Process of Adopting and Implementing BIM Technology: A Case Study

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On any relatively large construction project, coordination between stakeholders, project managers, superintendents, subcontractors or any other entity becomes vitally important to the project’s success. Building Information Modeling (BIM) creates a virtual design model of a building, which helps construction managers increase efficiency in terms of cost, schedule and overall quality. By connecting 3-D models to coordination and clash detection software’s, construction managers can solve issues quicker or prevent them from happening in the first place. This case study aims to analyze the implementation and use of BIM technology by Shawmut Design and Construction. This study will also focus on the effect of using BIM on customer satisfaction, employees and company reputation. The results of this case study show that companies who invest in BIM will increase project efficiency, customer satisfaction and company reputation.

Key Words: Building Information Modeling (BIM), project management, efficiency

Introduction

As owners and developers continue to ask for more complex buildings to be constructed while hoping to increase efficiency, contractors are forced to find ways to keep up with these growing demands. This concept of increasing efficiency by decreasing project cost, increasing productivity and quality, and reducing project delivery time is the basis of growth for all construction companies across the world. Building information modeling (BIM) offers the potential to achieve these objectives (Azhar, 2011). By using technology, one of the fastest growing industries in the world, construction companies are capable of taking the industry further than ever before.

According to a variety of sources available via the internet, online databases, conversations with individuals and companies in industry and more, BIM has the underlying effect of increasing efficiency throughout every phase of the construction process. From beginning designs, to estimation and all the way through the entirety of the actual construction process, BIM helps a company streamline productivity and improve the final product. So, the obvious question is why doesn’t everyone utilize it?

The answer to this question has a multitude of answers that defer from company to company. The ability for a company to adopt BIM heavily relies upon the employees using it. For BIM to be effectively implemented into a company, the employees need to learn how to use the technology for the company’s intended use. The model is only as good as the information or data put into it; the program is only as good as the competence, design and construction experience of the modeler (Deutsch, 2011). The implementation of BIM is a separate entity from the adoption of BIM in that the implementation is actually using the technology effectively after adopting a plan. Before using BIM software’s, it is necessary to train all intended users and develop a plan on how to successfully implement the adoption the BIM. This requires research, training, practice and certifications before it can be utilized on real projects in the construction industry.

Because of this, I have decided to focus on how one specific company adopted and implemented BIM into their company portfolio. Shawmut Design and Construction (SDC) is an employee-owned (ESOP) company headquartered in Boston, Massachusetts. They recently have began implementing BIM by using 3-D models and merging those with project schedules and clash detection software. SDC also helps in the adoption of these
technologies through the Construction Management Skills Training (CMST) program, which is a 3-year entry program for recent college graduates starting their careers with SDC.

General Background

Before analyzing how SDC successfully implements BIM, it is required to review a couple major topics of this study. First, we must define BIM and the different types of possible uses. Second, it is important to give more background of SDC and the CMST program.

Definition of BIM

Building Information Modeling (BIM) is a process that begins with the creation of an intelligent 3D model and enables document management, coordination and simulation during the entire lifecycle of a project, which include the plan, designing, construction, operation and maintenance (Autodesk, 2019). By creating a 3-D model based upon the plans created by the architect and engineer, the construction manager is able gain more building information than simply reviewing the plans. With an increase in design details comes a better understanding of how different parts of a project will interact, such the plumbing and mechanical equipment. Having a 3-D model of a building before it is constructed allows for the potential of solving problems before the construction manager arrives on-site. By connecting the model to clash detection software’s, the construction manager can discover design issues during the preconstruction phase and have the plans adjusted in time for construction. The 3-D models can also be transmitted into 4-D, 5-D, and 6-D models, which incorporate different aspects of the project management process respectively.

A 4-D model incorporates the factor of time in the form of a construction schedule. By connecting the project schedule to the 3-D model, builders are able to visualize the construction sequence and resolve issues relating to site congestion in the form of materials, subcontractors, etc. A 5-D model incorporates the factor of cost in the form of a construction budget prepared by the estimating department. This allows the estimating department to receive and send cost data to all stakeholders more efficiently and help the owner visualize the project in terms of an important factor: money. A 6-D model incorporates project lifecycle factors such as an energy analysis or maintenance and operation requirements. This allows an owner to view the project on a more holistic scale and visualize costs and requirements after the project in completed.

Shawmut Design and Construction (SDC)

SDC is a regional construction management company that focuses on a large variety of scopes throughout their 9 locations. Stretching from Boston all the way to Los Angeles, SDC services a wide range of customers, mainly focusing on relatively large projects. The company structure is broken up into eight divisions. These different sectors of the company are listed below.

