Application of Revit as Building Information Modeling (BIM) for Integrated Project Delivery (IPD) to Building Construction Project- A Review

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Abstract - *During the last three decades the construction industry has seen drastic improvement of the use of IT. The latest and most promising in these developments is the use of Building Information Modeling (BIM). BIM can be described as a tool that enables storage and reuse of information and domain knowledge throughout the lifecycle of the project. BIM has a main role of coordinating and integrating the exchange of information and knowledge between different disciplines and phases within the project. The use of BIM in a construction project has the potential benefit of both improving product quality and enabling more sustainable designs of buildings. Even though the economic and environmental benefits of BIM is widely acknowledged, the adoption of this new technology has been slow.*

This paper refers to Application of Revit as BIM for Integrated Project Delivery (IPD) for Building Construction Project .Also focus on current BIM trends, applications, benefits, possible risks and future challenges of BIM for the Construction industry.

***Key Words*: BIM, IPD, Revit, Construction, Integrated model, AEC**

1. INTRODUCTION

BIM is one of the most promising recent developments in the architecture, engineering, and construction (AEC) industry. With BIM technology, an accurate virtual model of a building is digitally constructed. This model, known as a building information model, can be used for planning, design, construction, and operation of the facility. When completed, the building information model contains precise geometry and relevant data needed to support the design, procurement, fabrication and construction activities required to realize the building.

Traditional project delivery systems offer a set of solutions in each of these domains. They routinely produce results that continue to disappoint owners and frustrate much of the construction industry. Integrated Project Delivery (IPD) seeks to systematically attack the deficiencies in each of these domains.

Within the building industry, there is a growing interest in IPD and the role Building Information Modeling can play in promoting integration among building professionals and improving design outcomes.

2. INTEGRATED PROJECT DELIVERY

Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction. The defining principles of IPD include:

- Highly collaborative processes that span building design, construction, and project handover.
- Leveraging the early contributions of individual expertise.
- Open information sharing amongst project stakeholders.
- Team success tied to project success, with shared risk and reward.
- Value-based decision-making.
- Full utilization of enabling technological capabilities and support.

Below table explains the difference between Traditional project delivery & Integrated project delivery

Table -1: Difference between the Integrated and Traditional Project Delivery

	TRADITIONAL PROJECT DELIVERY	**INTEGRATED PROJECT DELIVERY (IPD)**
		
Phases	Design, Implementation	Design, Implementation

Team	Hierarchical: consultants engaged on as only-as-needed basis	Collaborative: consultants engaged earlier in the design process
Work effort	Surge of work efforts occurs late in the process.	Surge of work efforts occurs early in the process
Decision making	Late	Early
Team Knowledge	Surge of work effort results in knowledge drop-off	Earlier Surge of work effort results in earlier knowledge drop-off
Collaboration	Limited collaboration between silos of expertise	Increased collaboration: mutual respect between parties
Data sharing	Avoided	Encouraged
Technology	2D/ 3D CAD	3D/4D BIM
Agreements/ Compensations	Standard agreements; goals and objectives are misaligned	Goals and objectives aligned through three-party agreements
Risk Performance metrics	Higher	Lower

3. BUILDING INFORMATION MODELING

The term "BIM" is often used interchangeably to describe the end product (the model itself) as well as the process (the building team using BIM as the project delivery method). From a practical standpoint, the design team uses BIM as a work process and means of communicating with one another, the end product of which is the model. BIM can be viewed as a virtual process that encompasses all aspects, disciplines, and systems of a building within a single, virtual model, allowing all design team members — owner, architects, contractors, engineers and consultants — to collaborate more accurately and efficiently than traditional processes. As the model is being created, team members are constantly refining and adjusting their portions according to owner preferences, systems compatibility, and design intent to ensure the model is as accurate as possible before the project ever physically breaks ground. The model itself can then be used to communicate design concepts to the owner and calculate materials take-offs for cost estimation, as well as for clash detection, which describes how the model electronically checks to make sure building systems are designed properly.

