Assessment of the impact of destabilizing factors on implementation of investment and construction projects

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Abstract. Among the distinctive features of construction projects, it should be noted the complexity and specificity of the final product in the form of buildings and structures for various purposes. Investment construction projects are affected by a large number of destabilizing factors at all stages of implementation. These factors negatively affect the final indicators of the construction investment project: failure to meet deadlines, the likelihood of construction in progress, increased cost, low quality. In this regard, conducting research on the study of destabilizing factors affecting the production activities of construction company during the implementation of investment projects is relevant in difficult times for the construction industry. Construction industry, as a complex, dynamically changing system, susceptibility to various destabilizing factors, requires a constant readiness to achieve the set goals and the final result at each stage of their life cycle. This article discusses the destabilizing factors that arise during the implementation phase of an investment construction project. In order to identify and classify the negative factors that may be encountered participants construction activity, it was prepared a questionnaire for the experts who have the necessary experience in the construction industry. Based on the polls conducted, destabilizing factors were identified and ranked. Statistical methods were used to evaluate the factors studied and determine their significance and impact on the project activities. The results of the study showed that financial, technical and labor factors have a significant impact on the construction process, therefore, special attention should be paid to the development of organizational and technological measures to prevent them. This will eliminate or minimize the influence of these factors on the production activities of construction company.

1. Introduction

The efficiency of a construction company at all stages of production depends on the impact of internal and external destabilizing factors. The quality of construction and assembly works, the duration of construction operations, the company’s profit, the investment payback period - all these key indicators are prone to change in the course of implementation of an investment construction project affected by the above factors. To stabilize its performance, the company seeks to reduce the negative impact of external and internal factors using additional resources thus increasing its costs and ensuring its stable competitive operations.

The existing regulatory mechanisms aimed at improving the efficiency of operations of construction companies, i.e. raising the quality level of implementation of investment and construction projects, as we can see recently, are not effective [1].

Stable functioning, sound management and correct forecasting of the future production operations of a construction company can ensure the timely identification of destabilizing factors thus preventing the
risk of unfinished construction and degradation of the technical and economic indicators of investment and construction activities. It must be borne in mind that the negative factors that affect the company from outside are difficult to identify, predict, and control. For this reason, the problem of the negative impact of external factors, including geopolitical factors, has been discussed at the international level for several decades. Experts agree that measures should be taken to prevent and eliminate the effects of negative factors in the interests of entrepreneurs. In addition, the liability for damage caused by effects of external destabilizing factors should not completely lie on general contractors and (or) subcontractors [2].

A construction company can exert a great influence on its operations and adjust the production capacities and efficiency of its work in advance, inter alia, by managing external destabilizing factors and minimizing risks of uncertainty at the stage of construction operations [3]. At the same time, experience shows that management of destabilizing factors associated with adverse external environment effects or incorrect behavior of third-party contractors related in one way or another to the activities of the construction company (suppliers, machinery operators, investors, banks, public services, etc.) is in most cases ineffective. As for internal destabilizing factors that affect deviations in the performance indicators of the company, they directly depend on the ability of the executive staff of these companies to manage and, in some cases, prevent these factors.

Forecasting of the probability of destabilizing factors requires consideration of the following circumstances [4]:

- Contractors are often indifferent to negative factors and their consequences with a resulting lack of necessary experience in dealing with them. For this reason it is vital for all parties concerned to be aware of the importance of the problem under review;
- Lack of measures to prevent and eliminate the possible consequences of destabilizing factors causes damage not only to the construction company, but also to the national economy as a whole;
- In order to create a management structure for destabilizing factors that may affect the implementation of a particular project, general contractors and subcontractors should classify and rank the most significant factors.

1.1. Types of destabilizing factors

Despite the diversity of destabilizing factors, construction companies focused on solving tactical problems classify, rank and study such factors using various research methods and methodological tools for statistical processing of information [5-20].

Destabilizing factors affecting construction companies can be classified by the degree and nature of their impact:

- Design factors (effect on the achievement of project objectives);
- Business factors (effect on operations);
- Environmental factors (external in terms of relation to the project; may have an impact on the project objectives);
- Internal factors of each participant in the construction chain.

