Implementation of Integrated Project Delivery (IPD) and Building Information Modelling (BIM) In the Construction Industry

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This project is dedicated to my dear Family and also my dear wife who brought joy to my life, for their endless support and encouragement.

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ABSTRACT

To increase productivity, the global construction industry has adopted several different project delivery methods and IT tools over the last 10 years. Although there have been previous efforts to define and Implement new generation methods such as Integrated Project Delivery (IPD) and Building Information Modeling (BIM) in the construction industry, but these concepts are still considered new-comers especially in most of developing countries. These countries widely use the traditional methods namely Design-Bid-Build (DBB) and Computer Aided Design (CAD) instead of using them. This study is to analyze Building Information Modeling (BIM) applications potential in the process of Integrated Project Delivery (IPD) and compare it with the Implementation process of conventional tool (CAD) into the Design –bid-build delivery method. For this reason, a case which is a three story residential apartment building located on Tehran is selected. The process of implementation of existing CAD drawings of this case into DBB will be analyzed. Then, the case will be modeled and simulated within BIM applications and its exploiting potential will be identified within IPD. It is expected that the shifting framework path from CAD-DBB into BIM-IPD based on the lessons learned from case study and conducted interviews are developed to clarify these concepts capabilities.

ABSTRAK

Kemajuan dalam bidang teknologi telah mencipta peluang bagi industri untuk menjadi lebih cekap dalam menyiapkan sesuatukerja. Salah satu industri yang dapat merintis kemungkinan ini adalah industri pembinaan ; dengan menggunakan perisian Pemodelan Maklumat Bangunan (BIM), Penghantaran ProjekBersepadu (IPD) telah menjadi satucara yang sangat berkesan dalam menguruskan sesuatu projek pembinaan. IPD adalahcara yang sangat berbeza dari cara yang sedia ada dalam menguruskan sesuatu projek pembinaan. Tujuan kajian ini dilakukan adalah untuk menilai potensi aplikasi Pemodelan Maklumat Bangunan (BIM) dalam Penghantaran Projek Bersepadu (IPD) dan perbandingan dengan proses konvensional dalam kaedah penghantaran Reka-Bida-Bina (Design-Bid-Build) oleh ACD. Objektif kajian ini adalah untuk mengkaji proses penghantaran maklumat Rekabentuk BantuanBerkomputer (CAD) dalam kaedah penghantaran Reka-Bida-Bina dan kaedah IPD, untuk mengkaji potensi perlaksanaan proses Pemodelan Maklumat Bangunant (BIM) bagi rekabentuk dan pembinaan, untuk mengenal pasti halangan dalam pelaksanaan Pemodelan Maklumat Bangunan (BIM) dalam Penghantaran Projek Bersepadu dan untuk mengenal pasti perbezaan antara proses Rekabentuk Bantuan Berkomputer (CAD) dan proses Pemodelan Maklumat Bangunan (BIM) bagi rekabentuk dan pembinaan melalui keskajian. Menggunakan IPD lebih kos efektif dan pengurusan masa yang lebih cekap berbanding kaedah tradisionalindustri. Penghantaran Projek Bersepadu (IPD) adalah satu proses baru yang semakin mendapat pengiktirafan dalam industri pembinaan. Pada masa ini, majoritiindustripembinaanmenggunakan proses Bida-Reka-Bina yang seringmenyebabkankoslebihtinggidankelewatantarikhakhirprojek.Dengan keupayaan penyelarasan perisian Pemodelan Maklumat Bangunan (BIM), seperti Autodesk Revit, ArchiCAD dan penggunaan syarikat IPD, pengurangan kos dan penggunaan masa yang lebih berkesan telah dapat dilihat. Objektif projek ini dicapai melalui pelbagaikaedahpenyelidikan: kajian sejarah, kajian literatur, soal selidik dan kajiankes

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CHAPTER 1

INTRODUCTION

1.1 General

The construction industry has suffered from a productivity decline since the 1960s while all other non-farm industries have seen large boosts in productivity. The problems in contemporary construction include buildings that are behind schedule and over budget as well as adverse relations among the owner, general contractor, and architect.

To increase productivity, the global construction industry has adopted several different project delivery methods over the last 10 years. Various project delivery methods (conventional) are in use in to most of developing countries. Two prevalent methods are design-bid-build (DBB) and design-build (DB) (Konchar and Sanvido 1998) and it drives to approach new methods of project delivery like developed countries such as Integrated Project Delivery (IPD) and Building Information Modeling (BIM).

Design bid build (DBB) is a project delivery method in which the owner enters into a contract with an architect/engineer (A/E) firm that provides design services based on the requirements provided by the owner. The A/E deliverables includes plans and specifications for the construction of the project.

