THE STUDY OF BUILDING MANAGEMENT BY USING 3D DIGITAL MODELING AND DATABASE: ABFM

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Abstract. The principal objective of building management is to control facilities planning and facilities operations and maintenance, that effective criteria in strategic planning about preventive maintenance and predictive maintenance. The key of success in managing the building and facilities is all about collecting and interpreting data on diverse facets of property use. Computer databases are the ideal vehicles in which to log, store and manipulate data; almost unlimited information can be measured and entered en masse. The strength of such information storage is its capacity for expansion and the diversity of subject; it becomes large and requires greater and greater operator familiarity with its structure in order to interrogate successfully. The ultimate solution is to computer–base the entire operation, by using the three-dimensional building modelling to control the operation. This solution will simulate building in virtual environment and the building system data (Architectural part and Engineering part) will collect in digital data type. The digital data will classification and made three-dimensional database relations. This research focus in three sections of the operation as three-dimensional database relationship, topological simulation and smart system, that applied to generate the prototype building management application "Architecture Building Facilities Management: ABFM".

Keywords. Building management; facilities management; 3D database; smart system.

1. Introduction

Building are no longer viewed as passive place to live and work in, they are being regarded as dynamic resources. The building management and

maintenance function has taken on a different role from being considered as a liability and nuisance to being essential to preserve and maintain capital values in order to level the highest utility and return from a building. The fundamental idea of managing space and facilities is to understand about building system: structural frame (beams, columns, etc.), exterior skin (exterior doors, windows, and roof), heating/ventilating systems (HVAC), and electrical system (also includes computer & phone networks). Most of the system are subject to wear and ageing and need periodic checking, adjustment and maintenance. Therefore, the technical installations in a building incorporate a large number of measuring, controlling and regulating functions, which annunciate deviations from desired values and standards and, if possible, take automatic corrective actions. Moreover, the conditions under which these systems have to operate vary constantly as a result of changing climatic conditions, wear and alterations of the building's layout and change of usage. Thus the criteria for the optimal functioning of such system continuously change, requiring ongoing optimization processes. Building management amounts to the management of all these facilities systems, mainly directed to the management of the technical installation.

2. Process of Building Management System (BMS)

The suggestion of successful process about building management is to implement with the outline of seven major processes of management, which set by Since Fayol and added by Urwick. The aspects of management known as the planning and executive functions have been subdivided as: Forecasting, Planning, Organizing, Motivating, Controlling and Co-ordinating.

Forecasting: forecasting or looking ahead is generally the prerogative of the Principals or Board of Directors, although it can enter into decision at any level.

Planning: planning is perhaps the most important tool of management, requiring intense application, precise attention to detail, imagination and sound knowledge of technical theory, but is always a means and not an end in itself.

Organizing: organizing provides the framework of management, the basic structure upon which the succeeding executive and supervisory functions can build in accordance with the policy principle determined by the directors.

Motivating: motivating is essentially a social process, the executive function of cultivating morale, inspiring loyalty to the leaders, and producing an emotional climate conductive to the proper fulfillment of all the tasks undertaken by the group.

Controlling: controlling is the tactical sphere of management, checking current achievements against predetermined targets and adjusting the deployment of resources to attain the desired objectives.

Co-ordinating: co-ordinating requires early introduction, direct personal contact, a reciprocal activity and continuous operation but is achieved in the main by the efforts and skill of the individual manager with due regard to the overriding human factors involved.

The perfection of the management process can only be produced by the full utilization and correct blending of all seven constituents (Figure 1). The criteria of successful management are:

a) Achievement of the undertaking's prescribed purpose,
b) Comparative productivity of the enterprise,
c) The contentment of the staff and employees. Although often considered last, the true satisfaction of the members of an organization is all important, for a manager can only achieve his goal through the work of his subordinates.

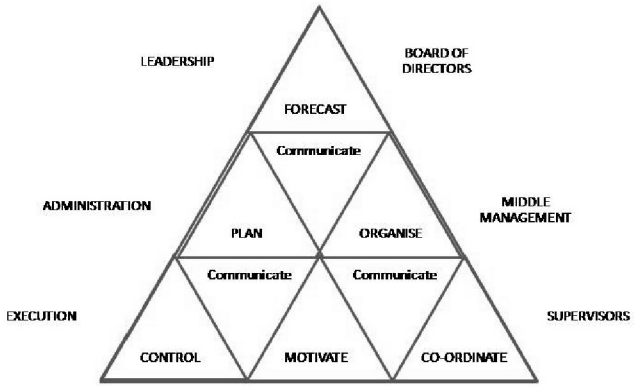

Figure 1. Pyramid of management

The concept of management maybe imagined as a control loop. The object to be managed, in the case the building or building complex, constitutes the process. The input to this process is formed by the goods, the energy and services needed to keep the process going. The services provided by the building by way of accommodation, comfort, security and the like constitute the output of the process. To be able to keep this output at the qualitative and quantitative levels required, the following conditions have to be met:

1. Methods are required for measuring the quantity and the quality of the output.

2. Set points and standards are needed with which the desired quality and quantity of the outpoint can be compared unambiguously.
3. Means are needed for controlling the process or its input in order to be able to adjust the output.

