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STEPS FROM TRADITIONAL DESIGN TO BIM

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Abstract

The rapid development of techniques and technology in recent decades causes the development and improvement of technological processes. The development, increase in quality and demand for the usage of modern materials cause an increase in the need for various resources, which directly affects the increase in the volume of transport. The need for the fastest possible delivery from the manufacturer to the user has a significant impact on the development of both passenger and transport vehicles. Vehicle characteristics have been changed in the period of 30 years. Vehicles have become larger and faster. As a result, existing infrastructure is becoming insufficient and doesn't provide the expected level of service. There is a need to build new roads and railways. The traditional way of designing, building, maintaining and managing infrastructure is not fast enough to keep up with economic growth, so we need to start to look for ways to improve this process. The main topic of this scientific work is dealing with all the difficulties that may occur in the process of using traditional tools. The first part of this scientific work is dealing with the daily problems which may occur in the process of developing designs and the process of construction work. The second part of this scientific work gives suggestions and directions for the further development of software, which should keep track of the entire process from feasibility study, through geotechnical and geological investigation, surveying the terrain, developing all stages of designs, dealing with construction works and commissioning of the investor of managing institutions. The process does not stop there but continues throughout management and maintenance during exploitation. The purpose of this is to increase the efficiency and quality of all the listed processes listed from the idea to reality.

Keywords: BIM, infrastructure, development, building, maintenance

1 Introduction

The construction of any facility is preceded by the preparation of technical documentation, followed by management and maintenance. People often observe these processes separately, but they are chronologically connected and as such represent a unique entirety and must follow each other. Throughout history, these processes have been developing and improving. At the beginning Designs were made on paper and drawn by hand and now with advanced technology, designs are made by various software on computers. However, man had the need to improve, so the next level in technological advance came quickly and it is spreading fast, and it is transitioning to BIM.
What BIM is and how it works, as well as the problems that appear with the transition to newer technologies, are presented in this work. The basic characteristics of BIM technology (methodology) as well as the conditions and concept of work and management (using) of information are presented. BIM stands for Building Information Modeling. As the name says, it is the creation of a model that carries with it data about that object.

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The purpose of the model serves as all inclusive database that is gradually formed from the idea to its realization and finally management of the future facility. Viewed in a wider sense, BIM can also be defined as a new methodology for designing and managing facilities.
With the use of BIM technology, a new phase in the digital revolution of project management begins. BIM supports not only the creation of 3D models but also the insertion of the 4th dimension of time, the 5th dimension of monitoring the project from the financial aspect and leaves the possibility of further upgrading. BIM is applied in all stages of design, during the construction and throughout the lifetime of the facilities [1].
In the planning phase, besides allowing designers to work together to better coordinate all the parts of the designs, it also helps during testing and simulation before the works are carried out. During the construction, it allows engineers of various occupations, contractors and suppliers to integrate into the information system and thus reduce the risk of errors. Also, it provides users with data (up-to-date information) in real-time with the exact state of the construction site (quantities of materials, scope of work performed, construction time, ...) [2].
Each participant in the project must be familiar with the general terms of use of BIM. The person managing the project (project coordinator) must have overall control over the data used in BIM. It is important to define how BIM will be used in the project and the appropriate responsibilities for of each participant. All responsibility, authority and way of managing information should be precisely defined standards (regulations) and rules that the state is obliged to adopt. This sets the same form and quality of information for everyone, facilitates project management, enables faster communication and reduces risks.

2 Advantages and disadvantages of BIM

People do not accept all changes easily and often, they have a lot of resistance. Until they know the benefits and see that they become more efficient and that the challenges they had are solved more easily. The use of BIM increases the quality control in the process of the execution of works, facilitates the maintenance of the building during its lifetime and finally manages the demolition if necessary. Connecting data into a unique digital information model enables:

- Easier decision-making because it provides simultaneous comparison of solution functionality, required quantities and costs,
- Improving quality control and data exchange making those processes more efficient,
- Enables a better visualization of the object together with the environment and analysis of construction feasibility and matching with the environment,
- More efficient decision-making and directly affects the shortening of the production time.

The aims of building an information model are [3]:

- Providing support for the decision-making process during design,
- The possibility of making a large number of variants,
- Improving coordination between different parts of the project,
- More efficient construction process,
- Optimization of works to reduce the costs of construction and maintenance of the facility,
- Increasing the lifespan of the facility.

