

## **BIM AS A MEANS OF DIGITALIZATION THE CONSTRUCTION ACTIVITY. WHAT IS MEANT AND WHAT BIM MEANS IN CONSTRUCTION**

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**Abstract:** *Digitalization of information is a process by which information is transposed into digital format, in order to allow quick access to it, processing, transmission, interpretation, multiplication, copying, rendering to infinity in different shapes and sizes. The digitization process aims primarily to streamline the activity to which it is addressing, by reducing costs, resource consumption, reducing execution time, improving the managerial act. Constructions as an important area of economic activity cannot avoid the tendency to digitize specific activities. The digitization will cause in constructions the transition from the traditional “line by line” type system of graphic design and representation, to a new managerial model in which the exchange of information will be continuous between all the participants throughout the life cycle of the construction. This paper try to be an introduction to what it is and why we must transform the traditional way of construction project management into Building Information Management – BIM in construction industry.*

**Adnotare:** *Digitalizarea informatiei este un proces prin care informatia este transformata intr-un semnal digital, cu scopul de a facilita, producerea, transmiterea, interpretarea, analiza, multiplicarea informatiei de catre toti cei interesati in infinite modele si forme utile fiecarui participant la realizarea/administrarea unui proiect de constructie. Constructiile, ca domeniu vital al economiei, nu poate sta departe de aceasta tendinta noua si trebuie sa treaca la o digitalizare a informatiilor specifice. Acest fenomen cauzeaza trecerea de la sistemul de desenare traditional “linie cu linie” a constructiilor, la un nou model care sa cuprinda alaturi de reprezentarea grafica a constructiei si o serie intreaga de informatii necesare managementului proiectului/administrarii constructiei.*

*Aceasta lucrare incearca sa fie o introducere privind ce inseamna si de ce trebuie sa implementam digitalizarea informatiei-BIM in activitatea de constructii.*

**Keywords / Cuvinte cheie:** *BIM, digitalization/digitalizare, management, digitalizarea informatiei/digitalization of information, construction management/management in constructii*

### **Introduction**

Digitalization of information is a process by which information is transposed into digital format, in order to allow quick access to it, processing, transmission, interpretation, multiplication, copying, rendering to infinity in different shapes and sizes. The digitization process aims primarily to streamline the activity to which it is addressing, by reducing costs, resource consumption, reducing execution time, improving the managerial act. In contrast, digitization is a process of transposition from paper to digital, of documents containing information, in order to preserve them and facilitate easy access. Constructions as an important area of economic activity cannot avoid the tendency to digitize specific activities. The digitization will cause in constructions the transition from the traditional “line by line” type system of graphic design and representation, to a new managerial model in which the exchange

of information will be continuous between all the participants throughout the life cycle of the construction.

At present, the process used in the construction of a building is the traditional system, which is a linear one, being the result of a series of cascade activities, in which each participant tends to realize his / her fragment of the project without communicating with the other participant.

BIM is a virtual model of construction, which is a common model for all those involved, where they add specific own data and from where they gather information necessary for their activity, and this reduces information loss and the lack of cooperation existing in a traditional and implicit way. The costs and execution times associated with the project are reduced.

The model with new specific information - for example: types of materials, operating requirements, conditions of execution, etc.) either to consult / analyze this information, everything happening in real time. In this way, all those involved in carrying out a construction project, are "consulted" from the beginning in everything that concerns the conception, design, execution and operation of the construction, eliminating from the design / design phase, the possibilities of non-conformities, which will subsequently generate additional labor costs and volumes.

The BIM manager follows the creation of the informational model of the construction, which will make available to the project manager all the information he needs for the fulfillment of a purpose and an objective that he proposes by realizing the investment.

This digital model of construction is a newer technique, which ensures the increase of the quality and productivity of an investment, in the phase of conception, design, execution and operation. The most interested in this concept are those directly involved (beneficiary, supplier, architect, etc.) but also those indirectly involved in the construction (public authorities, etc.).

