BIM–BASED BUILDING CURRICULUM VITAE SYSTEM

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ABSTRACT: During the life cycle of a building project, voluminous data and information are usually created along with the delivery processes of building products. Currently, most information management methods are based on several different file collection approaches, which are mostly unrelated. Therefore, the various project participants are unable to synthesize building information from different sources. To address this problem, we propose a new concept of system named "Building Curriculum Vitae", which collects and handles data generated from different systems, at different stages of construction. Furthermore, it provides a friendly visualization style that conveys the related building information clearly. This research developed a Building Curriculum Vitae System based on Building Information Modeling (BIM). This system not only provides various query methods for users to find and obtain the necessary and relevant data in a more direct and efficient way than current practices; it also provides 1D (text), 2D (graph and chart), 3D (3D Model) visualizations to assist people in efficiently acquiring applicable information. This system can assist architects, engineers and constructors to integrate and manage the building information effectively and efficiently during the construction stage, and assist owners and users in mastering information on the entire building through an easy-to-use Graphical User Interface (GUI), facilitating efficient building management and maintenance during the operation and maintenance stage.

***Keywords**: BIM, 3D Models, Information Integration, Information Visualization, Construction Life Cycle*

1. INTRODUCTION

During the life cycle of a building project, voluminous data and information are usually created along the delivery processes of construction products. The building project team must consider a wide variety of information when controlling the project and making project decisions, the operation and maintenance of the building in the future. Although much of this information is produced electronically and tends to be visual in nature, different teams within the project primarily use paper-based views of project information to share information with one another in project meetings. Because the information defined in the information distribution systems of various parties is usually different, it is generally difficult to integrate for the clear dissemination and information of information. Currently, important relationships between project information from different teams are not communicated clearly because construction information is not effectively integrated and used. As a result, there has recently been much research effort put into solving the problems of construction information integration and management. In construction projects, most engineering documents are managed using file-based management, whereby the project files are stored either in the file server or file cabinet. This method of storing and retrieving data is very slow and inefficient. Participants in the project need to communicate and transfer information, and this can occur either within a phase or between two phases. However, when information exchange between project parties is limited to individual files, the processes of information retrieval and exchange become inconvenient and inefficient. At present, some data models have been established for integration purposes. Building Information Modeling (BIM) [1, 2] is a computer model database of building design information, which may also contain information about the building's construction, management, operations and maintenance. Salford University has proposed the concept of nD Modeling, and has suggested revealed that

multidimensional information integration will be essential in future construction management [3, 4]. Wu designed and developed an integrated data model to describe and store the entire set of project information which can then be used to demonstrate the entire construction lifecycle, including project management, the processes of construction and facility operation [5]. Although these data models can fulfill the goals of information integration, they still fall short of providing the easy-to-use system and user-friendly Graphic User Interface for searching and viewing the integrated data. To address this problem, we propose a new concept, named "Building Curriculum Vitae". This concept guides the collection and handling of data which are generated from different systems during different construction stages. It also provides a friendly visualization style for clearly displaying and conveying interrelated building information. This research developed a Building Curriculum Vitae System based on Building Information Modeling (BIM). This system can assist architects, engineers and constructors to integrate and manage the building information effectively and efficiently during construction stage, and will also assist building owners and users to master the information on the entire building through an easy-to-use graphical user interface (GUI), greatly facilitating the management and maintenance of the building during the operation and maintenance stage.

2. BUILDING INFORMATION MODELING

BIM is the application of modern management techniques and systems during a building's lifecycle from inception onward, including the processes of construction and facility operation. Three-dimensional models serve as communication media between planning and design phases. BIM contains spatial relationships, covers geometry, light analysis, geographic information, quantities and properties of building components. BIM can also help to resolve construction problems, because it can be used during preconstruction, for scheduling and hazard analysis. Therefore, information management and construction management can be made easier and more efficient through BIM Technology. The National Building Information Model Standard (NBIMS) defines BIM as "a digital representation of physical and functional characteristics of a facility and it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life cycle from inception onward" [6]. In recent years, there has been renewal of interest in the application of Building Information Modeling (BIM). For example, Goedert et al. [7] extend the use of building information modeling (BIM) throughout the construction phase of the project life cycle. Other researchers have also applied BIM in construction management [8, 9] and to Green buildings [10]. In this paper, we also employ the concept of BIM in information management during the building lifecycle. The lifecycle of a building can be divided into three main stages, namely, the planning, construction, and maintenance stages as shown in Figure 1. Each stage is generally managed independently and various trade associations will be involved with voluminous data and information usually created by them. The objective is to propose a method and set of tools which make it possible to collect and combine information from each stage during the building lifecycle, and present them clearly for effective management. Thus, this present research aimed to develop a user-friendly and accessible system that would be able to store and visualize building information, making information exploitable and organized, enriching knowledge throughout the lifecycle of the building.

