BIM Education: Implementing and Reviewing "OpeBIM" - BIM for Teachers

Sunil Suwal[1] Päivi Jäväjä[1] and Janne Salin[2]

[1]Metropolia University of Applied Sciences, School of Engineering and Building Services, Agricolankatu 1-3, P. O. Box. 4023, 00079 Metropolia, Helsinki, sunil.suwal@metropolia.fi, paivi.javaja@metropolia.fi
[2]Tocosoft Oy, Lemuntie 7, 00510, Helsinki, janne.salin@tocoman.com

ABSTRACT

Building Information Modeling (BIM) is considered as a common language in construction industry projects today. It is rapidly being acknowledged as a driver for change on a global scale. The perceived benefits of BIM by the early adopters and various researches indicate that collaborative BIM approaches help in delivering projects with reduced time, lower cost, higher quality, and greater customer satisfaction. Recent government uptakes and demands for fully collaborative BIM as a requirement in different countries have resulted in a strong interest towards BIM adoption and its uses, creating a huge demand of BIM competent workforce. Thus, there is an accelerated need for upskilling the industry practitioners and educate the future engineers. However, there is a major challenge for academic organizations to embrace BIM in their curricula for educating the future professionals due to lack of skilled BIM educators. Engineering education is still often based on drafting, since most teachers are experts in 2D or 3D modeling, and only few in BIM. The present lack of skilled BIM educators calls for educating the educators and thus becoming acquainted with the BIM processes, concepts and technologies.

The present paper presents the current state and strategies of BIM academic integration in the School of Civil Engineering and Building Services (SCEBS) of Metropolia University of Applied Sciences, Finland. It describes both an initiation and the results derived from "OpeBIM" (BIM for teachers) implemented to educate the educators. The paper collects the feedback and recommendations provided by the participating educators.

INTRODUCTION

Engineering and technology are central to human progress. They address large-scale pressing challenges like tackling the following issues: energy, transportation and climate change; natural and man-made disaster mitigation; environmental protection and natural resource management; and sustainably built environments for better community and living (UNESCO 2010). Engineering encompasses a diverse and wide range of fields and it has played a vital role in human development from the earliest human civilizations. Engineers are considered important as they not only solve local or global problems but they also appear crucial

to both knowledge creation and transfer (UNESCO 2010; Morell et. al. 2012). Technological advancement today has marked up engineering fields and professions. It has provided versatile tools that support engineering works and professions to gain better results and increase the productivity of the industry. As for instance, adaptive use of BIM (Building Information Modeling) as a process of creating building information models has grown rapidly within the construction industry and the professionals. BIM today is a disruptive technology that has affected almost all the disciplines and fields of construction industry (Eastman et. al. 2011, Sabongi 2009). The perceived benefits and the adaptive use of BIM by the early adopters and various researches indicate that collaborative BIM approaches helps in delivering projects with reduced time, lower cost, higher quality and greater customer satisfaction (Jäväjä et. al. 2013).

BIM today has become a common language in the projects of the construction industry. BIM is considered not only as a tool but also as a process and a system that has a direct beneficial impact within an organization. It yields high-end benefits for all, both direct and indirect stakeholders. Today, there is a diverse approach of BIM in the construction industry and is known in various forms for various types of projects like vertical BIM, horizontal BIM, heavy BIM, sustainable or green BIM, social BIM and many more (Rahman et, al. 2013). These diversities of BIM and changes brought about by BIM in industry have created a greater demand for BIM competent professionals as well as new engineering graduates with an adequate knowledge of BIM know-how and competences. This has resulted in a clear, direct, and automatic impact upon engineering education systems with a need for adopting BIM in engineering education practices.

