Analysis of approaches and principles to the formation of key risk indicators in construction

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Abstract. Coronavirus COVID-19, exchange rate dynamics and other macroeconomic factors make the risk of implementing projects in the construction sector quite high and require effective management. This article analyzes the concept of key risk indicators in the construction industry. Key risk indicators help identify threats. Thanks to this, measures to eliminate them are taken in advance. It was found that the choice of key indicators depends not only on risks, but also on the strategies and objectives of companies. Correspondence of key indicators to key strategies helps the leader to obtain the necessary information to more effectively achieve goals.

1. Introduction
The construction market is subject to significant fluctuations, which are caused by the tense economic and political situation, the dynamics of exchange rates and other macroeconomic factors. In this regard, the construction sector has a fairly high level of project implementation risk and requires effective management. Scientists have published many scientific works on such important issues as: identifying, measuring and managing the risks of construction projects [1,2,3]. However, most of the research in the area of risk management based on key risk indicators (KRI) has been conducted in the banking and the transport sectors, while insufficient attention has been paid to key risk indicators in the construction industry. [4,5]. It should be noted that the development of KRI and their introduction into the risk management system can help construction companies to control, identify potential risk events in advance and make timely changes to the process of activities. It is an important aspect of project management in the current economic situation in the construction industry, which has uncertainty and variability.

2. Statement of the problem
In Russia, according to the Federal State Statistics Service (Rosstat) [6], in the first half of 2020, 365.9 thousand apartments were commissioned in multi-family residential and houses with a total area of 28 million square meters. In fact, the reporting period had 352.8 thousand apartments in multi-family
residential and houses with an area of 26.7 million square meters, which were commissioned. Thus, compared to the first half of 2019, the volume of housing commissioning decreased by 11.4%. The slowdown of housing commissioning in Russia cannot be called unexpected. It is generally explained by the coronavirus crisis and general trends in the economy. The postponement of completion is the most obvious explanation for the slowdown in housing commissioning. At the same time, for the most part, developers tried not to suspend the construction of facilities. Considering that we are talking about apartments that have already been purchased but not received, it can be predicted that developers may face a demand slowdown in the second half of the year.

Thus, the dynamics of sales may noticeably decrease, since potential buyers have seriously lost their income and it will be difficult to buy a new home even with the help of a preferential mortgage rate or with the use of maternity capital. Accordingly, developers are in a situation where it is necessary to complete existing projects and look for options for their effective sale. In this regard, the announcement of fundamentally new large housing projects, most likely, will not be in the second half of the year. It is obvious that the construction market needs to develop project risks and possible ways to minimize the identified risks.

3. Experiment

Key risk indicators (KRI) play a key role in the field of risk management. Some scholars believe that KRIs are interconnected with the strategies, objectives and operations of the organization. [7]. Key risk indicators are statistical metrics that need to be measured periodically (monthly or quarterly) to alert the company to changes that pose a risk. KRI show how risky the activities of an enterprise, project work or other company activities are. [8].

Other researchers interpret KRI as parameters that allow you to reliably measure the risk of business activities and warn of the possibility of undesirable consequences [9]. Many organizations began to implement Enterprise Risk Management (ERM) in order to control them and build a stable environment for the implementation of the company's business growth strategy [10].

Obviously, it is necessary to distinguish between Key Performance Indicators (KPI) and Key Risk Indicators (KRI). The researchers emphasize that performance indicators focus on historical indicators that are important for successful company management, while risk indicators focus on current activities [11]. In other words, performance indicators measure the degree to which a goal has been achieved, while risk indicators track and predict the occurrence of events. They are also a tool for continuous monitoring of management efficiency.

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) [13] has also identified distinctive features between the two types of indicators. The performance indicators have been determined to be based on the company's past performance. These indicators are calculated based on monthly, quarterly or annual reports. In turn, risk indicators are metrics that are used by management as early signals about the exposure to risk of a particular area of activity in the company.

