

Improving Project Document Coordination: Web Based Systems

Khalid Siddiqi,

Southern Polytechnic State University
Marietta, GA

Marcellinus Rendy Tendean,
US COST
Atlanta, GA

Zuhair El-Itr,

Southern Polytechnic State University
Marietta, GA

This paper presented the improvement in project documents coordination as the result of utilizing a web based collaborative project management system. For many AEC professionals, coordinating project documents to many individuals involved in the project in timely manner had been part of the industry challenge. While several web based collaborative project management systems had emerged to address the issue, the improvement and benefit from utilizing and investing in such system needed to be justified. The research was conducted by surveying various AEC professionals in their experience of using web based collaborative project management system. Analysis of the system benefits as offered by the system vendors was also incorporated in the research. The research found that the improvement in project documents coordination was realized in the anytime and anywhere accessibility, controlled accessed, and speed of project documents delivery. The research also found that the web based collaborative project management system could be the underlying information delivery method for BIM, where further research is needed. This paper would benefit both students and professionals in the AEC related industry, especially those in project management and project control.

Keywords: web based collaborative project management, project document, coordination, BIM, information delivery.

I. Introduction

The research was conducted as part of “management organization of A/E/C professionals through advanced communication mediums including World Wide Web and Internet” topic, which was part of management and business practices of the research agenda framework for the 21st century, under the Tenth Construction Management and Technology Research Conference.

Construction and technology has evolved together and been complementing each other since the beginning of construction. As construction projects advancing and get complicated, technology also evolved to provide solutions to many construction challenges. Today’s project has become more complex than ever before. They involve larger capital investments, embraces several disciplines, widely disperse project participants, tighter schedules, stringent quality standards, etc. (Alshawhi and Ingirige, 2003). As construction projects get complex, the amount of information generated is also increasing. Managing the vast amount of project related information and documents in an efficient and effective manner have been a challenge for many Architects, Engineering, and Construction (A/E/C) professionals.

Today, technology offers A/E/C professionals variety of means and methods in managing project related information and documents efficiently and effectively. The ability to produce information and documents electronically has made email and FTP site as the most common method to deliver project information and documents, with express mail (FEDEX, UPS, or courier) as secondary method. While email and FTP site is effective in delivery and storing, respectively, for immediate project teams (owner, architects, and engineers), it still lacks of efficiency and effectiveness in managing and coordinating documents for the extended project team members (immediate project team member, general contractor, sub-contractor, estimator, scheduler, superintendent, field engineer, etc.). With recent advancement in web based application, web based collaborative project management systems (WBCPMS) or sometimes also known as project specific web site (PSWS) has emerged to provide

solutions in managing and coordinating project documents for both the immediate and extended project team members.

A study conducted by Williams et. al. (2007) suggested that the construction industry expressed that having electronic and Web-based approach to exchange designs and conduct the approval process as an important need. The interesting part was such product that provide the capability to exchange design documents, receive approvals, and track document changes by different individuals had already available in the market to address the need. The research further indicates that although many construction companies eager to adopt the technology, many are either not familiar with the products available, or shy away from the cost of adoption, implementation and training. Many vendors such as Project Dux, Constructware, Prolog/Proliance/ProjectTalk, Autodesk Buzzsaw, E-Builder.net, and etc. have developed and tailored the application to accommodate A/E/C industry by including many integrated interface from online document or plan viewer with various files compatibility, overlay and markup tool, RFI forms and management, to 3D model / BIM viewer. While many of these interfaces are essential and very effective in managing project information and documents, one of the main purposes of WBCPMS / PSWS, which is to improve coordination and management of project information and documents, has not been tested or proven. Like many other technology products, it is important to test and measure its performance against its main purpose. As with WBCPMS / PSWS, it is important to test and measure the improvement in coordinating project information and documents for the extended project team members.

With the amount of information generated in a project lifecycle, managing project information and documents was a challenge to many A/E/C professionals. Furthermore, to this day, coordinating the project information and documents to the right person in a timely manner was still a challenge. For many A/E/C professionals, making many phone calls or sending emails before able to get to the much needed information when they need it has been part of their daily routine. Phone conversation might be useful to clarify the technical and managerial issues; however, phone conversation had limited problem-solving capabilities since they lacked a shared visual support (El-Tayeh and Gil, 2007). While email allowed attachment of drawings, sketches, files and documents, and was useful for conforming and clarifying issues, it was less useful for explaining and exchanging new ideas. Furthermore, professionals were aware that too much email communication could be detrimental to collaborative work because people lacked the time to reply (El-Tayeh and Gil, 2007). The delay in getting information and documents in a timely manner has created inefficiency and ineffectiveness for many project team members. Utilizing the available WBCPMS / PSWS technology should minimize the inefficiency and ineffectiveness due to delay in getting information or document. A well coordinated project would have project team members that are always informed, up to date, and on the same page during the entire project lifecycle.