Educational organizations play a major role in the current BIM transition. Lack of resources and the conservatism of the universities are the key obstacles to developing engineering education to meet the demands (Trine 2008). As BIM is changing the shape of how construction industry projects are handled, it seems like an intense requirement for educational organizations to address these changes. They should effectively support producing future BIM competent workforce needed for the industry. They not only need to reform the traditional engineering education but also should keep up the pace with the changing requirements of industry, with much more interaction between departments and industry (Graham 2012). These changes can already be seen growing rapidly. Different universities around the globe have started to incorporate BIM based education into the existing engineering education programs and curricula; and some have introduced BIM specialization programs (Suwal et, al. 2013). However, there are various aspects that need to be considered and the long-term results of these implementations are still a subject of study.

This paper presents the current state and strategies of BIM academic integration in the School of Civil Engineering and Building Services (SCEBS) of Metropolia University of Applied Sciences, Finland. It describes an initiation “OpeBIM” (BIM for teachers) implemented to educate the educators about BIM with a focus to develop BIM as a unity in their existing courses, and presents feedbacks and recommendations from the participating educators.

BIM EDUCATION PRACTICE

Helsinki Metropolia University of Applied Sciences. Helsinki Metropolia University of Applied Sciences (Metropolia) is the largest university of applied sciences in Finland. SCEBS is the department providing construction-engineering and building services education for Bachelor's and Master's degrees . BIM education is one of the main strategic focus areas of Metropolia and is thus committed to produce BIM competent engineers that the industry demands. Currently, BIM has been introduced as stand-alone courses with a vertical integration into different undergraduate and graduate programmes, both in national and international programs (Suwal et al. 2013). The students are provided BIM education through various BIM based courses, namely : CAD/BIM Technology; Basics of BIM; advanced Applications of BIM; "Product Modeling"; and "Practical Applications of Product Modeling".

Metropolia has a long-term strategy for implementing BIM education for the engineering degree it provides with the belief that BIM should not only be implemented and limited to as stand-alone courses with vertical integration but it should also reflect the horizontal integration amongst students from various disciplines, as it occurs in real life projects. Revisions of programs and curricula are currently in the progressive planning phases in close collaboration with industry participants. Metropolia identifies the true impact and benefits of BIM and thus encourages its educators to integrate BIM possibilities in their existing courses. To support and promote the strategic BIM education focuses, an initiation called "OpeBIM" (TeacherBIM), was implemented. The aim of this initiation was to support the educators find the possible benefits of BIM integration in their existing courses as well as to provide them with theoretical and practical knowledge.

OpeBIM. OpeBIM, financially supported by Metropolia, was designed as a course of 5 ects (European credit transfer and accumulation system). The course took place from September 2012 to May 2013 where the contact teaching was held once every two weeks. The course was structured in close collaboration with the Finnish construction industry. The participating companies were as follows: Nordic construction company (NCC); Skansa; Granlund; Finnmap consulting (FMC); Solibri; Tocosoft; VR track; Senate properties; and Tekla. Moodle was actively used as the virtual learning environment platform. A total of 20 teachers from different disciplines participated in the initiation and the average number of participants present for contact teaching was 50%.

Learning Objectives. Learning objectives of the course was to introduce BIM as containing intelligent data management methods and providing tools for the participants. The focus would be placed on observing BIM and brainstorming the possibilities of BIM as an educational tool that can be incorporated in education and training in all construction educational sectors. For example, BIM could be applied to the following fields: project management; construction technology; structural design and analysis; construction simulations;, production management;, renovation;,

infrastructure design and development etc. In addition to gaining knowledge about BIM utilization, a goal was also set for the participants to investigate different BIM requirements and guidelines. The common BIM requirements (CoBIM), developed by buildingSmart Finland were used as the base for this purpose.

Content of the Course. The course was divided into two sessions as of Autumn 2012 and Spring 2013, where the participants in the first starting period were exposed to current ongoing BIM development. Visiting lecturers from the industry were invited to demonstrate how BIM is used as well as to reveal their expectations concerning the graduates. In the later part, the basics of various practical sessions of BIM tools were carried out. The course content was designed in close collaboration with the industry participants as well as research organizations. Table 1 depicts the content of the course.