Of course, there are also disadvantages of this new concept, they are expected, also are most expressed at the very beginning of use. Besides users who find it difficult to adapt, there is also the problem of education and professional support. Training of all participants in one project is required regardless of age and professional qualification. Contractors and facility managers together with their teams must undergo training and education and must know how to master all software and technologies aimed at creating a BIM model of the facility.

Another disadvantage is that this entire process of introducing standards and training staff is expensive and takes a long time. It is something that is inevitable and that every country that plans to introduce must go through. Countries with a higher standard will go through the process faster. Every country needs to carefully plan and create an implementation strategy for itself so that it makes sense to talk about BIM.

3 Standards

Digital transformation and defining standards is not an easy task. In this chapter, an overview of the most important organizations dealing with the standardization and implementation of BIM, primarily in the world, will be given. The most important organization at the world level for BIM standardization is BUILDINGSMART INTERNATIONAL.

BUILDINGSMART INTERNATIONAL is an international neutral and non-profit industrial body that drives digital transformation and participates in the creation and adoption of open, international standards. Its goal is to enable better collaboration and digital workflows as well as better communication between participants of different professions in all phases, it achieves this through various forms of education, primarily seminars and webinars where experiences are shared. It also provides support to users for the implementation of standards through training and courses.

BUILDINGSMART is the international authority for a set of standards known as the IFC Industry Foundation Class that deal with processes, data digitization, conditions and more efficient project management and resource utilization in industry. These standards guide software certification and the organization of people through training and compliance testing. They also support cooperation with other international standards bodies such as (ISO - International Organization for Standardization), the European Committee for Standardization (CEN-) and the Open Geospatial Consortium (OGC). The IFC standard received ISO approval in 2012 [4].

Some of the more significant standards adopted in Serbia are listed below:

- The SRPS EN ISO 19650 series of standards defines the management of information and its creation during the life cycle of a built asset (better known as "information management") when using building information modeling (BIM). This standard defines the aspect of security in information management [5].
- The SRPS EN ISO 12006 series of standards defines the information model used to store or provide information about objects [5].
- The SRPS EN ISO 16739-1 standard defines Industrial Foundation Classes (IFC) as an open international standard for building information model (BIM) data that is exchanged and shared between software applications used by various participants in the construction industry sector or the maintenance management industry sector facilities and equipment (facility management) [5].

4 Use of BIM building information modeling technology in construction

After getting acquainted with the definition and basic concept of BIM and some of the standards, this chapter will present what is needed to move to BIM and how far we have come with adoption and implementation at the moment. How much do we still need to standardize the use of modern technologies? What prevents us from this lack of knowledge of technology or money? What can we achieve with the programs that are close to us and how limited is their use?

BIM has been implemented much more in building construction, but recently there is a tendency to use it in civil construction as well. In some countries, it has been introduced as mandatory, while in other countries it is still in the process of adoption. Greater use in building construction is expected because objects such as buildings consist of precisely clearly separated units (windows, doors, tiles, pipes, switches, valves and the like). If there is a problem with some built-in element during use, the model can be easily updated.
In the case of infrastructure facilities, the situation is different. The problem is how to define individual parts of the model, primarily the pavement structure and the roadbed, which are made of loose materials and are not from segments. How to define the location of a pothole where the asphalt has been replaced locally and update the model in line with the changes. The mentioned problem is more pronounced with roads than with railways. A railway consists of segments such as rails, fasteners, sleepers, etc. And that's why the mentioned problem is smaller.
Most existing software that is in mass use can create 3D models. The beginning of creating a BIM model is first of all the creation of a 3D model, which is the basis, but it is not enough in itself to be BIM. In addition, it is necessary to provide other information such as technical specifications and characteristics of the incorporated materials, analytical data and several other information. However, this problem can be overcome by upgrading the existing software and with newer versions, over time, new options will be added that would complete the creation of the model. The question arises as to how the data should be organized and handed over first to the Contractor and then to the Road Manager so that they can fully use them.
In chapter 3. STANDARDS, it was said that IFC standards deal with the definition of the aforementioned problem. However, the IFC standard 4.3, which refers to infrastructure facilities, was only approved as final on January 4th, 2024 and will become internationally accredited as the latest version of the ISO 16739 standard. It is expected to be officially published in a few weeks (site accessed on February 28, 2024) [4].
BIM is not only used for newly designed objects, it is also used for existing ones, which are significantly more than those that are being done or have been done as an information model. Modern infrastructure management requires the creation of a model that has all geometric and functional characteristics defined in it. Collecting data from the field is not demanding nowadays when there are a large number of applications and software that can be very easily installed and used in combination with modern equipment (360 cameras, drones, ...). What is a problem and requires a lot of time is the processing of the collected data and the formation of the database from which the informational BIM model is formed.
BIM also means the management of information obtained from the field in real - time. This is significant because it directly contributes to greater security. Providing information on time (about congestion or traffic accidents) to road users directly affects their behaviour and decision-making [6].
The tendency in the world is inevitably the implementation of standards and applications that support the development of BIM. How successful this is depends on the country and the standard of living in it. Richer countries are certainly at a higher level compared to less developed ones. An example of a medium implementation of BIM is Taiwan, where BIM is mostly used in the first stages, i.e. design and construction of facilities [7], while in the United States of America and Singapore, it is also applied in the management process. How far the use of BIM reaches can be seen in the example of NASA, which applies BIM technology in planning the development of settlements on Mars. The idea is to have settlements planned and completed before human crews are sent out. NASA uses VR (virtual reality) technology for this [2].

