A Study on Design of Virtual Desktop Infrastructure (VDI) System Model for Cloud Computing BIM Service

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ABSTRACT

Recently BIM technology has been expanded for using in construction project. However its spread has been delayed than the initial expectations, due to the high-cost of BIM infrastructure development, the lack of regulations, the lack of process and so forth.

In design phase, especially, collaboration based on BIM system has being a key factor for successful next generation building project. Through the analysis of current research trend about IT technologies, virtualization and BIM service, data exchange such as drawing, 3D model, object data, properties using cloud computing and virtual server system is defined as a most successful solution.

The purpose of this study is enable the cloud computing BIM server to provide several main function such as edit a model, 3D model viewer and checker, mark-up, snapshot in high-performance quality by proper design of VDI system. Concurrent client connection performance is a main technical index of VDI. Through test-bed server client, developed VDI system's multi-connect control will be evaluated.

The performance-test result of BIM server VDI will effect to development direction of cloud computing BIM service for commercialization.

Keywords -
VDI (Virtual Desktop Infrastructure); Cloud Computing; BIM; Design Collaboration; Virtualization

1 Introduction

The introduction of BIM in the construction industry has caused many changes in the existing process that had been used in the construction industry. The communication tools are available to allow designers and constructors to discuss through the introduction of BIM in construction environment. It can reduce the errors and changes associated therewith. Moreover, it supports for construction process and cost reduction while minimizing legal conflicts. Also, it facilitates implementing an entire project successfully.

However, the introduction BIM in construction site causes many problems due to the diversity of construction site environments. The problem types resulting from the introduction process of BIM are as shown in Table 1.

Of these problems, this study aims to focus on the systematic shortcomings in terms of BIM based cooperation. As for the previous studies related to the cooperation of BIM, they include "the Difficulty of Utilizing BIM in a Large-Scale Project (Chi Joo Lee 2009), "the Inadequate Configuration of BIM Based Cooperation System (Jung Wook Park 2009), "the Cost of Software/Hardware Burden for Use of BIM (Smart Market Report 2008), just to name a few. Summarizing the aforementioned problems, the current BIM based cooperation system has the important problem resulting from the adequate sharing configuration system. Thus, much emphasis has been given to the importance of study on the relevant areas.

Table 1 Simulation Conditions

Problems when introducing BIM
Lack of standards and guidelines
Compatibility issues with BIM Software
BIM process fixation problem
BIM tools utilizing professional shortage
The initial cost of risk when introducing BIM

This paper aims to conduct a study as to "A Study on Design of Virtual Desktop Infrastructure (VDI) System Model for Cloud Computing BIM Service" as a measure to improve the aforementioned problem associated with the cooperation system.

2 Theoretical Considerations

2.1 Virtual Desktop Infrastructure

VDI service generates virtual machine (virtual PC) to be operated in a cloud data center server. Moreover, it is a service that allows a user to use desktop environment anytime and anywhere through a device connected to a network all the time whenever a user needs. "To use desktop environment through a device connected to a network all the time" in the field of VDI is called "virtualization".

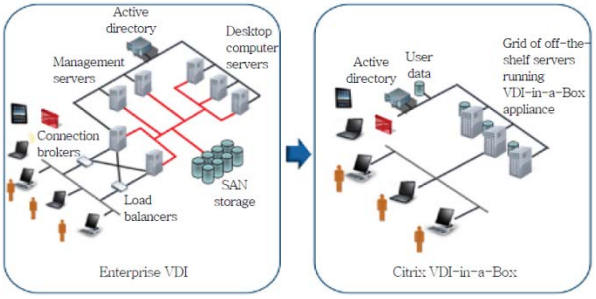

Figure 1 VDI Solution Architecture
< http://www.citrix.com/ >

The VDI (virtual desktop infrastructure) technology was first introduced in 2008. It has been growing rapidly with virtualization technology, cloud computing and increased use of mobile devices in the corporate, financial, telecommunication and public institute computer markets for the several years. Currently, the most prominent VDI companies are Citrix and VMware. Approximately 20 VDI companies, such as Microsoft that owns Windows OS, Quest and Virtual Bridges, have released the relevant products.

