ADOPTION OF VIRTUAL TECHNOLOGY TO BIM BASED PMIS

Suh, Bong-Gyo, Ghang Lee[2] Yun and Seok-Heon[3]

[1] Master's Course, Department of Architectural Engineering, Gyeongsang National University, Gazwa-dong, Jinju-si, Gyeongsangnam-do, Korea
[2] Professor, Department of Architectural Engineering, Yonsei University, SinChon-dong, Seoul, Korea
[3] Associate Professor, Department of Architectural Engineering, Gyeongsang National University, Gazwa-dong, Jinju-si, Gyeongsangnam-do, Korea
Correspond to cyjcheah@ntu.edu.sg

ABSTRACT: As construction project becomes big, PMIS has been progressed and developed as collaboration tool between project participants. But recently it has been transformed from collaboration function tool to one of formal systems, and used as a simple report or just database system. Many researches have been actively studying how to combine BIM to PMIS for solving the problem. There need transferability from PMIS to BIM, however, data size is getting big because of complexity in building size. Many users experience inconvenience in slow loading speed. Therefore, this study suggested an improvement method for high transferability by utilizing virtual technology of IT industry and analyses its suitability.

Keywords: BIM(Building Information Model);PMIS(Project Management Information System);Virtual Technology

1. INTRODUCTION

1.1 Purpose of Study

The life cycle of the construction industry spans planning to maintenance and has essentially emphasized cooperation between each step-by-step project participants. Such seamless exchange of relevant information warrants cooperation, and Project Management Information System (PMIS) is a trend that has been built and carried out in a similar form in terms of design, construction and supervision as well as the owner on the Web. In addition, since Building Information Model (BIM) gets deployed in construction recently, 4D technology is introduced including Schedule Data in a 3D virtual environment. 4D simulation of practical use is wide, but there is a need to secure compatibility and interconnection between BIM Tools. In this study, to analyze the problem in the Web environment that occurs when building the BIM-based PMIS, to suggest improvement ways which applying Virtualization Technology, and analyze performance.

2. BACKGROUND OF CASE STUDIES

Table 1. Previous studies on PMIS

Division	Researcher	Research contents
Build PMIS	Kim, Jin-Gyu et al. (2004)	-Suggested an improved scheme of domestic PMIS through a case study.[2]
	Kim, Jin-ho (2005)	-Suggested application of effective planning in PMIS by analyzing obstacles in building PMIS.[3]
Build PMIS based on BIM	Jeon, Seung-ho et al. (2007)	-Delivered a direction through analysis of the correlation between BIM and PMIS.[4]
	Moon, Sung-wee et al. (2008)	-Deducted a problem with existing PMIS -Suggested ways for applying BPMS based on PMIS.[6]
	Yoon, Su-Won et al. (2008)	-Suggested strategy for BIM+PMIS system focused on improving PMIS based on ASP.[6]

2.1 PMIS and BIM Research Trends

PMIS requires the information element to include the business processes for the entire life cycle of the facility for production, management and efficient operation. It has been introduced for efficiency of business, as management and sharing of information that occurs is a key productivity factor. Thus, it has been utilized centrally by construction companies and the owners. Also, PMIS has been evolving into a set of collaboration tools to facilitate communication and exchange of information between participants. Lately, the trend requires collaborative works and resource management. The system is effective in the construction projects, but in the planning and design phase, visualization about model and interference checking through simulation is rarely carried out. It is eventually shown as an unavoidable reality related to management of the construction phase. Recently, studies that are underway on production and

increased collaboration tackle problems including lack of management; identifying real-time field; correct saving data and misusing program by engineering, through BIM solution and introduction. Table 1 is a case study related to PMIS and based on BIM and tackles the problem wherein existing PMIS cuts off the information flow and data is simply saved on the database. However, these studies did not present a specific methodology as the initial step, and data processes are not tackled.

2.2 Research on Exchange BIM Data

As a tool for building the PMIS based BIM, 4D simulation of range is very wide, spanning planning and including design, construction, and maintenance. For this reason, BIM tools need compatibility and interconnection.

The International Alliance for Interoperability (IAI) has developed the Industry Foundation Classes (IFC) as the standard information model for exchange, sharing, saving and expression.