These documents are subsequently used by the owner as the basis to make a separate contract with a construction company. Although many methods are used for awarding this contract, the most common approach is to solicit bids from different construction companies. The company providing the lowest bid will then build the project based on the documents produced by the A/E. Therefore, two separate contracts, with two separate entities, are utilized by owners to complete one construction project, including two solicitations and procurement steps.

The major tool which is widely utilized in the traditional delivery method (D-B-B) is the computer aided design (CAD). Computer-aided design is one of the many tools used by engineers and designers and is used in many ways depending on the profession of the user and the type of software in question. CAD is one part of the whole project delivery activity within the Product Lifecycle Management (PLM) processes, that It still use in the most developing countries that would be convert with new methods like developed countries.

The Integrated Project Delivery concept (IPD) is a new approach to agreements and processes for design and construction. It's conceived to accommodate the intense intellectual collaboration that 21st century, complex buildings require. The inspiring vision of IPD is that of a seamless project team, not partitioned by economic self-interest or contractual silos of responsibility, but a collection of companies with a mutual responsibility to help one another meet an owner's goals.

To support that vision, owners, AEs, CMs and their lawyers are crafting contract terms intended to align the interests of the key project team with the project mission, increase efficiency, reduce waste and make better buildings.

Of course, we will never eliminate self-interest, but many of these concepts are making meaningful improvements in forging agreements that produce more collaborative teams. IPD is in an invention phase. It has not been around long enough

to gain accepted definition or for the process to become standard. That's as it should be.

Table 1.1: A comparison of traditional delivery methods vs. IPD methods on key project processes reveals

Project Factor	Traditional Project Delivery	Integrated Project Delivery
Teams	Fragmented, assembled on "as-needed" or "minimum necessary" basis, very hierarchical, controlled	Integrated team entity of key stakeholders, assembled early in the process, open, collaborative
Process	Linear, distinct, segregated, knowledge gathered "as-needed", information hoarded, silos of knowledge and expertise	Concurrent and multi-level, early contributions of knowledge and expertise, information openly shared, trust and respect
Risk	Individually managed, transferred to the greatest extent possible	Collectively managed, appropriately shared
Compensation/ Reward	Individually pursued, minimum effort for maximum return, often first cost-based	Team success tied to project success, value-based
Communications/ Technology	Paper-based, two dimensional, analog	Digital, virtual, Building Information Modeling, 5+ dimensional
Agreements	Encourage unilateral effort, allocate and transfer risk, no sharing	Encourage, foster, promote and support multilateral open sharing and collaboration, risk sharing

1.2 Problems statement:

Building Information Modeling (BIM) is an integrated process built on coordinated, reliable information about a project from design through construction and into operations. By adopting BIM, architects, engineers, contractors and owners can easily create coordinated, digital design information and documentation; use that information to accurately visualize, simulate, and analyze performance, appearance and cost; and reliably deliver the project faster, more economically and with reduced environmental impact.

In other words, Building Information Modeling (BIM) is dramatically reshaping the way construction project teams work together to increase productivity and improve the final project outcomes (cost, time, quality, safety, functionality, maintainability, etc.) for all the parties involved. The use of BIM on construction projects is growing rapidly. According to statistics from BIM Trends Smart Market Report 2008 (McGraw Hill Construction, 2007), 62% of BIM users indicated that they were going to use BIM on over 30% of their projects in 2009. BIM use is spreading in all construction sectors, and development of the best practices for BIM implementation varies according to specific needs and existing practices of the agencies concerned.

BIM is not just a fancy marketing term as some may have first thought. BIM is real and it is here to stay. Similar to what we saw 15-20 years ago when companies were moving from manual drafting to CAD (even though CAD had been around for several years); the same is happening today, only the shift is from CAD to BIM. BIM technology has been around for several years, but it is not until now that a major shift is happening somewhat exacerbated by the recession of 2008-2009. We also experienced a recession 15 years ago when the first shift happened. Today, companies need to find new ways of generating revenue and doing it in the most efficient manner in order to set themselves apart from their competition. BIM is one of the ways that architects and engineers are setting themselves apart.

Figure 1.1 shows the percentage of Architects, Engineers, and Contractors using BIM on more than 60% of their projects in 2008 and what they expect for 2009. (William Troeak , 2009)

