CHALLENGES AND SETBACKS IN THE IMPLEMENTATION OF BUILDING INFORMATION MODELLING (BIM): A CASE STUDY

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ABSTRACT

With the price of oil dwindling, Kuwait Oil Company has undertaken an endeavor to optimize cost and time savings. Therefore, Corporate Projects III of Ahmadi Projects Group, in its efforts to meet the new cost saving directives, has utilized Building Information Modeling (BIM) for its new upcoming projects. As is well known, most projects suffer from time and cost overrun due to inappropriate cost estimates and design changes during construction phase. For instance, there are escalating cost complications in one of the team's projects due to clashes and design changes during the construction stage. The architecture, electrical, and construction industry has been undergoing a major transition from a 2D-paper-based linear process to a 3D collaborative digital approach with BIM. BIM is a result of an evolution of the virtual design and construction (VDC) technology. Hence, as pressure intensifies, the team needs to be more agile and innovative to avoid the predicament above. The BIM process shall be applied to the new "Ahmadi Services Building" project with 3D visualization and walkthroughs, key stakeholders assembled early in the process and working collaboratively and openly. Therefore, BIM can be easily defined as a way of working together; efficiently exchanging data among all project partners resulting in a complete digital description of a building project. However, there are risks associated in adopting new technologies that would present itself as a great challenge in crossing the chasm. The team must strive to make an inevitable paradigm shift. The team's approach in using BIM is a worthwhile investment for the company. Cost savings reached almost 28%. This indicates great savings regardless of the size of the project.

Keywords: BIM, cost saving, project management.

1 INTRODUCTION

The Company's revenue has declined substantially due to the recent abrupt downward movement of oil prices. That has made the Company increasingly demand its projects be delivered faster and at a lower cost. This is not an easy task. Such directives mean to adopt new exciting technologies to revise and improve the workflow processes.

Moreover, according to the Construction Industry Institute (CII), about 57% of money spent in construction is a non-value added. This is pure waste. For example, the U.S. construction market is estimated at US$1.288 trillion for 2008, at 57% waste, over $600 billion wasted per year [3].

Furthermore, in the Kuwait Oil Company, just like others, some projects suffer from expensive change orders and substantial delays that in some cases are directly affecting the day-to-day production and operation bottom-line.

As a controlling team that is continually striving for excellence to meet the Company's set of goals and objectives, the team has undertaken a strategy to adopt and implement the BIM process to his newly assigned projects in order to minimize expensive change orders and enhance the design processes. Nevertheless, the journey of BIM adoption has proven itself as neither easy nor effortless.

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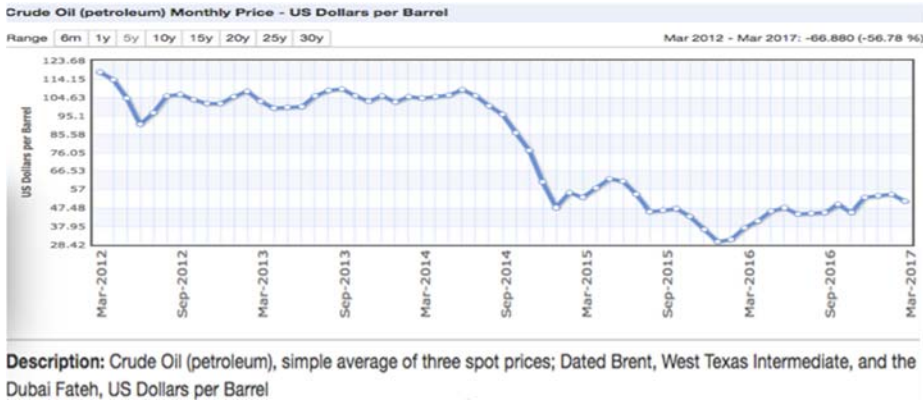

Figure 1: Six-month price history [2].

