Introduction of information modeling technologies in the construction of agricultural facilities

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Abstract. Digitalization of all sectors of the national economy including agricultural construction is one of the main tasks. The features of the formation of an information model of agricultural facilities are considered. Problematic issues are identified. A study of the software market for information modeling of such objects has been carried out and recommendations for participants in the construction of agricultural facilities have been proposed. The results of the study will help accelerate the pace of implementation of information modeling technologies in the construction of agricultural facilities.

1 Introduction

The task of digitalization of the national economy including agricultural construction is one of the priorities.

Agricultural facilities and complexes include enterprises of the agro-industrial complex, livestock complexes, poultry farms, etc.

One of the areas of digital transformation of agricultural construction is the introduction of information modeling technologies.

The information model of a capital construction object is a set of interrelated information, documents, and materials about this object, generated at all stages of its life cycle in electronic form (clause 10.3, article 1 of the Town Planning Code of the Russian Federation).

The life cycle of such an object includes the following phases: engineering surveys, design, construction, reconstruction, overhaul, operation and decommissioning and liquidation.

The paper considers the processes of information modeling of agricultural objects and analyzes the applied software.

The variety of different software products for information modeling dictates the need to develop recommendations for participants in the construction of agricultural facilities. This is a very important task.

The development of such recommendations will speed up the process of implementing information modeling technologies in the construction of agricultural facilities.

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2 Materials and methods

The issues of information modeling are addressed by the works of domestic and foreign scientists [1-17]. The BIM model of agricultural objects gradually goes through certain stages of development during the life cycle.

At the pre-project stage, conceptual modeling takes place, various options for the implementation of projects for their construction are considered.

At the design stage, a design BIM model of such objects is developed. First, a 3D model of agricultural objects is formed using, for example, programs such as Renga, nanoCAD, etc.

The data from the 3D model is transferred to the scheduling system. By adding information about the construction time to the information model, we get a 4D model of an agricultural facility.

Scheduling systems include: Spider Project, Plan-R, etc.

When developing a project for the construction of an agricultural facility, traditional technologies for determining the cost of construction are still used, based on flat drawings, bills of quantities, specifications for materials and equipment, etc. This is one of the obstacles to the digitalization of agricultural construction.

Let us further consider the main stages of the process of forming the estimated cost of construction using information modeling technologies.

At the first stage, data on the parameters of the structural elements of the model of objects are imported from design systems into a system that supports 5D modeling technologies (Hector: 5D Estimate, BIM-estimate ABC, BIM WIZARD, etc.) and the estimated norms are linked to the structural elements of the model, and also the implementation of other necessary processes.

This software has recently appeared on the market.

Such software is a very important component of the process of information modeling of capital construction objects.

At the second stage, data is exported from a system that supports 5D modeling technologies to an estimate program (Smeta.RU, GRAND-Estimate, RiK, etc.) and estimate documentation is generated.

Estimated information must be transferred to the summary information model of agricultural construction objects, which is formed using, for example, the Model Studio CS system and the CADLib module Model and Archive, etc.

At the construction stage, an executive BIM model of an agricultural facility is formed. According to the results of the executive survey, actual data on the performance of work are entered into it.

Using this information, a comparative analysis is carried out with what was planned. With the use of special software systems that support information modeling technologies, it is possible to visualize discrepancies in the duration of work and their cost.

For the formation of the executive BIM model, the same programs can be used as at the design stage [2, 3].

After the agricultural facility is built and handed over to the customer, the executive model is transferred to the operation service and an operational model is formed. It is created taking into account the developed plans for maintenance and repair.

Over time, if necessary, measures for the reconstruction of facilities can be carried out. Then corresponding projects and information models are developed.

The composition of the software may be the same.

As a result of these activities, the necessary information is then entered into the operational BIM model.

The introduction of new technologies in agricultural construction dictates the need to search for new approaches, mechanisms and methods to ensure the effectiveness of this process.

3 Results and discussions

A lot of support systems for 5D modeling technology have appeared recently on the market including Hektor: 5D Estimate, ABC BIM estimate, BIM WIZARD, Larix.EST, etc.

Each program has its own features and functionality.

As a result, organizations that plan to implement information modeling technologies in their activities face the problem of choosing the most effective software package for solving the problem of determining the cost of capital construction projects using information modeling technologies.

The article studies the functionality of these software systems, analyzes the needs of participants in the construction of agricultural facilities, and as a result, recommendations are proposed for them.

The software systems under study usually include special plug-ins for capital construction design systems (nanoCAD, Model Studio CS, etc.), which provide the relationship between these systems and the software package for 5D modeling (Hector: 5D Estimate, BIM estimate ABC, BIM WIZARD, Larix.EST or others).

Such plug-ins provide the implementation of the processes of uploading data from design systems to such programs, loading information back into the model, the ability to visualize model elements, and other functions.

Thanks to the "visualization" function, in the course of his work, the estimator can see and check to which elements of the model the estimated norms are already attached, and which are not yet.

When working in different software, the process of modeling a capital construction object should be carried out considering the concept of OpenBIM, the possibility of transmitting information through the IFC format [3, 5, 14, 15]. This also applies to the processes of formation of the cost of construction.

5D modeling software products have appeared on the market that provide the ability to work with projects in the IFC format, for example, Hector: 5D estimate, BIM estimate ABC, BIM WIZARD,etc.