II. Background

This research was conducted based on the push versus pull information transfer theory by Thorpe and Mead (2001). Thorpe and Mead (2001) proposed that a large part of information is pushed to other workers on a “just-in-case-they need-it” basis. This caused information overload that when a worker actually needs a piece of information, he or she may have to sort through piles of irrelevant data in multiple formats to find it. This also gave potential of a person withholding information from other project team members, thus restricting the free flow of information. The alternative to just-in-case information is “just-in-time” information or information on demand. Unlike the traditional push model, this pull model allows users to access information when they need it, eliminating information that is out of phase and reducing the transmission of irrelevant data. Using pull technologies, a user can use a simple web browser to access information from a wide range of distributed sources and systems (Thorpe and Mead, 2001).

The WBCPMS / PSWS developed based on the push versus pull information transfer theory. Instead of having a team member had to push or forward information to other team members (Owner>Architect>Engineer>PM>CM...), project team members have controlled access to upload, share, and get project information and documents in a centralized place whenever they need it.

As pictured in figure 1 (information transfer in a project team with only one member from each party involved), each team member had to push forward the information to every project team member whenever information had to be shared. The information transfer in push method multiplied and became redundant when the number of parties or multiple member from each parties involved increased, as pictured in figure 2 (information transfer in a project team with multiple members from each party involved). While email and express mail were sufficient to accommodate

the task of coordinating project information and documents, it was inefficient and ineffective since the task became redundant and repetitive. As example, in the case of RFI (Request For Information), many architects, engineers, or project managers had to repetitively explain or answer the same question or issue for several times.

With the information pull method, as pictured in figure 3 (collaborative workspace and information transfer in a project team using WBCPMS/PSWS), project information and documents are centralized, in this case using Project Dox as WBCPMS, and each party and project team member have controlled access to access, upload, or download the information needed anytime and anywhere. Thus, the sender only required uploading the information or documents once, while the receivers can access and receive the information or documents when they needed it.