Table 2 is a case study about BIM data compatible in Korea. Kim Ji-won analyzed problems in the design phase of the BIM Model for data compatibility with Architecture (BTA), ArchiCAD(ARC), and Revit Architecture(RVT). There is also an improvement plan based on the expert workshop and feedback. Jeong Ji-yong suggested an object-relational database (ORDB), and compared performance based on RDB-server through the BUCKY performance evaluation.

Table 2. Previous studies on BIM data compatibility

Researcher	Research contents
Lee, Su-Young (2002)	A Study on the Development of 2D Extension Model for IFC 2.x
Kim, Ji-Won et al. (2009)	A Study on the Interoperability Test and Model Improvement Bentley BIM Data through IFC system
Jeong, Jiyong (2010)	A Study of Efficient BIM Data Exchange and Sharing

In general, studies on the compatibility of data have been actively pursued. However, no study has been entirely satisfactory with regard to improving speed of data processing or an environment of data exchange when building PMIS based on BIM.

3. PMIS WITH BIM

Figure 4 presents BIM information on the PMIS flowchart at a construction site. First, input volume and resource information into 3D modeling and create a Work Breakdown Structure (WBS). Based on this, make the master schedule and correct the flaw through simulation. Also, make monthly and weekly schedules then check for specific interference. In this process, BIM data is added, systematically classified, and saved in PMIS through the Web. So each main user can move and share information. Information is managed in the same way during the construction phase. PMIS of the Web environment and using BIM data induce to check on interference in pre-construction phase through simulation. Furthermore, it helps prevent accidents during construction by forecasting accidents due to negligence. Cost reduction is also possible. That information used by PMIS is accumulated, it is managed to reuse in facility maintenance. Without visiting the site, a user will be able to know the progress, as visualization of completion rate through analysis schedule and simulation before and after construction is available. BIM based PMIS requires systematic classification of the information and documents, as well as a function of the overall visualization with regard to the construction. To meet the requirement, interoperability between BIM tools and smooth data exchange with PMIS on the Web are essential.

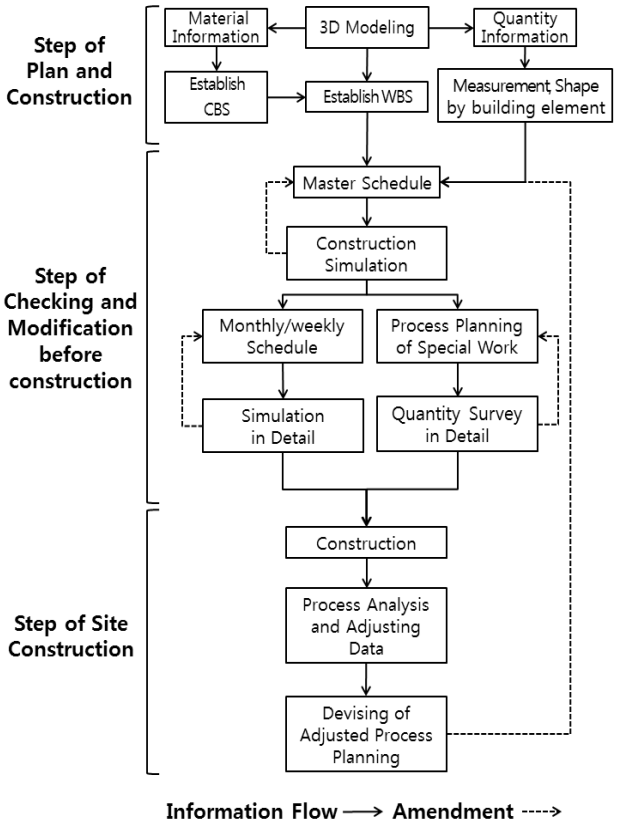

Figure 1. BIM-based PMIS process

4. USER SURVEY

This chapter seeks to analyze issues suggested by users related to the application of PMIS with existing BIM information. The respondents in the survey are specialists in actual work-site operations. The survey of recovery rate is 68% as 50 papers were distributed and 34 questionnaires were returned. Figure 3 presents the results from a survey on issues over the application of PMIS. The largest portion (38 percent) accounts for lack of service functions for practical use, followed by unsatisfactory classification of input information (24 percent) and unavailability of tracking functions for current BIM information (19 percent). This result suggests that PMIS only allows simple intake of BIM information. Also, it can be noted that customization of PMIS and its maintenance entail a costly burden in terms of its practical development.

