An Introduction to South Korea's BIM Knowledge Base Development Project

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ABSTRACT

This paper introduces an effort to develop a building information modeling (BIM) knowledge base system that includes various BIM-related statistics and best practices. This study is currently being conducted as part of a US$5,800,000 national research and development project in South Korea to build open BIM-based building design standards and information technology (IT) infrastructure to improve design and construction efficiencies. The project consists of three phases and is currently in the first phase. The main goals of our study within this project are to develop a standardized format for the collection of BIM project cases and BIM key performance indicators (KPIs) so that data can be sustainably collected and easily searched for via the Web. The indexes are to be used to rapidly and intuitively show the status of national- and international-level BIM projects. The first version of the standardized format for collecting BIM project cases has been developed by analyzing existing BIM projects. The format has been disseminated to several contractors, architects, and BIM consultants to ascertain the completeness and usefulness of the format. A web system, which we refer to as the "global BIM dashboard," is also being developed. It will allow national and eventually international BIM users, researchers, and BIM-related decision makers to rapidly and intuitively acquire BIM information, including BIM statistics, BIM KPIs, and the lessons learned from best practices. The first phase of the BIM knowledge base project will not include a reasoning algorithm. As the system and data grow, however, we plan to add more intelligence to the system so that users can more easily and rapidly access the data they would like to acquire.

Keywords –

Building information modeling (BIM), Knowledge base system, Key performance indicator (KPI), Best practice

1 Introduction

South Korea is one of the most proactive and advanced countries in the adoption of building information modeling (BIM) [1]. However, a survey conducted by the Korea Institute of Registered Architects (KIRA) [2] showed that 75% of small- and middle-sized architectural design firms (98% of the respondents were design firms with less than 20 employees) are still struggling to adopt BIM [3].

However, South Korea is not an exception. According to the 2014 BIM survey conducted by the National Building Specification (NBS) [4], in the UK, another country that is ahead of the curve in BIM adoption, 65% of small architectural firms (firms with less than five employees) are not using BIM. Furthermore, 73% of the small firms selected "no client demand" and 77% of the architectural firms with over six employees indicated "lack of in-house expertise" as the main barriers to BIM adoption [5].

To facilitate BIM adoption as a method to innovate the architecture, engineering, and construction (AEC) industry, many governments have mandated BIM at a national level. Accordingly, various programs have been initiated to help the AEC industry transition smoothly from traditional two-dimensional design and construction practices to BIM (Table 1).

Table 1 National BIM Mandate [6]

Organization (Country)	Mandatory requirement for BIM	Year
Senate Properties (Finland)	All national public projects	2010
Public Procurement Service (PPS) (South Korea)	All projects that Public PPS manages	2016 (phased in since 2010)
Statsbygg (Norway)	All national public projects	2016
Building and Construction Authority (Singapore)	All new buildings over 5000 m^2	2015
Cabinet Office of the Government Construction Board (UK)	All national public projects	2016

In one such effort, the Ministry of Land, Infrastructure and Transport of the South Korean government is providing US$5,800,000 over three years to build open BIM-based building design standards and information technology. In this open BIM project, we are in charge of developing a BIM knowledge base.

This paper introduces the goals and content of the BIM knowledge base development project. This BIM knowledge base project aims to help small- and medium-sized architectural firms and BIM-related decision makers and researchers find best practices and understand the current status of BIM adoption. The first phase of the BIM knowledge base project will not include a reasoning algorithm. As the system and data grow, however, we plan to add more intelligence to the system so that users can more easily and rapidly access the data they would like to acquire.

This paper first describes the background to the project and then delineates the goals, content, and current status of the project.

2 Background

The project participants and conditions of each AEC project vary, and thus, each AEC project is different. Nevertheless, each project is not entirely new because the AEC projects are created, engineered, and built based on knowledge gained from previous cases [7]. This is the reason design and engineering problems in AEC are often viewed as case-based reasoning (CBR) processes [8-12].

For example, a consistent and reliable collection of BIM projects and BIM-related statistical data can be used as best practices or metrics for understanding the status of a project. Many BIM best practices have been reported as case studies [13-17] or in a form of BIM guide [16, 18-20]. However, it is still rare to find BIM projects or related data collected in a structured and searchable format [21]. It is even rarer to find such data open to the public.

The BIM knowledge base project aims to develop such an open integrated source for BIM projects.