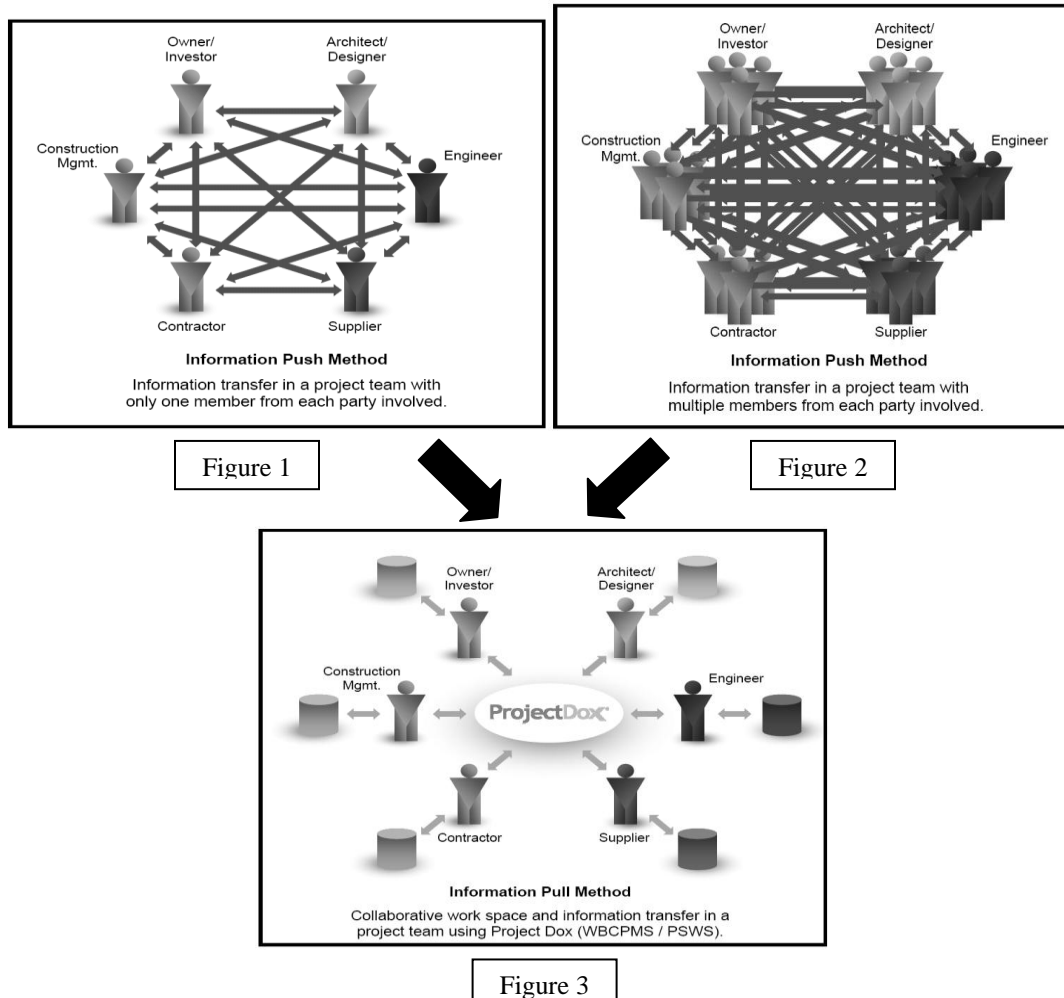


Image and illustration are courtesy of ProjectDox of Avolve Software

III. Research Methodology

Data Collection

To get a broader picture and understanding of what WBCPMS / PSWS was several data collection was utilized on the research. Initially, marketing literature and materials were collected and requested from several WBCPMS / PSWS developers to further understand the differences between several different products that were available on the market. Survey questionnaire was distributed to various A/E/C professionals in various industries, both those who had used WBCPMS / PSWS and those who did not. The purpose of the survey was to measure the performance of WBCPMS / PSWS in coordinating project information and documents through those who have experienced in using such WBCPMS / PSWS. Opinions from those who had no experienced in using WBCPMS / PSWS were also collected to see whether they perceived that WBCPMS / PSWS performed better than the conventional method in coordinating project information and documents. Several other questions were also asked in order to collect

additional data on the industry knowledge, perception, and absorbed WBCPMS / PSWS as a technology that would improved the flow of information in the industry.

Data Analysis

The responses received from the survey questionnaire were analyzed using statistical methods. First, each questionnaire received was analyzed individually to understand each participant background, experience with WBCPMS / PSWS, and perception of WBCPMS / PSWS. Afterward, all of the data collected were analyzed as a whole. Then, the data were sorted, arranged, and tabulated in spreadsheet for further calculation and testing. The frequency or modes of each answer from each question were calculated, and were put into percentage to develop graphical charts. The performance of WBCPMS / PSWS in improving coordination and management of project information and documents was measured through the response of those who had experience using WBCPMS / PSWS, those who knew about it but never used it, and those who heard about it.

IV. Result & Inferences

There were 41 survey questionnaires distributed through emails, and 34 questionnaires were handed out in person to various A/E/C professionals. Out of 75 survey questionnaires distributed, 30 responses were received, which gave a 40% response rate. Out of the entire respondents, 72% were in the construction industry, 13% were in engineering, and 15% were in architecture. 63% of the respondents have more than 10 years of experience in their respective industry, 14% of the respondents have experience between 6 to 10 years, and 23% have experience between 1 to 5 years. The short research duration, small sample population, and low number of participation and response rate were seen as a limitation of this research.

First, in order to understand how WBCPMS / PSWS could help in improving coordination and management of project information and documents, a clear understanding of the current state of project documents / information delivery method in the industry needed to be established. As shown in Chart 1, a majority of the respondents (77%) used FTP / Email as the most common method to share project documents / information with extended project team member. There were only 13% of the respondents used WBCPMS/PSWS, while the rest 10% were still using Express Mail. The low rate of adoption of WBCPMS / PSWS agrees with the study conducted by Williams et. al. (2007), as indicated in the introduction, that having electronic and Web-based approach to exchange designs and conduct the approval process was still expressed as an important need. Interestingly, one of the responder put a remark that his or her company was no longer relied on conventional delivery method, and 100% relied on the company custom build WBCPMS / PSWS to coordinate project documents.

