

BIM IMPLEMENTATION STRATEGY AND TASKS FOR ARCHITECTURAL INDUSTRY IN KOREA

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ABSTRACT: Even though attempts are made to transform from 2D CAD to BIM representation for building design and construction, it were not so successful for practical implementation until recently in construction industry in Korea. However, there is a dramatic change for the use of BIM by collaboration among government, independent organizations as well as industry itself. Government reckons that BIM is an important tool for environment friendly construction and industry competitiveness. The government not only makes national BIM standards and push policies in order to make market environment. Independent organizations such as BuildingSMART Korea does active role to stimulate the transformation process successfully. They act as opinion leaders for the Government to consider BIM implementation for industry competitiveness issue. They make roadmap as well as technical standards and guidelines. It also leads technical developments and supports for its implementation. Government supports researches for the implementation of BIM. The research includes BIM standards, guidelines, linking with existing Architectural Administrative Information Systems, making libraries as well as education. Government makes policy for BIM as a compulsory data for bidding process of newly designed government buildings. Private sector not only agrees BIM as a tool to adapt but also essential methods for its survival in domestic and foreign construction market. Architectural design companies and constructions companies currently develop technical skills and implement BIM for new projects such as Dongdaemoon Plaza that cannot be successfully drawn by conventional methods.

Keywords: BIM, strategy, policy

1. INTRODUCTION

BIM(Building Information Modeling) is one of the most mentioned topic during last 20 years in Korean construction industry. IT is recognized as a key tool to maintain competitiveness. The use of 2D CAD for the industry began from 1980's and matured enough for its use. Since then, the implementation of BIM technology has been attempted for more versatile use of building information and maintaining information integrity. It also was asserted as a means to solve a CAD market problem dominated by a particular commercial system.

The use of BIM technology in Korean construction industry began from construction feasibility studies at the beginning. Lately, there are various attempts to extend its use from partial implementation to more extensive use from initial planning stage to the maintenance area. Recently, there begins governmental policy to use BIM for public buildings for the efficiency of bidding process for clients.

2. MARKET CHANGE

Korean Construction Industry has been keen interests in BIM technology since non-profit international organization IAI begins in 1996. IAI Korea, currently becomes buildingSMART Korea, was found in 1998. As the use of CAD technology in construction industry mature, market shift attempts from 2D to BIM has been persists with only partial success. It is mainly because of the construction industry only use CAD as a tool to replace paper instead of changing work process along the

implementation. Unlike other industry such as manufacturing, construction industry heavily relies on software companies rather than develop for its own needs.

However, the adaptation of BIM technology for construction industry is in at the early stages for environmental solution as well as for industry competitiveness tool. Other related industries such as steel, precast concrete, equipments and mechanical system already use BIM technology in general, so that the industrial environment for adapting it becomes more available.

It also becomes a good chance to normalize CAD market dominated by a certain commercial system. Currently, a certain system dominates 2D CAD market so that the format becomes de facto standard. Under the market circumstance, it is not easy to implement open standard. It also means new idea and technology cannot be implemented easily.

2.1 IT tool for Environmental Solution

BIM becomes as a core tool for sustainable building construction. First of all, it becomes as an efficient tool to cooperate design process for environment friendly building design. Since the design requires knowledge and experiences of various domains, BIM becomes central tool to communicate during design developments and construction processes. For the eco-building design, early stage of design cooperation becomes more important since most of the design decisions are made during the stage. And it is possible to use the BIM data can be used for more accurate simulation of environmental factors

during later design stages. Since the lifespan of building is another factor for eco-design, the more complete building data as a BIM becomes essential for its maintenance and extension of the lifespan.

Current Korean government keenly interested in global environmental problems seriously. The government also recognizes it as a new market for the national development. The government reveals \$10 billion investment plan to make it as competitive industry that many of the areas are closed related with environment friendly construction industry. Recently, Ministry of Land, Transport and Maritime Affairs, and Public Procurement Service develop its sustainable policies to make environmental services as core national industry. Public Procurement Service is going to mandate BIM data for more than \$50 million public building projects from 2012. It also made 'Energy Saving Design Guideline and Environment-friendly Construction Material Procurement' manual. Recently as a pilot project, BIM design data is mandated of 'Digital Broadcasting Contents Center Building' for design-build bidding process as pilot project. The BIM data is going to be used for visualization, minimization of design errors, calculating bills of materials, energy analysis, construction planning as well as building maintenance. It intends to reduce 20% energy consumption for building maintenance. It intends to accelerate the use of BIM technology and technological developments. It also wishes to stimulate the use of BIM technology in public and private sectors for building industry.