There are several types of destabilizing factors that have been well studied and analyzed [6,7]:

1. Organizational factors arising from organizational plans for implementation of the project;
2. Labor and technical factors related to human resources and machinery;
3. Political destabilizing factors and security factors. Factors arising from political changes and the security situation;
4. Economic destabilizing factors - factors related to financial allocations and obstacles that may arise in this area;
5. Legal destabilizing factors - factors that arise as a result of violation of contractual obligations and laws.

Research sources [8-19] also mention a number of other important factors.

Further research should be focused on the development of an appropriate methodology that improves the stability of a construction company amidst destabilizing factors, with due regard for system
engineering principles. The authors of this article propose to divide the destabilizing factors into categories. This will allow developing an algorithm for maintaining the efficiency of construction operations in response to destabilizing factors. Using the categories of destabilizing factors (table 1), statistical analysis techniques and the expert evaluation method, it is possible to rank the factors that affect the efficiency of construction operations and, therefore, investment construction projects in general, and to determine the degree of their impact.

Table 1. Categories of destabilizing factors (compiled by the authors)

| Destabilizing factor category | Causes of destabilization |
|------------------------------|---------------------------|
| Organizational              | Acquisition of inappropriate land for the required type of construction |
|                              | Lack of necessary equipment and machinery for construction and assembly works |
|                              | Lack of material resources (territorial) |
|                              | Material supply failures |
|                              | Low-skilled labor resources |
|                              | Non-compliance with safety regulations |
|                              | Bankruptcy of subcontractors |
|                              | Poor planning of production and financial activities |
| Political, contractual support | Changes in legal regulations |
|                              | Delays in obtaining expert assessment for the project, denial of construction permits |
|                              | Unstable political situation |
|                              | Major changes in contract terms |
|                              | Inadequate engineering supervision |
|                              | Bureaucratic costs |
|                              | Non-compliance with RF government regulations |
|                              | Terrorism and crime |
| Economic                     | Delayed payment of wages |
|                              | Technical failures when transferring funds |
|                              | Lack of own financial resources |
|                              | Insolvency of consumers |
| Design                       | Errors in design documentation |
|                              | Major changes in design documentation |
|                              | Untimely modification of design documentation |
| Environment                  | Environmental pollution, damage to the environment |
|                              | Non-compliance with environmental laws and regulations |
|                              | Climatic conditions |

2. Method
The expert assessment method is known as an independent research tool with a wide scope of application:
- Identification and prioritization of management goals and objectives;
- Identification and prioritization of alternative solutions to problems;
- Alternative distribution and prioritization of resources for solving problems.

There is a variety of expert assessment methods currently used in tackling these typical problems: questionnaires, interviews, discussions, meetings, business games, case analyses, etc. Questionnaires are the most efficient and widely-used way to obtain information.

In this connection, the study performed by the authors is based on questioning designed to identify the most important destabilizing factors in the construction industry. The questioning was conducted by
correspondence to obtain answers of the greatest possible number of participants. Questionnaires were sent to state and private construction companies.

The collected information was systematized and processed in Excel to calculate the arithmetic average of each destabilizing factor, where the average represents the degree of importance (or degree of impact) of the factor affecting the construction project as a whole.

The questionnaire is in the form of a table, which lists destabilizing factors. Survey participants were asked to evaluate the importance and impact of each factor on an investment construction project on a scale from 0 to 100.

2.1. Determining the number of experts
The minimum number of experts to be involved in the study for ensuring a representative set of statistical data based on the confidence coefficient of the result ($\Delta = 0.95$) is determined by the formula (1) [20-22].

$$E = \frac{c^2 r_a r_o}{\Delta^2},$$

where:
- $E$ – the minimum required number of experts;
- $c$ – confidence coefficient (0.95);
- $r_a$ – the proportion of sample elements that have this attribute (0.95);
- $r_o$ – the proportion of sample elements that don’t have this attribute (0.05);
- $\Delta$ – representativity error (0.05).

$$E = \frac{(0.95)^2 \cdot (0.95) \cdot (0.05)}{(0.05)^2} = 17.2 \sim 18 \text{ Per.}$$

The information obtained during the survey is compared with other studies in this area. Subsequently, the collected questionnaires can be used by other researchers, who can make any additions as they think fit.

100 questionnaires (see table 2) were distributed among state-owned and private construction organizations. There were 73 responses received. This number exceeds the required number of samples and makes the results highly accurate.

Interviewees were divided into groups depending on experience and length of service. Figure 1 shows the number of responses given by each group of participants. As you can see, the vast majority of respondents had more than 15 years of work experience.