Table 1: Course content of OpeBIM.

Spring 2013 session	Autumn 2013 session
BIM in construction companies (NCC)	BIM tools (practical session)
Contractors' BIM; BIM in production management (Skanska)	BIM in facility management (Senate properties)
BIM tools and modeling criteria	BIM in infrastructure projects (VR-track)
Designers' BIM (FMC)	BIM in cost management (Tocosoft)
BIM and building services (Granlund)	
BIM in quality control (Solibri)	
BIM in quantity calculations	
(Name represent visiting lecturers from the companies)	

A questionnaire survey carried out after the first spring session mapped the participants' perspective concerning the course content and BIM. It resulted in positive responses from the participants (Suwal et. al. 2013). Furthermore, the participants were asked to provide a score from 0-3 for the visiting lecturers to determine the importance, where the scores represented the following:

0 – no new information,
1 – I was not present,
2 – average information,
3 – very inspiring and interesting

Figure 1 displays the results of the scores. It suggests it is always important for the learners to acquire the updated information about BIM and industry collaboration.

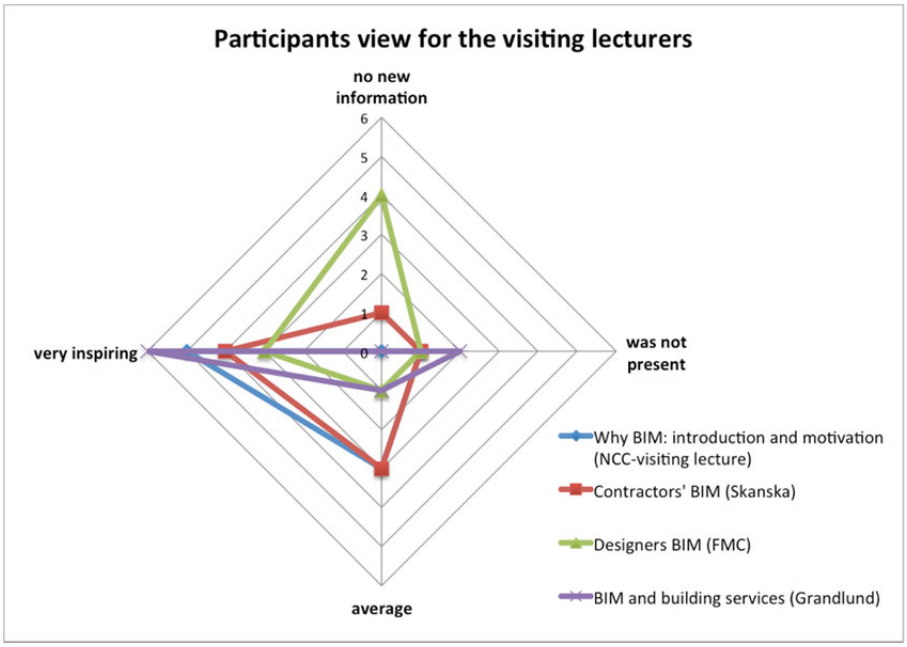

Figure 1. Importance of visiting lectures from the industry

The open feedback form the participants also indicated positive experiences from the participants in the OpeBIM initiation. They were enthusiastic to learn more about product modeling from various other perspectives, e.g. real estate developers and property owners. The participants also wanted to have practical hands-on sessions with the applications. Some feedback from the participants reads as follows:

1. It would be nice to hear BIM perspectives of real estate developers and clients, not necessarily BIM experts but ones that are familiar with the concept.
2. This is an excellent start and raises the level of BIM knowledge.
3. The visiting lectures were good but it would also be beneficial to have some practical sessions in the middle.
4. BIM is the future and ones who are competent will gain advantages.

