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Beginning of Real Wide use of BIM Technology in Czech Republic

Kristyna Pruskova¹

¹ Institute of Technology and Business in České Budějovice, Department of Civil Engineering, Okružní 517/10, 370 01 České Budějovice, Czech Republic

pruskova@mail.vstecb.cz

Abstract. As in all aspects of our lives, development and innovative solutions reveal every day. Life without progressive things, such as a mobile phone or the Internet, is unimaginable for man living in our modern age. Towards the current trend called Industry 4.0., which is the trend of data exchange and automation in manufacturing technologies, people are on the brink of big changes. Current digitization in our everyday lives helps us to enhance their quality. As many other branches, AEC (architecture, engineering and construction) industry also goes through the enhanced digitization process. As an effective tool following trend Industry 4.0 in AEC industry, BIM - Building Information Modelling (or Management) Technology has proven itself. Nowadays, in many not even European Countries, the BIM Technology is in different levels of using. Connected to it, BIM is on different phases of implementation into legislation these days. In some countries, using BIM Technology for new building design is compulsory for public service contracts, building infrastructures or for all building without the difference. In order to be competitive, in the Czech Republic's Legislation, the trend is the same. But there are many barriers for BIM implementation, or the BIM adoption. Proper solutions for many key topics is necessary to find before the introduction of BIM for widespread use. Of course, finding these solutions take a lot of time, expenditures and failures to reveal the most optimal solution of implementation. The Czech Republic is one of countries which already started with processes connected to BIM implementation and adoption. At these days, country is solving many issues connected to BIM implementation. This paper is a brief presentation of them and it reveals the reasons and ways to achieve this.

1. What is digitization bringing to us?

BIM technology is the bearer of the idea of Industry 4.0 in the AEC industry. As Bew, Underwood, Wix and Storar wrote, there is seen a people's transformation in their perception of the world. "Then, seeing really was believing", they wrote. The world made a big step in communication and data sharing by using digital technologies. Communication doesn't depend on place, time and number of people anymore. Social communication, learning materials, tasks, payments and others, all is moved to on-line variants [1]. We accept all these changes towards digitization in our everyday life. It causes that our everyday common communication, tasks and processes are less time-consuming than a few years ago, starting with the appointment dates, ends with a few clicks on Internet related payments, related to our living in our everyday lives. The information sharing is quicker, shared information is in higher quality, also quantity and information can have far greater reach than before. Digitization is a tool facilitating, improving the quality and making our everyday life much easier. The same was, is and is going to be, in AEC industry.

2. Development in building design

As in many other aspects, processes, etc., building design has its own development throughout centuries. From the sketches on a paper, we are able to design a building with the most advanced technologies, when the building and its solutions could be self-sufficient, from the view of energy demands management and adaptation over time.

2.1. *Traditional ways of building design*

In building design, BIM Technology is now on the top of the development pyramid in way of creating building design. At first, there was just making sketches, then proper drawings which were more detailed through the time – with using pen and paper. Development of technologies offered us making drawings with computing technologies, so-called computer aided design (well-known shortcut CAD).

The computer aided design was developed in 80's and first 2D drawing software has revealed. This made it easier to create project documentation, capture more accurate data, and better communication. Inserted data through the digital lines (according to the already used habits for drawing of buildings) were more reliable, better readable and better handed over to other participants in the construction process.

Then, 3D modeling software come to be used. 3D modeling is based on creating whole elements. Compared to 2D when the input is just line, in 3D we are modeling elements, which are automatically visualized in different model's cuts as drawings, means lines, according to the rules for building project documentation. 3D model serves for a better idea of the overall look and design of the building. Compared to 2D lines, modeling of 3D elements eliminates possible mismatches of drawings, e.g. floor plan and section drawing corresponds, because it's the kind of an output from the 3D model. This way of modeling is obviously less demanding on the imagination of building designer. It leads to time less-demanding work and eliminates failures caused by human factor, e.g. staircase drawings are quite difficult in the imagination and calculations of proper dimensions, but from a 3D models its automatically rendered. 3D modeling provides the basics for creating drawings as a part of project documentation. It is necessary to add lot of non-graphical information manually.

2.2. *BIM Technology in building design*

As building itself has developed, technical solutions were with more demanding requirements towards to cost efficiency and user comfort. At these times, we can use wide range of different materials with different properties, thanks to that, static solutions offer more possibilities, demands for energy are lower and all of these make the building more cost saving during its lifecycle and comfortable for use from a long-term point of view. But the solution is more complicated. Modern technologies are very difficult to design correctly and effectively using traditional ways of modeling (in these days it means 2D and 3D software). In the phase of building construction, many complicated details, which are not usually properly drawn in project documentation, or documentation mismatches, poorly executed design or just additional request for information, are the cause of additional cost, more time-consuming construction or workarounds. BIM Technology offers a system of tools leadings to enhanced quality of better design, save time and money in the whole scope.

It's not even about the enhanced quality of project documentation. The main purpose of this technology is to make communication between all the participant engaged to the whole building life cycle more efficient. Communication within BIM technology should set up the schedule of information exchange, its amount and content and responsibilities of each participant. All in order to save time and money.