- **Academic**: Academic Buildings, Residential Life, Science & Laboratories, Public K-12
- **Cultural/Historic**: Sacred Spaces, Museums, Historic
- **Corporate/Commercial**: Commercial, Corporate Fit-Outs
- **Healthcare/Life Sciences**: Hospitals, Laboratories & Research
- **Hospitality**: Fine Dining, Casual Dining, Hotels, Entertainment
- **Luxury Homes**: Family Residences
- **Retail**: Luxury, Specialty, Flagships, Jewelry, Banks, Spas and Health Clubs
- **Sports Venues**: Fan Experience, Food and Beverage, Core and Shell

Clearly demonstrated by the list above, SDC is involved in anything that needs a construction manager, whether it be from scratch, a remodel or some type of restoration. With that being said, the main goal of all construction projects is customer satisfaction. On the home page of the SDC website, a part of their mission statement is highlighted: We avoid “surprises.” We are proactive construction experts. We think through issues before they become issues. Oh, and we make sure you have a lot of fun along the way. That’s the Shawmut Design and Construction Way (Shawmut, 2019).
**CMST Program**

The Construction Management Skills Training Program (CMST) and SDC are looking for college graduates who are willing to work to become the best at their craft, not those who feel they are already sufficient (White, 2019). The CMST three-year entry program for recent college graduates allows employees with little industry experience to learn and develop their skillset by working directly under project executives. The program involves one year working as an Assistant Project Manager, one year as an Assistant Superintendent and one year as an Assistant Estimator. The goal and reason for the implementation of the program stems from a common issue in the construction industry. CM graduates are often unfairly criticized by their employers because they are new to the workforce and therefore have limited, if any, practical experience (Ghanem, 2016). Therefore, the goal of this program is to aid in the transition of CM graduates into the workforce by providing them with a “skills training” program focusing on different aspects of their future careers. At the end of the three-year program, the employee is free to decide what sector of SDC they would like to join and what role they would like to play in that sector.

**Objective**

Throughout my time in the CM Department at California Polytechnic State University (Cal Poly), I have always been interested in BIM due to the exposure and capability to transform the entire industry. The majority of lessons and industry knowledge coming through the department regarding BIM spoke highly of it and those who developed the technical skills required of BIM were rewarded with excellent starting positions after graduation. The more that I read about the subject, the more I wondered why BIM wasn’t used at a relatively large amount of companies that my fellow students and I interned for during our summer terms.

Upon conducting research, I realized that the adoption and implementation of BIM is a complex process that relies on technical skills, training, time, money, and employee desire to want to adopt change. The benefits after successful adoption and implementation are clear: increased detail in design, faster communication and coordination, clash detection, increased efficiency in project management, etc. The main question that this case study aims to answer, however, is how can a company adopt and implement BIM successfully into their company culture.

SDC began adopting BIM in 2013, mostly in their east coast branches because of their headquarters being located in Boston. By 2015, BIM was implemented into several academic projects by creating 3-D models with Autodesk’s Revit and connecting the model to Navisworks to run clash detection and coordinate between trades. The 3-D also connected to Sketchup, which allows the factors of time and cost to be connected to the model. The final product is a 5-D model that allows SDC to increase customer satisfaction, project efficiency and the company’s reputation.

The purpose of this study is to create a document that highlights the benefits of a successful adoption and implementation plan, which other companies considering making the switch to BIM could use to gain insight and help formulate an implementation plan.

**Methodology**

The main pathways for collecting data that would give me insight into SDC specifically was through a survey and an interview with an SDC employee. Scholarly research articles about SDC utilizing BIM were hard to find, but I did find one document that reviewed the entire process of design and construction for the Foisie Innovation Center on the campus of Worcester Polytechnic Institute. SDC was the construction manager on the project and used BIM throughout the entirety of the process. Further scholarly research was conducted on SDC and BIM as a whole as well as other companies who have successfully implemented BIM.

The survey was emailed to the Boston office where the majority of BIM at SDC takes place. The survey consisted of 10 questions regarding the benefits and implementation of BIM and received 51 responses from SDC employees.
The interview was conducted with Mike White, Senior Estimator in the Los Angeles branch, who is very aware of the transition to BIM and added benefits to all phases of construction.

The survey, interview and countless articles read about BIM aimed to answer the following:

- What are the benefits of adopting and implementing BIM for a construction company?
- What challenges do companies face when attempting to adopt and implement BIM?
- How can a company adopt and implement BIM?
- How does SDC implement and use BIM in their projects?

**Results**

The results of this study aim to analyze the answers to the survey questions while bringing in knowledge from my interview with Mike White and scholarly research. By analyzing the data collected, this section aims to give construction companies insight to the thought process and implementation strategies for adopting and implementing BIM.

The adoption of BIM is a daunting task for any company because of financing and time related issues, but also because of the company culture and strategies.

Question: Name one challenge other than cost and time that a construction company might face when attempting to adopt BIM?