However, with buildings there is no simple method to measure the quality and the quantity of the output. As described before, a building consists of a complex composition of systems, each of which forms a constituent part of the whole process. The output of these individual process, however can normally be measured easily, although sometimes, usable measurement can only be obtained at a detailed level.

3. Processing Method

The key of success in manages the building and facilities is all about collecting and interpreting data on diverse facets of property use. Computer databases are the ideal vehicles in which to log, store and manipulate data; almost unlimited information can be measured and entered en masse. The strength of such information storage is its capacity for expansion and the diversity of subject; it becomes large and requires greater and greater operator familiarity with its structure in order to interrogate successfully. The ultimate solution is to computer–base the entire operation, by using the three-dimensional building modeling to control the operation. This solution will simulate building in virtual environment and the building system data (Architectural part and Engineering part) will collect in digital data type. The digital data will classification and made three-dimensional database relations (Figure 2).

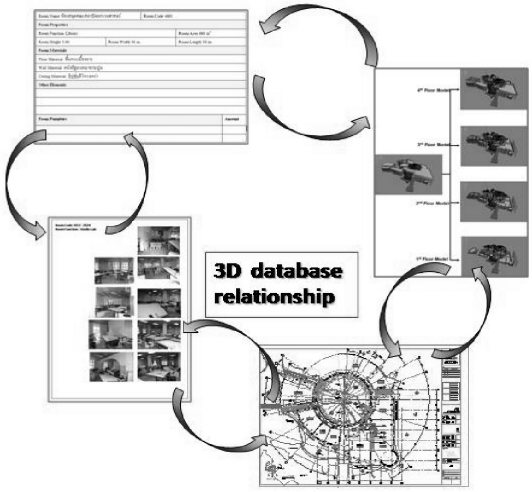

Figure 2. Building Data set

The design solution process of Building Management system applicative is focus in three section of the operation as three - dimensional database relationship, topological simulation and smart system, that applied to generate the prototype building management application "Architecture Building Facilities Management: ABFM".

3.1 SECTION ONE: THREE-DIMENSIONAL DATABASE

This stage is focus on the relation of architectural data and engineering data. The collective process will collect all of information and data of building system, activities and user. How the architectural design space controlled the user? What is the limited of architectural function? How the engineering design system controlled building skeletons and nervous of the building? What are the strong and weak points of the engineering system? Etc. Every relationship of data and

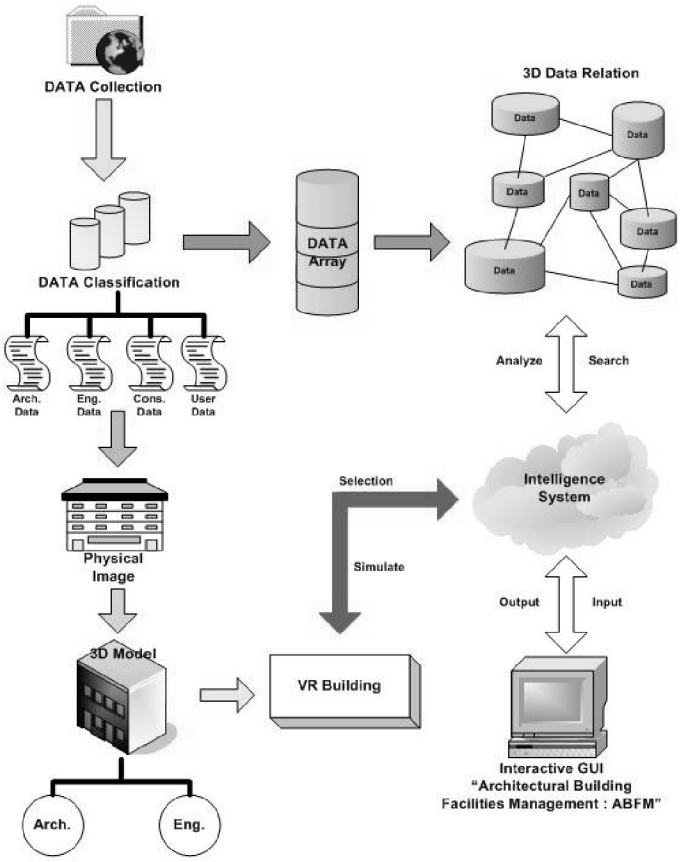

Figure 3. Three-dimensional database process

information will link together in multiple layers. In order to obtain useful information from this overwhelming amount of data, a classification method is required to assist the building manager in selecting data for the purpose being considered at that moment. The building data set (Figure 2) will be classification in the row of data: Architectural Row, Engineering Row, Construction Row and User Row, each of them providing information applicable to the management of a building. Each set will arrange to their row and linkable with network domain node. As is the case with all domain nodes, it is the gate, which determine the connectivity and flexibility of the system.