3. Current situation with BIM Technology use

Many European countries have already started the implementation of BIM Technology into their legislation and Czech Republic is one of them. They draw on the experience of other countries that are more advanced in BIM use. For example, American Institute of Architects (AIA) has revealed and

developed many useful methodologies for efficient BIM Technology use. This paper mentions on one of them, among the others, the common language for BIM design, Level of Development, as an example for suitable solution.

The benefits that BIM can bring with its proper use are countless. Main benefits are directed towards lower financial demands, especially in the building lifecycle's using phase, optimal building design, project documentation of higher quality, less failures and discrepancies within the project documentation, performance higher quality buildings caused by better understanding of the information in project documentation thanks to the visualization that technology offers, and many others.

Before we can make the best from these benefits, we should find the best way for implementing of this technology for wide use. Of course, there are many barriers for BIM adoption. As Nývlt (2015) wrote, there are barriers for BIM adoption not even inside organisations, but also among mutual dependencies and importance of mutual relations. Among these, there are: lack of senior management support, cost of implementation (software and training), scale of culture change required, other competing initiatives, social aspects, staff resistance and ICT literacy, legal uncertainties, ownership, intellectual property and many others [2].

4. BIM implementation and Czech legislation now

Czech Republic started with the first steps that led to the use of BIM technology in the Czech Republic. Initiation groups were formed, e.g. Czech BIM Council, Czech BIM Forum, etc. In these groups, we find many representatives mainly from practice, but also many academics or representatives of the stakeholders. These representatives are active in the field of BIM using and we may say that they are successful due to their diversity of the scope of work. They do the research about wide range of aspects connected to BIM, retrieve and incorporate reactions from others.

At present, several international standards are included in the legislation of the Czech Republic under the BIM CTS (Czech Technical Standard):

- CTS ISO 12006-2: 2015 Building construction - Organization of information about construction works - Part 2: Framework for classification
- CTS ISO 12006-3: 2014 Building construction -- Organization of information about construction works -- Part 3: Framework for object-oriented information
- CTS ISO 16354: 2014 Guidelines for knowledge libraries and object libraries
- CTS ISO 22263: 2014 Organization of information about construction works -- Framework for management of project information
- CTS ISO 29481-1: 2014 Building information models -- Information delivery manual -- Part 1: Methodology and format
- CTS ISO 29481-2: 2014 Building information models -- Information delivery manual -- Part 2: Interaction framework
- CTS ISO-TS 12911: 2014 Framework for building information modelling (BIM) guidance
- CTS ISO 16739: 2014 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

For BIM standards, grading characters are selected in the structure:

- 73 0101 to 0109 for general documents:
 - 73 0101 - ISO 12006
 - 73 0102 - ISO 22263
 - 73 0109 - ISO 16739 (IFC)
- 73 0111 to 0119 for libraries:
 - 73 0111 - ISO 16354
 - In the future, this will include ISO / DIS 16757 (Product Data for Building Services System Models)
- 73 0121 to 0129 for BIM rules:

- 73 0121 - ISO / TS 12911
- 73 0122 - ISO 29481
- 00 is always left for a future summary of the category terminology [3].

These standards are related to the “data part” of BIM Technology: connected to Industrial Foundation Classes format, data sorting, data sharing, mutual cooperation, and others. For the correct BIM using is necessary to define many other issues connected to BIM.

5. Concept of introducing the BIM method in the Czech Republic

Next step for BIM implementation into Czech Republic's legislation was approval of “Concept of introducing the BIM method in the Czech Republic” by the Decree no. 682. This document was published on 26th September 2017 and it was developed by the Ministry of Industry and Trade. Ministry is a guarantor in the implementation of BIM in the Czech Republic in cooperation with the BIM Expert Board and the State Transport Infrastructure Fund. “The document was submitted on the basis of the Government Resolution No. 958 on the Importance of Building Information Modelling (BIM) for Building Practices in the Czech Republic and the proposal for a further procedure for its implementation of 2nd November 2016.” [4].

The concept talks about the main issues connected to BIM implementation into Czech Republic and the schedule of its realization. The main motto of Concept is about savings in acquisition, reconstruction costs of buildings and operation of buildings. It will help the country to build and maintain buildings and facilities in their administration in bigger amount and for less money. Benefits of using BIM technology and reason for its implementation are well known at this time [4].

Czech Republic as a country, is the first and the main subject, who can benefit large amount of expenditures. Costs during the building life cycle are divided to three main consuming parts: 2% of costs for design, 34% for construction and 64% for maintenance and facility management [4]. It is obvious, that the most savings can be at the phase of use, maintenance and facility management. In Czech Republic's government administration is large amount of building or infrastructure, 20% savings which BIM promises is very large sum, which undoubtedly make up for costs associated with implementation.