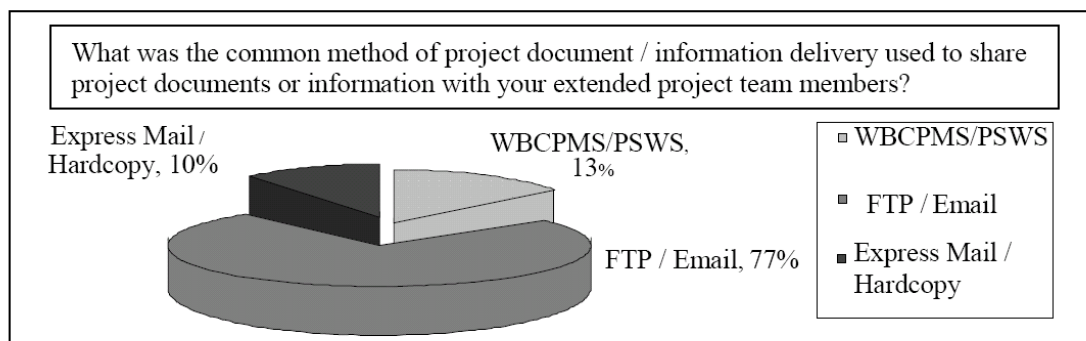


Chart 1: The most common method used to share project documents with extended project team member.

Understanding the frequency of difficulties in finding documents and the frequency of difficulties in getting documents to the right person in timely manner when using conventional delivery method would give an essential understanding of the problem faced by many A/E/C professionals in coordination and management of project information and documents. Therefore, participants were asked for how often they have difficulties in finding documents and the difficulties in getting documents to the right person in timely manner. Chart 2 showed that many A/E/C professionals (more than 50%) were sometimes and often still having difficulties in finding the document needed in a timely manner, and in getting the right document to the right person was still a challenge for many of

A/E/C professionals. Interestingly enough, Out of those who currently utilized WBCPMS / PSWS as their common method of project document / information delivery, 2 respondents sometimes were still having difficulties both in finding documents needed and in getting documents to the right person in timely manner, and 1 respondents never had any difficulties both in finding documents needed and in getting documents to the right person in timely manner. While it was an interesting finding, it might not reflect the larger group of those who are using WBCPMS / PSWS due to the small sample and low number of respondents who were currently utilized WBCPMS / PSWS, as it was stated in research limitation. These contradictions might indicate the fragmented and differences in technological literacy in the A/E/C industry.

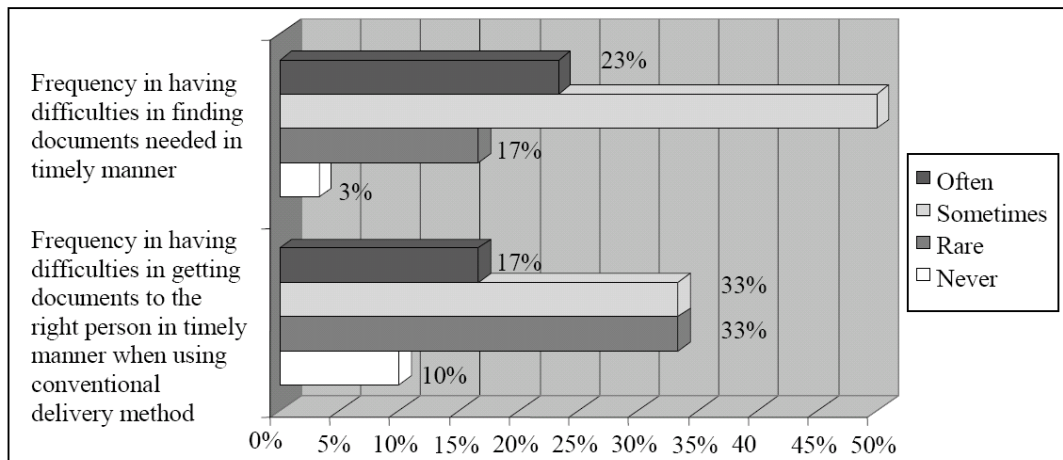


Chart 2: Frequency of difficulties occurred when using conventional delivery method.

