

BIM Transition Process in Construction Companies

B. Ozorhon ^{1,*}, S. Caglayan ¹, F. O. Ertürk ² and M. B. Arisoy ²

¹ Bogazici University, Civil Engineering Department, Turkey

² ENKA Construction and Industry Co. Inc., ENKA Design Centre, Turkey

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Abstract: Building Information Modeling (BIM) is considered among the most challenging developments in the Architectural, Engineering, and Construction (AEC) industries. BIM is a software based three-dimensional design process that helps the AEC staff obtain and manage the digitally represented building data to support engineering, construction, procurement, and installation activities. The diffusion of the BIM approach in the construction industry has gained acceleration in the last decade. With the advances in information technologies, existence of highly capable commercial software packages, and mandates dictated by the clients, many construction companies have started to employ BIM in their projects. This study aims to investigate the BIM transition process in the construction companies. An interview has been conducted with the executives of a Turkish construction company to analyze the BIM transition process, through three main phases: pre-transition period, transition period, and post-transition period. In the pre-transition period, the motivations of the company to adopt the BIM approach are examined. In the transition period, the challenges encountered and preventive measures taken are indicated. In the post-transition period, the short- and long-term effects of adopting the BIM approach are discussed. The study is expected to guide the construction professionals that intend to implement BIM in their transition process.

Keywords: Building Information Modeling (BIM), BIM transition process, construction management, construction companies, project management.

1. INTRODUCTION

With the help of computer-aided design (CAD) efforts, three-dimensional (3D) modeling development started in 1970s in several industries. While the integrated analysis tools and object-based parametric modeling were developed in many industries, construction industry got stuck in the traditional two-dimensional (2D) design for some time (Eastman and Sacks 2011, Gray et al. 2013). Design and construction industry has been slow to adopt the opportunities offered by the technology. The architectural and design drawings have been limited to conveying only the visual information (Holness 2006).

In the last decade, the traditional 2D design in the Architectural, Engineering, and Construction (AEC) industry has been mostly replaced by the 3D CAD design. 3D CAD design is defined by Autodesk (2018) as a technology for design and technical documentation replacing the manual drafting with an automated process. It can provide an extra dimension to accurately visualize and share designs. Building Information Modeling (BIM) is considered as a ground breaking 3D model-based process to efficiently plan, design, construct, and manage buildings and infrastructure.

* Correspondence: beliz.ozorhon@boun.edu.tr

BIM is a software based 3D design process that helps the AEC staff obtain and manage the digitally represented building data to support engineering, construction, procurement, and installation activities. BIM tools allow building simulations and a more efficient project management. Design mistakes can be decreased and productivity can be increased in the construction industry with the collaborative use of BIM through extending it from design to construction and facility management (Succar 2009). Even though the AEC industries show low maturity in BIM, its usage has been accelerating (McGraw Hill Construction 2014).

Many construction companies are willing to implement BIM to their projects. However, it is not possible to just decide and implement BIM in the project. BIM represents a new way constructing the project in more collaborative and informed environment. Thus, it is not an easy task for companies to change the way they execute the construction process. Companies need to make a good effort to embrace the new process and accomplish the BIM transition process smoothly.

In this study, the aim is to investigate the BIM transition process in the construction companies. In this context, an interview is conducted with four executives of ENKA, a Turkish construction company that has been implementing BIM to their projects for almost ten years. BIM transition process is analyzed through three main phases: pre-transition period, transition period, and post-transition period. The pre-transition period is about the motivations of the company to implement BIM. The transition period concerns with the challenges encountered by the company and the preventive measures taken by the company to overcome them. The post-transition period presents the short and long term effects of embracing the BIM concept.

Background

BIM has been an attractive topic for the academia in the last decade. Many researches have been conducted to investigate BIM from different perspective. Azhar (2011) carried out a comprehensive study to discuss the trends, benefits, risks, and challenges. Four construction projects are reviewed as the case studies. Azhar et al. (2011) conducted a case study on Salisbury University's Perdue School of Business building to demonstrate BIM usage for sustainable design and LEED certification process. They recommended to use a building information model as a by-product to run the analysis. Zhang et al. (2013) adapted the automated safety checking to building information models. Fall protection was reviewed as the safety area. The developed platform could report why, where, when, and what safety measures would be needed to prevent the accident before the construction phase. Sacks et al. (2010) studied the interaction between lean and building information modeling. They identified a total of 56 interactions, 48 of which were validated through a survey of experimental and practical literature.