2.2 IT tool for Industry Competitiveness

Even though construction industry recognizes the benefits of using BIM technology, it still remains fractional deployment and remains behind in comparison to other industries. The main reasons can be categorized into change of process, credibility and productivity problem. The use of BIM is not a matter of simple tool change. It also include change of work process overall. In design process, it enables to co-operate design process instead of linear ones. As a result, more complex design problems can be handled by multiple experts simultaneously more easily and can make more complete design data for later use while maintaining data consistency. Even though BIM design data can be used for later stages such as visualization and simulations, the model of the process including compensation for extra works is still experimental.

Credibility is mainly caused by in-experiences. BIM technology user has to not only master the use of it but also has to design with 3D instead of 2D. It requires technical skills as well as design abilities that only highly qualified worker can handle. Most of all, it results in low productivity. Low productivity is not only caused by unskilled workforce but also working environment. For more efficient working environment, it is necessary to build template and libraries that is not easy to make at the initial stages of using BIM systems.

In order to help to stimulate the shift from 2D technology to BIM, the government makes use of public projects as pilot projects such as 'Digital Broadcasting Contents Center Building.'

3. BIM IMPLEMENTATION STRATEGIES

Government, independent organizations as well as private industry understands the importance of the use of BIM.

3.1 Government Policy

There are two reasons that the Korean government is enthusiastic about to make policies for the wide spread of BIM technology particularly in construction industry. One is the emphasis on green economy. The Korean government intends to shift towards green economy not only participate to fight against global climate change but also to make more sustainable economic structure for the future. The other is the importance of the construction industry in economy currently 18% of the GDP. As a result, it becomes important to make construction industry more competitive using IT technology.

BIM Presidential Commission on Architecture Policy includes BIM in the 1st Architectural Policy Plan for 5 years announced in September 2009. For more active use of BIM technology, the government leads to make BIM standards and guidelines and links to Architectural Administrative Information System. Government will also support to make BIM library and for BIM related education.

According to the policy, Ministry of Land, Transport and Maritime Affairs makes roadmap for BIM develops National BIM Guideline early 2010. It intends to make open BIM standards that can be used by government, clients and private sectors. It includes the procedure, data format, procedure, procurement process and quality control processes.

Public Procurement Service mandates the use of BIM for the public building bidding process from 2012. As a first pilot project, BIM data was mandated for Korea Power Exchange project design competition project. Based on the Ministry of Land, Transport and Maritime Affairs Manual, BIM modeling manual and evaluation criteria was listed for the competition [1]. It intends to evaluate criteria of spatial requirements, quality requirements and energy performance automatically. As pilot project, BIM is used as a compulsory tool for some public project competition process such as Korea Electricity Exchange project and Korea Land and Housing Cooperation housing projects.

3.2 Role of Independent Organizations

BuidingSMART Korea performs the most active role for making BIM as an issue for the government and industry as an independent organization. IAI Korea, that later become buildingSMART Korea, was launched 1998 for the construction industry after attending as an observer for IAI international conferences [2]. IAI Korea was deeply involved with IAI member for the standardization and implementation as well as policy development in relate to BIM technology since then. As IAI develops IFC building model for open BIM standards for the practical implementation, IAI Korea has been involved for the development of the model. IAI Korea held Seoul international conference in 2001 where the decision of IFC for applying ISO standard was made. Later, IFC

becomes PAS standard. PAS standard offers different technical solution that is not conflict with existing Standards. It is reviewed three years to confirm the standard before process to become International Standard. Following IAI becomes buildingSMART international alliance, IAI Korea changes its name into buildingSMART Korea in 2008. It intends to adapt to paradigm shifts for the construction industry with wider range of specialties participation. BuildingSMART Korea becomes officially government approved nonprofit organization in 2009. BuildingSMART Korea involved making BIM roadmap for the government and performs researches for industrial applications, particularly to make and use of open standards.

