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An Analysis of the BIM Adoption Time in Building Construction Industries in Korea

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Abstract

Objectives: Long-term roadmaps for facilitating BIM will be developed pertaining to Korea and other countries. The current status and the time frame for BIM adoption will be analyzed, especially in Korea. **Methods/Statistical Analysis**: BIM can be utilized in the practices and business area in many building construction projects. In order to analyze the current status and future trend of BIM in Korea, survey and expert interview techniques are used in this study. Major technologies which could be used with BIM are identified, and when these technologies could be fully adopted in each area is asked in the survey and interview. **Findings**: BIM has limitations for practical application in Korea. However, it is an essential technology for efficiency improvement in building construction projects. In order to maximize the efficiency of BIM, it is required to go with ICT convergence technologies. In this study, ICT convergence technologies which can be used with BIM are identified, and the approximate time in which applied BIM technologies could be available is surveyed. For example, according to the survey, applied BIM technologies in the Design and Engineering phase could be widely adopted in 5 to 10 years, and BIM in the construction and facility management phase could be adopted in 10 to 20 years. **Improvements/Applications**: The applied BIM technologies and the time frame which they could be available in the future were identified and surveyed in this study. It will be useful for those who are preparing a BIM application strategy and are planning for their future.

Keywords: Building Information Modeling (BIM), Information and Communications Technologies (ICT), Lifecycle, Process

1. Introduction

Currently, the 2D design system is used for most building construction projects. This system has a high level of dependence on manual work and there is a large potential for error, omission, inconsistency and other problems in drawings. These problems cannot be found easily and they are usually handed down to the engineering design and construction phase. In the construction phase, they could appear in design change, rework and delay. It is much easier to find design problems and improve design quality with BIM (Building Information Modeling), and it could be solution for current design problems. Currently, many designers and engineers are trying to adopt BIM into their business and practices, and get less effect than expected. In order to maximize the effect of using BIM, the project management process also has to be modified considering BIM. In this study, the current process, practice and technologies used in each phase are analyzed with literature review and interview and future technologies which could be developed and used in the future are surveyed. We try to develop the future process which BIM related technologies are fully used.

BIM facilitation roadmaps have been developed in the UK, Singapore, Canada, and some other countries. Although BIM related technology development roadmaps are hard to find, some construction automation or U-City service related roadmaps were found in the literature review.

In[1] studied automation technology roadmap development cases and developed Hume Pipe Laying automation equipment development roadmap. In[2] has developed a

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template for U-Service Assessment and SRM (Service Roadmap). In this study, the 228 U-City services are identified, the classification structure is defined, and a service relation map and service unit roadmap has been developed. In[3] studied the status of the overseas construction market and the research development of domestic construction technologies. Also, he defined the construction technologies customized by overseas area (country) items for winning more overseas contracts. In[3]studied the current Facility Management scenario and suggested using BIM based FM system concepts in order to develop the future FM system.

In[4] studied the costs and benefits of applying the proposed robot system for construction works. In[4] considered the robotization of on-site reinforcement mat preparation, interior/floor finishing, quality inspection, and drones for carrying loads and proximity detection sensors.

In[5] proposes an integrated system development methodology of design and LCC process for an information-oriented design and LCC management system, which allows architects and LCC planners to easily access information to be provided in each design stage and its relevant LCC planning process, and for design and cost management companies to improve their performance through the systematic storage and usage of data after the completion of an educational project.

In[6] suggested important milestones in the construction of Multi Cloud Computing Systems (MCCS). He emphasizes on the design issues to be considered for multi cloud architecture, requirements for various groups involved in the development of MCCS and types of architectures such as cloud hosted proxy, proxy as a service, point-to-point proxy and on-premises proxy for MCCS.

In[7] presents the implementation of one such WSN useful for industrial applications. The advent of Wireless Sensor Networks (WSNs) has revolutionized the field of automation in many ways. These WSN clusters can be used for automation of various industries with the possibility of easy modification or expansion in the future.

2. Converged BIM Technologies

In order to develop the BIM adopted improved process, future technologies which are adoptable and can be further developed must identified. In this study, we surveyed and studied various new technology development cases and research reports. The categorized BIM related future technologies are identified in Figure 1.