In measuring the industry knowledge and absorption of WBCPMS / PSWS technology, Chart 3 showed a convincing growth and absorption rate of the technology with more than one third of the respondents had experience in using WBCPMS / PSWS, and also more than one third of the respondents had knowledge about the systems although had never experienced it. Only slightly less than one fifth of the responders had heard the availability of such systems, yet had no further knowledge about it. Again, the survey depicted and agreed with the study conducted by Williams et. al. (2007). Out the entire respondents, there were only two respondents who had never heard and had no knowledge about the availability of such system. To sanitize the data, the responses from the two respondents were removed from the data set, since their respond would be irrelevant.

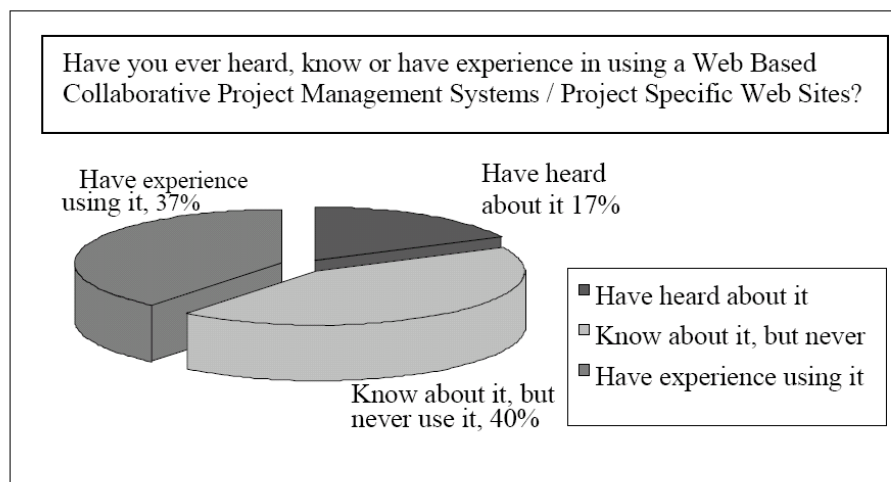


Chart 3: Respondents experience or knowledge of WBCPMS / PSWS

Chart 4 and 5 measured the objective of the study, which was to measure the effectiveness of WBCPMS/PSWS in terms of coordinating project information / documents. Chart 4 showed that both those who had experience using

and those who did not have the experience agreed with at least 50% of the respondents that WBCPMS/PSWS could and improved project information / documents coordination substantially, and 13% were agreed that the improvement in project information / documents coordination with WBCPMS/PSWS was very substantial. The result agreed to the study conducted by Mohamed and Stewart (2003), which suggested that the users' perception of web-based communication on construction project found that document transfer and handling, enhanced coordination and communication between project participants, and reduced respond time to answer queries as web-based system most values.

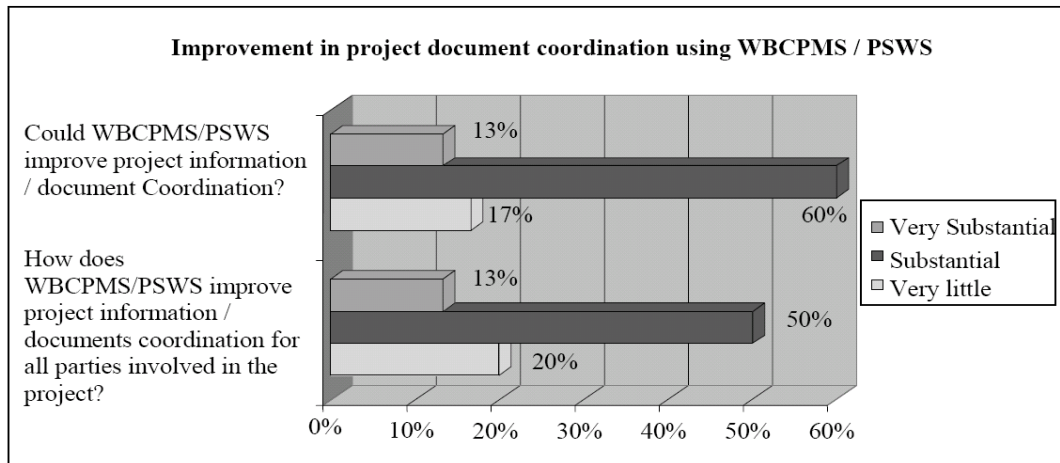


Chart 4: Overall responds on the effectiveness of WBCPMS/PSWS in improving project information / documents coordination for all the parties involved in the project.