Korean Institute of Building Information Modeling is launched on November 2010 for research as a result of the recognition of the importance of BIM technology in Construction Industry.

3.3 Role of Industry Leaders

Construction companies now begins to use BIM not only interference check before construction but also for construction managements, estimation, structural analysis along with energy simulations. Based on the survey for the use of BIM in Construction [3] perform to 89 but answered by 34 architecture, engineering and construction companies in Korea, the projects and personnel for BIM doubled from 2008 to 2010. Design companies mainly use BIM for drawing and design check. However, the use of BIM for energy simulation and structural analysis increases from 58% to 80%. In-house personnel for BIM for construction companies increase more than double from 8.7 in 2008 to 20.4 in 2010. In-house BIM team increases more than 4 times and subcontractor companies capable for BIM increases in design and other fields such as equipments, structure, estimation and construction.

Construction industry leaders are keenly interested in BIM mainly since most of the public building procurement changing into design-build system using BIM like many countries including USA and Europe. Since design-build system is easy to administer the project within the budget, the government favors the system in general. Recent mandatory use of BIM model for bidding government buildings stimulates the use of BIM of its own.

Construction industry also intends to use BIM as a means for quality and budget control. It is actively used in the area of construction feasibility studies including interference check and checking bills of materials for budget control.

4. BIM IMPLEMENTATION

There have been various cases to implement BIM in construction industry and research in Korea. Pre-construction feasibility is the most implemented area along with the environmental domain. The use of BIM for the modernization of traditional building design and construction is regarded as a promising domain too.

4.1 Pre-construction Feasibility Study

BIM is currently used for pre-construction feasibility studies including construction planning, interference check, building estimation. There are cases using BIM to use it as simulation tool to evaluate and select among different construction methods for more feasible construction [4]. BIM becomes important tool for superstructure buildings for efficiency and risk managements. Using BIM to support superstructure construction planning on virtual environment becomes essential. For the optimization of the construction, it becomes essential to plan construction schedules and resource allocation including labor, building material and equipments [5]. It becomes important to use it for eco-friendliness in construction phase for more environment friendly practices.

BIM becomes essential tool for the execution of free-form building design and construction. BIM is used for free-form design such as Dongdaemun Design Park and Plaza project in Seoul and Art Island in Han River project to design and construction. It also becomes a tool to verify accuracy of construction of free-form building in comparison with design [6].

4.2 Environmental Area

The most promising domain for the utilization of BIM is for environmental applications. There are many attempts to use BIM as a tool to evaluate environmental building criteria. Open BIM environment becomes essential element for more versatile use of BIM such as environmental BIM data creation, software use, data application and verification [7]. Building open BIM environment becomes essential since there are attempts to automate building performances including environmental criteria of fair and easy evaluation for competitions and certifications.

There are many attempts to use BIM as a automated tool to evaluate environmental performances in design processes. Oh, et al [8] uses BIM as a tool to evaluate daylighting performance at early stage of design. There are studies to develop energy efficiency assessments for buildings, and attempts to link LCC evaluation [9]. The environmental performance improvement for building renovation is another key issue in conjunction with BIM [10].

4.3 Traditional Building Design and Construction

BIM is regarded as a valuable tool to design and construction of Korean traditional building design and construction. It is not for the preservation of traditional building but for the modernization for further development using IT technology.

The traditional building components can be represented as parameter, and can be linked to control the components and used as assembly information. Currently, representation methods of the traditional building components are under research for the standardization [11]. BIM library for the traditional building is under development based on open standards. Methods of rule-based parametric system for design and construction using CNC technology are under investigation. There is a successful implementation of BIM in the process of a new Korean traditional architectural construction. In this

project, BIM is implemented in design and construction process for visualization as well as to define structural elements. Using the tool, analysis and solution for optimized construction methods and processes are generated [12].

