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## MODELLING OF INVESTMENT PROCESSES IN A CONSTRUCTION CORPORATION

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### **Abstract**

The article characterises the peculiarities of the modern method of construction management – investment process modelling. The main directions, stages, tasks and key elements of investment processes modelling in the construction corporation are consistently disclosed.

**Key words:** *Business Process Modeling, BIM technologies, Integrated Project Delivery, construction management.*

Business Process Modeling is a modern method of improving the efficiency of a construction firm, which is based on the process approach to construction management. The management of investment resources of a construction corporation is carried out in three directions:

- through the management of production capacities and investment attractiveness to budgeting and economic support of investment activity development directions;
- through planning and forecasting of investment activities to the effective development of investment flows;
- through technical support of investment activity within the framework of BIM using.

Modelling of investment processes in construction involves the sequential execution of stages, including all stages of the life cycle of a construction project. The use of BIM technologies allows to represent the construction object in virtual space, including structural and architectural elements, to define construction and installation works, to calculate the required amount of materials, to assess the level of costs and the efficiency of money investment.

The key elements of the investment model of an investment project are:

- investment objectives, which are generally aimed at ensuring financial stability, increasing the company's capitalisation, income generation, long-term growth and tax efficiency;

– risk tolerance, which manifests itself in the construction company's ability to mitigate external and internal risks. Investors with high risk tolerance are willing to accept higher levels of risk to achieve higher returns. Conversely, investors with low risk tolerance prefer less volatile investments;

– investment time horizon involves determining the relationship between the time period and opportunities to invest in assets with higher volatility (large-scale investment construction projects);

– asset allocation is the process of dividing an investment portfolio between different asset classes such as equities, bonds and financial resources;

– diversification and rebalancing, which involves allocating investments across different investment construction projects that have different values.

The main tasks of the technical customer within the framework of information modeling are formed in accordance with the requirements within the framework of the main stages of the implementation of the investment construction project. At the same time, the tasks of information modeling of a technical customer are logically divided into external (participants in an investment construction project) and internal (technical customer).

External tasks:

– formulation of the customer's information requirements for all participants of the investment construction project (reflected in the contracting agreement);

– creation of a common data base (a common platform for placing, storing and retrieving project data for all participants).

Internal tasks:

– information modelling for investment performance justification;

– information modelling for construction control.

In accordance with the stages of an investment construction project, it is necessary to define the main tasks of the technical customer at the pre-project and design stages, as well as at the construction stage.

The pre-project (pre-investment) stage includes the development of a feasibility study, preparation of the technical task for design and obtaining permits. The main tasks of the pre-project stage include formulating a project idea, searching for and evaluating a facility, evaluating a land plot, and developing a business plan.

For this purpose, work is carried out, including assessment of the land plot, development of variants of volume-planning and technological solutions, determination of engineering loads, assessment of environmental

impact, determination of sources and volumes of financing, assessment of economic feasibility of investments, determination of social and environmental benefits of operation of the construction object.

The result of the pre-project stage is the development of the project feasibility study and the preparation of the design specification. All collected documentation is the information basis for further modelling, so it is important to get it in a certain format. This work can be carried out either in-house by the technical customer or with the involvement of an external organisation.

Also, within the framework of the pre-project stage in many construction corporations in Europe, the quality system of investment projects is actively used, which is functionally aimed at establishing the priorities of owners, investors and clients; identifying reserves to improve competitiveness; identifying potential opportunities to reduce the time for preparatory work; market research; building a planning matrix "investor preferences – opportunities of the construction organisation". In general, the quality system of investment projects of a construction corporation combines the means of achieving the goal and the results, with the means of achieving the goal accumulating the investor's expectations embodied by the activities of the construction corporation, and the results depend entirely on the effectiveness of programme management. At the same time, four consecutive documents form the basis of the investment strategy:

1. The planning matrix, which translates the investor's requirements into the technical characteristics of the project.
2. Project Characteristics Structuring Matrix, which facilitates the transformation of the output of the planning matrix into the characteristics of the construction project in the previous stages.
3. Process plan and control charts providing for planned characteristics and means of their control.
4. Process instructions based on the project parameters and detailing the production operations.