Using this model has several advantages:

- Ensures the preparation of complete documentation, correct in conditions of increasing the productivity of its own activity;
- Facilitates the correlation of the design results between all the specialties, highlighting any non-conformities and inconsistencies in time ensuring their elimination;
- Ensures the preparation of complete editable technical documentation in any 2D or 3D format;
- The executives ensure a simple planning of the works and a cost management
- The digital model also provides control over the execution of costs and durations facilitated by the possibility to simulate processes;
- Ensures to the project manager, throughout the life cycle of the investment. Of the construction, all the information necessary for carrying out under conditions of maximum efficiency and productivity of his own activity;
- It accumulates all the information necessary for the correct and rational operation and administration of the construction;
- It allows the existence of a permanent real image on the construction in parallel with a cost management and project execution;
- Allows architects, designers, contractors easy access to products, their integration into digital models.

### **What is understood and what BIM means in construction**

The term BIM represents an abbreviation of some techniques, processes and procedures, all described or having names derived from English. So:

## **2.1 BIM – Building Information Modeling**

It is defined as a process that involves the generation and management of digital representations of the physical and functional characteristics of certain objects / facilities. In particular, these objects can be constructions as a whole or construction elements, BIM in this case being a source of information necessary for making the most varied decisions throughout the life cycle of the construction from the design phase to the demolition phase. .1 Therefore, according to this definition, BIM is a process of informational modeling of constructions, a process of creating a virtual model of a construction. BIM is a procedure / process, through which the necessary information is established, their presentation in digital format and the way of managing this information throughout the life cycle of the construction, for the benefit of all those involved in the construction project. The information may refer to the construction as a whole (residential building, industrial hall, etc.) or to parts of this construction depending on the level of detail desired (foundation, beam, access door, etc.). The information may concern a single discipline (stability of construction, quantitative evaluation, etc.) or involved participant (designer, contractor, etc.) or all useful information is provided to all participants and disciplines involved. The realization of the informational modeling of the construction (the realization of the virtual model of the construction) is based on the existence of computer programs / platforms, whose facilities ensure the attainment of all BIM objectives.

## **2.2 BIM – Building Information Model**

It is a virtual representation, a virtual model of the construction, which allows the provision and storage of information, the exchange of information and from which the information needed to make the decisions regarding the respective construction can be extracted. The virtual model of construction is a common model for all those involved (beneficiaries, users, architects, structuralists, contractors, users, etc.) where they add their own specific data and from where they gather the information needed for their activity. This reduces the information loss and the lack of co-operation traditionally and implicitly reduces the costs and execution times associated with the project. The virtual model of the construction is the result of the process of informational modeling of the construction. For the design of the virtual model of the construction, software programs / softwares capable of not only describing the construction from a geometrical point of view are used, but also to provide other types of information. Traditionally, the representation of a construction is made by two-dimensional (2D) or three-dimensional (3D) drawings.

Over time, along with the geometric dimensions, information about the duration of execution (4D models) and cost information (5D models) were added. In principle, in order for a computer program to be used to create a virtual model of a BIM construction, two conditions are required, namely:

- to provide a three-dimensional (3D) geometric representation of the construction along with other facilities;
- it must include information about the construction and the component elements / objects, along with the geometric dimensions (spatial relations between elements, light analysis, energy analysis, material properties, execution details, etc.).

Therefore, a computer program that allows three-dimensional (3D) representation of the construction, either using parametric drawing or based on objects (line, arc, circle, etc.), simply without incorporating information other than geometric, it cannot be considered software that generates a virtual-BIM model of the construction.

Some software programs in addition to drawing facilities (2D and / or 3D) also contain information specific to a single discipline, useful to a single professional involved in the realization of

the construction project (analysis software regarding the stability of constructions, etc.). These can be considered to the limit, computer programs that generate BIM models. In order to create truly virtual models of a construction, the software must allow the integration of all the information regarding a construction or the component elements and which are useful to all participants in carrying out the construction project.