![Figure 1: Challenges in adopting BIM (51 Responses)](image)

The results in Figure 1 above show that 37% of SDC employees believe that the most challenging part of adopting BIM is training employees on how to use the software. As buildings become more complex, construction companies demand greater technical and applied skills from new entrants to the job market and are seeking heightened skills from workers already in the workplace (Ghanem, 2016). The difference with SDC is that they focus more on improving the skills of their employees, specifically through the CMST program. In my interview with Mike White, he stated that even if a newly hired college graduate has very low technical skills, as long as they have the motivation to learn, SDC will give them the tools to be successful. The message here is that if a construction company buys into adopting BIM and investing in their employees, they will have a much higher chance of successfully adopting BIM.
The other top answers received from the survey were that the average company age of employees and the reluctance to adopt change are challenges to implementing BIM. 18% of SDC employees said age of employees is a challenge to adopting BIM and 22% stated that the challenge was a reluctance to adopt change. Company age and reluctance to adopt new technology generally blend together. Construction professionals that have been in the industry for many years have developed a system of going about their duties without the use of BIM. Older employees have a tendency to not want to adopt new technologies, but the CMST program helps combat this issue. By focusing a lot of time and money on newly hired college graduates with a motivation to learn new technologies, the older employees can take more of a passive role in the adoption process.

Question: What BIM software’s are currently being used in the office and in the field?

- **Autodesk’s Revit**: 2-D and 3-D space where building plans can be transformed into a function 3-D model
- **BIM 360 Glue**: Cloud-based software that allows all stakeholders to communicate in real time
- **Navisworks**: 3-D software that allows for collaboration between trades and clash detection services
- **Sketchup**: 3-D software used for site plans and implementing project schedules with 3-D model
- **SkySync**: Cloud-based software that allows mitigation large files and easy communication

To begin a project, SDC takes the plans handed to them by the architect and constructs a 3-D model in Autodesk’s Revit. Subcontractors, such as the mechanical and plumbing subcontractors will design their respective systems and either give these plans to SDC or create Revit models for themselves. After all of the models have been created, they are combined into Autodesk’s Navisworks in order to coordinate between different scopes of work. Navisworks has a “Clash Detective” tool which assess any potential clashes/intersections occurring in 3D space of the different trades’ models as well as the location of the clashes (Palermo, 2019). By running these clash detections, SDC can discover problems during the design phase that would have resulting in RFI’s during construction.

After clash detection has been ran and issues with coordination have been dealt with, the 3-D is loaded into Sketchup in order to prepare site plans and link the project schedule. This allows the project manager and the owner to see the schedule visually and track progress quickly and easily. Creating a 4-D model also helps plan site logistics by being able to see what trades, equipment, material, etc. will be on the site at the same time.

Question: What are the added benefits of implementing BIM into a company’s design and management processes?

![Figure 2: Benefits of Implementing BIM (51 Responses)](image-url)
The number one answer what added benefits are gained from the successful implementation was that it saves time and money, which was no surprise. 51% of SDC employees stated that saving time and money was the largest benefit. The reasons for saving time and money come due to the other two top answers. 14% of company employees said that increased efficiency in coordination was a benefit and 10% said that the owner gaining a 3-D perspective was a benefit.

As for the increase in coordination efficiency, BIM 360 Glue and SkySync have the biggest roles to play in the increased coordination between stakeholders. SDC uses BIM 360 Glue for quickly communicating coordination issues found via Navisworks or during actual construction on-site. All stakeholders are connected to this program and receive notifications when action is needed on their part. Because the 3-D model is connected to this system, employees are able to easily visualize the issue without having to be on-site and can resolve the problem in an efficient manner.

The owner benefits from the implementation of BIM numerous ways as well. A 3-D model gives the owner the opportunity to visualize their product and make changes early in the design process as opposed to last minute changes that slow down the workflow. The owner is also connected to all cloud-based coordination systems, such as SkySync. The added benefit of SkySync is that large files are able be sent directly and easily. This allows the owner to view time lapses created in Sketchup and respond to any question quickly.

Question: How is company reputation impacted by implementing BIM?

As seen in Figure 3 above, 82% of SDC employees reported that company reputation is significantly increased or increased by implementing BIM as compared to 14% reporting that it is unaffected. Company reputation factors into a company using BIM because it correlates directly with customer satisfaction. If owners are continually happy with the product produced by SDC and efficiency with how its produced, company reputation will continue to grow, which produces more work. The impact on company reputation can be seen through the numerous articles online about construction company’s deciding to make the switch to BIM.
Conclusion

The construction industry continues to grow in complexity and demand year after year and is slowly forcing companies to adopt technology to keep up with the changing times. The adoption and implementation of BIM allows companies to increase project efficiency, customer satisfaction and company reputation, all of which are vitally important to stay ahead of the industry. The initial upfront costs and time needed to be successful with BIM are proven to be worth the investment as long as the company is financially stable and has an implementation plan in place.

SDC has successfully adapted to the growing technologic world by implementing BIM company wide. Through the use of their CMST program and motivation to adapt, SDC stands as a great representative of how a company can devise a plan to adopt and implement BIM and follow through with it. If a company is consider making the leap to the world of BIM, I would recommend following in the footsteps of SDC. This means researching what software would work for your specific company, creating a plan to train your employees, motivating them to want to make the switch and finally creating a plan to being using it.

References


White, Mike. “Senior Project Interview.” 13 May 2019.