projects (-7) with customer feedback (-2) – score ($\sum$ FAR=-9);
• Availability of a quality control system – score (FAR=+1);
• Absence of a quality control system – score (FAR=-1).

4.3. Financial standing
The customer should request details of the bidders’ financial standing and long-term profitability in order to assess their financial sustainability. It is recommended to inquire whether the bidders have any arrears, including those of wages payable to their employees.

Index k as an indicator of the firm’s financial standing is taken to be equal to 0, if information is not provided or incorrect. Index k is taken to be equal to 1, if all required documents in confirmation of the firm’s financial sustainability are provided.

As a result, the information submitted for participation in the tender and characterizing the significance of each FAR should be reflected in an overall mathematical model.

CRP (Company’s resource potential), an indicator of a construction firm’s resource potential, is calculated according to the following formula:

$$\text{CRP} = k \sum_{i=1}^{n} V_i = k(V_1 + V_2 + \ldots + V_n),$$

where $V_i$ is the aggregate of FARs and k is the financial standing index.
Assessment of bidders:

\[-30 \leq CRP \leq 0 \text{ – this company is excluded from participation in the project;} \]
\[0 < CRP \leq 10 \text{ – a weak bidder for the project;} \]
\[10 < CRP \leq 20 \text{ – a moderate bidder for the project;} \]
\[20 < CRP \leq 30 \text{ – the main bidder given priority in the project.} \]

5. Conclusions

This research has resulted in theoretical recommendations for an efficient assessment of a construction firm’s potential.

For an appropriate selection of a contractor, it is recommended to:

- Apply a systemic integrated approach to evaluating the resource potential of a construction firm taking into account the significance of each factor that affects the result and using the mathematical model described in the article;
- Ensure, to the extent possible, equal conditions for participants in the tender and similar scopes of proposed projects in order to achieve an objective comparison.

References

[1] Organization and control in the governmental procurement system: domestic and international experience: Monograph / V.V. Pankov, L.A. Chaikovskaya, V.L. Kozhukhov, et al.; edited by Pankov, L.A. Chaikovskaya, V.L. Kozhukhov. – M.: AUDITOR, 247 pages, 2015 (Russian).

[2] Directive 2014/24/EC of the European Parliament and of the Council of 26 February 2014 on public procurement repealing Directive 2004/18/EC.

[3] W. Hughes, P. Hillebrandt, D. Greenwood and W. Kwawu. Developing a System for Assessing the Costs Associated with Different Procurement Routes in the Construction Industry. Paper to 10th International Symposium, Construction Innovation & Global Competitiveness, CIB W65 and W55 with TG23, TG31, TG46. September 9-13, 2002.

[4] I. Abramov, Formation of integrated structural units using the systematic and integrated method when implementing high-rise construction projects HRC 2017 (HIGH-RISE CONSTRUCTION-2017) E3S Web of Conferences 33. 03075 https://doi.org/10.1051/e3sconf/20183303075

[5] A. Lapidus, I. Abramov, Formation of production structural units within a construction company using the systemic integrated method when implementing high-rise development projects. HRC 2017 (HIGH-RISE CONSTRUCTION-2017) E3S Web of Conferences 33. 03066 https://doi.org/10.1051/e3sconf/20183303066

[6] Federal Law No. 44-FZ dated 05.04.2013 (as amended on 28.12.2016) On the Contracting System in the Field of Procurement of Goods, Works and Services for State and Municipal Needs. (Russian).

[7] Federal Law No.223-FZ dated 18.07.2011 (as amended on 28.12.2016) On Procurement of Goods, Works and Services by Certain Types of Legal Entities. (Russian).

[8] G.G. Malykha, A.Yu. Reshetova, V.N. Cherrykh. Development of criteria for holding construction design project tenders // Bulletin of the Moscow State University of Civil Engineering. 2014, No.9, pages 116-122. (Russian).

[9] A.A. Lapidus and I.I. Abramov. A systemic integrated method of implementation of construction projects. Science and Business: Ways of Development. 2017, No. 10, pages 39-42. (Russian).

[10] A.A. Lapidus and A.Yu. Berezhniy. A mathematical model of evaluating a composite
environmental load index of a construction project // Bulletin of the Moscow State University of Civil Engineering. 2012, No. 3, pages 149-153. (Russian).

[11] A.A. Lapidus. An efficiency potential of organizational and technological solutions of a construction project. Bulletin of the Moscow State University of Civil Engineering. 2014, No. 1, pages 175-180. (Russian).

[12] A.A. Lapidus and I.L. Abramov. Work scheduling in designing low-rise construction projects. Science Review, 2017, No. 4. (Russian).

[13] I.L. Abramov. Systemic Integrated and Dynamic Approach as a Basis for Ensuring Sustainable Operation of a Construction Company. IOP Conference Series: Materials Science and Engineering 2018. Vol. 463, Part 2. 463 032038 https://doi.org/10.1088/1757-899X/463/3/032038