The force for starting with BIM Technology use in Czech Republic, governments is going to impose an obligation to use the BIM Method for over-limit public contracts for construction works financed from public budgets and for preparing their preparatory work and project documentation from the beginning of the year 2022. Of course, the using BIM Technology is now at the beginning, so it would be taken into account the results of the pilot projects and specifics of each type of construction [4]. This obligation is nowadays the main impulse for many companies for investment in to the BIM Technology implementation.

As written above, the implementation is just at the beginning in Czech Republic. It is necessary to find the optional way for the implementation and using. It means, that it is necessary to figure out, how to issue many key topics related to BIM.

5.1. Key topics related to BIM

In Concept, many key topics are defined. These topics should be issued for the effective implementation of BIM technology into Czech Republic use.

5.1.1. Construction 4.0. Construction 4.0 is an initiative in AEC industry towards the Industry 4.0. The AEC Industry is the least digitized sector of industry. Due to its increasing complexity of construction, responding to different energy, environmental and other requirements, as well as due to the widespread use of less productive workforce, construction is developing very slowly in this area [4].

5.1.2. BIM in the importance of Building Information Model. Compared to traditional way of building model design, BIM Technology offers enter all data, both graphical and non-graphical, into a single

model, in one place. This excludes the documentation discrepancies, which is a very common undesirable phenomenon, because model elements and their attributes are automatically linked to the all parts of the model and all changes are projected to the whole model, virtual reality. It also offers very rapid development and evaluation of each solution variant and this leads to the selection of the best option from the point of view of various criteria. But it also means to start using new methodology of design, new approach to data sharing and mostly using of new tools, new software. That's one of the barriers for BIM adoption by construction engineers and designers. The obligation of use BIM Technology in public contracts is one of the motivations for them [4].

5.1.3. Requirements for the properties of construction products and building elements for creation of a building information model. This topic is about the quality and amount of shared information between manufacturers, design companies, contractors and other participants affecting the building life cycle. It is necessary to standardize this sharing and software communication on the basis of open-data format. Industrial Foundation Classes seems to be the suitable data format and, in this time, IFC is the only common format supported by SW manufacturers for building design. This format is able to define elements' parameters, which SW can already communicate to each other and many aided applications are created on its basis [4].

5.1.4. Content of the BIM documentation. In traditional way – nowadays using, the content of project documentation should correspond to Decree No. 499/2006 Coll, on construction documents as amended by Decree No. 62/2013 Coll. And Decree No. 146/2008 Coll., on the scope and the contents of the project documentation of the transport structures. For this, many recognized professional organizations are working on the basis for new technical standards or methodologies [4].

One of these works is a document of Czech BIM Council's active working group #03: BIM & Realization, called "Level of Development draft assignment to the individual stages of project documentation in the Czech Republic". This draft follows the document "Draft of unified data structure for Building Information Modeling in the Czech Republic", which is a list of building elements' attributes sorted by type of construction. This list is a table containing 7010 lines and approximately 900 different attributes. There are 575 lines and 277 attributes just within the architectural-constructional solution. This document helps to unify the content of information within the project documentation. As written above, nowadays content of project documentation should correspond to current legislative. The document "Level of Development draft assignment to the individual stages of project documentation in the Czech Republic" is created by definition of attributes' Level of Development (LOD) according to the project stages defined by current Czech Republic's Legislation [5]. This document will help to achieve unified content creation of the documentation via the common BIM language – the LOD [6]. In short, Level of Development defines the amount of graphical and non-graphical information about elements according to the Level of Development Specification developed by American Institute of Architects [7].

5.1.5. BIM and Facility Management. As mentioned above, according to the division of costs through the building life cycle, facility management phase is the most cost saving phase. It seems to be the first change, where the BIM's benefits will reveal, because other processes connected to the building design will be more time consuming thanks to their starting use and learning new processes. This key topic also includes the issue of digitization of building, which are already build and which weren't design by the BIM Technology [4].

5.1.6. Other key topics. Among other key topics mentioned in Concept, we can find link of BIM to geographical information system, issue of ownership and copyright, education and many others [4].

6. Conclusion

BIM Technology is gradually coming to the consciousness of people connected to AEC industry. Due to their shallow knowledge of the issue and the initial inability to imagine BIM's benefits and its complicated structure, potential users are not so familiar with implementation using this technology, in a wider scope. They see more barriers and complications, than benefits. It is necessary to motivate them by more detailed education in BIM Technology, implementation recommendations, detailed manuals, clear and clearly defined standards, support and may be required in legislation, including simplification of approval processes. Only then is possible to widely adopt BIM Technology in relatively easy way and with proper using and comprehension.

Concept of introducing the BIM method in the Czech Republic is the first big step for introduction the plan of implementation BIM Technology into Czech Republic's legislation, the first initiation of wide implementation of BIM. Solving mentioned key topics is the main work, which would take a place in upcoming years. Finding the optional ways is now the goal of many researchers, recognized professional organizations and national entities created for BIM Implementation. BIM technology is a very widespread matter, and for its proper wide use and correct communication, it is necessary to define many sub-processes associated with it, to make them the clearest as is possible. Starting with legislation, ending with internal processes of companies within the AEC Industry.

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