The effective use of key risk indicators can provide a number of benefits to an organization. One of them is the ability to determine a company's risk appetite. Risk appetite reflects the amount of risk that is acceptable for an enterprise or an individual business unit in terms of a trade-off between risk and profitability. [42]. Thus, the threshold values of the indicators set the acceptable level of risk, and the company's management can monitor and make sure that the activities remain within the established framework of the risk appetite. In addition, KRI help to avoid not only losses and reduce the impact of negative consequences, but also to improve the working environment and operational activities [14].

Key risk indicators are used as a means of controlling operational risks, such as: cost overruns, issues with release, information security and others [15]. However, a unified system of KRI, as well as their boundaries of permissible values, has not been developed. The definition of key risk indicators depends on the specifics of the company, process and project. It should be noted that there cannot be a universal system, because each company / project is specific.

Key risk indicators, as noted above, play an important role in the company's risk management. Despite the fact that there is no universal list of KRI, some scientists have made attempts to classify
them. One group of scientists divided them into four groups [16]:
1) Coinciding indicators allow you to identify factors that can indirectly affect the occurrence of a risk event.
2) Indicators of the effective management - there are constant monitoring and control of compliance with the established regulations using these indicators.
3) Causal indicators are associated with the causes of the occurrence of a risk event.
4) Volume indicators: these indicators are often also KPIs, however, they can also be referred to as KRI. This type of indicator allows you to track measurable volume indicators that are dynamic in nature (for example, the number of online applications), as well as influence the increase or decrease in the probability of risk occurrence.

Scandizzo built his classification on the relationship between key risk indicators and two main characteristics of operational risk, namely the likelihood and severity of risk. He identified three main types of KRI [17]:
1) Descriptive indicators reflect information about such business values as: size, volume and quantity, and, therefore, they are associated with the impact on operating losses. For example, the number of transactions and the size of assets. Changes in these indicators reflect the likelihood of a particular risk event.
2) Performance indicators relate to the results of business processes and show how well a particular job is being performed. These indicators include the number of corrected errors and losses associated with them, as well as lost time due to downtime and delays in work.
3) Control indicators are variables that are controlled by top management and the leader. Such indicators include the amount of compensation, the components of the investment portfolio and the number of years of the IT system.

Having considered the two above classifications, you can notice a certain similarity between them. Thus, volume indicators are similar in their characteristics and purpose to descriptive indicators, because both types are related to the measurement of quantitative indicators and their influence on the likelihood of risk. In addition, the meaning of indicators of good governance can be found in performance indicators because they measure productivity and performance in a set order.

It should be noted that there are three main groups of indicators, which are characterized by temporal affiliation. [18]:
- Leading (predictive) indicators determine the possibility of risk situations in the future, that is, they are used to predict and avoid threats.
- Current risk indicators identify jobs at risk at a given time.
- Lagging indicators are historical estimates and determine the degree of achievement of the set goal in the past.

The frequency of measurement of the indicator is very important. The more often the information is updated, the more relevant data can be obtained.

In addition, a group of indicators is distinguished that are not associated with losses, but are used to track changes in business processes. Such parameters help to assess the quality of transactions for different types of risk. They are lagging because they reflect information about what has already happened. However, these indicators can be transformed into predictive ones by identifying the number of unrealized operations in the system after a certain period of time. Moreover, the percentage of errors and the reliability of the system can be used as characteristics on the basis of which business processes are managed [19].

It should be noted that leading and lagging indicators are used together for effective risk management. Threshold values of a particular risk indicator are difficult to establish accurately, therefore, they are quantified at the very beginning and then adjusted in the process [20]. The process of selecting suitable indicators is laborious, because the selected indicators must accompany the risk over time and not disappear when its level increases or decreases.

