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THE LEADING ROLE OF THE CUSTOMER IN THE ORGANIZATION OF THE INFORMATION MODELING PROCESS

АҚПАРАТТЫҚ МОДЕЛЬДЕУ ПРОЦЕСТІ ҰЙЫМДАСТЫРУДАҒЫ ТАПСЫРЫС БЕРУШІНІҢ ЖЕТЕКШІ РӨЛІ

ВЕДУЩАЯ РОЛЬ ЗАКАЗЧИКА В ОРГАНИЗАЦИИ ПРОЦЕССА ИНФОРМАЦИОННОГО МОДЕЛИРОВАНИЯ

Abstract. *The article analyzes the complexity of the tasks of the BIM-design process of construction objects. This requires consistent modeling of parts of a BIM project created by different participants. The necessity of choosing the customer as the organizer of the information modeling process is substantiated. The scheme of BIM organization under the guidance of the customer is proposed, its information requirements, the structure of the shared data environment, the responsibility matrix are formulated.*

Keywords: *Principles of BIM modeling, technical customer, information requirements, shared data environment, responsibility matrix, customers BIM department.*

Аңдатпа. *Бұл әртүрлі қатысушылар жасаған BIM жобасының бөліктерін дәйекті модельдеуді қажет етеді. Ақпараттық модельдеу процесін ұйымдастырушы ретінде тапсырыс берушіні таңдау қажеттілігі негізделген. BIM ұйымдастыру схемасы тапсырыс берушінің басшылығымен ұсынылған, оның ақпараттық талаптары, жалпы мәліметтер ортасының құрылымы, жауапкершілік матрицасы тұжырымдалған. Тапсырыс берушінің BIM-бөлімінің функциялары анықталды.*

Түйін сөздер: *BIM-модельдеу принциптері техникалық тапсырыс беруші, ақпараттық талаптар, жалпы мәліметтер ортасы, жауапкершілік матрицасы, тапсырыс берушінің BIM-бөлімі.*

Аннотация. *В статье анализируется многоплановость задач процесса BIM-проектирования строительных объектов. Это требует согласованного моделирования частей BIM-проекта, создаваемого разными участниками. Обосновывается необходимость выбора заказчика, как организатора процесса информационного моделирования. Предложена схема организации BIM под руководством заказчика, сформулированы его информационные требования, структура среды общих данных, матрица ответственности. Определены функции BIM- отдела заказчика.*

Ключевые слова: *Принципы BIM-моделирования, технический заказчик, информационные*

требования, среда общих данных, матрица ответственности, BIM-отдел заказчика.

Introduction. Building information modeling is a process with many participants, and moving from one stage to another, with different performers, so someone must be its organizer. The world practice of information modeling shows that during the construction of the object, the main profit (savings from the allocated investment resources) goes to the customer. Hence, it is quite natural to believe that it is the customer who is best suited to the role of the organizer of the BIM process.

In this article, we will talk about how the customer's work should be organized in a BIM environment. At the same time, whether the customer himself performs this work, or entrusts it to a technical customer (an engineering company), fundamentally changes nothing, so we will write everywhere in the future about the role and functions of the customer in information modeling.

Materials and methods of research. Since the technology of building information modeling is constantly developing and improving, it will not be superfluous to recall the main statements corresponding to modern views on BIM [1].

So, BIM is an information modeling process, and it does not happen by itself but is determined by the need to solve specific tasks that arise before the contractor when working with a construction object [2, 3].

With this understanding, an information model is the final result of a certain stage of modeling, and the result is "side", since the main result of each stage of information modeling is the solution of the problems formulated at the beginning of the stage. The information model can be considered as a kind of "design" of the found solution to these problems.

The latter means that the information model can change greatly during the transition from one stage of information modeling to another since the stages are usually associated with solving different problems. This means that the information model can either be filled with new information or be freed from the old one if the need for it disappears at the next stages. In other words, it would be wrong to consider an information model as a kind of repository of information about an object that is only being updated.

Since construction objects are very complex formations, it is quite justified to talk about their complex model, which is obtained from a coordinated combination of models of different systems and different stages. This model is usually called the building information model.