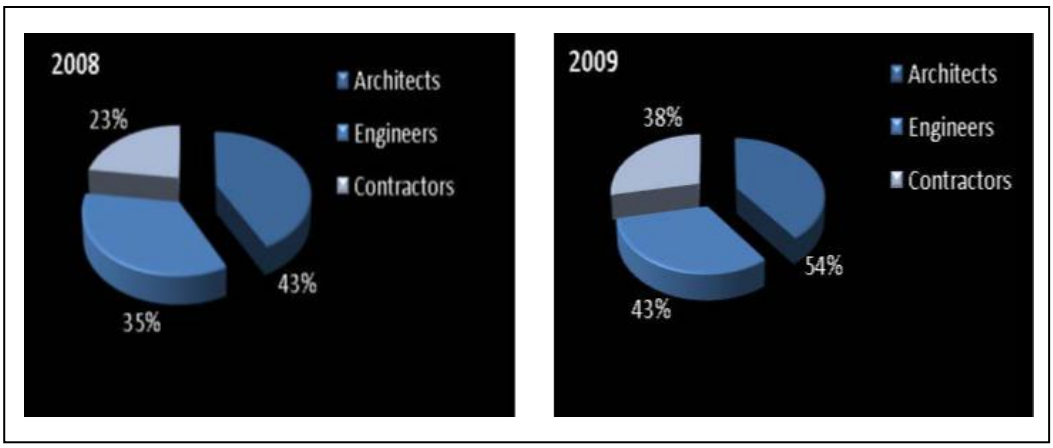

Figure 1.1: shows the percentage of Architects, Engineers, and Contractors

F Franklin in D. Lancaster, PE, RA1 and John Tobin worked in to IPD with BIM, said that:

The continued growth of Building Information Modeling (BIM) has prompted new contractual arrangements, of which the best known is Integrated Project Delivery (IPD). In IPD, early contributions of downstream partners provide crucial credibility of design information, and require that fabrication knowledge be engaged much earlier in the process.

So what can building owners, design teams, contractors and fabricators expect from the growth of BIM and IPD? With closer collaboration and trust, the future of project delivery promises alignment of common goals, better documentation with fewer gaps, more efficient and faster speed of the design process through construction, and higher overall value of the resultant project.

Although there have been previous efforts to define and Implement new generation methods such as Integrated project delivery (IPD) and Building information modeling (BIM) in the construction industry, but these concepts are still considered new-comers especially in most of developing countries and they widely

use the traditional methods namely design-bid-build (DBB) and computer aided design (CAD) instead of using new methods.

Although there have been previous efforts to define and Implement new generation methods such as Integrated Project Delivery (IPD) and Building Information Modeling (BIM) in the construction industry, but these concepts are still considered new-comers especially in most of developing countries. These countries widely use the traditional methods namely Design-Bid-Build (DBB) and Computer Aided Design (CAD) instead of using new methods.

1.2.1 Traditional–Design-Bid-Build Cons

- Allows no input from contractors during the design phase (the only team member that knows construction cost)
- May not provide the best "value" to the owner
- Often bids come in over budget
- Change orders required for plan deficiencies
- Takes more time for a thorough bidding phase
- Difficult to identify long lead items which can lead to scheduling delays
- Makes "fast track" construction difficult if not impossible
- Can lead to an adversarial relationship between the design team, the contractor, and the owner.

In terms of scientific purposes, there is a lack of thorough study to address the traditional methods shortcomings and a comprehensive comparative analysis of shifting conventional methods toward modern delivery methods and their tools.

1.3 Research Questions:

It is essential to develop research questions in order to help on focus the area research and the presentation of the report. Followings are some research questions that will arise when conducting the research:

1) What are the information transmission of the Computer Aided Design (CAD) processes in the Design-bid-build delivery method and the IPD method?

2) What are the potential of implementing Building Information Model (BIM) process for design and construction?

3) What are the barriers in the implementation of Building Information Model (BIM) in Integrated Project Delivery?

4) What are the differences between the Computer Aided Design (CAD) processes and the Building Information Model (BIM) process for design and construction through the case study?

1.4 Aim and Objectives:

This study is to analyze Building information modeling (BIM) applications potential in the process of Integrated Project Delivery (IPD) and compare it with the Implementation process of conventional tool into the Design –bid-build delivery method. This aim will be covered by the following objectives:

1) To identify challenges and issues of computer aided design (CAD) processes within Design-Bid-Build delivery method.
2) To identify the specification of Building information modeling (BIM) processes within Integrated Project Delivery (IPD).
3) To convert a conventional case study into Building Information Modeling (BIM) applications and identify its technical features.

4) To develop a framework to identify shifting path from design-bid-build – (CAD) processes toward Integrated Project Delivery (IPD)-BIM) process.

1.5 Scope of the Study:

Each study in order to achieve its objectives appropriately must be limited on some specific scopes. In this thesis, a case study which is an apartment with three floors and two units located on Tehran, Iran is selected. As you know, BIM has a wide range of software from design to analysis and simulation thus, to materialize as the scoped thesis, it just will focus on BIM‘s design software (Revit Architecture) and will analyze it within the Integrated project delivery context from the perspective of shifting conventional method into new method.

1.6 Significance of the Study:

The study strongly will contribute to the body of knowledge in various aspects of academic and professional perspective. Academically, the study will generate a considerable data in regard to IPD, the state of art of the integrity of IPD with BIM and will produce a framework which will be able to open a new window of opportunities to investigators. Meanwhile, to professional‘s circle, the study will propose a high potential possibility of radical improvements within project delivery by new method of IPD into BIM's software.

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