

Igor Svetel¹, Milica Pejanović², Nenad Ivanišević³

BIM - SREDSTVO A NE PRINCIP

Rezime

Informaciono modelovanje građevina (BIM) je smatrano za revolucionarni pristup projektovanju zgrada pomoću računara, ali svakodnevno iskustvo sa BIM aplikacijama kao što su Revit i ArchiCAD pokazuje nedoslednosti sa ovim stavom. Rad prikazuje tri glavna ograničenja koja utiču na trenutni nedostatak jedinstvenih principa u osnovi BIM aplikacija i predlaže realniji pogled na BIM oblast. Ako korisnici imaju jasnu ideju šta postojeći alati zaista pružaju oni će znati kako najbolje da koriste postojeće aplikacije, a zatim da zahtevaju poboljšanja koja će da vode ka stvaranju BIM principa .

Ključne reči

BIM, IFC, modelovanje, Revit, ArchiCAD

BIM – A TOOL NOT THE PRINCIPLE

Summary

The Building Information Modeling (BIM) was regarded as the revolutionary approach to computer assisted building design, but everyday experience with BIM applications like Revit and ArchiCAD demonstrates inconsistencies with this view. The paper demonstrates three main limitations that influence recent lack of unified principle behind BIM applications and proposes more realistic view of the BIM field. If users have a clear idea what existing tools provide they will know how best to use existing applications and then to make requests for improvements that would go toward creation of BIM principles.

Key words

BIM, IFC, modeling, Revit, ArchiCAD

¹ *dr, naučni saradnik, Inovacioni centar Mašinskog fakulteta d.o.o. Kraljice Marije 16, 11000 Beograd, isvetel@mas.bg.ac.rs*

² *mr, Arhitektonski fakultet Beograd, Bulevar kralja Aleksandra 73/II, Beograd, pmilica@arh.bg.ac.rs*

³ *dr, vanredni profesor, Građevinski fakultet u Beogradu, Bulevar kralja Aleksandra 73, nesa@grf.bg.ac.rs*

1. INTRODUCTION

With the advent of object-oriented programming in the 1990s and the growth in the software development, programmers faced a problem of finding a way to coordinate their task among different software specialists, clients and users. They came up with the inventions like Unified Modeling Language (UML) [1] and Model-driven architecture (MDA) [2] that all fostered notion of the model as the central repository of all information regarding software project. The model was intended to record all client's requirements, phases of software development, results of the tests, user's experience, and to provide visual representation of the software system that all participants can use in their communication and negotiation. Soon the model-oriented approach became a standard in the software engineering and quickly inspired other professions to use same approach in their disciplines.

Initially, the Building Information Modeling (BIM) was regarded as the revolutionary approach to computer assisted building design [3]. A lot of researchers and practitioners dreamed of the new working environment where all architectural, engineering and construction (AEC) disciplines collaboratively develop one shared building model using a variety of specialized software tools that reflect their professional expertise. A talk about radical paradigm shift in building design practice was commonly associated with every mention of BIM.

Everyone expected that BIM will bring radically new principles that will change design and construction processes, and naturally, looked at BIM applications as the source of the new doctrine in the AEC industry. This view is still dominant, but everyday experience with BIM applications like Revit and ArchiCAD demonstrates inconsistencies with this view. The paper demonstrates three main limitations that influence recent lack of unified principle behind BIM applications and proposes more realistic view of the BIM field that can provide better ground for larger BIM adoption.

2. MODEL LIMITATIONS

At first sight all BIM applications appears as the exercise in the object oriented modeling. The process starts from defining classes representing all building components, and they are implemented in the BIM application as the library of intelligent parametric building elements. Actual modeling turns into a process of choosing elements from given classes and, by providing actual values of parameters, instantiating them into objects depicting actual building components. The user interface of all commercial BIM application is consistent with this understanding of unified modeling mechanism. The idea of central information model that all stakeholders in the process are using to cooperatively develop building design was further fostered by the development of the IFC interoperability data format.

But in reality neither Revit nor ArchiCAD were initially designed as the BIM applications. The older one, ArchiCAD started as the application that uses information rich 3D model composed of parametric elements to achieve consistent traditional 2D building documents, like plans, sections, elevations, etc. The main goal behind parametric objects and inherent information was to enable effortless creation of the building model and to provide mechanisms for automatic adjustment of elements (connection of same materials,

trimming unnecessary parts, etc.) and creation of complex assemblies of elements that function as the whole (windows and doors in wall etc.). The main goal behind Revit application was solving the problem of revision management that can take too much designers time in the process of model's modification.

To achieve established goals each software developer used core mechanism that suits most their intentions. The ArchiCAD is based on the geometry oriented mechanism that uses specific programming language - Geometry Description Language (GDL) to describe all model elements. The language is flexible and enables definition of any geometry, inclusion of custom parameters, and even creation of custom user interface. Since each element is represented as the separate set of GDL commands, the model making process in ArchiCAD resembles virtual construction or mock-up making. The designer chooses the element, defines proper values of parameters to adapt general element definition to particular needs, and defines location of the element in the whole model. According to inherent rules the system includes the element into a model. If the element does not fit perfectly, the designer can use various application tools to make appropriate modifications. If the designer can not find the appropriate element in the application's library she/he can use GDL to create any kind of new element.