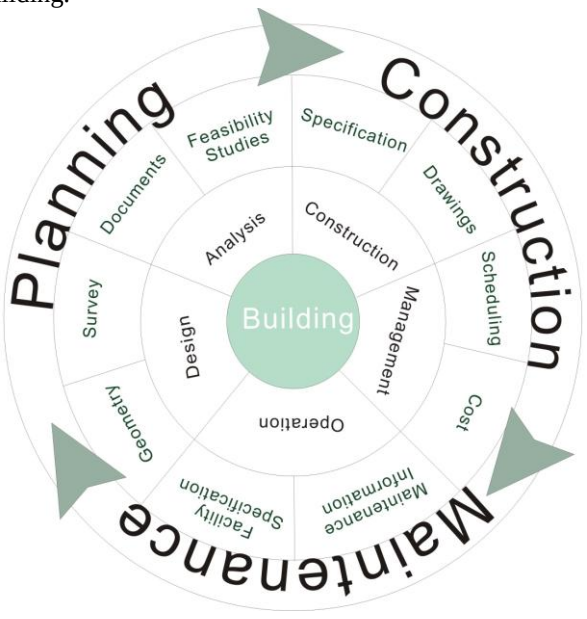

Figure 1. Information components of the building life cycle

3. BUILDING CURRICULUM VITAE SYSTEM

Building Curriculum Vitae (C.V.) System is implemented based on the Bentley MicroStation, which supports visualization of the 3D plant model with some capabilities for 3D object manipulation and information query, and also provides APIs (Application Programming Interfaces) for functionality extensions. The BIM concept is employed in the development of the Building Curriculum Vitae (C.V.) System, as shown in Figure 2. The entire integrated dataset will be stored into a database (non-geometry) and a MicroStation dgn file (geometry). The system provides users with a full view of the building project, along with functions to integrate the information and display it in a multi-dimensional view. There are four main functionalities of Building Curriculum Vitae (C.V.) System, which are described as follows: (1) **Search**: The system provides multi-way for users to search for the required and relevant information easily and efficiently. (2) **Create**: Users can create and input the related data into the BIM model. (3) **View**: Users can view the required data they need through viewing functions. (4) **Manage**: These management functions are responsible for data management and manipulation.

