The Use of Building Information Modelling (BIM) in Construction Project Management- Experience from Projects in Sweden

Sofia Sideri

Civil Engineer and Master Student at DXT/SST/HOU

Siderh_sophie@hotmail.com, std081155@ac.eap.gr

George D. Hatzigeorgiou

Associate Professor and Director at DXT/SST/HOU

hatzigeorgiou@eap.gr

Abstract – **This master thesis addresses all engineers that use BIM programs in everyday practice from a project management scope. Both literature study and interviews were analyzed in detail in order to frame the advantages and disadvantages of using BIM programs. It answers the questions arisen after the changes in the working-BIM process. The new role of a project manager and the changes between the communication and relationships between engineers and entrepreneurs are studied.**

Keywords: BIM; construction project management; Building Information Modelling

I. INTRODUCTION

As a countermeasure to human errors, waste of time and money, Building Information Modeling (BIM) was developed. According to the International BIM Standards Committee (National BIM Standards Committee-NBIMS) BIM is defined as "a complete digital representation of digital and functional characteristics of an infrastructure. A BIM model is a source of building information for constructions thus creates a reliable basis for obtaining improved decisions throughout the life cycle, which is available from the early stages of the design concept until demolition. According to the ISO 29481-1: 2010, Part 1, BIM (Building construction information model) is defined as a common digital representation of physical and functional characteristics of any construction object (including buildings, bridges, roads, etc.) which forms a reliable basis for decision making (see Fig. 1).

Figure 1. BIM parameters and applications

In Sweden, there was great concern about productivity in construction since according to data published in 2005 by the Building Management Center (CMB), the productivity in constructions showed losses of 30-35%. This large percentage is mainly due to poor forecasting and reporting of operations undertaken. The use of BIM has spread and continuously increases from swedish construction companies because in this way the effectivity and productivity of a project are increased. In addition, the same model used for the construction may also be used through all its lifetime for the facility management. (Byggindustrin, 2011).

Advantages

The first advantage of using BIM is the easiness to determine from early stages the cost of a project and the feasibility of the model selection as well as monitor and reassure the desired level of quality from the initial stage. It is observed that using BIM programs, the time of the design phase can be reduced or at least restricted to the estimated time schedule. Any changes may happen more easily than before. The check for collisions of elements helps a lot and decreases mistakes that would take place during the construction phase. BIM facilitates also the direct export of detailed two-dimensional drawings. The collaboration between different disciplines of engineers has been increased.

It is possible and valuable to use 4D CAD to BIM model, which means that the parameter of the time is implemented into the CAD 3D model. Not only the construction itself but also the construction conditions, materials and equipment can be simulated in the BIM model.

After the construction is completed, the BIM model can be used for the facility management, which means that it includes all the information needed about the construction which could be used for its maintenance throughout its life-cycle.

Expected challenges

The changes in the working processes and the different roles that the engineers are expected to play in terms of cooperation can be a challenge. Challenges lay also on file ownership and production issues. (Eastman et al, 2011)

II. METHODOLOGY

As methodology for this master thesis, firstly a thorough study of the existing literature was conducted about the advantages and disadvantages of BIM as well as the role of project managers in construction projects. The second part of this thesis was the results and conclusions from interviews. As a suitable method for the data collection by the interviews conducted, the qualitative research method was chosen since the number of people interviewed was 7-10 people, who work in similar or joint projects with the same softwares and all apply primarily BIM method as a way of working in their job. Several people from Sweco in Sweden were selected and interviewed separately in order to analyse their working process and the upcoming changes in the project management role as well as the changes in the relationships between all people involved (engineers, entrepreneurs, owner, etc.).

The questions focused on several areas:

1. The subject of the users work.
2. The level of expertise on the BIM program in use
3. Questions about the technical part of BIM: the level of BIMs efficiency, the simulations
4. The BIM method and its advantages/disadvantages in practice
5. The BIM method for the project management and the changes in the role of the project manager
6. The changes in quality and time of the delivered projects
7. Changes in the way of working method (simultaneous work between different disciplines, data share)
8. Changes in the role and duties of the engineers involved

III. SELECTED RESULTS

The following results were selected as the most important in order to get concrete conclusions.