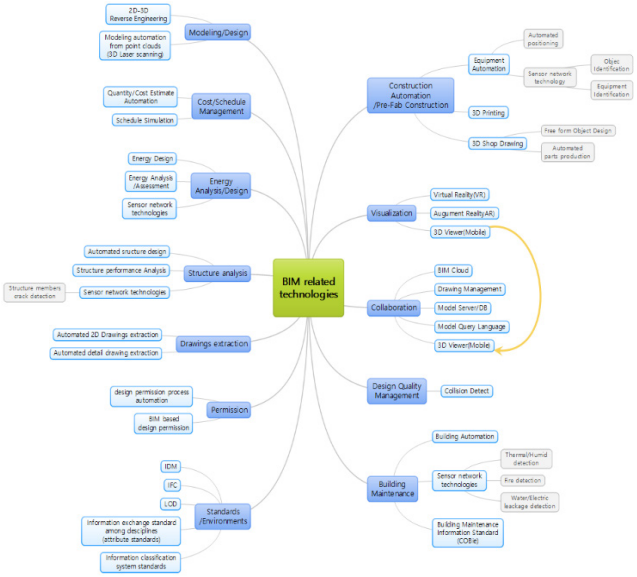

Figure 1. BIM related future technologies.

3. BIM Adopted Improved Process

BIM could be adopted in the whole lifecycle of the construction project, and could be utilized by all participants in all of the disciplines, so it is difficult to identify and analyze all the technologies used through the construction project lifecycle. For this reason, it is difficult to find BIM related technology roadmap development studies.

For adopting BIM in building construction industries, it is required to consider systematic plans and strategies for applying BIM technologies to the lifecycle of a building construction project. For this, it is necessary to anticipate and design future practices when BIM is fully adopted in building construction projects. As a result of analysis of current reports and papers of BIM technologies, the process of a building construction project is developed as Figure 2.

4. Survey of BIM Adoption

In order to analyze the future trends of BIM, the future time frame to analyze is to be defined. In this study, 5, 10 and 20 years are selected as a short term, midterm and long term period. 30 Experts who have experiences of BIM are selected in design, engineering and construction area and are surveyed for the current status and future

time frame when BIM related technologies could be fully adopted in each area.

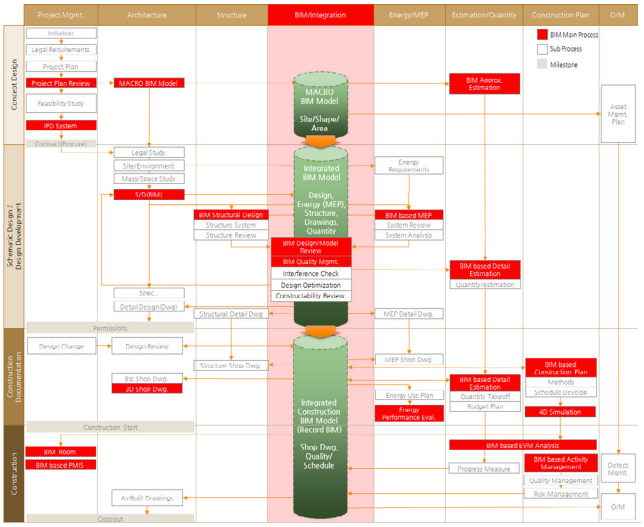

Figure 2. BIM adopted future process.

4.1 BIM Adoption Time

BIM is already mandatory in design-build public construction projects from 2002. However, BIM engineers and environments such as software, hardware and guidelines are not ready for BIM adoption. 3D modeling is the only BIM technology that they use in their projects for constructability and design review such as collision detection. With this experience, many engineers donot know why BIM is required and think BIM is useless. If they followed the newer standards and guidelines for BIM modeling and data exchange, they could use other modeling data in their practices, and receive the full benefits of BIM.

According to the survey, BIM can be fully used in design practices in 5 years as shown in figure X. At that time, architects could design buildings with 3D models instead of 2D drawings. Most design documents could be extracted from the 3D model and the more accurate 3D model could get priorities over 2D drawings if they are different. Furthermore, experts anticipate that design automation technologies could be developed and utilized within10 years as shown in Figure 3.