Since chart 4 included opinion and perception of those who knew but had never used it and those who have heard about it, while it gave a picture of the A/E/C industry perception of WBCPMS/PSWS, the result measured might not be accurate. Thus, in order to truly measure the improvement in improving coordination and management of project information and documents that WBCPMS/PSWS offered, the population observed needed to be focused only to those who had experienced in using WBCPMS/PSWS. Out of those 37% who had experienced using WBCPMS/PSWS, 18% said that the improvement was very substantial, 55% said that it was substantial, and 27% said that the improvement was very little. The result showed that the perception of the sample population agreed or was in line with the perception of those who had experience using WBCPMS/PSWS. Through further interviews, those who said that the improvement was very little commented that their experienced was due to their involvement were long time ago when WBCPMS/PSWS were still developing, and due to inexperience project manager when utilizing WBCPMS/PSWS.

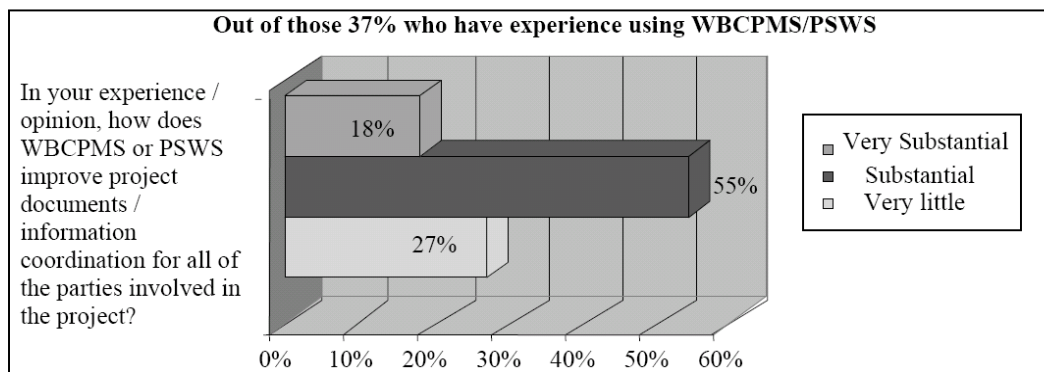


Chart 5: Responds from those who had experienced using WBCPMS/PSWS on its effectiveness in improving project information / documents coordination.

With many variables that could be attributed to the substantial improvement in coordinating project documents / information using WBCPMS/PSWS, a further validation of which attribute of WBCPMS/PSWS made a significant improvement in project documents / information coordination compared to the conventional method needed to be

justified. Chart 6 showed that the significant improvement in coordinating project documents / information using WBCPMS / PSWS was found in anywhere and anytime accessibility (47%), supporting Thorpe and Mead (2001) push vs. pull theory, as indicated in the background. Respondents found that controlled accessed and speed of delivery as secondary. This can be inferred that while controlled accessed (20%) was mandatory and a requirement, the digital security technology has already well developed, thus many respondents were not concern with the issue. The speed of delivery (only 13%) also became insignificant since users could access the information and documents whenever and wherever they need.

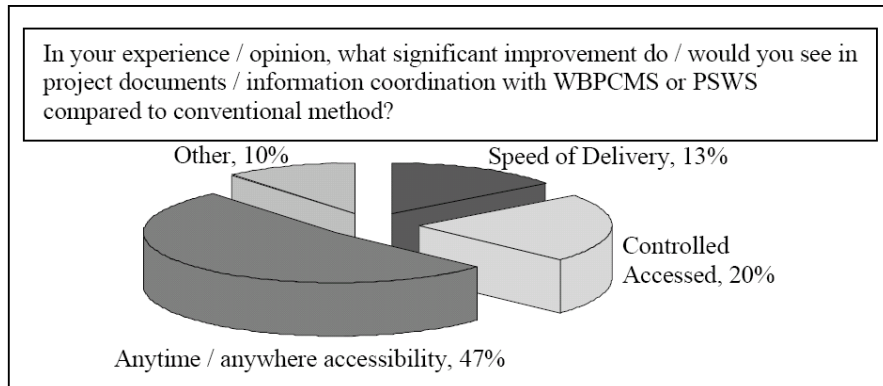


Chart 6: Significant improvement in project documents / information coordination with WBCPMS/PSWS compared to conventional method.