It is also important to note that the stages of information modeling usually do not coincide with the generally accepted stages of building construction, there are much more of them, but they are very closely related to each other since they are parts of a common process [4, 5].

The stages of information modeling are carried out by specialists in this field. They use special software packages to create their own models. This process is driven by the capacity of [6] and the level of training in our universities [7]. The specificity of object modeling requires a special approach, as an example, it is applied in the reconstruction of cultural heritage objects [8, 9, 10].

The customer's activity covers several stages of the life cycle of the building at once, actually ending with the transfer of the object into operation, after which other responsible persons (operators) manage this object. This division of functions fully corresponds to the global understanding of the specifics of BIM at different stages of working with an object, when models are divided into two types according to their structure [11, 12], tasks to be solved and features of use - design (PIM) and operational (AIM). I would like to emphasize that in global terminology, design models include everything related to the creation or significant modification of an object, and operational models include everything related to the management of this facility. According to this logic, design models can also arise at the stage of operation, when, for example, reconstruction or major repairs, as well as the demolition of an object appear (Figure 1).

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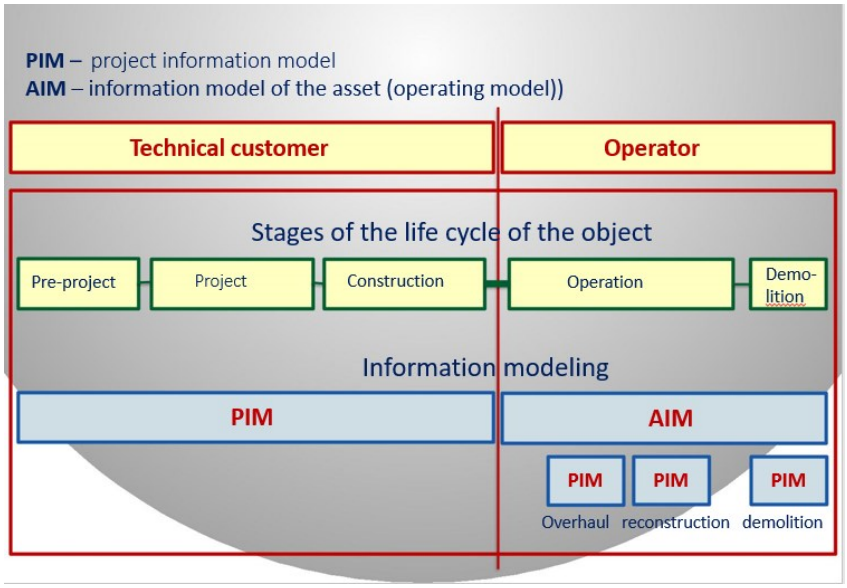

Figure 1. Two types of information models of the construction object
(According to international standards PAS-1192-3:2013 and ISO 19650)

The process of information modeling at any stage of working with an object is subject to the general principles [13]:

1) The principle of a single model, meaning the consistency of model information when working;

2) The principle of pragmatism, according to which exactly as much is modeled each time as is required to solve the task, project information model asset information model technical customer – operator;

3) The principle of consistent modeling, which means the need for a unified (coordinated) approach to work on the entire project.

If at least one of these principles is violated, the efficiency of the information modeling process drops sharply or simply becomes zero. But for the customer, who is obliged to direct and control all processes related to the construction of the facility, the third principle of coordinated modeling is of particular importance, since its observance by all project participants under the general guidance of the customer can guarantee interconnected information modeling throughout the project.

If we consider the general scheme of the organization of the information modeling process by the customer for all project participants, it looks as follows (Figure 2).