Some of the software systems under consideration provide for the separation of the jobs of the estimator and designer.

In our opinion, this is convenient when the estimator's computer has only software for the formation of estimated construction costs, and design systems that usually "take up a lot of space" are located on another computer with the designer.

The user-friendly interface for work is equally important, when, as they say, "everything is at hand."

All changes in the project or errors in the work are "highlighted" in a certain way.

If required, one can make the necessary settings in the program for the convenience of work.

Such functionality of the software package is particularly important as intelligent binding of estimated norms, work with a group of resources, amendments, application of templates, etc.

These functions allow you to automate the routine work of the estimator.

The search and binding of estimated norms to the elements of the model is carried out automatically in accordance with the parameters of the elements (length, width, height, weight, etc.).

Working with a group of resources, amendments, applying templates also allows you to significantly speed up the marking process.

One of the important functions of the software under consideration is the automated generation of bills of quantities with the possibility of data control.

The function of control in cost management using information modeling technologies, including changes in the project, etc. is very interesting and important.

If after the work on marking the object model is completed and suddenly there are any changes in the project, the software in question should help solve this problem.

There are programs on the market that automatically detect changes that have occurred and, where possible, automatically make the appropriate replacements for the norms.

If the technology to produce construction and installation works has changed, then there is also the corresponding functionality that allows you to make the necessary adjustments.

After binding the norms to the elements of the model, the selection and binding of resources is made, the necessary correction factors are applied, the structure of the estimate is formed and the data is exported to the estimate program for further calculations, incl. entering information on the cost of resources, accrued overheads, cost estimates, etc.

Data export should be carried out in any estimate program used in the construction of agricultural facilities (Smeta.RU, GRAND-Estimate, RiK, etc.).

As a result of determining the estimated cost of agricultural construction objects, the estimated information is then transferred to the consolidated information model.

The transfer of information is carried out in XML format about the codes and cost of model elements, codes of tied norms, labor resources, materials, etc.

It is also possible to transfer such information to a project in IFC format, to ERP systems, etc.

Not all software systems support the listed functions data transmission. It must be considered when choosing a software tool.

4 Conclusions

The use of information modeling technologies in the design and construction of agricultural facilities requires the formation of a complex of interrelated software products.

The work carried out a study of domestic programs in this area, incl. programs supporting 5D modeling technologies were studied and their functionality was analyzed.

There are quite a lot of such programs on the market now, and future applicants have questions related to the choice of effective software that supports 5D modeling technologies.

To solve this problem recommendations for participants in agricultural construction are proposed.

The practical implementation of the results of the study will allow the specialists of these organizations to choose the necessary software competently and reasonably for information modeling of agricultural facilities.

With their use, cost, and time management during the construction of such facilities will become more efficient.

As a result, the cost of construction will decrease, the terms of design and construction of agricultural facilities will be reduced.

All this will have a positive impact on the development of agriculture.

References

1. S. Yu. Glazyev, The Great Digital Revolution: challenges and prospects for the economy of the XXI century. Available at: https://glazev.ru. (Date of access: 10.11.2022).
2. S. E. Alekseev, T. R. Alekseeva, Water supply and sanitary technique **2** 32-39 (2020)
3. T. Alekseeva, S. Alekseev, Lecture Notes in Civil Engineering **231** 23-31 (2022)
4. A. N. Rozhkov, Plumbing, Heating, Air conditioning **4(136)** 34-37 (2013)
5. V. V. Talapov, A. S. Nesipbayev, A. V. Khapin, B. E. Makhiev, Bulletin of D. Serikbayev EKTU **1** 111-119 (2022)
6. V. I. Travush, Arkhitektura i stroitel'stvo **3** 100-117 (2018)
7. V. Nývlt, Role of BIM process participants within managing knowledge in BIM data model *18th International Multidisciplinary Scientific GeoConference SGEM 2018. Conference proceedings, 2018* pp. 711-718
8. K. Wang, C. Zhang, F. Guo, S. Guo, Journal of Management in Engineering **38(4)** 04022033 (2022)
9. N. V. Anikina, T. R. Ishtryakova, Modern Economy Success **6** 37-42 (2021)
10. A. N. Ovchinnikov, A. A. Volkov, Nauka i biznes: puti razvitiya **5(95)** 38-42 (2019)
11. S. G. Abramyan, O. V. Burlachenko, O. V. Oganesyan, A. O. Burlachenko, Bulletin of Volgograd State University of Architecture and Civil Engineering Series: Civil Engineering and Architecture **4(85)** 305-313 (2021)
12. K. V. Bambetova, A. A. Kabzhihov, Voprosy nauki i obrazovaniya **7(132)** 32-34 (2021)
13. A. L. Nevzorov, Stroitel'stvo i rekonstrukciya **3(101)** 51-59 (2022)
14. L. A. Oparina, Smart Composite in Construction **2(2)** 48-55 (2021)
15. T. Yu. Ovsiannikova, A. A. Patsukov, Real Estate: Economics, Management **1** 13-18 (2022)
16. T. F. L. Da Silva, A. V. Arroteia, S. B. Melhado, M. M. De Carvalho, D. R. Vieira, Journal of Modern Project Management **8(3)** 125-135 (2021)
17. B. Manzoor, I. Othman, S. S. S. Gardezi, H. Altan, S. B. Abdalla, Applied Sciences **11(12)** (2021)