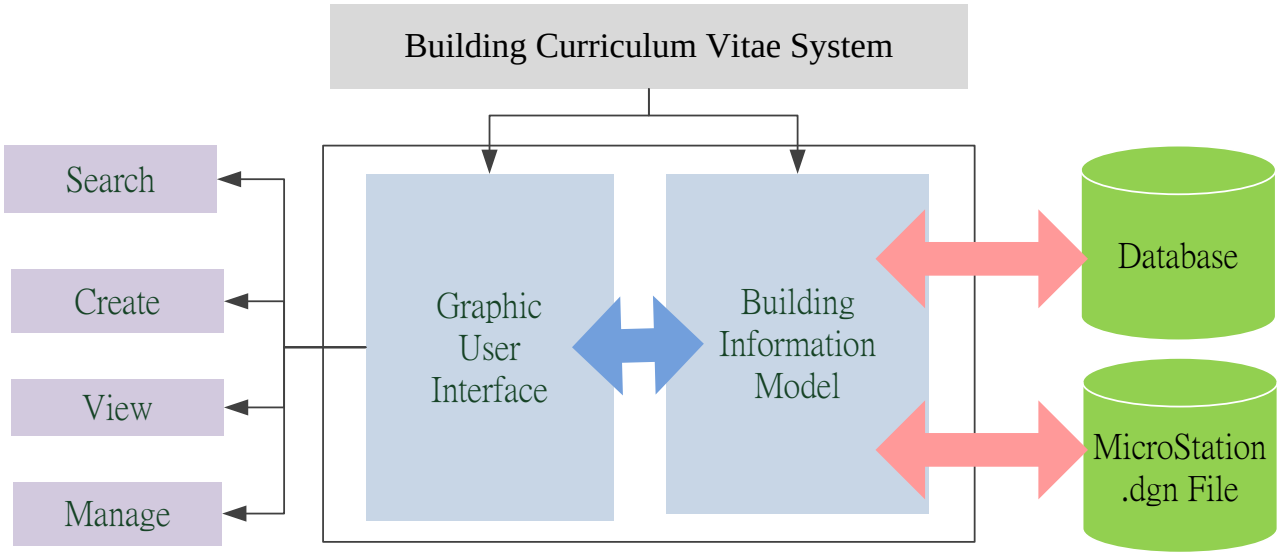

Figure 2. System Framework for Building Curriculum Vitae System

3.1 GRAPHICAL USER INTERFACE

Figure 3 illustrates the main GUI of Building C.V. System. The menu bar located at the top (as indicated by frame A) consists of menu items for quick access to the functions of the Building C.V. System. The left-hand side window (as indicated by frame B) is used to manage the various data from the BIM model, and users can choose the specific tree view (i.e. object-view, owner-view and document-view) to view the required data. The right-hand side window (as indicated by frame C) is used to show the related information in detail when users double-click a data object in the tree view. The bottom window (as indicated by frame D) facilitates searches by keywords and items.

3.2 SYSTEM CHARACTERISTICS

The Building C.V. System we have prototyped can assist planners, constructors and owners in the manipulation and management of information for a building project. There are four main positive characteristics of the Building C.V. System.

- **Ease of use**

  This research focused on matching systems to what the user is trying to achieve. Through clear, user friendly interfaces, users would embrace our system because they help get the job done, without giving them more work to do. Building C.V. System provides a user-friendly GUI that is visually effective, simple and interactive.

Moreover, this system provides a set of icons that denotes a program and a command easily in a GUI, as shown in Figure 4. This system provides natural and easy direct input methods and also provides output methods that facilitate natural, quick and clear visualizations.

- **Interactive GUI**

  Because the Building C.V. System is implemented on the Bentley MicroStation, it is important that the interaction between the developed GUI and MicroStation is maximized. The developed system has been able to take full advantage of MicroStation's capabilities in manipulation and visualization of the 3D objects, and then expand the interaction functionalities for the Building C.V. System. For example, users can double-click the 3D object in MicroStation and summon detailed information on the 3D object that was extracted from the Building C.V. system, as shown in Figure 5.

- **Searching in Multi-way**

  There are two methods of searching in the Building C.V. System. One is "Keyword search" whereby the user can input keywords to find information from the Building C.V. System when conducting a search. Another one is "Item Search" whereby the user chooses a specific item and the system will list this part that can be viewed separately from the whole.

- **Multiple Viewing Options**

  The Building C.V. System provides multiple viewing options for users to find and obtain the necessary and relevant data directly and efficiently. Viewing option of data can be divided into three types, Object View, Document View and Owner View, as shown in Figure 6. For example, the building owner can view the related information according to door number in Owner View. The planner will be able to view the drawing document by drawing type in "Document View".

