Cost formation of the digital information model of agricultural objects

Tatyana Alekseeva* and *Stanislav* Alekseev

Moscow State University of Civil Engineering, Moscow, 129337, Russian Federation

Abstract. Digitalization of agricultural construction is one of the most important tasks. One of the areas of digital transformation in this area is the introduction of information modeling (BIM) technologies into the processes of forming the cost of agricultural construction projects. The features of determining the cost of elements of a digital information model of such objects have been studied. Recommendations are proposed for modernizing the organizational structure of enterprises participating in the process of information modeling of agricultural objects. The need to develop regulations for the interaction of specialists of these organizations, to make changes to the BIM standard, etc. is substantiated. The application of the research results will speed up the introduction of BIM technologies into practice and the transition to a management system for the life cycle of agricultural objects based on their information models. This will contribute to the development of agriculture.

1 Introduction

The digital transformation of the Russian economy is one of the important tasks. All its sectors are involved in this process [1, 2]. It is planned to introduce digital technologies into the activities of organizations, including information modeling technologies (BIM technologies) [3-5].

Creating information models of agricultural objects is a necessary task during the transition to a system for managing their life cycle. Such objects and complexes include poultry farms, agro-industrial enterprises, livestock complexes, etc.

An information model of a building or structure is understood as a complex of interconnected data about these objects, which are generated in electronic form during its life cycle [1]. BIM technologies make it possible to increase design efficiency, while developing an information model is not an easy task [6, 7].

The requirements for the development of an information model of an agricultural facility at each stage of its life cycle are different. For example, at the design stage, a three-dimensional model of this object must first be formed, consisting of a complex of elements (its parts, including walls, windows, doors, ceilings, etc.). Such elements are characterized by certain information, including geometric and attributive.

* Corresponding author: atr-mgsu@mail.ru

Attribute data of a model element represents its properties, incl. this can be: description and brand of the element, its code, weight, cost and other information.

To generate attribute information of any model element, it is necessary to implement certain processes. This article discusses the process of forming the cost of elements of an information model of an agricultural facility.

2 Materials and methods

Analysis of costs carried out during the life cycle of a building or structure is an important task for making economic decisions during the construction of these objects [8-10]. The life cycle cost of a building or structure is the sum of the costs incurred during its service life [11]. This amount of expenses includes capital investments and operating costs, as well as costs associated with the repair of these facilities, reconstruction, decommissioning and liquidation.

At different stages of the life cycle of an agricultural construction project, these costs will be different; there are various methods for determining them.

If we consider capital investments, then first the estimated (marginal) cost of construction is formed, then the estimated cost is determined, after passing the examination the initial maximum contract price is formed, then the contract estimate is prepared, after the procurement procedures the contract is concluded. And its actual cost is formed during construction.

Consider, for example, the process of forming the estimated cost of construction using information modeling technologies.

Previously, the process of determining the estimated cost of construction was carried out based on “flat” drawings. The estimator received from the designer a set of drawings, specifications and statements for materials, equipment, etc. and began to develop estimate documentation.

With the advent of information modeling technologies, an estimator can work with a three-dimensional digital model and take the necessary information from it. In this case, the designer’s task is to fully reflect this information in the properties of the model elements, i.e. in sufficient volume for testing.

It should be noted that some of the information, due to various factors, still remains in “flat” form, some in text form. For example, to estimate the cost of earthworks using information modeling technologies, a pit model is required. Such a model cannot always be provided to the estimator, because sometimes there are not enough specialists who can create such a model, the necessary software is missing, etc. If we talk about buildings or structures, then some of their elements are not modeled. This may be due, for example, to the customer’s decision, etc.

To determine the cost of the modeled elements of an agricultural construction project, a set of special programs that are integrated with each other is required. Among the domestic BIM NanoCAD, Renga, Model Studio CS, etc. should be noted. Using plugins, data is exported to BIM estimating software, such as: Gektor: 5D-smeta, BIM-smeta ABC, Smeta.ru BIM, etc. [1] In this way, information about the parameters of elements is transmitted, incl. their length, height, width, area, volume, grade of materials, etc., i.e. information that is necessary for estimate the cost these elements is transmitted.