There has been another group of studies concentrated specifically on BIM adoption in construction companies. In a study conducted by Kaner et al. (2008), the adoption processes of two mid-sized structural engineering firms were investigated through four detailed case studies. The motivations of the companies to adopt BIM were explored and the modeling difficulties and successes were discussed. They reported enhanced engineering design quality and steadily increasing improvement in labor productivity. Ku and Taiebat (2011) directed an online survey to the national and regional U.S. construction companies to assess the current status of BIM implementations, training requirements, organizational structures, and expectations from the graduates regarding BIM knowledge. Coates et al. (2010) identified the key performance indicators of the BIM implementation process by examining a KTP (Knowledge Transfer Partnership) project undertaken between the University of Salford and John McCall Architects.

Khosrowshahi and Arayici (2012) analyzed the UK's construction industry to understand BIM adoption and provided strategies and recommendations for wider BIM implementation.

The objective of this study is to analyze the BIM transition process through three main stages: pre-transition period, transition period, and post-transition period. For this purpose, an interview is conducted with four executives of ENKA. In the pre-transition period, the motivations, the most significant reasons for ENKA to adopt BIM, are discussed. In the transition period, the challenges confronted by ENKA are listed and the way ENKA responded to these challenges are presented. In the post-transition period, the short and long term effects of employing the BIM working methodology are clarified.

Methodology

A BIM-based software, Revit, was introduced to ENKA in 2005. At that time, ENKA was using AutoCAD intensively and Autodesk, the owner of these products, offered Revit together with AutoCAD without imposing any additional costs. Therefore, the executives of the company had a chance to explore the software in detail. Autodesk also offered free Revit education service to the ENKA staff (15-20 people), which shortened the adaptation period.

In 2011, BIM was stated as a requirement in the specifications of the Muscat Airport Project. Although the extend of BIM was not clearly specified, it was just noted that BIM approach had to be adopted for this project. A BIM design group was established with 180 personnel specifically for the project and the design group was given in house training with the educated company staff. Autodesk also gave support during that time. After completing the Muscat Airport Project, a number of projects involving the BIM concept has been completed including mall & commercial projects (Kuntsevo Multifunctional Trade & Business Center, Kashirskaya Multi-Functional Trade Center), healthcare projects (Multifunctional Medical Complex in Gelendzhik), and high-rise & office projects (Erbil Training Centre, ENKA Pazarlama Administration Building, Sadi Gülçelik Office Building, Riverside (Renovation) Towers in Moscow).

An interview is conducted with four executives of ENKA to assess the three BIM transition stages mentioned above. A literature review has been conducted to prepare a list of the BIM transition factors (Table 1). The list was shared with the executives to familiarize them with the BIM transition concept. The interview took around 3 hours. It has been recorded and then translated to highlight the key points. The interviewees are requested to emphasize the components of the BIM process based on each transition stage defined in this study. The reason for taking ENKA as an example organization is because they are familiar with the BIM process and BIM software packages for more than ten years and have completed many construction projects with this approach.

Table 1. BIM transition factors

Factor		Source
Pre-Transition Period		
▶	Motivations of the company	
•	Keeping pace with the technology	Khosrowshahi and Arayici (2012)
•	Improving the company prestige	Coates et al. (2010)
•	Expectation of mandates regarding BIM	Oktem and Ergen (2017)
•	Increasing the productivity	Kaner et al. (2008)
•	Enhancing the documentation quality	Kaner et al. (2008)
Transition Period		
▶	Challenges to be encountered	
•	Lack of experienced personnel	Ku and Taiebat (2011)
•	Lack of company experience	Ku and Taiebat (2011)
•	Determining which software to use	Coates et al. (2010)
•	Setting up the infrastructure	Coates et al. (2010)
•	Deciding on the BIM extent	Oktem and Ergen (2017)
•	Legal challenges	Ku and Taiebat (2011)
▶	Measures to be taken	
•	Training the existing personnel	Ku and Taiebat (2011)
•	Hiring experienced personnel	Ku and Taiebat (2011)
•	Implementing BIM on pilot projects	Coates et al. (2010)
•	Receiving consultancy service	Coates et al. (2010)
•	Comparing available software packages	Coates et al. (2010)
•	Budgeting the infrastructural costs	Khosrowshahi and Arayici (2012)
•	Establishing a BIM department	Ku and Taiebat (2011)
Post-Transition Period		
▶	Short and Long Term Effects	
•	Accumulation of company knowledge	Coates et al. (2010)
•	Having the edge on the tender phase	Coates et al. (2010)
•	Better financial control	Ku and Taiebat (2011)