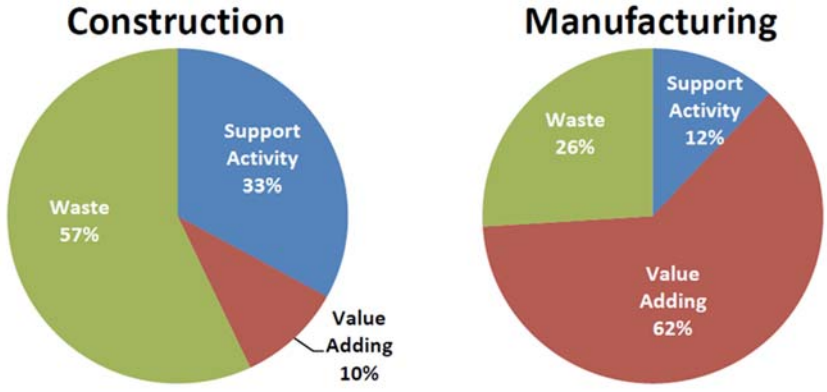

Figure 2: A large portion of the money spent in the construction industry is wasted, especially when compared to the manufacturing industry.

2 METHODOLOGY

This paper focuses on the team's journey and efforts of the transition from the traditional CAD-based design to BIM process for its new projects such as "Ahmadi Services Building". BIM is a front-loaded process that allows quick solutions to various design problems to be closely examined, streamlined, and enhanced. Hence, this shall improve the efficiency of the team's project management.

Applying BIM, the paper examines the significant value-added benefits (if any) to the project management team as whole.

The project will prove if the implementation of BIM processes is justified; the project is a total site area of 25580 m^2, an office building comprised of Main building with Three linked 2nd floor blocks (Block A, B, and C), a parking area, and a 12 MW Substation.

3 CROSSING THE CHASM

BIM is the process or methodology of managing the project from its inception stage throughout its entire life cycle and beyond (facility creation to facility performance).

Among other companies, falling oil prices has increased pressure on the Company to cut cost and improve performance across all departments. Oil Companies stared redefining its business success strategies. Corporate projects III is a controlling team that is responsible for managing the Company's Ahmadi Township projects. Pursing excellence, the team sought the need to improve his design processes to minimize design change orders.

With the team's continuous journey of striving for excellence in managing projects, and aligning his objectives with the Company's directives to minimize cost without compromising quality, the team's top objectives are:

- Eliminate change orders caused by design oversights and errors that cannot be detected in the traditional 2D AUTOCAD design methodology.
- Have more accurate cost estimates and accurate material quantities.

The team is realizing that the traditional 2D paper based linear processes are becoming inefficient; and the new BIM process is one of the answers to the new challenges lie ahead.

According to Macleamy Curve [5], as projects move forward to the right, the ability to reduce and control construction cost decreases and the cost of design change increases.

However, Macleamy states that using collaborative integrated project delivery (IPD) method shifts the curve to the left where the cost of changes is significantly reduced and controlled.

Adopting best practices, the team realizes that simulation and visualization enables front-loading; in early 2015, the team has initiated the journey of BIM process adoption. The decision has been made to gradually switch to Autodesk Revit® BIM software (architecture, MEP, and structure). However, the journey has proven itself neither easy nor effortless.

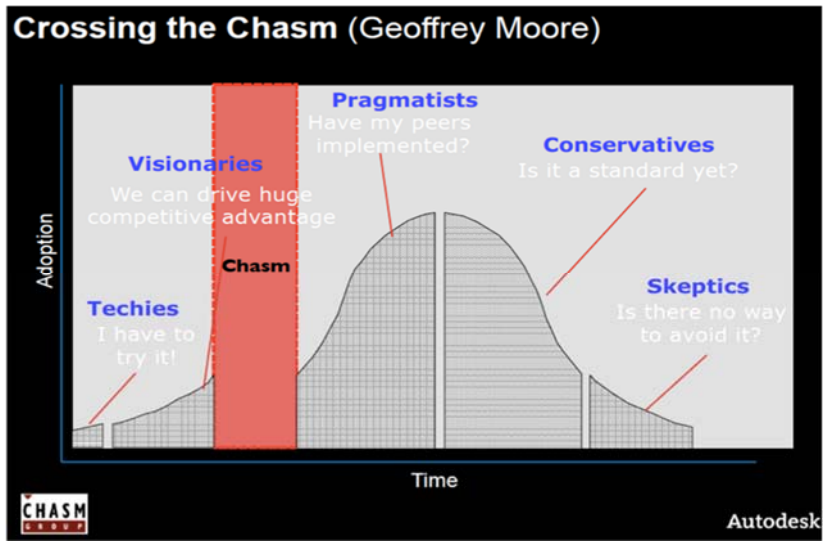

Figure 3: Crossing the Chasm by Moore [4].