Next, using the functionality of the BIM-estimating software package, estimate norms and resources are linked to model elements, correction factors are entered, an estimate structure is created, and all this information is then transferred to any estimate program, for example Smeta.ru, GrandSmeta, etc. [1]. It further generates estimate documentation and determines the cost of construction.

Cost information must be passed back to the model. This process is carried out by converting data using special BIM estimate software (Gektor: 5D-smeta, BIM-smeta ABC, etc.), because conventional estimating programs (Smeta.ru, GrandSmeta, etc.) do not allow storing data on model element codes. As a result of data conversion, an XML file is generated, which contains information about the codes of model elements and their costs, codes of associated standards and resources, etc. Information from this file is transferred to the BIM system in which the three-dimensional model of the object was initially generated, and information the cost of its elements is recorded in their properties. Thus, attribute information about the model elements about their value is generated.

3 Results and discussions

The cost of any element of the model can combine the cost of one or several works necessary for the construction of this element (for example, walls, ceilings, partitions, etc.). The cost of such work includes direct costs, incl. the amount of wages of workers, the cost of operating the machine and mechanism, the amount of remuneration for the driver, the cost of material resources, as well as overhead costs and estimated profit.

At the same time, the total cost of all elements of the model does not determine the total cost of construction, since there are elements and other data that have not yet been modeled, the cost of which must be included in the estimate. The full cost of construction is generated in estimating software (Smeta.ru, GrandSmeta, etc.)

The rules for forming the estimated cost of construction using information modeling technologies, the features of interaction between specialists when forming it using these technologies must be reflected in the organization's BIM standard. It is necessary to develop appropriate regulations for estimators, designers, BIM managers, etc. The introduction of BIM technologies dictates the need to change the organizational structure of enterprises participating in the BIM process.

To develop estimates based on the BIM model, the organizational structure of enterprises must have specialists with advising competencies in this area. In view of the complexity of the processes under consideration, in our opinion, it is advisable to distinguish two types of specialists:

BIM estimators who will work with a software package that provides the ability to link estimated properties to model elements, form an estimate structure, export data for further calculations, and also transfer information about the cost of elements back to the model (Gektor: 5D-smeta, BIM-smeta ABC or etc.).

Estimators working with classic estimate programs (Smeta.ru, GrandSmeta, etc.), which carry out further preparation of estimate documentation and implementation of other necessary functions when forming the cost of construction based on an information model.

During information modeling, designers develop the relevant sections of the project, BIM coordinators, BIM managers and other BIM specialists solve their problems in this process. At the same time, it is necessary to train them in terms of the range of tasks that they will have to solve when implementing cost estimation process using BIM technologies and new software.

4 Conclusion

Formation of attribute data of elements of a digital information model of agricultural objects is a complex task consisting of many labor-intensive processes. One of them is the process of forming the estimated cost of model elements at the design stage. To determine the cost of the simulated elements, special software is required. We need specialists who know and

can work with these programs. The introduction of information modeling technologies into the processes of forming construction costs dictates the need to modernize the organizational structure of organizations participating in the BIM process, develop regulations for the interaction of BIM specialists and introduce changes and additions to the enterprise BIM standard.

The process of introducing BIM is not an easy task; it is necessary to teach enterprise employees to work in new conditions. They may need to be retrained. Many of them are not ready for such innovations. For a more effective implementation of information modeling technologies in the estimating processes, we propose to distribute responsibilities for generating construction costs among specialists as follows. The tasks that are performed in BIM estimating software are assigned to BIM estimators specially trained to work in it. And the tasks that should be implemented using classic estimate programs should be transferred to those estimators who have been working in the organization for a long time and have experience working with these software systems. At the same time, appropriate training of those and other specialists is necessary.

The implementation of the research results into practice will allow organizations to quickly implement information modeling technologies in the processes of estimate the cost of elements of models of agricultural objects. This will ensure that you can get all the benefits from using these technologies. The number of errors will be reduced, incl. from the estimators. It will be possible to automatically control their operation. When changes in the project, the use of information modeling technologies and related software allows you to quickly update construction cost indicators. For new projects, it is possible to use templates, which will make the cost estimation process faster. This will reduce the time required for the development and implementation of agricultural construction projects while saving investments. All this will accelerate the transition to a life cycle management system for these objects based on their information models and will have a positive impact on the development of agriculture.

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