![Figure 1. Number of responses by years of experience](image-url)
Table 2 shows the weight of significance of destabilizing factors that were calculated on the basis of the results of the questioning. The significance range varies from 0% (no impact) to 100% (very high impact).

**Table 2. Weights of the significance of destabilizing factors**

| Destabilizing factors                                                                 | Symbol | Weight of factor % |
|-------------------------------------------------------------------------------------|--------|--------------------|
| Unstable dynamics of labor productivity of employees                                 | $s_1$  | 69                 |
| Non-compliance with safety measures                                                  | $s_2$  | 58                 |
| Incompetence of work performers (workers)                                            | $s_3$  | 75                 |
| Lack of qualified engineers and technicians, quality materials and up-to-date equipment | $s_4$  | 52                 |
| Use of up-to-date equipment and technology without required experience or proper training | $s_5$  | 56                 |
| Political and social pressure                                                        | $s_6$  | 44                 |
| Supply of substandard materials                                                      | $s_7$  | 71                 |
| Errors in the design documentation                                                  | $s_8$  | 63                 |
| Administrative barriers erected by the state                                        | $s_9$  | 41                 |
| Legal disputes between participants in the project at the construction stage         | $s_{10}$ | 34               |
| Sudden discontinuance of funding                                                    | $s_{11}$ | 79              |
| Inflation and price fluctuations                                                    | $s_{12}$ | 73               |
| Corruption                                                                          | $s_{13}$ | 62              |
| Discrepancy between specifications and implementation due to misunderstanding of diagrams and specifications | $s_{14}$ | 49              |
| Inadequate engineering supervision                                                  | $s_{15}$ | 33              |
| Adverse climatic conditions                                                         | $s_{16}$ | 40              |
| Changes in legal regulations                                                        | $s_{17}$ | 29              |
| Inaccuracies in work scheduling                                                     | $s_{18}$ | 37              |
| Delays in obtaining expert assessment for the project, denial of construction permits | $s_{19}$ | 35              |
| Terrorism and crime                                                                 | $s_{20}$ | 45              |
| Cooperation between the general contractor and subcontractors                        | $s_{21}$ | 39              |
| Equipment breakdown and emergency situations                                         | $s_{22}$ | 76              |

The destabilizing factors under review were ranked according to the degree of significance in Table 2; the results are presented in figure 2.
Figure 2. Ranking of destabilizing factors by degree of significance (compiled by the authors)

Figure 3 shows an example of determining the degree of significance of sudden discontinuance of funding as a destabilizing factor. This factor is indicated by $S_{11}$. The example shows that 40 out of the 73 respondents attribute 100% significance to this factor, while those who attach 75% significance are 15 out of the 73, etc.

Figure 3. Factor weight (compiled by the authors)

Conclusion
This study was focused on determining the significance of destabilizing factors and their impact on the main indicators of investment construction projects (duration, costs, and quality of construction). The analysis covered some projects implemented by state-owned and private companies with engineering and technical personnel, project managers, and design and production research consultants involved as experts.
The results showed that there are a large number of destabilizing factors (financial, technical, labor, legal, etc.) that have a significant impact on the activities of construction companies.

Depending on the area of their occurrence, destabilizing factors can be classified into internal factors dependent on the operations of the company and external factors determined by the environment.

The information obtained during the analysis will be used in further studies to develop a methodology that includes measures to prevent and eliminate the consequences of destabilizing factors that arise in the implementation of investment construction projects. Such measures will ensure the timely adoption of well-considered and developed organizational decisions and identification of specific responses to destabilizing situations.

Destabilizing factor management plans should include a number of important points providing for:

1. Training of participants in a construction project in responding to destabilizing factors, reducing their level of impact, and methods of maintaining a given stable state of the construction company at all stages of the project.
2. Elimination of bureaucratic barriers that make it difficult to obtain the appropriate licenses and permits for construction and assembly works.
3. Refusal to implement construction projects in politically unstable regions (to avoid financial losses).
4. Checking basic materials and assessing their compliance with specifications at each stage of the project, using high-tech and highly efficient equipment.

The development of a decision-making mechanism aimed at reducing the level of impact of destabilizing factors allows preventive measures and responses to deviations at the initial stage rather than post factum when it is difficult or impossible to exclude losses.

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