5. TASKS FOR BIM IMPLEMENTATION

Even though there is common sense about the importance of BIM in the construction industry, the use of open BIM standard as well as many subjects such as quality control problem remains for more general use of BIM technology.

5.1 Tasks for Company Level

For the successful use of BIM technology, it is essential to have more systemic approach for the technology introduction including work process remodeling, performance management, establishing of project management system, library building and consideration of interoperability.

Development of work process model becomes essential. It requires shift from drawing-based process to model-based process. It requires clarification of necessary information and flows as well as inter-relationships of the information.

Work process remodeling includes the recognition of the value of BIM design data than design 2D data. BIM data can be linked to 2D drawings so that data consistency can be maintained easily and effectively.

Even though BIM data can be utilized and optimize later process, building BIM takes more time and efforts than conventional 2D drawings [13]. In order to make more comprehensive BIM data for later usage, it is essential to compensate processes of building BIM data. BIM Project Execution Planning Guide for the implementation of BIM for architectural design practice is under development.

Organizational change particularly for design firms is an essential element for efficient use of BIM. BIM is a good tool for collaboration while existing design organizational structure is based on specialization. There are numerous attempts to make more open and cooperative working organization for the design companies [14], while construction companies have not been changed.

Establishment of working environment is necessary for more efficient use of BIM. For the information management, it is essential to have its own information classification system and modeling standard. It also needs software management system and quality control system. For the knowledge management, building BIM library becomes critical for the effective use of it.

Education also becomes important factor for its use. BIM education was mainly focused on design professionals. However, in order to improve efficiency of BIM application in the industry, it becomes essential to educate personnel in planning, construction as well as maintenance fields. It will improve technical skills for the use of BIM, and will establish a harmonious collaboration system in the industry general. Currently, nonprofit organization such as buildingSMART KOREA, KIRA,

and other BIM-related institution play a active role for the education.

5.2 Tasks for Industry

Open BIM standard becomes essential for the diverse use of BIM data in the construction industry [15]. Ministry of Land, Transport and Maritime Affairs made national BIM roadmap and guidance in the architectural field. It consists of operation standard manual, technical standard manual and management manual. The technical standard manual defines data format and information classification system. Based on the manual, BIM is used for the bidding processes of governmental and public projects. Even though there are some problems of its implementation, open environment for the implementation of BIM is in progress. However, there still problems including data ownership, usability and liability problem.

Data Ownership

Data ownership is closely linked to profitability of the business. Since the BIM data can be used for various means including simulations and building maintenance, the ownership becomes critical issue. It is not easy to insist the ownership of the data and to ask more payment for extra works in current competitive market as design companies particularly in design-build system. The BIM data made by design companies can be used for other purposes such as environmental simulations and maintenance of the building. Since BIM data includes detailed information of library and design methodologies that is the key technical know-how of the design company, it can be easily copied and used by other companies.

It is important to build open BIM format working environment for data protection. The use of open BIM format makes it possible to extract necessary information for particular service in order to protect data ownership.

Data usability

The usability of CAD data becomes important as the CAD data becomes main building information storage system. In comparison with lifespan of building, current lifespan of CAD data format is quite short. When building design drawings are kept in paper, CAD format is not important factor since it is regarded as auxiliary information of the building. Many CAD systems upgrade its data format quite often for technical improvements as well as market strategy. It becomes important to open old CAD data for building maintenance and remodeling for its efficiency. The use of open BIM standard can be an alternative for the extension of data usability.

Liability

BIM data means more detailed and complete design. It is more likely to have more chance to involve in legal disputes that can ruin the business. It can be legal dispute for various reasons. First of all, it is more likely to be identified as design and construction fault even it is trivial matters. The performance of the building can be a legal dispute if the simulation by BIM data has discrepancies. It also can be sued if the results are different in comparison with design.

5.3 Extensive Use of BIM Technology

Extensive use of BIM technology means more comprehensive of the technology in overall process as well as parties involved in the process. It is essential to have BIM guideline for more versatile use of the data. If a BIM is made by a certain guideline it is possible to evaluate quantitative factors automatically. It can filter unqualified design before the process of qualitative evaluation.