### **2.3 BIM – Building Information Management**

The information about the construction project refers to the entire life cycle of the construction. Managing information modeling processes as well as creating the virtual model, requires specialized management activity. The BIM manager and his specific activity is usually performed on behalf of the beneficiary / investor and starts from the design phase and ends at the demolition of the construction. It aims at modeling information and creating a virtual model of construction, so that the purpose and objectives of the beneficiary / investor are achieved / achieved at each stage of the construction life cycle. Therefore, the BIM manager aims to create the informational model of the construction / virtual model, which will make available to the project manager all the information necessary for achieving / achieving by him the purpose and objectives proposed by realizing the investment. Also, each of the participants in the execution of a construction project, can develop their own BIMs, which contain certain information and their levels of detail, depending on their own interests, but which must subsequently be integrated into a general BIM. The management of the Information on the Construction Project at this level implies the generation of the information necessary to carry out its own activity but also their integration at the general level of the entire construction project (investment). Nowadays, all those involved in carrying out a construction project, are obliged to fulfill their tasks under limited budgets, lack of skilled labor force, very short execution times and a conflict environment, resulting due to the lack or contradictions of the existing information. The activity of the architect, of the structural designer, of the installation designer must be coordinated, in order to avoid conflicts between the proposed solutions. The actual execution of the construction should not be affected by uncertainties related to the project or regarding the production and delivery of supplies, materials and prefabs. Suppliers must know all the technical and commercial details of the products they must deliver, the date, place and mode of delivery. The execution must be made completely safe with the avoidance of waste production as far as possible.

The management of the Information about the Construction Project at the level of its life cycle, implies the realization of a virtual model of the construction, which will integrate and contain all the information necessary for the project manager, so that he can plan, organize, control and correct the evolution of the project. construction (investment).

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### **2.4 Impact of BIM introduction in the construction industry**

The digital model of construction is a tool for modeling and project management, which has developed in the context of the existence of a fragmented investment / construction process, which generates low productivity and non-quality chronic for the construction industry. The emergence of

this new technique was facilitated by the existence of a digitization of the own / specific activity of some of the "actors" involved in making an investment / construction.

The emergence and implementation of the digital model of construction-BIM, has led to a change in the way of achieving the investment / construction, in the sense of developing communication, cooperation, integration of the activity of all the actors involved.

These have led and continue to lead to changes in the construction industry, which have led to other changes in those regarding the organizational structure of companies in this industry as well as the competencies of the employees involved in the process of using BIM. New technical norms, new standards, new regulations, new conventions, new professional qualifications, adapted to the specific techniques of digital modeling of construction-BIM have appeared and continue to appear.

Those involved in making an investment / construction by using the digital model of construction-BIM, must adapt to these new rules, which implies, on the one hand, the modification and adaptation of their own equipment and equipment with adequate means (computer networks, editing means), means of communication in real time, spaces suitable for these new technologies and implicit investments) and on the other hand the change of the organizational form of the company, of the relations of collaboration, communication, decision within the company.

The application of the principles, techniques and methods specific to the digital model of BIM-constructions, in the sense of modeling and information management and in the sense of modifying the relational and communication system within a construction / investment project, has attracted changes in terms of itself. professional skills, skills and abilities of employees, led to the emergence of new trades and professions. All this implies from the companies in the construction industry a reconsideration of the personnel structure, and from the employees a professional reconversion.

A professional in project management in constructions, who uses in his own activity the digital model of the construction-BIM, must develop a specific set of competences:

1. Managerial competences, which represents the ability to make decisions with long-term impact on investments / constructions. These also refer to the development of the abilities of: the management of the organizations, the planning of the activities, the management of the organizations, the motivation, etc.

2. Administrative competences respectively daily administrative activities necessary for the implementation and achievement of the proposed objectives, such as: drawing up of documentation and offers, personal recruitment, contract management, etc.