Davies J. and Finlay M. [21] identified three main criteria that key risk indicators must meet: effectiveness, comparability and their practical application, and ease of use. The effectiveness of the
indicator lies in the fact that it can be applied to at least one specific risk and/or business transaction; it is objective; it is measured at a specific point in time. According to the criterion of comparability of KRI, they should be quantitatively measurable, either in percentage or proportionally; they must be accurate and reliable; they must be verifiable; they should be comparable across organizations. The researchers say that indicators need to be understandable and interpretable, as well as cost-effective to measure.

In addition, the authors emphasize that the organization should develop basic standards for working with CRI, which reflect the following features [22].:

- Detailed description of the data to be collected;
- How to measure and calculate KRI;
- KRI implementation program (sources, collection process and use).

Today, the development and application of key risk indicators are becoming an increasingly common practice among organizations, mainly international. The growth in popularity of KRI is due to the fact that many companies have found in practice that the introduction of a method of risk management based on KRI promotes business growth and development, thereby confirming the theoretical arguments of the researchers. However, the successful identification and application of the KRI require a structured approach, that is, it is necessary to carry out a number of sequential operations for their effective implementation. Thus, a number of scientists have proposed several different approaches for KRI’s introducing into a company.

For example, a group of scientists have identified six basic steps [23].:

1) Identify existing risks: the business needs to identify risks and understand the reasons for their occurrence, that is, their origin. Business experts identify mainly 5 to 10 key indicators, i.e. 1 or 2 of each type.
2) The effectiveness and reliability of the identified key risk indicators should be measured. This can be done with the help of two tools:
   - Gap analysis: it includes an assessment of indicators on a scale from 1 to 5, where 1 shows that KRI are very weak / almost does not meet the criterion, and 5 - KRI is completely satisfied. It is assessed by such characteristics as: frequency of measurement, the ability to set threshold values, the indicator is leading or lagging, there is available data.
   - Matrix: it is a quantitative tool that determines the relationship between different risk indicators and their causes.
3) Improving risk indicators: risks are assessed based on gap analysis and matrix, as a result of which the number of KRI is reduced to the five most significant.
4) Confirmation of selected indicators and definition of threshold values. To accurately establish the effectiveness of the selected indicators, it is necessary to conduct a statistical analysis of past (historical) data between the risk event and its indicator. However, in many cases, data is not available.
5) Develop a risk dashboard. This tool allows you to create graphs and tables for visual and accurate information about risks. It can also help you detect indicators that exceed the established boundaries.
6) Drawing up a control plan. It is needed in order to effectively manage KRI with the help of characteristics and their changes. The control plan can be used as an attachment to the control panel in order to provide detailed information about the specifics of the management of one or another key indicator. Also, if the management changes, information about KRI will be available to the new manager of the company or project.

It should be noted that AKS-Labs has identified two key steps in the KRI building. First, the risks must be identified. At this stage, you need to identify key risk indicators, test them and select the most appropriate. Second, you need to analyze the risks. Here you need to make sure that the selected indicators are effective and set thresholds for them, develop types of reports for each of the KRI and draw up a control plan [24].

The American company SAS Institute, based on its many years of experience, has proposed its own algorithm for the KRI managing:

1) Determination of risks depending on the specifics of the enterprise, its scale and policy. At this
stage, a risk map can be drawn up. Scandizzo identifies several ways to build a risk map. One of the most common tools is the classification of risks depending on the likelihood of their occurrence and impact [18]. However, this method does not allow you to define ways to manage risk. Another approach is to map the risk depending on the phase of the project / operation and identify the key indicators and drivers at the current time. Despite the fact that not quantitative, but qualitative assessment is assumed by this approach, it shows management in which part of the business process it is necessary to make adjustments in order to reduce the impact of risk in general. It should be noted that a risk map can be drawn up from the top to bottom, from considering large and extensive business processes to analyzing detailed units in an organization. [49]. A risk map is often drawn up at the highest level of the company, and then it is consistently implemented and supplemented with risks at the next lower levels.