A. To the question if there is something that cannot be modelled today in a BIM model, the BIM-strategist of Sweco replied that everything can be done in a BIM model as there is no limit to imagination.

The specialist in BIM topics from Oslo also responded that very few things can not be stored in a BIM model and certainly there is information that is not stored as common practice. However, BIM as known today is used at its full potential.

However, the remaining engineers expressed some shortcomings or the wrong practice that leads to mistakes or delays: specifically, the project managers indicated that never until now have they relied 100% on the BIM models because they are not reliable. If the model is not 100% correct, then the extracted information (e.g. how many toilets are in the building) is not precise and that leads to the old time-consuming working methods.

Many engineers mentioned the lack or insufficient library of standard materials available from BIM programs. Indeed, a structural engineer stated that it would be better if a greater library with standardized connection details of prefabricated components was available.

BIM is considered as a great tool for the comparison of alternative technical solutions or their cost estimates. But, this is relatively difficult in practice because it is time-consuming and therefore only few solutions are checked and the cost estimations are usually taken from other programs, other than BIM.

As for the visual capacity of BIM programs, it is considered that BIM models are not so good and for this reason architectural models are often used for the representation of HVAC models. The architectural design programs have better effects (rendering). For example, the Navisworks program is good for the representation, but not for all the relevant disciplines of engineers. Therefore, it is quite common to use different programs because each one of them is specialized in something else.

B. The time for modelling and design has increased a lot in comparison with the traditional working methods. There are some things that need to be improved in the use of the BIM programs and that comes in contrast either with the programs' efficiency or the estimated budget of the client.

The time to create a BIM model varies and depends on the desired level of BIM. Although, the design time (two-dimensional drawings, etc.) has been reduced drastically due to the increased rate of automation included in the BIM programs (see Fig. 2)

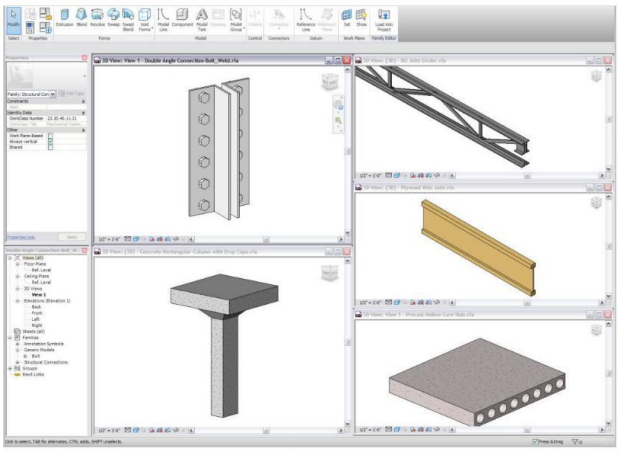

Figure 2. Example of parametric drawing (www.autodesk.com)

However, since customers can now request more extensive design studies in relation to the past, the

workload has increased and it is difficult to compare the Pre-BIM with Post-BIM era.

C. Connection between BIM model and related documents (plans, views, sections): the use of BIM significantly reduces the differences between the various model representations since from the same 3D model, other 2D drawings are extracted, which are like a snapshot of the basic model. Even when a change is performed at the model, this is automatically updated in all views / plans. Thus, information cannot get lost in the process and no errors or failures are generated. In addition, during the BIM-modelling phase, the engineers can focus more easily on major problems at earlier stages than in the past.

D. Nowadays, meetings require only a 3-D BIM model, no drawings are printed because the model shows much better and all participants are well aware of the discussion topics and actively participate. The meetings are usually short and engineers can easily control the construction for possible collisions and other problems. As a result, the errors and omissions that would later appear in the stage of construction of the building, are now treated much earlier and yet there is a timeframe to focus on more serious structural issues, which dramatically increase the service quality.

E. As for the communication, it is much easier now to discuss via Skype and exchange messages via a Navisworks model with pictures where the problematic areas are pointed out. The project managers emphasized that the new way of working has increased remote collaboration, messaging and the common perception that no colleague needs to be informed about changes since these can be seen in the BIM model.