As far as Europe is concerned, the most advanced country is Great Britain, as much as 73% of all projects are done in BIM. Behind it, according to research, is Germany, Poland, France, Austria, Russia, Poland, Croatia, etc., Figure 1. In Great Britain, since 2016, it has been adopted that all projects financed by the Government must be done in BIM, which has brought to the top the leading leaders in Europe in this field [8].

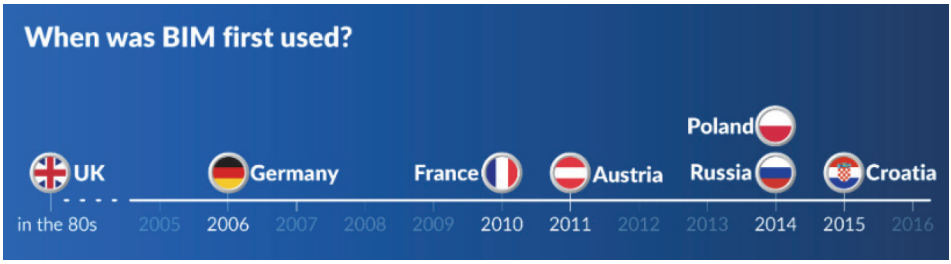

Figure 1 Use of BIM in Europe [8]

The implementation of BIM in Serbia and the surrounding countries is at a much lower level compared to Western Europe, and therefore to the countries mentioned above. Therefore, from all the above follows the conclusion that it is a mistake to think that the biggest problem is in the process of designing and making software. The BIM model, as mentioned, is active from the idea until the demolition of the building. This means that it is in the hands of the Designer for the shortest time, and it is the longest in the hands of the Manager. It follows that the Contractors must adapt to the BIM model and must participate in its creation to hand over the correct model to the Manager, with whom it will remain as long as it exists.

5 Conclusion

Answer to the questions asked: What is needed to switch to BIM and how far have we come with adoption and implementation at this point? How much do we still need for the use of modern technologies to be standardized? What prevents us from this lack of knowledge of technology or money? What can we achieve with the programs that are close to us and to what extent is their use limited? It is not easy and unambiguous to give. In the work it is tried to answer these questions in a simple way. What can be clearly concluded is that the transition to BIM is a big undertaking and a challenge for all countries and it requires systematicity, expertise, money and time. The next phase of the use of BIM technology in modern society should be oriented towards sustainable development and the transition to the creation of the so-called SMART CITIES. Smart cities imply digital monitoring and management of all resources such as e.g.:

- Water management, both purified and wastewater, its consumption and quality,
- Waste management (collection and processing of all types of waste, recycling),
- Traffic monitoring (loads and congestion on the streets),
- Monitoring of air pollution parameters.

Further development of the BIM model should go towards enabling a greater level of implementation in the infrastructure. The development of technologies should combine experience in design, planning, construction, financing and thus simplify and enable faster exchange of data among all sectors participating in the formation of the model. The overall development of information technologies, not only in the field of construction, would certainly be reflected in the development of other branches of a country, such as the economy and industry.

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