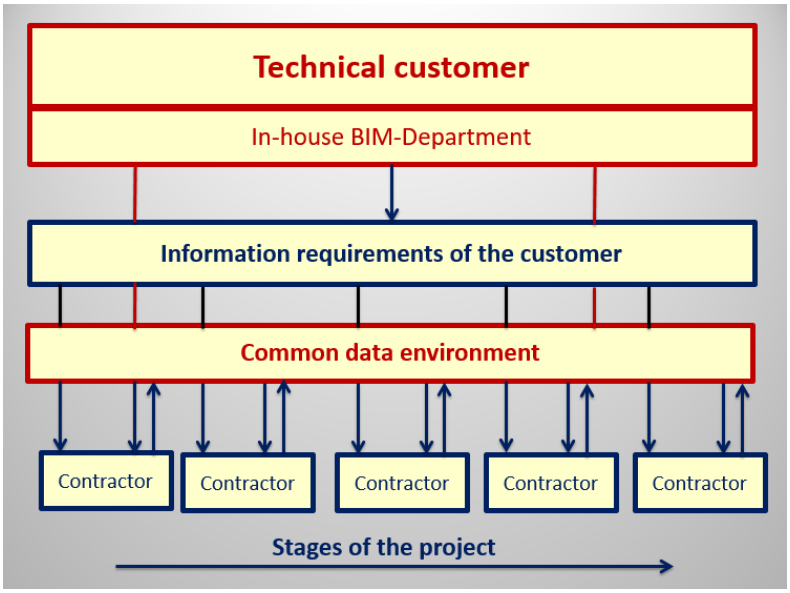

Figure 2. General organization of BIM under the guidance of the customer when creating a construction object

From the above diagram, it is visible that the customer in the field of BIM organization has two main, at the same time interrelated tasks: creating a Shared Data Environment (SOD, in the English abbreviation CDE) and formulating the employer's Information Requirements (ITZ, in the English abbreviation EIR) for all project performers [14].

Today, according to global practice, SOD is a mandatory element of any serious project (or multi-project activity) using BIM.

Information modeling is a process of joint work on the creation of a construction object, therefore, when implementing it, the basic principles of joint work must be observed:

1) Project participants create, control and verify information, as well as receive data from other project participants by reference, association or direct exchange, in cases where it is necessary.

2) Provision by all project participants of clearly defined information requirements for others.

3) Evaluation by the customer of the proposed approach and capabilities of each potential participant in the information modeling process (contractor, subcontractor) before his appointment.

4) Providing participants in the information modeling process with an appropriate level of access to a managed shared data environment.

5) Ensuring reliable storage of materials in a shared data environment.

The general scheme of the organization of the Shared Data Environment is shown in Figure 3.

This scheme has already been tested quite well in the world and has been included in a number of regulatory documents, including the PAS-1192-3:2013 and ISO 19650 standards, although it is only the basics and allows certain additions and changes related to the specifics of the project.

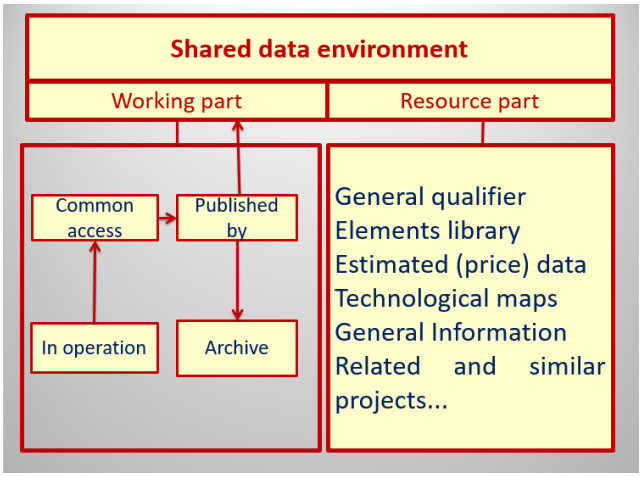

Figure 3. A shared data environment with two main parts: working and reference information

Now we will briefly describe its main provisions.

1) The shared data environment is a single source of reliable and consistent information for all project participants, allowing effective interaction, repeated use of verified, consistent and up-to-date data, as well as a lossless exchange of them. Maintaining a shared data environment is an essential part of the information modeling process.

2) The procedure (algorithm) for providing and exchanging information between the customer and the contractor (supplier of the information model) through the common data environment is established in the customer's information requirements.

3) In a shared data environment, any information on an ongoing project should be in one of four sections: "In progress", "Publicly available", "Published", "Archive".

4) The data section "In progress" is the storage space of the current unfinished parts (sections) of the information model, which are being worked on by the performers, and which have not yet reached the required level of readiness.