3. Functional skills require general skills to manage projects such as: teamwork, managing conflict situations, preparing and conducting an operational working session, etc

4. Operational skills, skills that allow the completion of activities, such as: simulation, analysis of activities, quantitative estimation, value estimation, programming techniques, etc.

5. Technical competences, regarding modeling and understanding of digital models, information management, highlighting non-conformities and inconsistencies, etc.

6. Competence of implementation, represents the activities that ensure the implementation of the digital model of the construction-BIM, such as: application of technical standards and regulations, use of data libraries, etc.

7. Competence for ensuring the functioning of digital models, respectively skills for ensuring and maintaining the functionality of technological systems for information and communication exchange.

8. Research and development skills, require skills to evaluate the digital model, to identify shortcomings and defects, to develop and / or improve existing models.

9. Fundamental competences, with reference to those skills resulting from the overall, individual experience in the project management activity.

In order to cope with these changes and to ensure the rapid and effective implementation of the digital model of BIM-construction, trainers, universities, vocational schools or vocational training companies, which have to provide the theoretical and practical framework, have a great responsibility. necessary to implement the new project management technology.

### **Conclusions:**

Under the heading BIM is understood 3 different activities / processes in relation to the information related to a construction project during its life cycle.

The digital model of the construction-BIM comprises two defining elements, respectively: graphic representation of the construction. This representation can be 2D or 3D. In general, the digital model allows a 3D visualization of the construction and its component elements, facilitating the geometric modeling of the construction, allowing the visualization of the construction as it is imagined, as it will be constructed, in other words what it will look like in reality. The same model must allow the 2D graphic representation of the construction and its component elements, especially for the preparation of the execution documentation;

A database and information. The importance and usefulness of the digital model of the BIM-construction, results from the volume and variety of the information it contains, necessary for the efficient realization of the construction / investment, corresponding to its stage of development (feasibility, design, design, execution, operation). The digital model of the construction-BIM, is a huge database / information, centralized and permanently updated throughout the life cycle of the construction. Therefore the data / information contained in the model are very varied, usable for all professions and trades involved in the construction / investment and may refer to: a. Composition and composition, the nature of the materials from which the construction elements and the construction as a whole are made ; b. the physical properties of the constituent elements of the construction: thermal resistance, mechanical properties, acoustic performance, fire resistance, etc.; c. identification data: location in construction, number of identical elements, etc.; d. the technical data sheet of the element according to the manufacturer; e. geometric dimensions: lengths, surfaces, volume, quantities / consumptions of associated materials, etc.; f. technological details for commissioning and joining with other construction elements; g. behavior in time, maintenance methods, repairs, replacement for keeping the designed functional characteristics; h. maintenance of the construction elements and of the construction as a whole i. consumption and costs associated with the construction and / or construction elements as a whole; j. data on the execution times of the elements; k. fiscal and financial-accounting information of the "asset" construction.

BIM is a very popular term today, being used more often by software developers, to describe the quality and capability of their own products. For this reason, the definition and content of the term BIM is the subject of many confusions. Therefore it is important not only to define theoretically the term BIM, as a technology for digitizing information in construction and as a managerial tool for working with construction projects, but also to clarify clearly the situations in which an IT product or a digital technology does not It can be called BIM, respectively:

a) Computer products used for the graphic, 2D and / or 3D representation of constructions and construction elements, but which do not contain other information about them or do not generate intelligent analyzes of the project geometry (overlaps, non-conformities, etc. )

b) IT products that do not use parametric design, so that do not take into account the position of the construction elements and the mutual interdependence between these positions (changing the position of one element affects the position and properties of all the other construction elements);

c) Computer products that do not automatically take over and make the corresponding changes to the entire construction, when the size of a construction element changes in a 2D file.