2.2 Cloud Computing

To utilize VDI effectively, one needs a cloud computing service model that is suitable for a given usage. This is a service that allows users to use a service by accessing the shared pool of computer resources that can control environment. DaaS(Desktop as a Service) based Cloud computing service can be provided as shown in Figure 2 below.

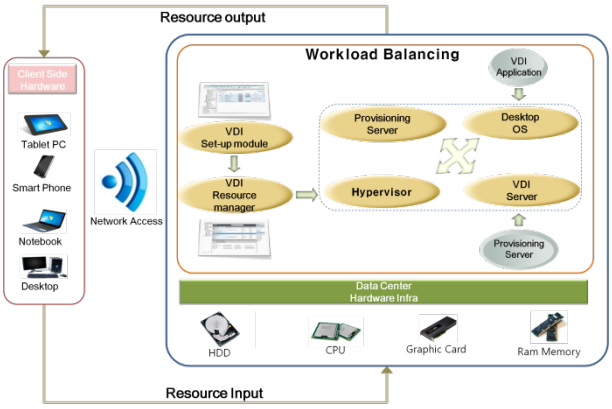

Figure 2 DaaS Service Platform

SaaS(Software as a Service) is to provide an environment that can develop, distribute and manage PaaS(Platform as a Service) applications (or cloud applications). The prominent companies thereof include Salesforce.com, Google and Facebook.

IaaS(Infrastructure as a Service) is to provide an infrastructure environment such as server and storage. The most prominent giant in the field of IaaS is Amazon. Amazon is the first company that embarked on cloud business in earnest. On that account, Amazon has the highest degree of reputation and competitiveness in terms of infrastructure compared to the other companies.

3 The factors of adapting to BIM area

The introduction of BIM (building information modeling) in the field of construction has caused a significant change in many areas of construction. CAD (computer aided design) work, which implemented BIM, has resulted in reduction of work time, reutilization of extensive design data, efficient placement of workforce, improvement in design quality, economic profit, etc. Also, it has brought about a significant change across the construction industry.

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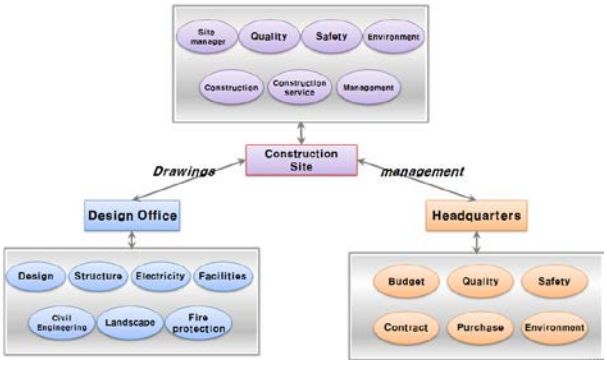

Figure 3 Construction Projects relationship

As for small-sized buildings, a variety of variables influence them. Thus, there are many difficulties for the management of construction sites. However, the introduction of BIM in the remodeling sites of small-sized buildings has resulted in an improvement in the quality of buildings. Furthermore, it makes it possible to conduct an economical construction by eliminating those factors of construction delay such as design change and reconstruction

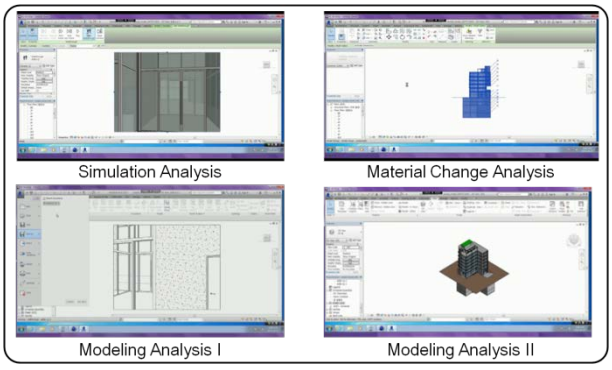

Figure 4 based VDI application analysis

In particular, designing an atypical structure with the conventional 2D design method has caused a lot of errors on a floor plan. This is because an atypical structure has many areas that cannot be represented with 2D drawing. However, 3D based BIM reviews an inconsistency between the structural members; thus, it has a smaller number of design errors requiring additional review compared to 2D drawing. On this account, it has many improvements in such areas as additional construction cost, responsibility issue for an increased construction cost and maintenance and management issue, which take place in the construction process of an atypical structure.