Aside from many improvements in many aspects of project documents / information coordination and management, many WBCPMS/PSWS vendors included various additional features complementing their product and services giving additional benefits to their clients and users. Those additional features included but not limited to documents / plans viewer, online RFI forms management, control of intellectual property ownership, and 3D Model / BIM (Building Information Modeling) Viewer. Chart 7 showed that document and plan viewer (33%) with various files compatibility, and ability to markup, overlay, and put comments was selected by respondents as the most valuable feature benefits followed by Online RFI (Request For Information) forms and management (23%). The documents and plans viewer were an important tool that eliminate the need for users to have various software installed on their machine, and eliminating any concern of file format incompatibility. The online RFI forms and management was significant in reducing the redundancy of RFIs which usually occurred and faced by many architects and engineers. 3D Model / BIM viewer and control of intellectual property ownership were tied with equal 13% respondents.

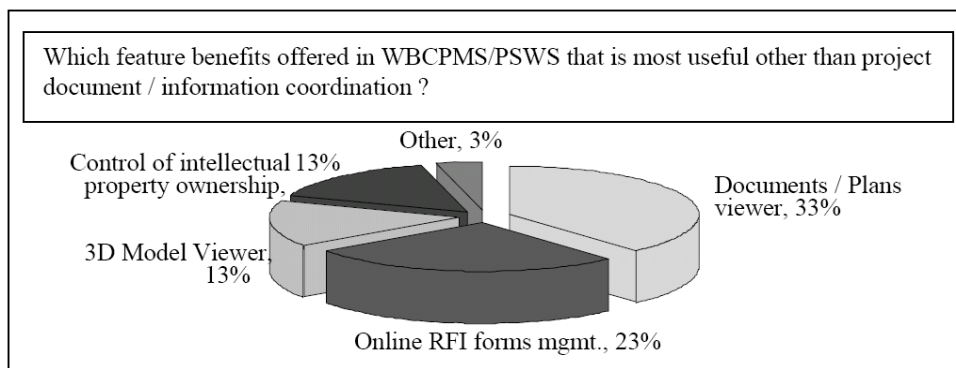


Chart 7: The most useful featured benefits in WBCPMS/PSWS other than project document / information coordination.

The inclusion of 3D Model / BIM viewer as an added feature and benefit was to support the growth and transition of the A/E/C industry in utilizing 3D Model and BIM (Building Information Modeling). Several of the barriers to BIM adoption, growth and implementation throughout A/E/C industry wide were the high cost of investment or implementation of purchasing expensive CAD / BIM software and training for various project participants, intricate BIM software literacy to operate or pull information, and the legal issue of controlling intellectual property ownership, where BIM files had to be shared with various project participants. With the emerging and development of various web based or online estimating and scheduling software, the inclusion of 3D Model / BIM viewer to

WBCPMS/PSWS would minimize those barriers and possibly could even promote the adoption and development of BIM throughout A/E/C industry. To find out the industry perception of this significant feature and its implication toward BIM future adoption and development, participants were asked for their opinion on the previous statement, as well as whether WBCPMS/PSWS could be the underlying delivery method for BIM throughout the industry.

Chart 8 suggested that about one third of the respondents believed that WBCPMS / PSWS when combined with a 3D viewer, which starts to be integrated to WBCPMS/PSWS, would promote the adoption and development of BIM, while almost half of the respondents answered “may be”, which showed a strong possibility. Also about one third of the respondents believed that WBCPMS/PSWS could be the underlying project information and delivery method for BIM. The same number of respondents also answered “may be” to this particular question, which signaled a strong possibility in the future.