All feedback from the spring sessions were taken into consideration and the autumn session was revised to incorporate the recommendations provided by the participants. Most of it focused practical sessions as well visiting lectures were invited. A final project focusing on how the participant would include BIM in his existing course was set as a mandatory requirement for completing the course. In addition, participants were also allowed to plan a new course that could actively support ones' studies. A total of 11 participants submitted their proposals and are in the review processes for their implementation. Currently, one of the results, namely a pilot course "BIM in Site Management (5ects)" is being implemented with support from the Virtual Design and Construction (VDC) team of NCC as an industry partner.

Feedback and Views of OpeBIM. OpeBIM initiation has been able to raise the awareness of the educators to think towards "BIM is already here and in use… how do we prepare BIM competent graduates?" One of the major barriers in this

implementation has been the time factor. Not all the educators were able to participate because of the clashes between their mandatory schedules and assignments. However, the participants of the initiation had positive experiences and seemed enthusiastic for practically implementing an integrated BIM unit in their future courses. Some of the feedback collected for the course read as follows:

1. The scope of this education was too wide , which had its own challenges not only for the organizers but also for the participants. As the subject matter was too broad, at the end it rarely gave my course specific information. However, on the whole, this was a comprehensive information package concerning the benefits of BIM and how it is currently utilized today in construction projects.
2. Personal participation proceeded quite well in the spring session but could not actively participate in the autumn session because of my mandatory lectures. I fell behind and my motivation started to fade, however, the lectures were interesting and I was able to see the possibilities of BIM integration in my work.
3. OpeBIM was a good experience, it was a much-needed implementation and it has deepened my BIM know-how. The applications learnt were too numerous and may be it would have been good to learn BIM utilization through those learnt applications than starting to learn how to model.
4. The training and education were useful and there was a good effort made for organizing it. It was good that there were visiting representatives from different companies, however, most of them started with " what BIM is ..:" which I think is repeated very often and not needed. The exercises conducted during the practical sessions were good and I was able to grab the operating principles of BIM applications. Negative aspects included the teaching schedule overlapping with OpeBIM at the end, however, I think BIM integration in my course will need deeper understanding and familiarization with product modeling.
5. The versatility of the wide range of speakers and various software walkthroughs was interesting. It was very useful to get to know different applications and their utilization for all the construction sectors, however, the repetition of information like "transition from 2d to 3d" took place quite often. It might have been good to start with a hands-on practice with BIM tools to generate more interest towards the studies. More focus could also have been targeted towards utilizing BIM in construction economics. Overall, the course provided quite a good picture of BIM utilization in today's practice in Finland and abroad.
6. The course provided necessary possibilities to idealize BIM unity in my courses which I believe is important in future.
7. My negative perception on actual utilization of BIM at the beginning was changed to some extent during the course, however, I personally believe we are still far away to get most out of BIM.

CONCLUSION

The engineering profession is highly competitive in nature and engineering projects involve a wide array of engineers. The engineering projects nowadays call for integrated ways of working. Collaborative work is considered as a key to success for engineering projects. These kinds of collaborative approaches seem rare in engineering education and the graduates primarily learn them mostly in their professional career. As BIM is here to stay, long term BIM incorporated education is needed rapidly? Educational organizations not only need to produce BIM competent workforce but also should also successfully revisit existing engineering education to incorporate BIM for both horizontal and vertical integration. One of the primary issues for incorporating BIM in engineering education is to make the educators aware of various BIM utilization aspects and encourage them to find possible solutions for optimizing BIM unity in their existing course. However, there are still various major barriers for its implementation. Lack of resources and conservative practices at universities are the key obstacles to developing engineering education. Educating educators about BIM should be the basic forefront and important step that engineering education should focus on and initiate in close collaboration with the industry participants. Moreover, these types of initiations should not be only one-time implementations. Conversely, continuous activities should be regularly planned. Establishing dedicated national and international BIM education working groups can be highly recommended for the continuous development of engineering education and work towards addressing the ongoing and future changes of the industry. Metropolia currently seeks to establish and develop such an academic forum. Metropolia also has ongoing plans for developing and implementing “OpeBIM 2” in near future.

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