4.2 BIM Technology Adoption in Design Phase

In the design phase, BIM could be used with a project feasibility study, code check, and site analysis. With BIM, architects can design buildings easily using 3D libraries such as LEGO blocks, and they could use 3D data from laser scanning and drone for site analysis. Architects could analyze the 3D model with a standard model query language, and they could get design analysis reports such as design area and quantity takeoff automatically. According to the survey results, design supporting technologies could be available in 5 years, and automated design and analysis technologies could be available in 10 years as shown in Figure 4.

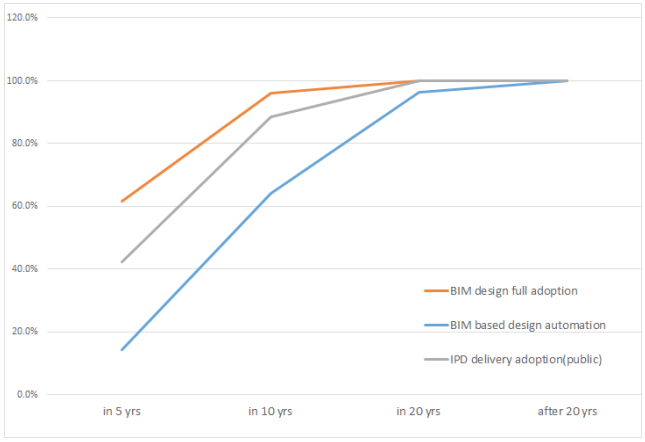

Figure 3. BIM adoption time.

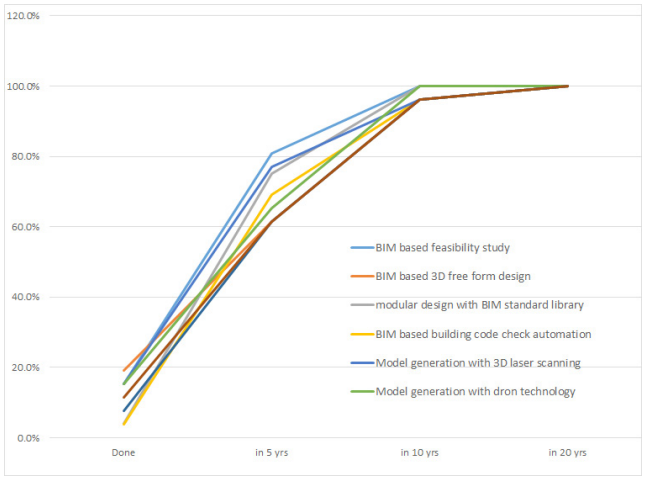

Figure 4. BIM technology adoption in design phase.

4.3 BIM Technology Adoption in Engineering Design Phase

The engineering area mainly includes structure, environment and energy design and analysis technologies. Although detail engineering parts are different in subjects and contents, the basic processes are consisting of

requirements analysis, engineering design and interpretation process in common. Also, this area includes the process of producing detailed drawings. BIM application technologies supporting engineering processes are actively developed by many organizations, and they could simplify the process of engineering analysis and design. According to the survey, standards for energy and environment analysis such as the data exchange standard, templates and libraries, and automated engineering design technologies could be available in 5 years. Also, Structural engineering analysis and design automation technologies and standards could also be available in 5 to10 years as shown in Figure 5. Some automated engineering and detail drawing-producing technologies are already available and more intelligent drawing production technologies will be developed in the near future.

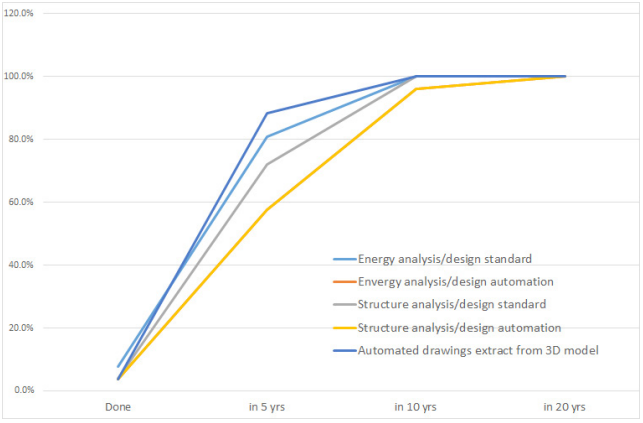

Figure 5. BIM technology adoption in engineering design phase.