3 Research goals

The overall goal of the BIM knowledge base project is to collect and analyze BIM projects and related information as a vast knowledge source for future BIM projects. This undertaking is a three-year project, which is composed of three steps (Figure 1).

The first step comprised the collection and analysis of BIM-related project data. During the first step, a standardized data collection sheet for collecting and analyzing BIM project statuses and cases was developed so that the same standardized data collection sheet could be used to collect BIM data and cases across different regions. In the second step (currently underway), the data are being processed to create a best-practice database. The third step will be to construct the database as a web-based application where users can easily search for BIM cases and best practices aligned to their projects.

The developed knowledge base is expected to be linked to Seumteo, the online Architecture Administration Information System [22] of South Korea — similar to CORENET [23] of Singapore — as a test bed.

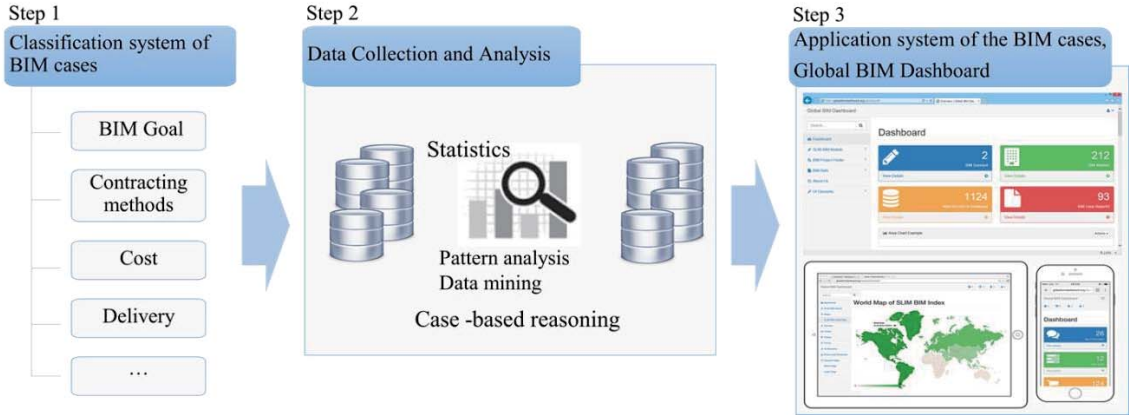

Figure 1 BIM Knowledge-based system development process

4 The national-level BIM knowledge base

This section describes the components and current status of the BIM knowledge base development project. The three main research components are: (1) a classification system for BIM cases and standardized

data collection sheets, (2) data collection, analysis, and visualization, (3) and a web-based system, the Global BIM Dashboard, to support data collection and sharing.

4.1 Collection of BIM cases and standardized data collection sheets

To develop a classification system, we first investigated and analyzed existing cases. The existing cases were collected through three channels: 1) the BIM project registration system developed and managed by buildingSMART [24], 2) a literature survey of previous BIM project reports, and 3) a survey of practitioners.

In the first instance, the BIM project registration system already contained over 600 BIM cases. However, the following problems made data analysis difficult:

(1) Some projects had been reported repeatedly with slightly different project names and data from different project participants depending on the role the participants took in the projects.
(2) There was no common classification system for the project types and other data.
(3) Many fields were left blank.

To overcome these problems, we proposed several amendments to the BIM project registration system:

(1) The BIM project registration system should be linked to Seumteo so that the basic project information can be retrieved from Seumteo using consistent project names and scope information.
(2) To ensure consistency in data input, input data should be structured and limited to multiple-choice data types classified by national building codes and regulations and international construction classification systems such as the OmniClass Construction Classification System (OmniClass) [25] and Unified Classification for the Construction Industry (Uniclass2) [26].
(3) An algorithm to check the validity of the data should be added.

buildingSMART Korea is updating the BIM project registration system following these suggestions.

Second, another data collection sheet was developed by analyzing BIM project cases via a literature review. The BIM project cases that were found in the literature were mostly best practices. We developed several scenarios to search for best practices by BIM users and for non-BIM users who would like to learn about BIM, and extracted a list of key data fields according to the scenarios.

Third, we developed a survey based on the data collection sheet proposed for an improved BIM project registration system and distributed the survey to designers, contractors, and BIM consultants. Thus far, we have collected 147 cases, and the number of cases is still growing.