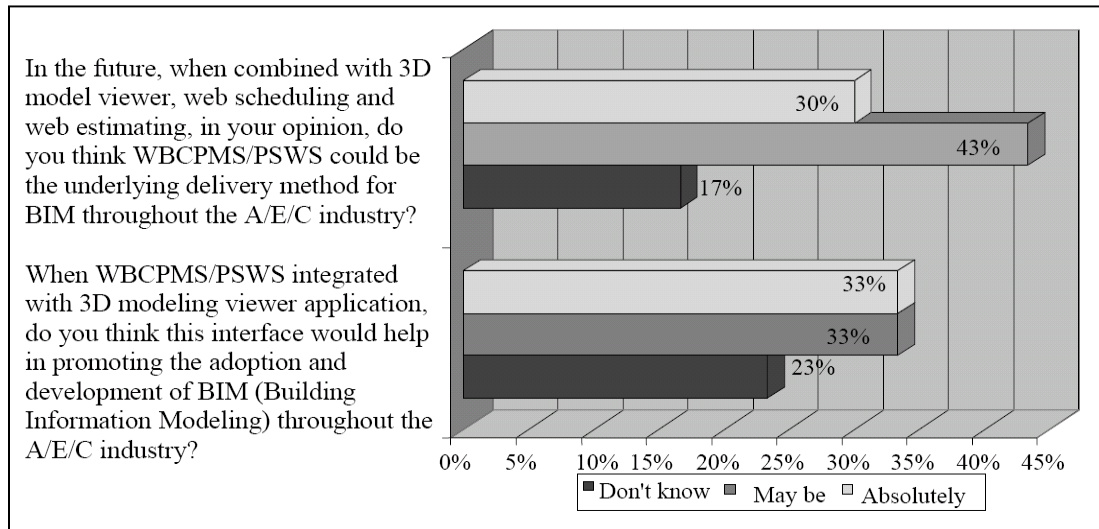


Chart 8: Future possibility of WBCPMS/PSWS integration with BIM.

The low rate of adoption of WBCPMS/PSWS in the construction industry could be identified due to lack of collaboration in the business, lack of training, and the high cost of implementation (Williams et. al., 2007). Another study also suggested that for new technology to be adopted required some external requirements, such as client or government requirements that specified the use of a specific technology (Mitropoulos and Tatum, 2000). The ideal situation was one in which the owner leads by implementing the systems and required WPMS in the contract of the project (Dossick and Sakagami, 2008).

V. Conclusions

The complexity of today's capital project and the growing number of project participants from Architectural, Engineering and Construction (A/E/C) industry produced tremendous amount of information. The massive amount of information had caused problem for project participants especially in sharing, managing and coordinating project information / documents with other project participants. The delay in getting information and documents in a timely manner has created inefficiency and ineffectiveness for many project team members. The emerging web based collaborative project management systems (WBCPS) or sometimes also known as project specific web site (PSWS) aimed to provide solutions in managing and coordinating project documents, yet it has not been tested or proven in improving project documents and information coordination. The research was conducted to measure the performance of WBCPMS / PSWS in coordinating project documents and information.

In conclusion, the research found that WBCPMS/PSWS improved project documents / information coordination between extended project team members substantially compared to conventional method. The improvement in coordinating project document / information was found in anytime and anywhere accessibility, while speed of delivery and controlled accessed became less significant. The research also found with the integration of 3D Model / BIM viewer to WBCPMS/PSWS, there was a strong possibility that WBCPMS / PSWS could helped in promoting the adoption of BIM, as well as could be the underlying project information and document delivery method for BIM in the future, where further study on the possibility was recommended.

VI. References

- Alshawi, M., and Ingirige, B. (2003). "Web-enabled project management: an emerging paradigm in construction." *J. Automation in Construction*, Elsevier Science, 12, 349 – 364.
- Dossick, C. S., and Sakagami, M. (2008). "Implementing Web-Based Project Management Systems in the United States and Japan." *J. Constr. Engrg. And Mgmt.*, ASCE, 134(3), 189 – 196.
- El-Tayeh, A., and Gil, N. (2007). "Using Digital Socialization to Support Geographically Dispersed AEC Project Teams." *J. Constr. Engrg. And Mgmt.*, ASCE, 133(6), 462 – 473.
- Mitropoulos, P., and Tatum, C. B. (2000). "Forces Driving Adoption of New Information Technologies." *J. Constr. Engrg. And Mgmt.*, ASCE, 126(5), 340 – 348.
- Mohamed S., and Steward, R. A. (2003). "An empirical investigation of users' perceptions of web-based communication on a construction project." *J. Automation in Construction*, Elsevier Science, 12, 43 – 53.
- Nitithamyong, P., and Skibniewski, M. J. (2004). "Web-based construction project management systems: how to make them successful?" *J. Automation in Construction*, Elsevier Science, 13, 491 – 506.
- Thorpe, T., and Mead, S. (2001). "Project-Specific Web Sites: Friend or Foe?" *J. Constr. Engrg. And Mgmt.*, ASCE, 127(5), 406 – 413.
- Williams, T., Bernold, L., and Lu, H. (2007). "Adoption Patterns of Advanced Information Technologies in the Construction Industries of the United States and Korea." *J. Constr. Engrg. And Mgmt.*, ASCE, 133(10), 780 – 790.