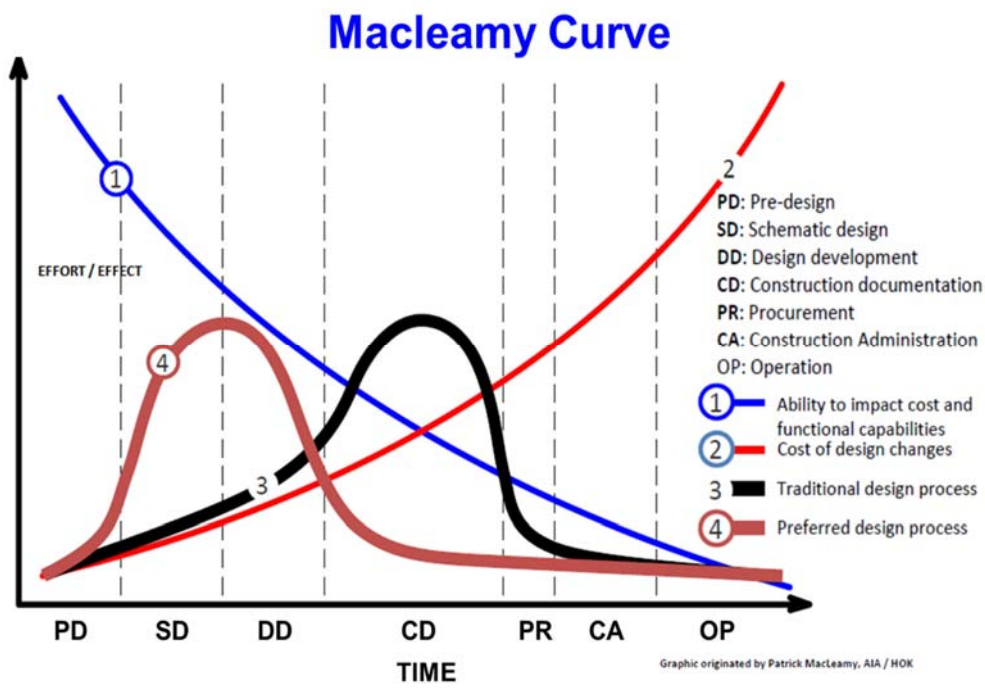

Figure 4: Macleamy Curve [5].

3.1 Acquiring Autodesk Revit® BIM software

One of the foremost obstacles was to convince the Company's responsible IT Technical Systems Team to purchase the software and provide training sessions. After several memos and meetings, the team successfully obtained Autodesk Revit® BIM software. It took almost 5 months to acquire the software.

3.2 Frequent Revit crashes

Autodesk claims that 4GB of RAM is the minimum requirement for Revit® BIM software. Which exactly complies with the Company's desktops. However, 4 GB has proven to be insufficient; Revit kept on crashing most of the time. It is apparent that a hardware upgrade was inevitable.

3.3 Hardware upgrade

Upgrading to workstations was a big challenge due to some operational reasons; the team had taken an unusual approach by making a presenting its case to the Company's upper management. An immediate decision had been made in favor of the team's new requirements. Upgrading to workstations (8G, i7, 4GB Graphic cards), Revit becomes saner than before.

Minimum: Entry-Level Configuration	
Operating System [1]	**Microsoft® Windows® 7 SP1 64-bit:** Windows 7 Enterprise, Ultimate, Professional, or Home Premium **Microsoft® Windows® 8 64-bit:** Windows 8 Enterprise, Pro, or Windows 8 **Microsoft® Windows® 8.1 64-bit:** Windows 8.1 Enterprise, Pro, or Windows 8.1
CPU Type	Single- or Multi-Core Intel® Pentium®, Xeon®, or i-Series processor or AMD® equivalent with SSE2 technology. Highest affordable CPU speed rating recommended. Autodesk® Revit® software products will use multiple cores for many tasks, using up to 16 cores for near-photorealistic rendering operations.
Memory	4 GB RAM • Usually sufficient for a typical editing session for a single model up to approximately 100 MB on disk. This estimate is based on internal testing and customer reports. Individual models will vary in their use of computer resources and performance characteristics. • Models created in previous versions of Revit software products may require more available memory for the one-time upgrade process.
Video Display	1,280 x 1,024 with true color

Figure 5: PC minimum requirements for Revit [6].