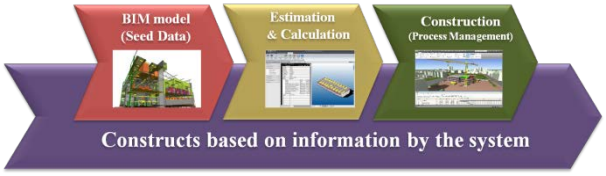

Figure 5 BIM-based information system building

3.1 BIM process in design phase

This study limited the scope of study to the utilization of BIM in the design phase. Therefore, this study aims to present a clear criterion as to the design area for construction project prior to the main text.

Table 2 Simulation Conditions

Activity	Specific Activity
1. Review & Approval of Design Plan	Review of Design Plan and RFP(request for proposal) Revision
2. Design Interface Management	Review of Design Interfaces between Participants
3. Analysis of RFP Requirement and Review of Propriety	Analysis of RFP Requirement
	RFP Revision by Correcting Unclear or Illogical Requirement
4. Review of Drawings and Documents	Deciding Design Review Methods
	Preparing Design Review Plan Report
	Preparing Design Review Checklist
	Design Review of Each Discipline
	Preparing Design Review Decision Report and Quality
	Preparing Design Review Report for Clients
	Checking Design Change Status in accordance with Design Review
5. Review of Constructability	Deciding Constructability Review Schedule
	Gathering Related Information
	Preparing Constructability Review Checklist
	Selecting Key Review Items
	Constructability Review
	Preparing Constructability Review Report
	Checking Design Change Status in accordance with Constructability Review
	Monitoring and Evaluating Review Effectiveness
6. Design VE	Kick-off Meeting and VE Team Building
	Gathering VE Requirement and Related Information
	Deciding Design VE Targets
	Functional Analysis
	Ideas Generation
	Ideas Structuring and Development
	Detailed Evaluation and Alternative Generation
	Preparing VE Report
	Submitting VE Report

	` Upgrading Design Plans Accordingly
7. Approval of Drawings and Documents	Evaluating Design Drawings and Documents
	Reporting Evaluation Results for Clients
8. Permission Check	Review Related Permission Laws
	Support Architects during Permission Process
9. Design Process Management	Actual Design Process Control against Planned Schedule
10. Conducting Design Modification Meeting	Agenda Selection for Design Review Meetings
	Conducting Design Review Meetings
	Checking Application Status of Design Review Result
11. Design Management Completion	Preparing Completion Report on Design Manage- ment

Figure 6 Specific Activity of Design Management In general, the design area for construction project is classified into preliminary design and implementation design. Preliminary design phase reviews on whether to reflect the requirements of an orderer in design as well as project direction. Also, this phase conducts a broad review as to implementation schedule for design project and construction productivity (cost, constructability, quality, etc.). Implementation design phase specifies actual works and also conducts a review on design outcomes as to whether an actual construction can be conducted. Moreover, this phase provides various supports for design VE task, construction schedule management and licensing procedure along with a contractor.

