

PROJECT MANAGEMENT AND COORDINATION WITH BIM

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Abstract: Building Information Modeling is one of the most talked about subjects within the industry parameter that involves Architecture, Construction and Operation Engineering (AECO), being a concept in constant development as it is improved. BIM is approached by several authors in different ways, so the most effective way to achieve its assertive definition is through studies of its norms and decrees, existing flows, stages, characteristics and responsible persons for the processes. Therefore, the methodology adopted involves the collection of data from previous cases regarding BIM, which inform and investigate the concepts, processes, steps, and standards that were used to analyze the efficiency of methods and charts that aim to assist and order the management and coordination process, which may be elements that, like BIM, are parts of a developing process. With this, the document in question aims to create a database that is intended to show the importance of using BIM consciously as the project manager must manage data correctly for his process coordination through virtual, parametric and intelligent objects that are related to the building cycle.

Keywords: management; coordination; BIM.

GESTÃO E COORDENAÇÃO DE PROJETO COM BIM

Resumo: Building Information Modeling é um dos assuntos mais falados dentro do parâmetro da Indústria que envolve Arquitetura, Engenharia Construção e Operação (AECO), sendo um conceito em constante desenvolvimento à medida que é aperfeiçoado. O BIM é abordado por diversos autores de formas distintas, com isso a forma mais eficaz de se conseguir sua definição assertiva é por meio de estudos de suas normas e decretos, fluxos existentes, etapas, características e personas responsáveis pelos processos. Logo a metodologia adotada envolve a coleta de dados de casos anteriores referentes ao BIM, que informam e investigam os conceitos, processos, etapas e normas que foram usadas para análises de eficiência de métodos e gráficos que tem por intuito auxiliar e ordenar o processo de gestão e coordenação, podendo ser elementos que assim com o BIM, são partes de um processo em desenvolvimento. Com isso, o documento em questão tem por objetivo criar um banco de dados que tem por intuito de mostrar a importância de se usar o BIM de forma consciente à medida que o gerente de projetos deve gerir os dados corretamente para

a sua coordenação de processos por meio de objetos virtuais, paramétricos e inteligentes que estão relacionados com o ciclo da edificação.

Palavras-chave: gestão; coordenação; BIM.

1. INTRODUCTION

Management and coordination are activities to be programmed and carried out by those responsible for a construction site, where the traditional process ends up demanding a grouping and analysis of data that are not capable of achieving effective control in the follow-up of the life cycle of the constructions. For an assertive understanding of it, it is necessary to establish its importance. The concept of Building Information Modeling is not absolute, since it varies according to the author that portrays it, without having an exact definition of what it is, understanding that BIM is one of the most discussed and questioned themes by AECO (Architecture, Engineering, Construction and Operation). Given this, the text in question aims to demonstrate the main definitions intended for BIM over the years and inform its regulations and flows, understanding that it is a concept that is in development, changeable along the information technology growth. In general, BIM is seen as a new approach, still under development, and therefore a multilevel approach.

2. METHODOLOGY

For this paper, we used the descriptive research method in order to analyze the connections involving BIM and project management, through a study on the current state of the art, starting from a bibliographic review composed by the main authors of the area. The research methodology was adopted based on data collection, data processing, data analysis and presentation of findings, considering in two categories: Qualitative or Quantitative. This paper is designed within a qualitative study to interpret the project management process using BIM, as well as traditional and customary project management practices. Thus, the work is part of the conceptual-analytical method, since concepts and ideas of authors that approach the theme were used to construct a scientific analysis on the object of study. Through data collection in secondary sources such as academic papers, articles, books and the like, this research systematically increases the flows of BIM project processes, planning, documentation, management, contracts and bids for BIM developments.

3. RESULTS AND DISCUSSION

BIM

a) CONCEPTS THROUGHOUT HISTORY

BIM is an innovative methodology of approach to information management in construction based on a virtual model of the building [1], offers benefits of consequent use, having as products vastness of details with faster information production and faithful to the real plan. Given this, one can approach the efficiency of BIM in providing data with reduced errors, with short deadlines and better costs, having therefore a definition of integrated information model associated with Building Information Modeling (BIM).

It can be understood as a technology based on virtual, parametric and intelligent objects. It is understood that 3D models referring to buildings and facilities are developed by means of the virtual objects corresponding to the components understood as necessary for the actual building model. When referring to parametric objects, it is concluded that they enable the change of measures and characteristics of their constituent parameters.