The Revit application was designed from the beginning to achieve effective revision management. To achieve that goal, designers devised core mechanism that enables quick propagation of modifications from one component to all related components. Since the core mechanism is based on the relations between elements, all components that are part of the application's library are predefined as the families, and if the designer wants to create new element, he can do that only by adapting existing families to suit her/his need. The application exhibits a kind of "machine like" behavior during modeling process. The designer defines parameters without any preview how change in the parameters influence component that she/he is shaping. After the designer chooses location for the new component the system checks relations between all components and reports to the user about all found inconsistencies that have to be resolved before component is included in the model.

The ArchiCAD and Revit use two different core mechanisms to accomplish similar task. Two native models significantly differ. Some functionality existing in one model completely lack in another model. So, it is impossible to transfer full model with all modeling logic between current BIM applications.

3. IFC LIMITATIONS

The problem of interoperability between BIM applications is addressed by the Industry Foundation Classes (IFC) standard [4]. It is a neutral and open object oriented data model designed to provide highest level of interoperability in AEC. The standard defines classes necessary to represent all concepts related to building during its lifetime and affords data interchange without information loss among all AEC applications.

It was intended for IFC to provide unified model-based description of all building components. Unfortunately, core mechanisms in BIM applications were developed independently from the development of IFC standard lacking direct mapping between native application's model and IFC model. Instead, the IFC export routine in the BIM application extracts information from the native model and assigns them to the appropriate

IFC data structures. In the same way, import routine of the receiving BIM applications interprets IFC file and constructs elements of its native model using information obtained from IFC file.

To address all possible information exchange in AEC field, IFC designers developed rich and redundant data model. That led to many errors in the models translated with the first IFC import – export routines. Recognition of the problem with the rich data model that lacks any directions on proper use led to the development of the Model View Definitions (MVD), subsets of the IFC schema targeted toward precise information exchange between BIM applications. Final development is the IFC 2x3 Coordination View 2.0 [5]. IFC coordination view is developed through a lengthy process of negotiations between software developers to achieve mutual agreement on the way IFC information is used. It led to many compromises and the quantity of information transferred between applications is reduced to the level where there are no mistakes in interpreting the transmitted information. This approach is fostered by the fact that many users restrain from the exchange of BIM models because they can be found legally responsible for giving incorrect information.

4. LACK OF MODELLING RULES

Given above limitations, it is no surprise that majority of practitioners and all software developers concentrate their efforts on the native application's model. Everyone ignores a global model of the building that is designed. Instead, they look how to realize results using existing BIM applications, and the model becomes just a mean to achieve them, not a subject of their interest. Consequently, no general principles on BIM modeling exist, and the designer can exploit radically different modeling procedures even in the same BIM application.

It is clear that software developers foster this approach to achieve market competitiveness. Consequently, improvements in Revit or ArchiCAD applications are related to better and more efficient production of native models and how to effectively manage native model in the application. No BIM application provides a solution to manage a model of the real building that is designed. Some development toward BIM server technology addresses management of the whole building model, but they are restricted to the single or limited number of data formats, and accordingly prone to the same problems as native or IFC models.

The BIM education is largely influenced by the lack of general modeling rules. If someone is inclined to teach about general principles she/he is in danger of presenting a fiction, not reality. On the other hand, if teaching about particular BIM applications, she/he will inevitably miss the general principles. This presents a large obstacle in BIM adoption and prevents development toward BIM applications that will support more general design principles.

5. CONCLUSION

At the current level of development, BIM has failed to provide a principle of making information model of the building. Model created with BIM application is not the center around which to organize other applications, but just another model in a series of computer-

generated models in the AEC field. BIM missed opportunity to provide analog to what exists in other model-oriented disciplines, the basic way of modeling that enables all participants in the process to agree on and harmonize their positions using a model for it.

Does this mean that the BIM concept failed? By no means, BIM is here to stay. There are many valuable contributions that will keep BIM in use. Parametric modeling and libraries of elements that simulate real building components are irreplaceable contribution to computer based building design. Construction companies recognize this advantage and in a growing number provide models of the components of its production program in the formats used by major BIM applications.

Also, new standards are developed that will provide a new foundation for the development of BIM applications. The new IFC4 Design Transfer View [6] is intended to enable transfer of full BIM models between applications, including all modeling logic. Taught by previous experience, software developers are not rushing to provide quick support for the new standard, and probably wait for a certification program that will guide development. It is interesting to see how the Revit and ArchiCAD will meet requirement to export and import full model, and whether this advance will get both applications closer to general BIM model.

But without waiting for further developments, it is possible to take steps toward general understanding of the utility of the computer generated model in the AEC industry. The information model of the building already exists but is distributed across all the applications that are used. Since current BIM applications does not provide a unifying approach it is necessary to analyze all existing applications and formats of information exchange to create a picture of this distributed building model. Seeing each application and their inherent data models as the part of the larger model can provide foundation for better understanding of the model's role in the computer assisted building design. After that, a new step toward building information **modeling** can be achieved.

Seeing BIM applications as separate tools, each having its own advantages and disadvantages eliminates the need for fans attitude toward their functionality. Instead of "ArchiCAD vs. Revit" approach, we can develop awareness of the value of each computationally generated building model and consider possibilities of its wider application. At this moment there are no specific tangible rewards for such enterprise. But the current way of displaying BIM scene is counterproductive. The user expects that there is a universal principle of BIM, and instead faces with the independent tools that partially fulfill the promise of BIM benefits. This often leads to the abandonment of the whole concept after a lot of working hours are devoted to the first training. If users have a clear idea what existing tools provide they will know how best to use existing applications and then to make requests for improvements that would go toward creation of BIM principles.

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