The design stage (investment stage) includes the development of design documentation required to ensure the implementation of the investment project at the construction stage. The main task of this stage is the development of the project of works, creation of the project information model of the object, including detailed design documentation, as well as the creation of the information model for passing the expert examination.

In this case, the information model should meet the technological requirements of the investor (customer), ensure the possibility of using all data entered into the project database created on the basis of BIM by all

project participants, including construction contractors, and be the key (main) source of data for construction control implementation.

At the design stage, the use of BIM is carried out in accordance with the requirements of the technical customer, which are reflected in the technical task for design. Solving the tasks of the design stage involves the use of BIM Level 3, which allows to perform design work by sections, create a unified information model of the object, solve design problems to pass the expert examination. This model includes all sections of the project, ensures consistency of information, allows to verify the accepted design decisions and make changes at the construction stage. The model is transferred to the technical customer for further use during the construction phase. The main result of the design stage is the creation of an information model of the object for passing the expertise and fulfilment of the project at the construction stage.

At the construction stage, information modelling involves solving many different tasks in terms of complexity and content, including construction and installation works, project logistics and construction control. The main document at the construction stage is the information model of the construction project, which contains information about the object to be built, is in a database of common data, and is available for use by all construction participants and for the construction control system.

During the construction phase, the technical customer ensures that the information model is adjusted to reflect changes made to the work design, logistical models and construction control results. The corrected information model is a source of information on the object and is generally available in the general data base. Logistics is a separate stage of information modelling of the object and is carried out on the basis of the object model in parallel with other stages.

Information modelling of construction control contains information on processes and results of control, analysis of results, management of the process of remediation of remarks. The information model of the object and the model of the project of work production during the construction process are supplemented with flow charts and used for construction control.

As a result of implementation of the construction stage, an operational information model of the object is created, including project adjustments and information requirements of the investor or operating organisation. It should be noted that information modelling of investment construction project implementation is carried out under the guidance of the technical customer at each stage of the project life cycle.

To organise effective interaction between project participants, it is recommended to use Integrated Project Delivery (IPD), which is designed for information modelling projects. Integrated Project Delivery (IPD) is a tool for the implementation of investment construction projects, allows to reduce costs and increase efficiency at all stages of planning, design and construction. The use of IPD makes it possible to unite in a single process the fulfilment of all stages of the project, as well as to take into account the interests of the participants of the investment cycle. The principles of IPD approach realisation are fixed in special contractual relations between all participants of construction object creation. The main task of IPD is to ensure the fulfilment of the construction schedule, including compliance with the deadlines for the development of working documentation and delivery of necessary construction materials during the construction process. The use of IPD allows the distribution of risks and responsibilities in the process of investment construction project realisation between the project participants.

The result of the construction stage is the commissioning of the facility and the creation of a model of the facility for operation. At the operation stage (operational stage), information modelling of the facility operation is performed, including marketing strategy, facility maintenance plan, operation risk management strategy.

Implementation of BIM technology facilitates effective design decisions and provides the following advantages for the construction corporation:

- unlimited possibilities to make the best design decision taking into account all available data;
- the ability to share information between all project stakeholders;
- reduction of costs and design errors;
- reduction of time spent on project development, as it becomes possible to realise some operations jointly;
- BIM-technologies make it possible to accurately build the engineering systems of the building;
- faster and easier selection of required equipment;
- accurate specification through automation;
- the main economic and ecological characteristics of the building are determined already at the stage of preliminary design, which allows to make changes in the project in advance;
- the management and control process are optimised in accordance with the work schedule. As a result, a 30% reduction of construction and operation costs is achieved; a 40% reduction of errors, errors in project documentation; a 50% reduction of project implementation time;

– reduction of technologists' work time by 20%; reduction of architects' work time by 10% [1].

Applying BIM-technologies allows to create an effective management system at all stages of the project life cycle. In this case, the information model is a reliable and objective source of information about the object, which significantly increases the efficiency of the design, construction and operation processes.

#### **Literature:**

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