But the definitions have not ended, having infinite definitions to be discovered and addressed, with the definition of [9] who reports that it is not a new technology, but a set of policies, processes and technologies that, combined, generate a methodology for the process of designing a building or facility, testing its performance, and managing its information and data, using digital platforms (based on virtual objects) throughout its life cycle. So what's new is the construction industry's access to the technology in question.

b) INTERNATIONAL, NATIONAL STANDARDS, PROTOCOLS AND BIM DECREE

BIM BR

The first Brazilian BIM standard appeared in 2011 focusing on the information classification system. Therefore, NBR 15965 refers to the feasibility that BIM offers the interactions between computers and computers, and between humans and humans (CCI and HHI respectively). The importance of the standardization and regulation of the application/execution of processes derived from the Building Information Modeling technology is evident.

Within the Brazilian scenario there is the BIM BR Strategy, which aims to promote an appropriate environment for investment in BIM, as well as the following decrees:

- Decree No. 10,036, April 2020 - use of technology in the execution of engineering works and services performed by agencies and entities of the federal government;
- Decree no. 9,983, August 2019 - use of progressive BIM implementation, containing methodology for project development. This being divided into three phases, the first in 2021, the second in 2024 and the last in 2028.

BIM INTERNATIONAL

NBR 19650 was created by means of parameters from the British standard BS 1192, absorbed despite its successful practice. Its role covers operational asset management, informal modeling, and digital environment handling, and is divided into parts 1 and 2. The first refers to concepts and principles, and the second to the phases of asset delivery.

Next are the types of information requirements informed in NBR 19650-1, which were created with the intention of promoting collaborative work mechanisms with a sequence of development stages:

- OIR (Organization Information Requirements);
- PIR (Project Information Requirements);
- AIR (Asset Information Requirements);
- EIR (Information Exchange Requirements);

Asset Information Models:

- AIM (Asset Information Model);
- PIM (Project Information Model);

When it comes to NBR 19650-2, the detailing of the design stages is through the processes of:

- Organization Management;
- Project and Project Management;
- Information Management;
- PIM (Delivery Phase);
- AIM (Operations Phase);

It directs responsibilities to all project participants (contractor, contractor and subcontractors) and informs them that a version of the execution plan (BIM use) must be made available during the bidding period for public building. Therefore, these topics are what differentiate it from other ISOs.

The adoption of the standard allows projects, regardless of their size, to interact more quickly, but a good integrated BIM Execution Plan (PEB) is always necessary. It also allows Brazilian projects to be internationalized more easily.

c) BIM PROCESS FLOW EXPERIENCES

i) Steps

- Design concept: BIM gives the opportunity to investigate various design possibilities not only based on their geometric expression, but also their performance in achieving the optimal result in spatial design, whether in energy consumption or cost or construction, as well as errors and conflicts that can be reduced in interaction with the other design disciplines.
- Pre-Building: initial phase in which the sub-activities planned for the appropriate development of the work stage take place. They range from cost estimates to executive project, the latter being the antecedent to the beginning of the building, along with legal approval. It can be fragmented as product conception, project development, interface management, and project and interface analysis.
- Building: The execution phase comprises assistance in contracting companies, detailing (product and production), planning for the execution of building, and execution and direction of building.
- Post-Building: At this stage, BIM can contribute to the operation and maintenance of the asset using several associated technologies that can contribute to the life cycle such as the use of IoT. In addition,

owner's manuals can use mixed reality resources for information on building elements and systems.

ii) Manager e PMI

As defined by [1] PMI or Project Management Institute is a non-profit organization that aims to establish standards for project management, providing a means where managers can gather and share information, generating common discussions. By showing the importance of the project manager, it establishes the idea that he or she must pay attention to the context that will concern his or her management, the life cycle, those involved with the project, the organizational and socioeconomic influences. Therefore, the manager must have leadership, communication, negotiation, problem solving and influence skills.

The PMBOK Guide (Project Management Knowledge Guide) is PMI's flagship publication and a key resource for effective project management in any industry according to PMBOK Guide-Seventh Edition, 2021. It presents twelve project management principles and eight project performance domains. Thus, PMI describes management in nine areas described through thirty-nine different processes. If any of the processes in any of the areas is not performed, the project will be negatively affected, but this does not necessarily mean that it will affect the morale of the team and the performance to deliver the product. With proper management, consequences are generated for the project that range from cost and deadline reduction to assertiveness of project success.

The education of the project coordinator should not be restricted only to graduate courses, but above all, the basic education in undergraduate courses will allow the acquisition of conceptual bases that can be deepened in graduate courses.

The training of design professionals, especially that of the architect, must be reviewed in its scope, which still retains in its origins the traditional vision of the project, seeking its integration into the global context.

(Leonardo Manzione, 2013)

iii) PERT Charts and Critical Path Method

Program Evaluation and Review Technique or PERT charts and the Critical Path Method or CPM, provide control over the project. Both were built by Herry Gantt and are bar charts of tasks in a process [Sisk 1998]. They take care of time and cost reduction for the project and are usually used together and can be applied to different fields.