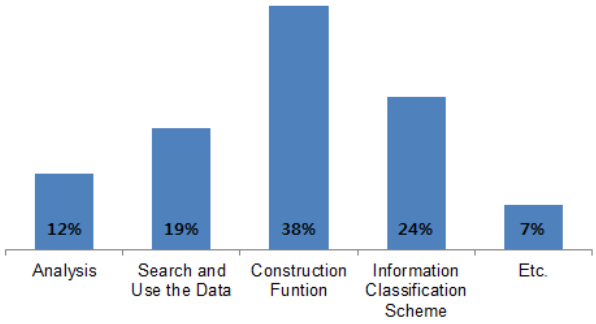

Figure 2. Survey of problems using information by PMIS

While many researchers have been devoted to improve the adaptability of PMIS with BIM information, such practical and cost issues could become drawbacks for present PMIS developers at this early stage of BIM development.

In the following survey, common practical issues from BIM Tool users were collected as presented in Figure 4. The users commonly urge the issues of BIM Tool's inadaptability with engineering information and lack of managerial functions in practical applications. The majority of opinions point out that the enormous size of the whole software and project files is problematic when it comes to constructing PMIS sets with BIM information.

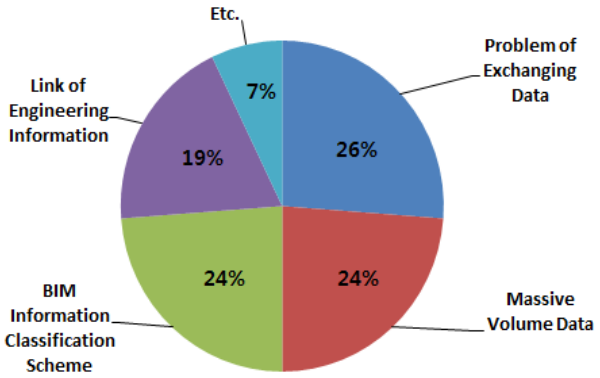

Figure 3. Survey of problem using information by BIM

The creation of enormous file sizes is simply due to the result of unnecessary exchanges of base data from specific module information, which will cascade congestion as the size of dimension and form information rises. This issue regarding IFC file size results in lower processing speed in both programs and even online exchange. Low speed during on-line exchange of IFC files should cause dissatisfaction in most contemporary and future work environments. In PMIS, the adoption of BIM information and function should be matched with the improvement in the exchange of module data for any Web-based environment. Thus, this paper discusses "Virtual Technology" as the solution for effective data exchange. Methods for improving PMIS' performance efficiency will also be discussed.

5. APPLICATION OF VIRTUAL TECHNOLOGY

Being considerably similar to Cloud Service, Virtual Technology refers to a logical concept to allow the division of a single physical resource into multiple numbers of logical resources, and vice versa. For example, Virtual Technology allows use of several serves based on a single hardware like a virtual server or using a storage device by integrating various data storage devices. In Figure 5, current users share a single module server and download IFC files at need. In this current environment, the performance of users' individual computers differs. Virtual Technology allows the even distribution of image views previously conducted from a module server.

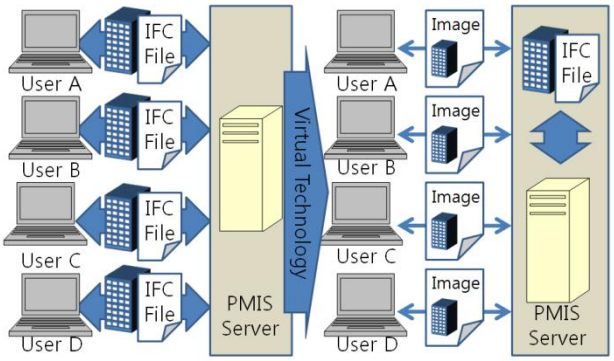

Figure 4. Application of Virtualization Technology

This application benefits users with various standards of computer performance at a steady, high processing speed. The major factors for a server's processing speed include the emulation of three dimensional images and transfer of data. Current server computers are also fully reinforced with durable peripherals and are fast enough to deal with multiple inquiries from user computers. Figure 6 shows the images generated from an architectural construction simulation prototype on IFC using the Virtual Technology service.