5) The "Shared access" section is already intended for joint (parallel) work with related parties. The data from the "Shared access" section reflects the current state of the information model. Before placing information in this section, you must perform the following actions:

– Evaluate the suitability of this information for solving further design tasks;

– Implement the provided procedures for checking the model (section) for collisions;

– To check the required level of detail of information;

– Approve the work performed by the head of the relevant group.

6) The exchange of data that is "Publicly available" is regulated by the internal regulations of the organization, as well as the rules established by the customer.

7) The "Published" data section is a space in which ready-made materials agreed between the project participants on a certain stage of work with the model are placed for transfer to external participants in the process or to regulatory authorities on the part of the customer.

8) Before entering the "Published" section, the data must undergo verification procedures for compliance with the customer's information requirements and authorization.

9) The management of changes/releases of information materials must comply with the docu-

mentation management system established by the technical customer for a specific project. Records of all publications, if necessary, should be kept in electronic and printed form.

10) The "Archive" section is a space into which data from the "Published" phase is transferred for further storage and accounting of all actions for transmitting information and tracking changes (auditing) in case of disputes.

11) All materials in the "Archive" section must be closed for editing.

12) The reference part of the ODS is filled in by the technical customer or, in agreement with him, by the project executors and contains general information on the project, unified databases for project execution, and any other information useful for coordinated information modeling by all project participants.

13) The shared data environment can take the form of a local or network file server, or a model server, as well as represent a cloud service.

14) The responsibility for the implementation of the shared data environment is borne by the customer or a contractor engaged by him.

Today, also according to global practice, ITZ is another mandatory element of any serious project (or multi-project activity) using BIM. This is, without exaggeration, the main set of documents (appendices to contracts with contractors) that defines the entire process of information modeling when creating a construction object. The information requirements of the customer are presented individually to each contractor (and are agreed with him) while being a clarification of the general information requirements of the customer for the entire project.

The information requirements of the customer are compiled to:

– to facilitate the understanding of the tasks by the executors of the contract (to determine the appropriate level of knowledge and qualifications of the executors, as well as the complexity of the work performed);

– reduce risks in the performance of the contract (incompetence of contractors, deadlines, quality, and cost of work performed);

– project information management (uniform rules for the accumulation and use of information, preparation of input and output data for any task);

– maximize all the advantages of information modeling (a single model, the relevance of information, and access to it for all project participants).

Now let's move on to the main elements of ITZ. Usually, the customer's information requirements are divided into three sections: technical, organizational, and informational [15].

The technical requirements must contain:

1) Rules for connecting project sections into a single (coordination) model;

2) Rules for forming a model within one section of the project;

3) Rules for combining project sections executed in different software (different file formats);

4) Rules and conditions for combining sections performed both using information modeling and without them;

5) Rules for naming and designating model elements;

6) Rules for structuring and processing of final information;

7) Other requirements necessary from the point of view of the customer for the quality of the project.

The technical requirements should also specify:

1) Data formats (name and versions of the software used, basic modeling formats, data exchange formats, CAD data formats, other data formats);

2) Data separation structure (common coordinates and binding of model parts, separation of model parts into files);

3) Data security (confidentiality, scheme, and access levels for various project participants).

Organizational requirements should include:

1) Basic rules for the organization and use of the Shared Data Environment (data storage, notification formats, etc.);

2) Conditions based on the experience of performers (the level of completed projects in information modeling technology, the level of qualification or necessary training of personnel in information modeling, the availability of internal standards and regulations for information modeling for performers);

3) The main stages of the project (stages, key stages, and deadlines, etc.);

4) Rules of information exchange (frequency of information provision, methods, and regulations of data exchange, rules of access to information of other performers, etc.).

Information requirements must contain:

1) The level of detail (LOD) of the model elements (set for the main groups of elements);

2) Requirements for rationalization and acceleration of geometric modeling;

3) The level of informativeness (LOI) of the model elements (set for the main groups of elements in the form of specific specifications);

4) Structure of element property fields, including empty fields for perspective information;

5) General principles of entering information;

6) General principles of working with the combined model (setting up views, specifications for checking the model, rules, and tools for checking collisions, rules, and tools for checking design solutions, etc.). The above list is only the main part of the customer's Information requirements. The formation of the final version of the ITZ, which becomes an annex to the contract for the performance of the relevant work, can take place in several visits in close cooperation with future project executors.