**In conclusion, the digital model of construction-BIM is meant to digitize the process of performing a construction / investment throughout its life cycle, based on the creation of intelligent 3D models that have all the information structured according to the stage of the life cycle and which to allow the collection and exchange of information, the collaboration between all those who participate or are interested in the construction / investment.**

The digital model of construction-BIM refers (it is useful and usable) for the whole life cycle of the construction / investment. Each person involved in any of the stages of the construction / investment life cycle, has the opportunity to extract the information he needs and the obligation to add in the common model, the information he produces as a result of his own activity.

The use of the digital model of the BIM-construction, implicitly attracts a new philosophy of realizing the constructions / investments, respectively the transition from the individual working system (each in its capsule / square) to a collaborative / integrated system, system in which the cooperation is paramount. between those involved (teamwork). The digital model of construction-BIM facilitates the exchange of information and results of its own activities, for all those involved in the design, implementation and operation of a construction / investment.

The traditional / current system

➤ Entrepreneur, Investor and financier, authorized designers and suppliers, administrator

Using the Digital Model

➤ Entrepreneur, Investor and financier, authorized designers and suppliers, administrator, BIM

The information included in the digital model of the construction-BIM, is of digital type, being easy to store and transmit, simple to sort and filter as needed. At the same time, the digital format of this information must ensure interoperability, respectively the possibility of use regardless of the users' software, access to information by anyone and from anywhere without restrictions, the unitary understanding of the information regardless of the specific language of the software used, allowing collaboration between those involved in the construction / investment.

Currently in the world there are two formats for implementing the digital model of the BIM-construction, respectively a format entitled "open" and a format entitled "of the owner". The use of the "open" format ensures the use of the digital model of the BIM construction by anyone. For this, both the design of the digital model (both the graphic part and the information / data part) and its use are based on existing computer programs used universally and on a standardization of the conception, content and presentation of data and information. This system allows the involvement in the construction of all those who want without adaptation efforts. The use of the "owner" format implies that all participants in the construction / investment use a certain digital model of the construction-BIM, designed by using certain computer programs and with a database / information designed according to the "owner" desire.

Depending on the nature of the information included in the digital model of the BIM construction, several types of such models can be defined:

a) 2D BIM-digital construction model This digital model includes only graphic information, describing the shape and dimensions of the 2D two-dimensional construction elements. Typically, this

digital model is composed of drawings, drawings and technical drawings, used for the actual execution of the construction. It is the most used system today and unfortunately the vast majority of architects, designers and contractors continue to operate using this system.

b) digital model of the 3D-BIM construction It is also a predominantly graphic model, describing the construction in three-dimensional 3D system. The model allows the visualization of the construction from any position, the detection of non-conformities and overlaps, the calculation of the geometric dimensions, the calculation of the geometric quantities, the editing in any format (2D or 3D) of any sections, views, free plans chosen from the general 3D model. The 3D graphic model of the construction, is the foundation on which the digital model of the construction-BIM was developed.

c) 4D BIM digital construction model This model adds in addition to the three dimensions X, Y, Z and the time dimension (execution time) as additional information attached to each construction element. This fact allows those involved in the construction / investment to estimate execution times, to visualize the progress in execution stages.

d) digital model of the 5D-BIM construction Compared to the previous model, a new type of information on "cost" is added (quantitative consumption of resources and costs). This model allows cost-related analysis, both in terms of choosing design solutions and in terms of execution solutions.

e) 6D BIM digital construction model This model contains, in addition to the previous models, information needed to analyze the sustainability of the construction / investment (energy analysis, solar studies, waste analysis, etc.)

f) digital model of construction-BIM 7D This model includes, in addition to the previous models, all the information necessary for the operation / use of the construction, its maintenance, the behavioral monitoring in time, the technical and financial-accounting management, in general all the information necessary for the owner for construction operation and maintenance.

g) digital model of construction-BIM XD This model contains all the information and data, other than those described above, which are necessary for the investor / beneficiary in connection with the construction / investment.

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