The data collection sheets are being checked and improved through an iterative process of collecting the data and modifying the sheets to resolve problems through identified applications.

4.2 Data collection, analysis, and visualization

We are simultaneously developing simple and intuitive ways to represent the analyzed data. An example is the slim BIM model [27]. A slim BIM model is a simple and intuitive graphic representation for rapidly visualizing and comparing the implementation level of BIM in multiple regions or organizations at different times. To date, we have developed three types of slim BIM models: a diamond model, a rugby ball model, and a triangle model

The slim BIM models employ the most commonly used indexes to represent the level of BIM adoption/implementation, namely, the BIM adoption rate, the depth of BIM implementation, the level of BIM proficiency, and the years using BIM. In the diamond and rugby ball models, the horizontal axis represents the implementation breadth, and the vertical axis represents the implementation depth. The triangle model represents the BIM implementation level focusing on BIM users while the other two models consider both BIM users and non-BIM users. The area of each shape represents the overall BIM implementation level.

Another example is the BIM map. BIM maps visualize BIM data by reg5ion and year. Any BIM-related data that allows international comparison can be visualized. In the first data set, we conducted a survey to understand the BIM implementation levels on different continents. We sent out 1,310 solicitations and received 168 responses.

In addition to the slim BIM models and the BIM maps, we are developing other representation methods to rapidly and institutively visualize BIM data.

4.3 Global BIM Dashboard

The BIM knowledge bases and visualization modules are being implemented on the global BIM dashboard website (globalbimdashboard.org). The global BIM dashboard website will be connected to the national Seumteo website.

The global BIM dashboard website is currently under construction, and the first version will be publicly available in March 2015. The global BIM dashboard will be continuously developed and upgraded until the end of the BIM knowledge base project.

The global BIM dashboard is being developed using

a responsive web design technique [28] so that the layout of the website can automatically adjusted to the screen size of users' mobile devices (Figure 2).

Figure 2 The global BIM dashboard website is being developed using a responsive web design technique

The main content of the global BIM dashboard website is as follows:

(1) Global BIM Dashboard: The dashboard summarizes and visualizes the main BIM statistics (Figure 5).

(2) BIM Maps: The maps show the status of the global BIM market.

(3) Slim BIM Models: The slim BIM model section includes a slim BIM survey and a site that shows the results of the survey using three slim BIM models and a BIM map.

(4) BIM Project Finder: In this section, users will be able to find projects of interest using keywords from the constructed database. This section also includes a page where users can input their own project data. Best practices will also be added.

(5) BIM References: The BIM references section lists a collection of frequently used BIM references, such as BIM surveys and BIM guides.

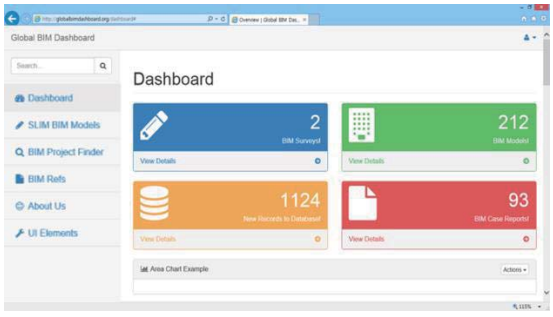

Figure 3 The Global BIM Dashboard

We are implementing the global BIM dashboard website using Amazon Web Services (AWS) [29], Laravel [30], and Google Charts [31]

After the first three years, the second phase of the open BIM project will begin. Reasoning algorithms will not be added to the BIM knowledge base until the second phase of the open BIM project. During the first phase of the project, we are focusing on developing a standardized template for collecting BIM project data and data collection. We plan to add case-based reasoning (CBR) and knowledge management (KM) modules during the second phase of this project.

5 Conclusion and further research

This paper reports the BIM knowledge base development project, which is being conducted as part of a government-funded project to develop standards for open BIM projects. The main objective of the BIM knowledge base development project is to build a knowledge base that can provide BIM users, researchers, and BIM-related decision makers with helpful information in an intuitive and efficient way. We are currently in the second year of the project. Thus far, we have developed standardized data collection sheets, and collected BIM project data and cases using the data collection sheets. We have also developed several methods for visualizing the analyzed data. All these components are being implemented on the global BIM dashboard website.

To make the BIM knowledge base useful and sustainable, global-level collaboration is essential for data collection and analysis.

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