Moreover, in certain situations arising during the implementation of the project, the Information requirements of the customer may change (be adjusted) in agreement with the performers. This is most likely in cases where different performers are involved at different, including overlapping, and therefore interrelated, stages of the project.

World experience shows that to increase the efficiency of BIM in response to the Information requirements of the customer, after the conclusion of the contract between the customer and the contractor, the main Plan for the implementation of information tasks (PRIZE, in the English abbreviation BEP) is formed and approved by both parties.

This plan lists the main information materials transmitted and determines when by whom and based on which protocols and procedures information about the project should be prepared (for each stage of information modeling).

The main plan for the implementation of information tasks is developed based on a series of plans concerning the implementation of information tasks for individual sections of modeling. It should be developed jointly by the project manager (BIM manager) on the part of the customer and interaction managers from the relevant groups of performers.

The plan for the implementation of information tasks should contain the responsibilities of the project participants regarding the solution of any specific task of the information modeling process of a construction object.

Results and their discussions. To consolidate the basic procedures of the information modeling process of a construction object, the customer must develop an information protocol of the project - a legally binding supplementary agreement to the contract containing detailed information about the information model of the construction object, which must be performed by the contractor

(contractors) during the implementation of the project.

Each plan for the implementation of information tasks should specify:

a) Compliance with the information requirements of the customer;

b) The period of providing information and the actual dates of delivery of information (following the stages or key milestones of the project); c

) The method of providing information;

d) What kind of information should be provided;

e) Responsible persons providing information.

Part of the planning process for the provision of information must be carried out by the contractor (general contractor) before the conclusion of the contract, as this is necessary for the evaluation carried out by the customer when appointing a particular contractor.

The information team must make sure that the decisions made are correct and comply with the project execution plan before starting work on creating a project information model.

Part of the planning process for providing information to the customer is the responsibility matrix. Within the framework of information modeling, the responsibility matrix should determine: the roles of project participants responsible for information management; the tasks of information modeling (project information model or asset information model) following the requirements for asset information or information requirements of the customer.

As you can see, the use of information modeling technology in the construction of a construction object, which promises a considerable benefit to the customer, in response requires very qualified work from the customer on its organization and execution.

The customer's own BIM department is best suited for solving emerging problems. This name is conditional. Also, this division may not be located in the structure of the technical customer, but may be an involved third-party engineering company. Combined options are also possible. The number of the BIM department (according to international experience, very small) and its technical equipment depend on many factors, in particular, on the size of the project, the frequency of execution of such projects by the customer, the BIM qualifications of the involved performers and much more. The main tasks solved by the BIM department of the customer are shown in Figure 4.

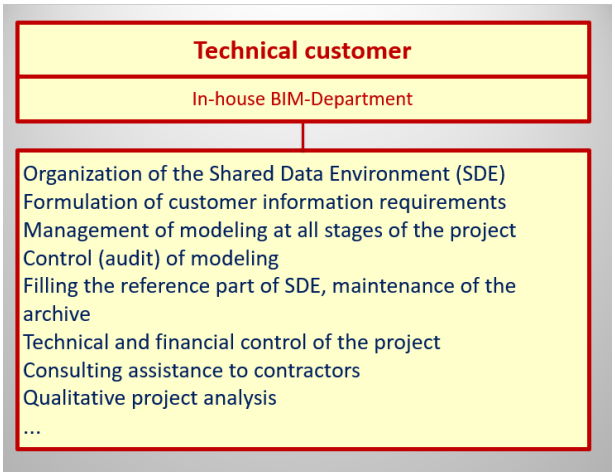

Figure 4. The main tasks solved by the BIM department of the customer

Other tasks may be added to these tasks, depending on the specifics of the project. For example, training in the field of BIM specialists of contracting organizations.

Conclusion. So, according to world experience, the use of BIM on large projects, and not only on them, will receive the greatest efficiency if it is organized and managed by the customer. Therefore, when switching to information modeling, a lot of attention is paid to the training of the customer's specialists, especially the state customer.

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