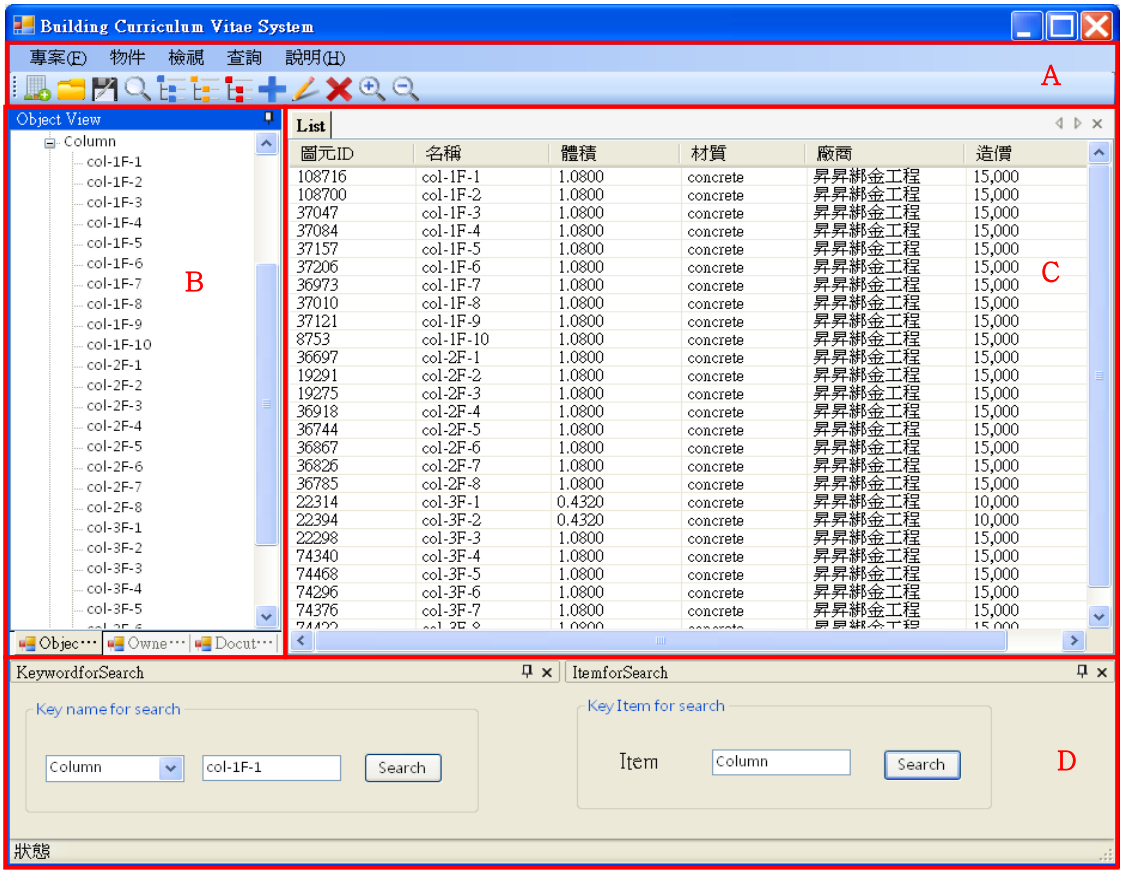

Figure 3. Graphical user interface

	Create Project		Building View		Edit Object
	Open Project		Owner View		Delete Object
	Save		Document View		Zoom in
	Search		Add Object		Zoom out

Figure 4. Icons facilitating ease of use

Figure 5. The interactive GUI

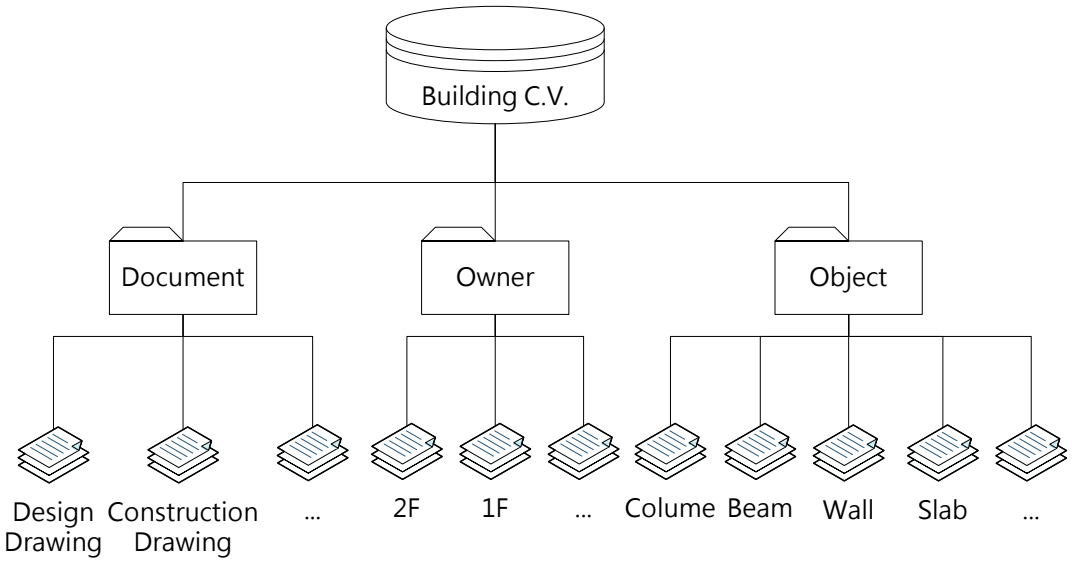

Figure 6. The multi-view concept

4. CONCLUSION

A Building Curriculum Vitae System based on BIM was implemented in this research. A simple building project was used as an example to demonstrate the applicability and feasibility of the Building Curriculum Vitae System. This system can be applied to all stages of the building life cycle, including the planning, construction and operation stages. This system can also help architects, engineers, construction firms and owners to integrate all information about the building, and increase user capacities for information management. There are three key characteristics of the Building C.V. System that give it much potential: (1) With the establishment of an integrated BIM model, building project information can be stored intact and complete; (2) A good visual representation of data can assist people in efficiently acquiring required and relevant information. This system represents a building's information visually, enabling the user to quickly grasp the required data of a building project through 1D (text), 2D (graph and chart), 3D (3D Model) visualization technology; (3) Multiple search pathways are provided to assist users in finding and obtaining necessary and relevant data directly and efficiently. With an easy-to-use GUI, the efficiency of BIM manipulation and information acquisition is increased. Building information is also robustly stored and managed throughout all stages of the building life cycle.

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