Reducing Risks in Construction Using Innovative Technologies

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Abstract. The Construction is an activity with a heightened level of risks, arising, of course, at all stages of the life cycle of an object. The main focus of the research is to reduce the risks associated with the construction at each of its stages using innovative technologies. Risks that can be reduced or eliminated altogether using innovative technologies, namely building information modeling (BIM), deserve close attention. The purpose of the study is to search or design methods for reducing risks in construction at all stages. BIM-technologies allow reducing risks during construction at its three stages: design, construction and installation, operation (sometimes recycling). The results of the research on risk reduction in construction using innovative technologies are information modeling technologies that minimize the possibility of human error, accompany the smooth and productive work on the construction site, and also allow you to maximally use the already constructed facility without loss.

1. Introduction

Construction is developing by leaps and bounds, every day there are innovative materials, work methods, design methods and methods of construction itself. At the same time, there are new risks that may arise with the staff, with the design process, with the production process at the facility, with the facility itself, and so on. [1-4]

Today, the number one goal is to reduce risks during construction, since this leads to lower costs and a reduction in the implementation time of an investment and construction project. [5,6]

It is about innovations that not only increase the efficiency of project implementation, but also improve various indicators, [7] namely:

• Safety performance;
• Labor safety indicators;
• Reducing the cost of the project;
• Reducing the payback period of the project;
• Management of risks.

Unfortunately, there are reasons why information technologies are slowing down their development - this is the absence of a single state standard and the lack of truly trained personnel for working with BIM technologies.
2. Materials and Methods
BIM-modeling is a completely new approach to managing the life cycle of a construction object. BIM is the process by which the building information model is formed. [8-10]

The process of modeling itself allows solving problems arising at various stages of construction, respectively, the information model serves as a direct solution of these problems, and therefore eliminates the occurrence of risk.

Project risk is a situation in consequence of which it is possible:
• Delay in the implementation of various activities;
• Reduced project quality;
• Of course, the occurrence of additional costs.

Advantages of creating an information model:
- the ability to control the life cycle of the construction object;
- constant interaction of participants in the investment and construction process (customer, designer, contractor, builder, supplier).
- the change of any one of the object's parameters entails an automatic change of the other parameters and objects associated with it, up to the drawings, visualizations, specifications and the schedule;
- improving the quality of design, in terms of
- prevention of errors by eliminating collisions (the intersection of engineering systems and building structures).

Collisions - the most common mistake in design - the mismatch of structures and engineering networks.

Figure 1. Collision Example.

The figure shows an example of a collision report containing the UId (Identification Numbers) of the objects, the coordinates of the collisions and a graphical representation.

The later the collision is detected, the more expensive it is!

BIM-modeling allows you to run an automatic check for collisions, which allows you to eliminate them, which helps to eliminate the occurrence of risk, improve the quality and subsequent minimization of project corrections.[11-14]

Figure 2. Chart of the dependence of costs on the stages of the life cycle of the building.
Horizontally in the form of numbers are defined Stages of the life cycle of buildings (7): pre-design preparation (0-1), design (1-2), stage "Project" (2-3), stage "Working documentation" (3-4), logistics (4-5), construction (5-6), operation (6-7). Vertically shows the cost of resources, divided by the result. The diagram shows that errors cost less when using BIM, as they are detected in the early stages of the building life cycle.

As it is known, in the course of project implementation there is a detection of errors. The sooner the error is found, the lower its cost, as it will require less resources to correct. Using BIM, errors are directly at the Design stage, which allows minimizing their cost. Without the use of a BIM, an error can be found both at the construction stage and at the operation stage, which entails the use of a large amount of resources, and sometimes the redevelopment of a project.

The use of BIM technologies in construction contributes to the transition from current design methods in flat drawings to new methods of 3D modeling, which contributes to the timely finding of conflicts before construction begins, improving occupational health, safety and risk management indicators.[16]

3. Results and Discussion
After analyzing, the advantages of BIM were identified:
- reduction of errors in design;
- interaction between project participants;
- more accurate information;
- competitive advantage;
- insignificant, but reducing the duration of the object;
- cost reduction;
- process automation;
- and as a result, reduced project risks.

It is also possible to exclude an unnecessarily filled estimate, which makes it possible to reduce the inaccuracy to 2% and exclude unplanned expenses.

The massive introduction of BIM-modeling of buildings in the design and construction practice, of course, the process is lengthy and complex. The introduction of BIM is a strategic issue, and the decision on its implementation is an objective necessity.

It is a known fact that the further the design process has gone from the starting point, the more difficult it is to make any adjustments and changes. If the project is completed, then no painless changes are either impossible, or their cost will increase significantly. [18]

4. Conclusions
BIM technology exists recently, but its use leads to a reduction in design time, reduce costs and improve quality, and thus increased the competitiveness of the firm and project participants.

Of course, at the moment Russia lags behind the developed countries, where such technologies are widespread and reach large volumes of construction. We have to rely on the experience of countries that have long used new technologies. There are initial costs of implementation, lack of qualified personnel and a single standard.

The introduction of BIM is expensive! However, the effect that is achieved by means of this modeling allows to reduce risks, to be supported by improving the quality of project documentation, reducing the cost of the project, reducing the timing of implementation. [19]

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