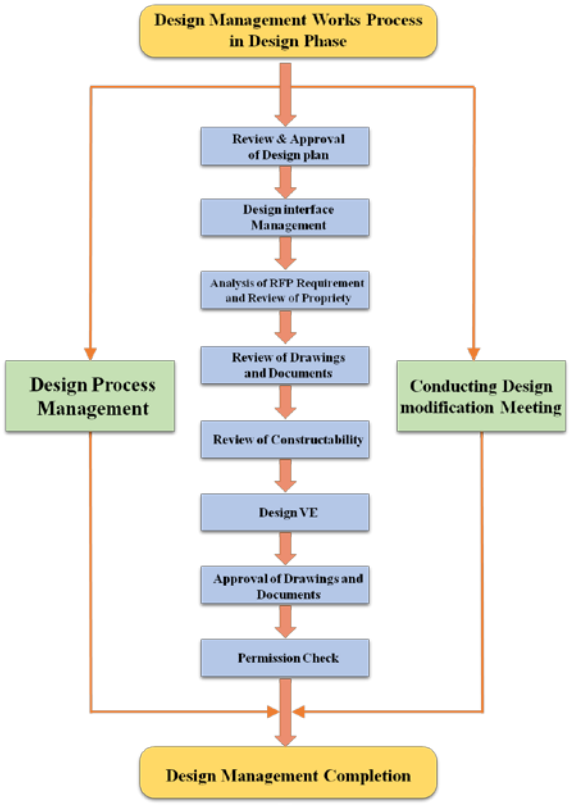

Figure 6 Specific Activity of Design Management

3.2 Advantage of BIM virtualization

In general, the reason for introducing VDI is that one can build an environment in which one can process tasks anywhere as though one uses one's own PC.

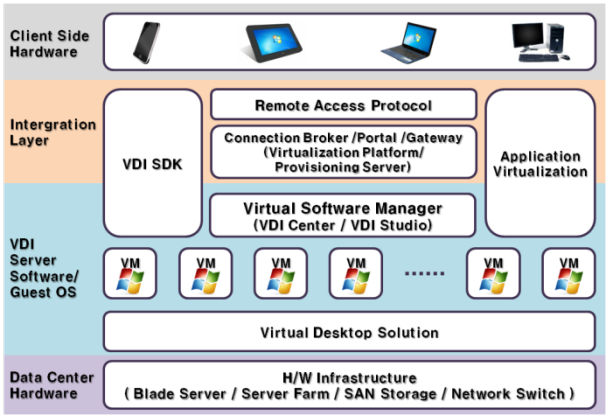

Figure 7 VDI Component Diagram

Users are able to process tasks by accessing personal virtual desktop environment in other departments or sites. They are able to implement flexible work by

conducting VDI with their PC used for their work.

The system considerations for configuring VDI can be classified into the following three factors: system configuration, user configuration and data configuration.

① System configuration

A construction project typically uses a lot of software. When utilizing a variety of software, VDI is capable of conducting batch management function through central management. It can proceed with batch upgrade by using the software distribution function when conducting security patch of user window based on the software installed in VM (virtual machine) by collecting hardware and software inventories. Moreover, it can be applied equally to the upgrade of office software installed in VM. Even those users who do not use high-end programs are able to manage computing resource and conduct efficient installation and distribution of applications.

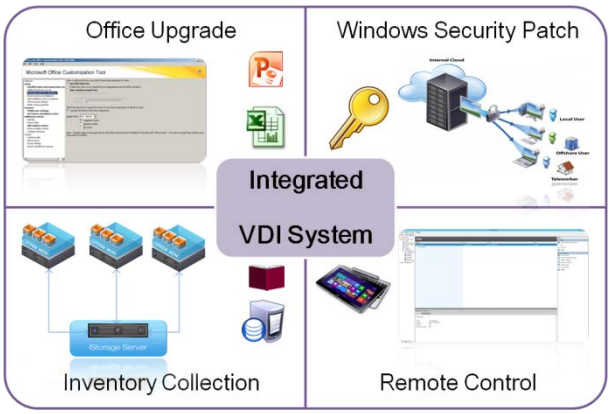

Figure 8 VDI based Integrated Management Systems

② User configuration

Figure 9 VDI User configuration

A variety of users exist in a VDI based BIM project suitable for construction site. They can be sub-divided into the three broad user types. The first type is a practitioner who performs high-performing modelling task. The second type is a cloud access user who performs relatively less-performing tasks such as presentation and mark-up. The third type is a user who accesses private cloud in order to upload simple work journals.