PERT Charts

It consists of a base with mathematical data and graphics that help in the planning project management process. With it the following actions are possible: Organização das atividades e seus caminhos;

- Organization of the activities and their paths;
- Understanding impacts, tracking costs and delays occurring in the process;

Critical Path Method

It is a method that indicates the maximum total time related to the project, where a single project has more than one CPM. It can be defined as the middle task segment.

Maintaining a product's quality level is directly linked to the control of its production, from its conception to its delivery and use by the customer. The control over development is inserted in the complex framework of costs, deadlines, market positioning, and desired quality levels. This control allows for feasibility, management follow-up, productivity in product development, operation, and maintenance. (Thiago Jabur, Patrícia Duarte, Larissa P.C. dos Santos, Luana Lopes apud Vargas, 2009)

iv) Classification Process

In 2009 was created through an initiative of the Ministry of Development, Industry and Foreign Trade, a Special Study Committee on Building Information Modeling, which developed BIM standards. The building classification system, contained in NBR 15965, was developed with the goal of helping institutions with BIM processes, merging the elements with the components and forming two distinct interactions, the HHI (Human to Human Interactions) and CCI (Computer to Computer Interactions) referring to software.

v) PRINCE

Recognized in Europe and the UK, PRINCE is a project management method created in 1989 by the Central Computer and Telecommunications Agency (CCTA). PRINCE is a little-used method, especially since it is in a format very similar to the previously existing PMBOK. The explanation is that the new method is based on the principles of PMBOK, being a Guide to Project Management Practices. Soon, the PRINCE method acquired the practices exercised by SCRUM (software industry) and although little used, there are already cases of its appearance by the HH (Man-Hour) building.

The use of agile tools, such as Scrum and PRINCE2 Agile, proved to be fully viable in the AEC, where analyses focused on time and cost were prioritized. As a result, best practice guidelines were established for the processes of each stage of the project life cycle. At HH, the PMBOK (2017) techniques were implemented in parallel with the SBOK (2016) with proposals that facilitated communication between the management team and the execution team, engaged employees through the planning and use of 5S at the construction site, and detailed the execution forecasts in parallel with risk management.

(Jaqueline Guerra apud TSO, 2018)

4. CONCLUSION

It is concluded that BIM, being a "mutable" technology still under development, tends not to be defined assertively, having numerous definitions for it. Therefore, understanding and practicing BIM through its management is linked to the

understanding of its stages and concepts, because they do have an exact definition, which are made effective through case studies of its operation. Another important point to be taken into consideration are the national and international standards in the BIM definition journey, since they are legal documents of it. Given the variety of definitions destined to it, one can filter its intrinsic relationship with technology based on virtual, parametric and intelligent objects that participate in stages related to the building's life cycle, covering from pre-building to post-building, with an important relationship with the design conception, therefore BIM's integrated management processes make use of workflows, present appropriate classifications, which address in their steps the presence of managing agents (PMI). Even though variable, BIM is mentioned almost unanimously, as being technology used to create digital and 3D models, forming a methodology focused on the Civil Construction and Architecture industry. Therefore, it generates methods and graphics that are intended to assist and organize the management and coordination process, and may be elements that, like BIM itself, are part of modernity in development.

5. REFERENCES

¹MONTEIRO, André, **Building Information Modeling (BIM): theory and application**, 2011.

²GONZAGA, Amanda, **NBR 15965: understand how the BIM standard works in Brazil**, 2021.

³ZIMERMANN, Maria, **ISSO sets international standards for the use of BIM**, 2017.

⁴MANZIONE, Leonardo, **Proposition of a Conceptual Framework for the Management of the Collaborative Project Process using BIM**, 2013.

⁵SPBIM|Digital Architecture, **PMI-BIM**, 2019.

⁶ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS, **ABNT catalog**, 2021.

⁷RIBEIRO, Sandra, **There are BIM standards**, 2020.

⁸GUERRA, J.N.²; SAKAMOTO, A.R.³; GLORIA, A.L.P., **Agile Management in Civil Construction: PRINCE 2 a complementary application to PMOK in a residential construction site**, 2019.

⁹SILVA, Wilton, **10 Reasons to Evolve with BIM**, 2017.

¹⁰CONTALDI, Ana Carolina; DIMITROV, Stefania, **Project Notebook in BIM**, 2020.

¹¹CAREZZZATO, Gustavo, **BIM Forum Brazil**, 2021.

¹²Brazilian Association of Technical Standards, **BibLus**, 2022.

¹³ BRASIL. Decreto-lei nº 9.983, 2019.

¹⁴Project Management Institute, **PMBOK Guide**, 2021.