3.4 Training

After all the investments, initially, training presented itself as a challenge for the team. Training means more time and money to spend. Not only qualified certified trainers were hard to find but also many sessions and levels of training were needed to scale the design team quickly and cost effectively. Nevertheless, initial training sessions were delivered as planned, on time and budget.

3.5 Winning the hearts and minds

Success of training is one thing and retaining and applying the acquired knowledge to practical skills and daily tasks is another. Change is the only constant in life (Heraclitus of Ephesus, Greek philosopher, 535–475 BC). Embracing change is not an easy task. Leaders in the team started promoting the higher purpose of this paradigm shift that shall become as a shared best practice among all the company's departments. Fortunately, we have won the hearts and minds of the staff in using the Revit® BIM software.

4 APPLYING BIM

BIM process started on the project with the Autodesk Revit® software for BIM (architecture, MEP, and structure) to help the team's architects and designers to bring ideas from concept to construction with a coordinated model-based approach. In contrast with the traditional design method, BIM optimizes the efficiency of the team's design processes. Virtual design and construction (VDC) enabled the design team to streamline all the clashes and design errors.

Figure 6: Project design with Revit.

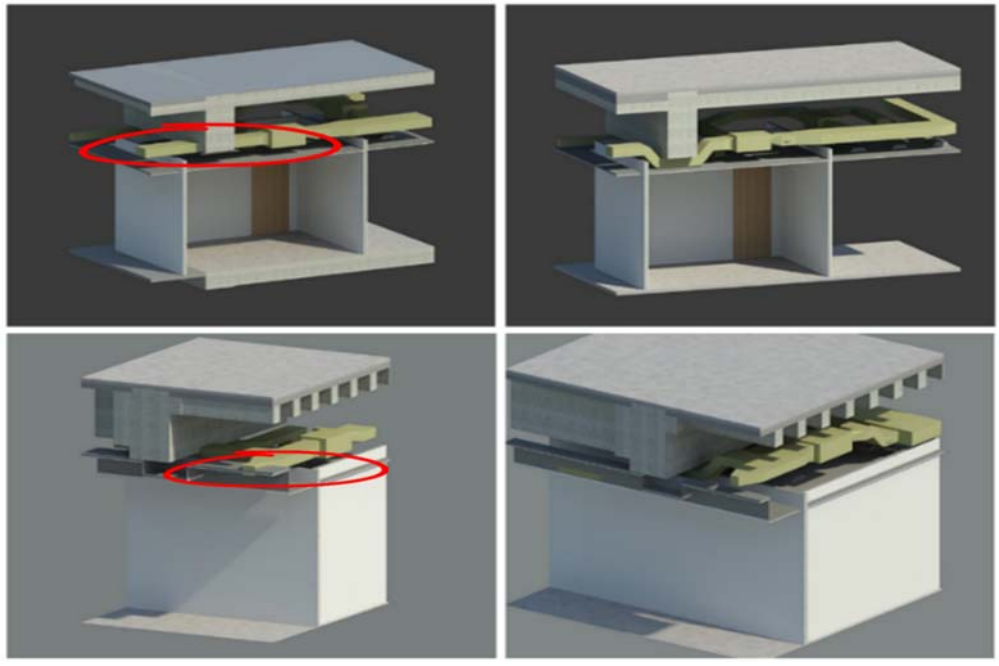

Figure 7: Clash detection.

Clash detection could be geometric and schedule base. The team at this stage is utilizing 3D BIM dimension. Geometry clashes such as piping intersecting columns and ducts are tedious to detect in the 2D paper based processes. Clash detection is cumbersome without BIM. In this project, simulations and walkthroughs made the clash detections easy.

The project is still in the design stage and already the potential money waste has been detected and normalized. As of now, the design team is building up libraries database where in future projects, the module will be imported accordingly and the time and cost saving shall be undeniable.

5 SUMMARY

The Team is at the BIM Maturity Level 1 and at 3D in BIM services. The next challenging step for the team is the gradual transition to Level 2 and 4D. Nevertheless, the benefits of using BIM in this project are:

- Enhanced Collaboration: Stakeholders communicated more effectively.
- Centralized Projects Database: All information needed can be accessed instantly and simultaneously.
- Improved Change Management: A change somewhere is a change everywhere. A change is reflected throughout the entire projects documentation.
- Visualization: Thanks to VDC. The project is clearly visualized without any assumptions. What you see is what you get.
- Clash Detection: Clashes caused by design errors and oversights were immediately mitigated.
- Cost Saving: All design conflicts were mitigated before breaking the construction ground. No need for change orders during construction.
- Reduced claims, disputes, and conflicts.