2) Risk classification based on the information received according to the degree of priority: low, medium and high

3) The KRI selecting for a high probability risk.

4) Checking the selected indicators for effectiveness: experts rate each indicator on a scale from 1 to 5. Based on the ratings, we select KRI with the highest average score.

5) Reporting: a formal description and illustration of KRI using tables and graphs that clearly demonstrate the most vulnerable areas for the company.

One of the important aspects of the KRI developing is the quality of the available data that is used to assess a specific risk. Sources of information can be internal and external. Internal sources include projects that were implemented by the company and the corresponding project risks. [12]. However, the risks of past projects may not be applicable to the current situation, because each project is unique and the environmental conditions are different. Often the risks that affect the company are caused by external factors such as: changes in the economic environment, the adoption of new laws or regulations and increased competition in the market.

External sources of information include data from information and analytical agencies, news reports, published reports of competitors, analysis and forecasts of the World Bank and others. It should be noted that it is necessary to verify information from external sources in order to develop an effective and reliable KRI.

A. V. Molvinsky emphasizes that indicators should be clearly defined and understood by managers and employees at different levels of the organization. It is necessary to develop the main characteristics for each indicator, establish the methods and frequency of its measurement, and appoint responsible persons [14]. Therefore, such a clear and detailed approach to indicators will allow obtaining the most reliable information about the risk and taking timely measures to avoid it.

The goal of developing an effective KRI set is to determine the appropriate parameters that reflect the necessary information about the potential risks that may affect the achievement of the organization's objectives. [25]. Thus, before the KRI selecting, it is necessary to analyze the objectives and goals of the company and identify the corresponding risk events that may affect their achievement. Moreover, building the relationship between the organization's strategies and key risks will help to obtain relevant data and, with its help, determine leading indicators of emerging risk [26].

Key risk indicators are indicators that require periodic measurement to prevent the occurrence of risk. No universal classification of KRI has been developed. However, some scholars have attempted to suggest their division into leading and lagging, performance and control indicators, and other types of groups. The first chapter of the work gives several variants of the algorithm for the KRI constructing. It was found that the choice of key indicators depends not only on risks, but also on the strategies and objectives of companies. Correspondence of key indicators to key strategies helps the leader to obtain the necessary information to more effectively achieve goals.

4. Conclusions
Thus, the more correctly it is possible to determine the causes of a risk event and develop appropriate indicators for them that allow them to be identified, measured and controlled, the more likely the manager will take timely action to reduce the risk, that is, he will work proactively.

Building an integrated management system for key risk indicators and its successful implementation in the organization's activities will open up opportunities to prematurely identify threats and promptly take measures to eliminate them, thereby providing a competitive advantage in the market.

Key risk indicators help identify threats and help proactively take action to eliminate them. To use KRI effectively, they need to be integrated into the overall risk management system of the organization and it is necessary to provide management based on an internal separation of powers and responsibilities.