Results

The most significant points under the pre-transition period, transition period, and post-transition period are listed and explained in detail. Figure 1 shows the summary of the topics discussed during the interview. In the pre-transition period, two major motivations are listed. In the transition period, five challenges and six measures taken are presented. In the post-transition period, three main effects observed in the short & long term are stated.

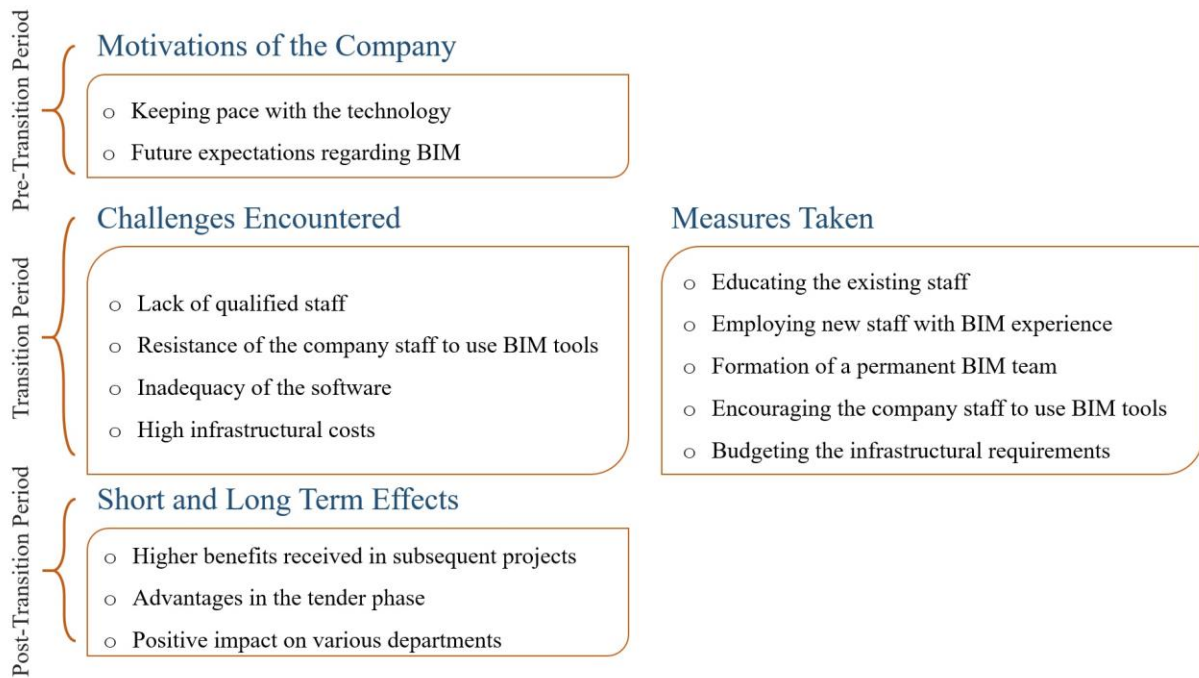


Figure 1: Topics discussed during the interview

Pre-Transition Period

Pre-transition period mainly deals with the motivations of the company regarding BIM adoption in their organization.

- *Keeping pace with the technology:* ENKA has always been a company that adapts itself to the technological changes rapidly. For example, when the windows operating system became first available, they quickly embraced the new operating system and left the old one, which was DOS. Similarly, when the computer-aided design (CAD) software became available, they stopped manual drafting and started using AutoCAD as a CAD software. ENKA considered BIM as a radical technological change. Thus, in order to embrace the latest technology, ENKA was among the first construction companies in the world to adopt the BIM approach.
- *Future expectations regarding BIM:* ENKA executives expected BIM to take place in project specifications in the future. They felt that they had to have full control over BIM-based software before BIM was made mandatory by the authorized institutions.