4.4 BIM Technology Adoption in Construction Phase

In the construction phase, the construction plan should be developed and shop drawings and other construction documents are to be produced. During construction, many automation and Information and Communications Technologies (ICT) related technologies are used in order to improve efficiency and quality level. Also, ICT related technologies can be used for gathering construction project information. Because BIM models, drawings and documents produced in design and engineering phase can be utilized in the construction phases, BIM technologies supporting design and engineering should be developed earlier than those for construction. In the construction phase, the building components are produced and they are required to be constructed or assembled by construction equipment as designed in the design phase. Also, the BIM supporting construction technologies should include automated building construction or producing building technologies such as automated construction equipment or 3D printing technologies. These BIM related technologies for construction phase maybe available in 10 years or later as shown in Figure 6.

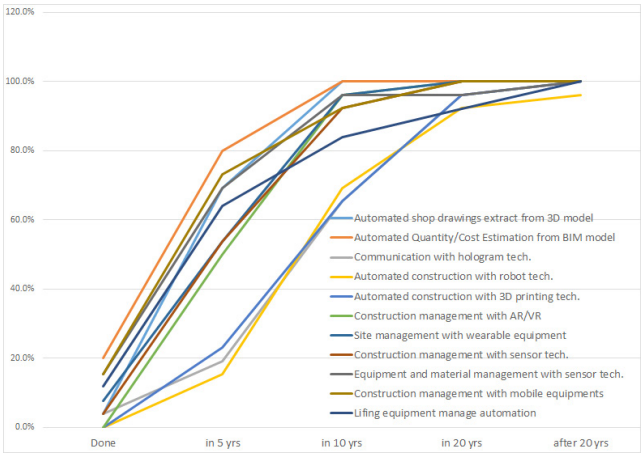

Figure 6. BIM technology adoption in construction phase.

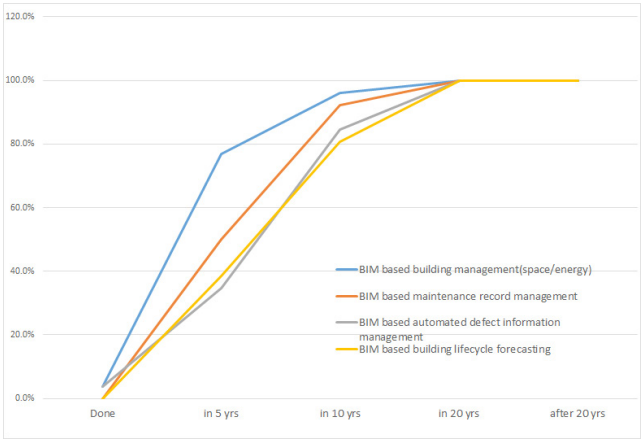

Figure 7. BIM technology adoption in facility management phase.

4.5 BIM Technology Adoption in Facility Management Phase

Space management, building repair, clear and security management are included in the facility management phase. Financial management and asset management are also included in the in the broader view of facility management. Because of this, the work scope and the period of facility management are the widest, the longest, and is the most expensive during the building life cycle; the

facility management is the most important process in building construction projects. However, facility management technology is less developed than its importance. Some energy usage analysis technologies have been developed and could be used with BIM model data, and other technologies for automated and more efficient facility management could be available in 10 years or later as shown in Figure 7.

5. Conclusions

In order to solve the problems and overcome limitations of current design and construction practices, BIM technologies will be essential to the construction process. In order to maximize the efficiency of BIM application, a redesign of the overall process and environments in building construction projects is needed, and BIM could be used with applied ICT technologies for efficiency improvement. Although many designers and engineers are trying to adopt BIM in their business practices, many of them received less benefit from using BIM than expected. In order to maximize the benefits of using BIM, the process of building construction projects has to be modified or redesigned considering BIM.

In this study, the current process practices in each phase are analyzed with a literature review and survey, and the technologies which could be developed and made available in the future are identified. The ICT convergence technologies which could be used with BIM are identified, and the future processes for which applied BIM technologies can be fully adopted are developed. Although some of them are available now, most of them are being developed and will be further available in the near future. In order to develop a plan or strategy of BIM adoption, it is required to anticipate when they could be available. In this study, the approximate time in which applied BIM technologies could be available in future is surveyed and analyzed. According to the survey, applied BIM technologies in Design and Engineering area could be available in 5 to10 years, and those in construction and facility management could be available in 10 to20 years.

6. Acknowledgment

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