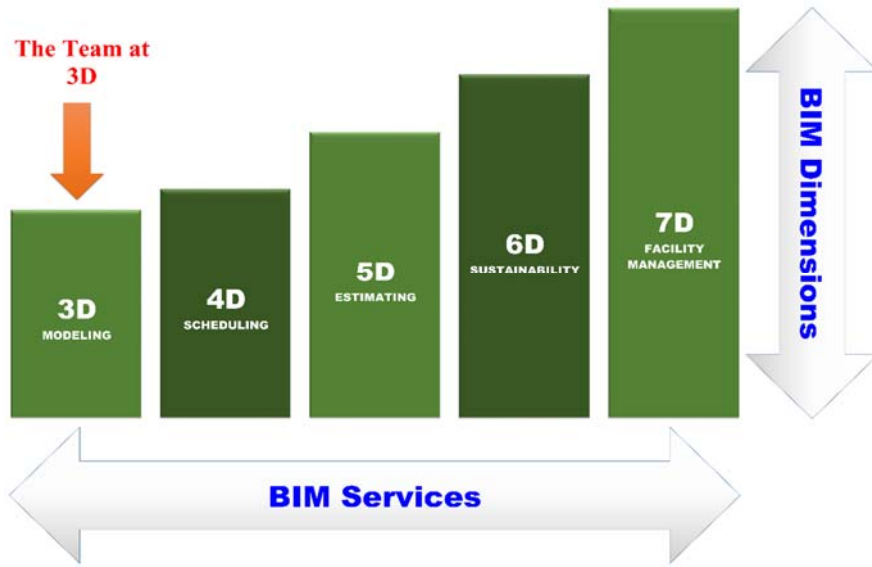

Figure 8: BIM services vs. BIM dimensions.

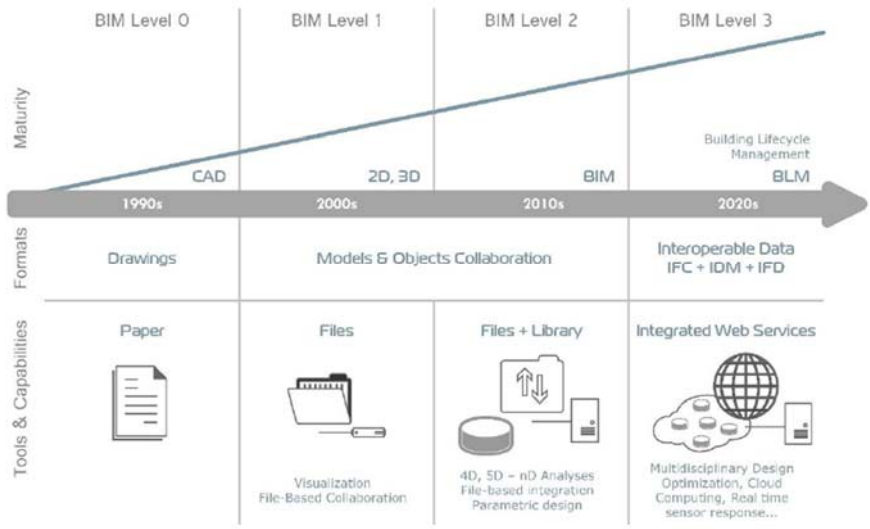

Figure 9: BIM maturity levels [7].

Figure 10: VDC modeling of the project.

6 CONCLUSION

Even though the team is still at BIM maturity level 2 and 3D BIM services, the team has made its gradual paradigm shift successfully. Moreover, despite the BIM transition obstacles and difficulties, savings in the project are optimized up to 28%. This indicates great savings regardless of the size of the project. Three main areas of tangible success with the VDC of BIM are:

1. Cost saving.
2. Increased team collaboration.
3. Higher-quality architectural designs.

In the graphical 3D BIM model, from the beginning, the results were very encouraging. Many design errors and oversights have been detected and mitigated in a click of a mouse. This would have been hard to do with the 2D AUTOCAD traditional approach. The transition to BIM has a positive impact on the team in managing his own tasks and portieres in aligning itself with the Company's strategic goals and objectives to cut cost and enhance performance. The gradual adoption to BIM is successful and the investment is undeniably worthwhile.

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