4. INTEGRATED PROJECT DELIVERY USING BUILDING INFORMATION MODELLING

An integrated model has the entire data as listed below:

- **Engineering visualization**
  - ✓ Helps users to visualize the building well in advance before the structure is constructed.
- **Documentation**
  - ✓ All project document are stored in a centralized placed.
- **Structural co-ordination**
  - ✓ All the structural co-ordinates can be easily viewed in the IPD model
- **MEP Co-ordination**
  - ✓ All the MEP co-ordinates can be easily viewed in the IPD model
- **Clash detection**
  - ✓ Major advantage of the model is Clash detection. The routing of services can be efficiently made & the clashing if any can be detected well before the actual construction. This eventually helps the contractor save time & material.
- **Schedule & Quantities**
  - ✓ Project schedule made in Primavera or MSP can be imported in Naviswork.
  - ✓ Accurate BOQ can be extracted from the integrated Revit model.

5. REVIEW OF RESEARCH PAPER

Barry Jones (2014), The paper discusses a proposal for an integrating partnership for decision-making at pre-construction stages of major construction projects. IPD and BIM form essential tools and strategies in this decision environment. IPD linked to the "Big Room" concept will be discussed. The paper will focus on some of the challenges that are presented and ways that might assist in creating a safer, greener, more sustainable environment. The environment proposed is one that fully utilizes the strengths of intelligent collaborative computer agents that interact with the multi-discipline pre-construction team to interrogate and refine the design solution before construction commences. All contributors are collaboratively drawn into the design and pre-construction process. Time is saved because a concurrent problem-solving approach is adopted rather than a sequential problem-solving approach that has typified pre-construction activities in the past. In particular, the system proposed will assist the design process to deliver safely-built sustainable buildings.

Ireneusz Czmoch & Adam PĆkala (2014), This paper presents the history and development of the traditional

design in civil engineering. Next, the idea of Building Information Modelling (BIM) and its practical benefits are described. Main part of the paper is devoted to discussion about what kind of difficulties we may encounter during the implementation of the BIM technology and how they are related to the potential benefits.

It is very important to conclude that BIM based design can be effectively implemented in the design practice by experienced designers. BIM allows for simplification of many tasks and considerable savings both in terms of money and time. However, the successful implementation of this technology requires skillful design team who acts exactly in accordance with BIM system procedures. Nowadays, given the high cost of implementation, application of BIM is profitable mostly for large projects. As the software and hardware become cheaper, the accessibility of BIM would spread over smaller projects. Doubtlessly, BIM is the most complete designing tool, which can change radically the designing process in the following years.

Joseph A Wright (2014), Building Information Modeling (BIM) has been making significant inroads in the construction industry in the early part of this century to the point that now 4- and 5-dimensional models are common practice. Software is also getting better at communicating between packages without loss of data. The use of BIM has significantly enhanced the ability to deliver satisfaction to construction Owners by enabling the use of Integrated Project Delivery (IPD) as the preferred method of project delivery. However, there still is significant room for improvement in the area of integrating the knowledge or informational aspects of the constructed project. This paper explores the need for the integration of information, or emphasizing the "I" in BIM and IPD through the use of case studies.

Saravanan S (2016), In construction projects, the life cycle is implemented in a cradle to grave approach. It is split into planning, design, construction, operation & maintenance and facility management phases until the useful life of the facility. Traditional project approaches that are used in the industry still face a lot of challenges due to cost & schedule overruns poor collaboration among the project participants and inefficient ways of handling the constructed facility during the implementation of the life cycle. In order to create an interdisciplinary work environment among the project participants, Integrated Project Delivery (IPD) process, a substitute for traditional approaches focusing on defining the roles of project participants and creating successful project outcomes is introduced last decade. To execute the IPD process, Building Information Modeling (BIM) which is a digital representation of physical and functional characteristics of a facility in which the entire project information that are used during each phases of the project life cycle can be stored in a single database subsequently providing a virtual model can be used as a tool.

Ryan T. Manning (2012), Integrated Project Delivery (IPD) is a new method of project delivery that uses collaboration and a team of key stakeholders (Owner, Architect/Engineer, and Contractor) early in the life of a project to make the process more efficient, optimize results, and reduce waste (American Institute of Architects 2007). Building Information Modeling (BIM) is a set of interrelated models created by the project team that offers the ability to exchange information. BIM embeds the three dimensional model with detailed information, such as schedule and cost data. When IPD and BIM are combined, the result can be a very successful project that reduces claims from design errors and omissions.