It is possible to improve work processing capability by identifying the work environment patterns and characteristics and distinguishing the authorities for each of the aforementioned three types of practitioners in each construction environment and also by distributing resources efficiently and designing virtual model in advance.

③ Data Construction

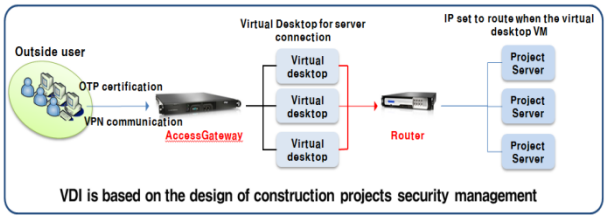

Figure 10 VDI based Data security design

Given the nature of construction project, there are many occasions of working jointly with partners. Herein, there are the two data types. The first is data that needs to be shared together. The second is data that needs security management.

It is possible to configure in a way that an external user can access a corresponding project server only via virtual desktop after accessing VPN and desktop when an external user accesses a corresponding project server. In this case, an external user can conduct a task only after accessing a corresponding server via network, whereas it cannot retrieve data to outside via virtual desktop.

4 Proposal of BIM CLOUD system framework

The BIM based information exchange framework, which is proposed in this study, is built on the basis of the system model that is ideal for VDI supporting cloud system and virtual environment simultaneously. Therefore, the proposed BIM service framework model of virtual desktop environment is as follows.

The framework of Figure 11 is the type that integrates BIM with the conventional cloud. The purposes thereof are to minimize excessive network construction cost by reflecting the latest cloud technologies and construction

tasks and also to improve speed and work efficiency through information exchange primarily based on required data.

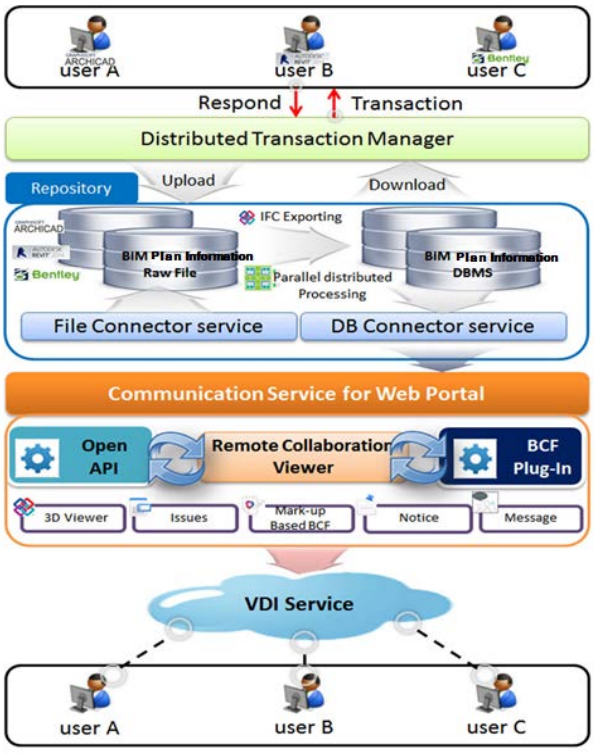

Figure 11 VDI based BIM CLOUD system framework

5 Conclusion

This paper proposed the BIM CLOUD system framework for construction site. The results proposed in this study would improve many areas of BIM project by leveraging VDI in the construction environment BIM process.

However, it is also expected that there will be many adverse effects if leveraging it recklessly in the conventional IT environment and general work environment. To address these adverse effects, it would be required to conduct a thorough investigation in advance as to the systems suitable for construction environment. Moreover, it would be imperative to identify the tasks and environment of users, consider the characteristics of each construction project and conduct a follow-up study in the mid and long term.

As for the results of this study, it is believed that it will be necessary to conduct development and research continuously as to BIM data lightening, shape/attribute data parsing technology and resource allocation for the implementation of the framework as shown in Figure 13

6 Acknowledgement

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