Currently, BIM technology is adopted by large construction companies for public building projects under design-build system. However, the usage of BIM data still remains minimal since the design and modeling relies on outside design companies. It also limits the usage by other companies including subcontractors. It is essential to use BIM technology by large construction companies more general in order for the extensive use of BIM in society general.

6. CONCLUSIONS

It becomes inevitable to adopt BIM technology in construction industry for environmental and competitiveness reasons. For the benefit of the whole construction industry, it is essential to adopt open BIM standard. It is a good chance to correct CAD market dominated by a certain software and format. Open standard is a fundamental base for versatile use and participation as well as technical advancement of the market.

Korean government made policies relating BIM technology and developing National BIM standards. Industry leaders now making their standard based on the National standard for its own use. The government also intends to support related organization in private sector through legal and financial supports for public benefit.

Independent organizations including buildingSMART Korea also do active role for BIM also. They act as advisory organization for the government for BIM. They also do researches for the government including making roadmap, policies as well as BIM standards.

Industry still remains the limited use of BIM technology. Architectural design companies began implement as pilot projects. Construction companies mainly concerned BIM for design-build projects of public building. They still remains partial deployment of BIM technology of the overall work process of its own.

REFERENCES

[1] Oh, J. S., and Suh, W. J., "Thought of Evaluation of BIM at the phase of design competition", *BIM Conference 2010 Proceedings*, pp. 27-28, 2010.
[2] BuildingSMART Korea, "Current Status Report", *Inaugural Assembly document*, pp. 4-10, 2008.
[3] Won, J. S., Lee, K. and Park, Y. H., "2010 Survey on BIM Adoption in Korea", *The BIM*, Autumn, Vol. 4, pp. 30-34, 2010.
[4] Jang, S., Park, S., and Park, D., "A Study on the Process for Making Decision of Alternative Constructible using BIM using the BIM", *BIM Conference 2010 Proceedings*, pp. 35-36, 2010.

[5] Li, H. et al, "Optimizing construction planning schedule by virtual prototyping enabled resource analysis", *Automation in Construction*, pp. 912-918, 2009.
[6] Kwon, S., "Object Recognition and Modeling Technology Using Laser Scanning and BIM for Construction Industry", *Journal of Architectural Institute of Korea*, Vol. 53(4), pp.31-38, 2009.
[7] Kim, I., Jin, J., and Choi, J., "A Study on Open BIM based Building Energy Evaluation based on Quantitative Factors", *Journal of Korea CAD/CAM*, Vol. 15(4), pp. 289-291, 2010.
[8] Oh, M. H., Yoon, J. H., Lee, J. W, and Lee, J. K., "A Study on the Evaluation of Daylighting Performance Using the BIM Tools in Initial Design Stage", *BIM Conference 2010 Proceedings*, pp. 21-22, 2010.
[9] Jang, W., and Jun, J., "Q Study of Green Building Technology using a BIM Process Is Possible", *Proceedings of Architectural Institute of Korea*, Vol. 29(1), pp. 331-334, 2009.
[10] Ko, D., "A Study on BIM-based Sustainable Design Process using Building Performance and Energy Efficiency Evaluation", *Journal of Architectural Institute of Korea*, Vol. 26(9), pp. 237-247, 2009.
[11] Kim, J. Y., Park, J. D., Lim, J. K. and Kim, D. W. "A Basic Study on the Parametric Data Structure for Modernized Traditional Building", *Proceedings Korea Housing Institute*, pp. 245-250, Fall 2010.
[12] Park, S. H., and Kim, S. H. "An application for Korean Traditional Architectural Building Curved Members Using BIM", *Proceedings of Society of CAD/CAM Engineers*, pp. 37-45, 2010.
[13] Kang, J., "Understanding BIM in a Different Way", *The BIM*, Autumn, Vol. 4, pp. 44-47, 2010.
[14] Yoon, Y. J. and Kim, D. H., "A Study on the Organizational Change in Architectural Design Firm by Introducing BIM", *Journal of Architectural Institute of Korea*, Vol. 24(6), pp. 11-18, 2008.
[15] Kim, I., "The History and Concept of BIM", *Journal of Architectural Institute of Korea*, Vol. 54(1), pp. 16-21, 2010.