Transition Period

Challenges Encountered

- *Lack of qualified staff:* Finding qualified staff with BIM experience was one of the biggest challenges. Although the BIM concept was not new at that time, the BIM-based tools were totally new. It was very difficult to find Turkish personnel with BIM experience.
- *Resistance of the company staff to use BIM tools:* The company staff were unwilling to use BIM tools as they were used to and could draw significantly faster in AutoCAD. Considering also the time pressure created on the staff, they strongly insisted on using the traditional software that they could work in a more efficient way.
- *Inadequacy of the software:* The available BIM software were at elementary level and it was risky to model the project in a BIM software. All the commercially available BIM software had many issues to be solved in order that the project could be smoothly modelled using the software.
- *High infrastructural costs:* Implementing the BIM transition process required significant infrastructural costs. BIM software required computers with high performance processors and best graphic cards. Thus, it was a necessity for ENKA to change most of the existing computers with the new expensive ones. In addition to the computer replacement, there were some other costs such as the server setup and software costs.

Measures Taken

- *Educating the existing staff:* In order to overcome the lack of qualified staff, ENKA mostly preferred to educate its existing staff. In 2005, Autodesk offered free Revit education service to familiarize construction companies with the software. In the following years, ENKA continued to take the education service.
- *Employing new staff with BIM experience:* In addition to educating the existing staff, ENKA employed new staff with BIM knowledge. However, considering the BIM team with 180 personnel formed specifically for the Muscat Airport Project, only two of them were the new employed ones with BIM experience.
- *Formation of a permanent BIM team:* Apart from the temporary BIM team formed specifically for the project, a permanent self-learning BIM team was formed with four existing company staff from ENKA Architectural Project Group. The permanent BIM team was expected to create a BIM organizational structure, a sustainable workflow in accordance with the company culture, an object-based coding system, and an ENKA BIM library.
- *Encouraging the company staff to use BIM tools:* The company staff were unwilling to draw in Revit because they were not familiar with the program and therefore could draw a lot faster in AutoCAD. The executives of the company insisted that the model would be drawn in Revit and gave a warning to the staff using AutoCAD.
- *Budgeting the infrastructural requirements:* The high cost of the infrastructural requirements made board members unwilling to make such a transitions. However, some of the executives tried to convince them by stating that BIM concept would become a requirement in the future. The board members started to appreciate the importance of BIM as they noticed the increasing number of projects with a BIM requirement in specifications. Thus, they decided to budget all these costs.

Post-Transition Period

Short- and Long-Term Effects

- *Higher benefits received in subsequent projects:* The benefits of utilizing the BIM concept were realized much higher in the subsequent projects. Due to the inadequacy of the software, the 3D model was even hardly generated in the first project. However, subsequent projects took the advantage of various benefits such as early detection of clashes, accurate quantity take-offs, 3D coordination with other disciplines, daylighting analysis, and 4D scheduling.
- *Advantages in the tender phase:* Existing of experienced BIM staff brought benefits to the company in the tender phase of the subsequent projects. To illustrate, in the tender phase of some projects, the designers modelled the tender drawings by using Revit and this was highly appreciated by the clients. The clients felt that the project was well-understood and analyzed by the ENKA staff. In another project, ENKA designers even made the day lighting analysis. Such events increased the reputation of the company and increased the opportunity to win the tender.
- *Positive impact on various departments:* In addition to the design department, the benefits of BIM implementation has been realized in other departments such as the cost-control and tender departments. Cost-control department could make better analysis with the help of accurate quantity take-offs. Also, tender department could evaluate the project in a better way with 3D visualization and could give more precise tender with accurate quantity take-offs.

Conclusion

BIM is one of the ground-breaking developments in the construction industry. Rate of BIM usage has been accelerating in the construction industry. Many construction companies are willing to implement the BIM working method to their projects. BIM transition is a challenging process that must be investigated in detail. The objective of this study is to analyze the BIM transition process in a Turkish construction company, ENKA. For this purpose, an interview is conducted with the executives of the company to investigate the BIM transition through three main phases: pre-transition period, transition period, post-transition period.

The results reveal that there are two major motivations for the company to carry out the BIM transition. The company has encountered five challenges and has taken six measures to be able to overcome them. In the short & long term, the company has observed three main effects. This study is expected to be beneficial to the construction professionals and companies to figure out the BIM transition process: what kind of challenges they might face, which actions they should take to deal with them, and what the short & long term effects would be.

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