References

[1] Nechaev A S and Antipin D A 2014 Mechanism for assessing the efficiency of financing the enterprise innovative activities Actual Problems of Economics 154 (4) pp 233-237
[2] Zakharov S V 2015 Algorithm for implementing research and innovation performance outcomes of small innovative enterprises into regional economic turnover Actual Problems of Economics 166(4) pp 198-203
[3] Nechaev A, Antipin D and Antipina O 2014 Financial and tax instruments for stimulation of enterprises innovative activity Problems and Perspectives in Management 12 (2) pp 173-180
[4] Kuklina M V, Kuklina V V, Bogdanov, V N and Starkov R F 2018 Extension and risks of development of social and technical networks in tourism Proc. Int. Conf. on Research Paradigms Transformation in Social Sciences (RPTSS) 50 pp 651-8 doi:10.15405/epbs.2018.12.80
[5] Zakharov, S., Shaukalova, A. 2020 Methodological aspects of optimization of small enterprises in modern conditions of the Russian economy. IOP Conference Series: Materials Science and Engineering 667(1) 012108
[6] Website of the Federal state statistics service Available at: www.gks.ru
[7] Samarukha V, Davaasuren A and Samarukha A 2020 On the real leap in social and economic development of Russia Global and Regional Research 2(1) pp 15-22
[8] Svetnik T V and Fedukovich Ye V 2015 The businessman in service sphere: subjective-objective approach to managing the training and activities Izvestiya of Irkutsk State Economics Academy 6(3) DOI: 10.17150/2072-0904.2015.6(3).14.
[9] Nechaev A S, Antipin D A and Antipina O V 2014 Efficiency estimation of innovative activity the enterprises Journal of Mathematics and Statistics 10(4) pp 443-447
[10] Scarlat E, Chirita N 2012 Indicators And Metrics Used In The Enterprise Risk Management (ERM) Economic Computation & Economic Cybernetics Studies & Research 46(4) p 14
[11] Svetnik T V 2017 Systemic nature of the hoodwinked investors’ problem in Russia Baikal Research Journal 8(4) DOI: 10.17150/2411-6262.2017.8(4).26.
[12] Samarukha A V 2018 Topical Trends of Improving Economy of Regions and Municipal Entities in Siberia Baikal Research Journal 9(3) DOI: 10.17150/2411-6262.2018.9(3).7.
[13] Beasley M, Branson B and Hancock B 2010 Developing key risk indicators to strengthen enterprise risk management Committee of Sponsoring Organisation of the Treadway Commission p 12
[14] Molvinsky A 2007 How to develop a system of key performance indicators General Director 3
[15] Repinskii O 2019 Education System Improvements as One of the Factors of Innovative Development of Russia Adv. in Soc. Educ. And Hum. Research 333 pp 534-537
[16] Konyuhov V, Gorban A and Gladkikh A 2019 Investment in the improvement of maintenance service efficiency of processing equipment of an industrial enterprise J. Phys.: Conf. Series 1353 pp 178-183
[17] Scandizzo S 2005 Risk Mapping and Key Risk Indicators in Operational Risk Management
Economic Notes by Banca Monte dei Paschi di Siena SpA 34(5) pp 231–256

[18] Samarukha A V 2018 Topical Trends of Improving Economy of Regions and Municipal Entities in Siberia Baikal Research Journal 9(3) DOI: 10.17150/2411-6262.2018.9(3).7.

[19] Barykina Y 2019 Risks of long-term leasing transactions for construction industry development IOP Conference Series: Materials Science and Engineering 667(1) 012011

[20] Konyuhov V, Gladkii A and Zott R 2020 Accelerator as an effective replacement of a business incubator in the Irkutsk region J. Phys.: Conf. Series 1582 pp 202-206

[21] Davies J, Finlay M and others 2006 Key Risk Indicators – Their Role in Operational Risk Management and Measurement p 31

[22] Samarukha A V, Makarova G N 2019 Design of Industrial Technological Revolution on the Principles of Sustainable Development, Taking into Account Counteraction of Unfair Competition Baikal Research Journal 10(2) DOI: 10.17150/2411-6262.2019.10(2).9.

[23] Nechaev A S and Antipina O V 2016 Concept of the life cycle of innovation Journal of Advanced Research in Law and Economics 7 (3) pp572-583

[24] Barykina Y 2019 Analysis of information support for innovation development IOP Conference Series: Materials Science and Engineering 667(1) 012012

[25] Ruposov V, Bayaskalanova T and Dneprovskaya N V 2018 The impact of the company's patents on the value of its brand MATEC Web of Conferences. electronic edition 08006

[26] Ruposov V L, Bayaskalanova T A, Belikov A and Urintsov A 2018 University innovation funnel model The European Proceedings of Social & Behavioural Sciences EpSBS pp 156-164