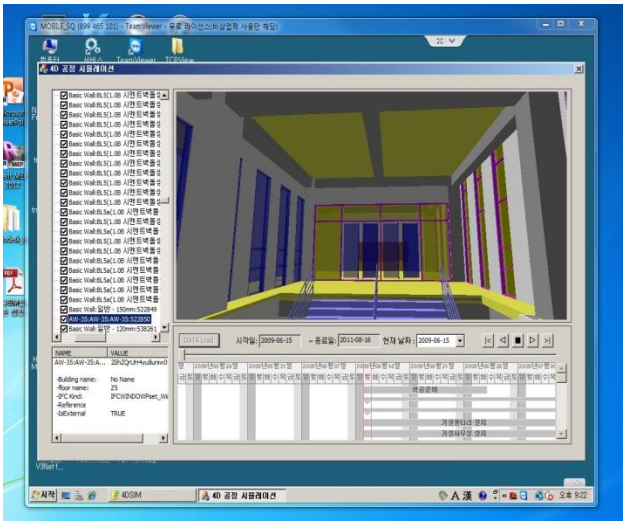

Figure 5. Simulation System using Virtualization Technology

6. DISCUSSION

For a comparison between the Virtual Technology environment and the Web-based environment in terms of efficiency, a time lap for the constructional information sets from the loading of a three-dimensional module and a four-dimensional module information was measured. In this measurement, the format of the three-dimensional module was IFC. According to this illustration, the speed of the loading process became 2.5 faster with the Virtual-Technology-based environment compared to the Web-based environment. This increase in processing speed would significantly benefit users. While the Web-based environment poses some technical issues with relatively low speed in data exchange, low quality in pixels, and low response speed, opportunities with advancement in usage environment and emergence additional programs allowing remote operations would also be realized later on.

7. CONCLUSION

The construction industry is aware of the limitations of using PMIS technology. An increasing number of recent studies are devoted to the utilization of BIM technology in order to overcome the limitations of PMIS. There is a consensus to allow BIM-based PMIS to exchange data among project program software in the industry, whereas questions regarding the IFC (from IAI) format for safe compatibility still arise. As the alternative for the IFC format, the IFC module server is relatively effective in data exchange but not for heavy IFC files, low speed and file exchange door. This paper seeks solutions in which the virtualization of a common server helps facilitate effective data exchange between BIM-based information and PMIS. Although this Virtual Technology marginally requires improvement in servers' functions and remote operations of programs according to the current stage of manufacture, the development of the Virtual Technology for effective data exchange should respond to the industry's strong demand for open-BIM environment. Future research on Virtual Technology development will require additional analysis and studies on data exchange rate, usage environment, and user interface through user participation.

Acknowledgement

This research was supported by the grants(2011-001585) from National Research Foundation of Korea.

REFERENCES

[1] Lee, SY., "A Study on the Development of 2D Extension Model for IFC 2.x3", *Kyung Hee University*, 2002.

[2] Kim, JG., "Example Analysis and Development of Project Management Information System - Case Study of Subway Construction in D. Area.", *Journal of Architectural Institute of Korea*, Vol. 11(1), pp. 593-596, 2005.

[3] Kim, JH. "Effective Application of PMIS through Analysis of Barriers At the Development of PMIS", *Journal of Architectural Institute of Korea*, Vol. 5(4), pp. 107-115, 2005.

[4] Jeon, SH. "A Study on Analysis of the Correlation between Building Information Modeling and Project Management Information System.", *Journal of Architectural Institute of Korea*, Vol. 27(1), pp. 757-760, 2007.

[5] Moon, SW, "Application of BIM-based PMIS Considering Construction Life-Cycle", *Journal of Korea Institute of Construction Engineering and Management*, pp. 655-658, 2008.

[6] Yoon, SW, "A Strategy for Building BIM+PMIS System", *Journal of Korea Institute of Construction Engineering and Management*, pp. 75-81, 2008.

[7] Kim, JW., *"A Study on the interoperability Test and Model Improvement Bentley BIM Data through IFC system", Seoul National University of Science & Technology*, Feb, 2009.

[8] Jeong, JY., "A study of efficient BIM data exchange and sharing", *Yonsei University*, Dec, 2010.