Challenges also present themselves when using IPD for the delivery of a project, such as overcoming decades of mistrust, lack of communication, and opposition between the Architect/Engineer and Contractor. There are some insurability issues iii and legal concerns due to the overlapping of the historical roles and responsibilities of the Architect/Engineer and Contractor that must be considered when using IPD and BIM. The historical roles and responsibilities have been defined by a history of case law and legal disputes between the Architect/Engineer and Contractor. These concerns and issues can be neutralized within the IPD and BIM Agreement(s). This paper examines some of the challenges, benefits, and risks presented when using IPD and BIM. IPD and BIM are changing the way projects are delivered with early, and often, interaction from all parties involved in the project, and by creating a model embedded with detailed information that will ultimately be used to construct the project.

Simon Beveridge (2012), The research was undertaken to determine the frequency and best practices of using BIM in commercial construction. Leading commercial contracting firms were contacted and employees were selected to complete a telephone survey that was designed to determine how they are using BIM. It was found that BIM is being used with more frequency on projects, with plans to continue to implement it even further on all projects that allow for its use. Most companies are incorporating trade contractors in their coordination meetings but are taking the lead to ensure a high standard is maintained. Trade contractors are given responsibility to resolve smaller clashes while bringing the larger problems to the clash detection meetings. The model quality being received is increasing as well the frequency of models being received from the design team; however, there is a lack of consensus as to the level of development requirement to ensure the model can be used for facilities management. Commercial contractors are adopting building information modeling for a variety of reasons. These include client requirements, innovative technology strategies, and fear of being left behind. Overall, its use improves processes within their companies. The general agreement is that BIM is having a positive impact on profitability, schedules and sales. BIM further improves the efficiency, effectiveness and competitiveness. The best practices undertaken by commercial contractors include using BIM as a sales and marketing tool, utilizing subcontractors knowledge and allowing them to resolve minor clashes, having combination of BIM teams and BIM experts and investing in training employees and further development of BIM uses.

Aryani Ahmad Latiffi , Suzila Mohd , Narimah Kasim & Mohamad Syazli Fathi (2013), The aim of this paper is to explore BIM implementation in Malaysian construction industry. Building Information Modeling (BIM) is a set of digital tools that can manage construction projects effectiveness. BIM has been used by the Architecture,

Engineering and Construction (AEC) industries in Malaysia. The idea to implement BIM in Malaysia was introduced by the Director of Public Works Department (PWD) in 2007. A literature review was done to explore previous BIM studies on definitions and history of BIM, construction issues, application of BIM and BIM tools in construction projects as well as benefits of BIM. Malaysian government encourages construction players to apply BIM to construction projects because it can overcome construction project problems such as delay, clash of design by different professionals and construction cost overrun. Autodesk tools have been suggested by the government as a BIM tool platform. Other tools include Revit Architecture, Revit Structural, Revit MEP, Navisworks and Cost-X. It is crucial for construction players to be aware of the importance of BIM application in construction projects. This is because BIM can be one of the conditions required of a company to qualify for government and private projects, similar to what is practiced in some other countries. Moreover, BIM helps to increase construction project efficiency and effectiveness. It can also be implemented to improve communication and collaboration between construction players. The implementation of BIM technology is expected to become more widespread in Malaysian construction industry because of the government's efforts in promoting BIM.

6. CONCLUSIONS

Integrated project delivery is upon us already in use in some form on many projects and the source of intense discussion for everyone in the building industry. BIM solutions enable IPD and can deliver dramatic advances in building technology, but the full potential of BIM will not be achieved without adopting structural changes to existing project delivery methods. Key issues regarding compensation, contractual relationships, risk allocation, and so forth can be overcome.

The study until now was carried out on application of BIM. Many researchers defined different methods for effective use & use of BIM for IPD. This study will continue with application of Revit as Building Information Modeling (BIM) for Integrated Project Delivery (IPD) to Building Construction Project by a questionnaire survey & actual project case study.

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