F. The role of a project manager has changed. The role of the project manager is to set out the rules that the quality delivered is constantly improved. The project manager in the future will work according to the customers criteria and will set the rules for how the BIM model will be and how it will behave in every part of the project. In summary, the role will be to coordinate the BIM process.

G. Through BIM, there is a greater understanding of the content of the work of other specialized engineers and that introduces a new engineer faster to the working environment. Now any engineer can challenge the work of others without having expertise in some particular field. It changes the way of cooperation and communication between same and different disciplines. Moreover, the engineers do not try to imagine the construction and what possible problems they may encounter because this is most obvious in the 3-D model. The increased collaboration during the BIM-meetings has increased the feeling of collegiality and all the engineers understand the clients' needs and share the responsibility for eventual mistakes or omissions.

H. The arrival of BIM in the construction industry has contributed to major changes in the working procedure. For this reason a BIM-expert should be available for all groups of specialties in order to resolve BIM issues and reassure the cooperation between different programs and also offer the right guidance to design the model correctly. Each company should develop its own policy for the use of BIM programs in order to facilitate their use for the upcoming projects and improve its working methods. In addition, a BIM-strategist is valuable in big companies in order to spread out the idea and importance of working with BIM.

IV. CONCLUSIONS

The Building Information Modelling or BIM appears to give solutions to the ever growing needs of the construction industry. Rising growth in many countries requires the rapid evolution in technology available for engineers. The future will absolutely include BIM. In this thesis, the benefits of using BIM were analyzed in depth and the philosophy behind BIM. BIM is a working method since it promotes the cooperation and understanding between the different specialties of engineers who work on a project.

The interviews, which took place at Sweco in Sweden showed the great importance of the adoption of BIM in order to deliver projects of high quality. With regards to a model, a lot of studies can be made from the initial stage, thus later changes are decreased. Furthermore, the information stored in the model can be used by engineers and facility managers through its whole life-cycle. Therefore, it is a necessary-identification tool which is accessible and useful for all the end-users: for the designer and the engineer in order to determine for example that the beam collides with a wall, or the manufacturer, who will see the construction phases and will show them to the workers.

The fact that BIM is a much more intuitive tool compared to a 3D image, allows engineers to reduce errors, which would occur in the construction phase and lets them focus their attention on important points of the structure. As a result, the financial management of the project is more controllable and reduces the risk factors that may put the customer at economic risk, but also the time management has been improved. For all these reasons, BIM has become a valuable tool to the project manager, who has now redefined his role in order to cope up with the new working method.

BIM has and will continue to play an important role in relations between the people involved in a project such as engineers, the customer, the end user, the manufacturer and others who now have gained perspective on decision-making for the project. All these changes affect the intermediate role of the project manager who has to take into consideration the changes in technology and update the processes needed to be followed so that the project runs smoothly and efficiently.

The future as stated by all the engineers, who took part in the interview, will include BIM as a way of working, but a lot of things will change as well. Initially, it is expected to abandon the printing of drawings and use only 3-D models instead. The BIM programs will be enriched

with enhanced applications, analysis tools and libraries with standard (codes) materials with national implementation. Major changes are also expected in the simulation of building sites. The cloud has begun to make its appearance as an invisible server for storing and sharing files and is expected to be developed and adopted by construction companies for the new and old projects. New types of files are expected to be developed that will allow open communication between programs.

In the next decade, many changes are expected to take place in the construction industry and all parts involved will need to improve their working methods in order to keep pace with the ever-growing technology.

REFERENCES

Autodesk. (2013). BIM Adoption and Developments. www.autodesk.com, last access: 29-04-2016

Byggindustrin. (2011), Eastman C., Teicholz P., Sacks R., & Liston K.. (2011). BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors, Second Edition. John Wiley & Sons.

ISO Standard, ISO 29481-1:2010(E). (2010). Building Information Modeling — Information Delivery Manual — Part 1: Methodology and Format

https://www.nationalbimstandard.org/faqs#faq1