3.2 SECTION TWO: TOPOLOGICAL SIMULATION

Second stage will find out the processes to simulate the architectural building that compliment with building system in virtual environment. Actually, this virtual building is not only a virtual model but it is a three- dimensional building data model. The Solution of this problem is to use the basic idea of object-oriented programming and software is to combine data and geometry into the same object. The building model must be defining as a set of "industry foundation classes" (IFC). However, the set of building model still not connect to communicate with data structures and algorithms. Software applications, even object-oriented ones, consist of two basic components: data structures and algorithms. Data structures are the organizational templates for information that a software application is designed to manipulate. An algorithm is a sequence

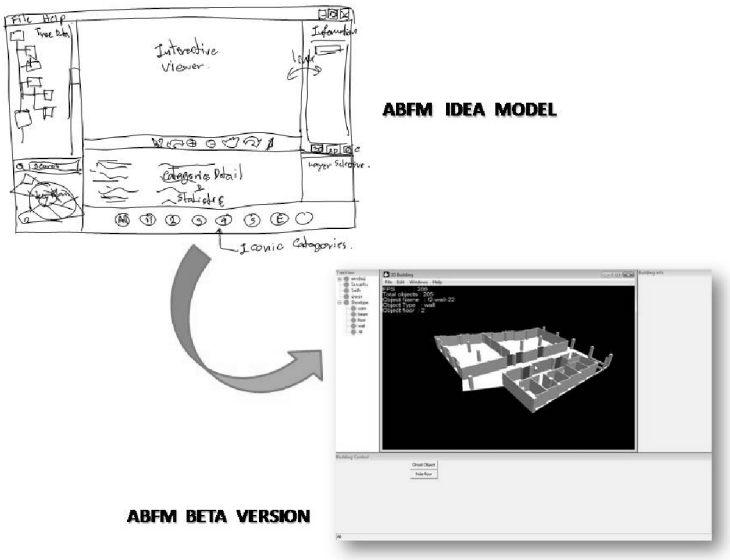

Figure 4. ABFM Design Application

of instructions designed to manipulate the data structures to generate a desired, reproducible result. This step of research must design the software application or a building management tool as a prototype for testing by the building manager.

A building management tool must satisfy the following basic criteria:

a) A building management tool must be used by the building manager, not a surrogate.
b) A building management tool must allow the building manager to define relationship between building components that affect the performance or appearance of the environment, relative to explicit or implied criteria.
c) A building management tool must provide interactive (preferably dynamic) feedback concerning the performance or appearance of a planning as the building manager modifies its component.

3.3 SECTION THREE: SMART SYSTEM

Last stage is smart system to make the efficiency facilities management. The smart system will be adding to ABFM interpreted by interactive GUI that easily learning and working for building manager. The idea of smart system for building management system (BMS) for the ABFM application performs in three functions:

1. The collection of data: in some cases this is automatic data transfer from other field of control system.
2. The storage of data: digital databases are almost limitless in capacity and, through the ability of computers upon a defined command to search the data for matching entire at exceptional speed but the need of filtering still recommended for any unknown case.
3. The analysis and retrieval of data: on the data storage an interrogation command containing a requirement to match the dataset reference will be enough to scan the entire asset register and print an extract report containing a full list of the dataset with locations.

From The building manager's recommendation, ABFM need to be reproduction for flexible control and intelligence communicate with the other applications. As the following condition to effective main key person in a process of BMS:

a) implementing with the other general application,
b) controlling and working with friendly GUI, and
c) adjustable of collective and classification in building data structure.

In the result, the ABFM smart system will compute and guide the solution for the executive to manage the building. With the final stage, ABFM is flexible system that economies of data collection point towards logging all available

information on a ‘may be useful’ basis and covers all eventualities on the principle that all the information is in the databases so additional management modules can be created by building manager.

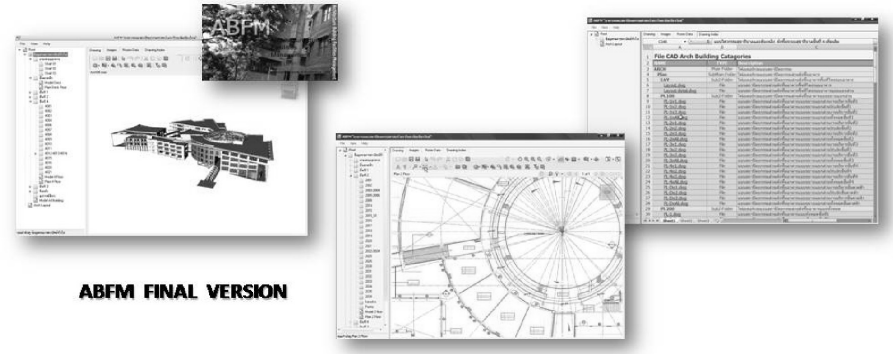

Figure 5. “Architecture Building Facilities Management: ABFM” Final Version

4. Conclusion

This research use the building of Faculty of Architecture at Chiang Mai University to be a case study because of this building have several activities and use in multipurpose. It is not only an academic building is also being an office, residential and exhibition. This building has users almost 24 hour and non-stop uses. The other aim of this case study is to be the prototype of the academic building to experimental with the 3D virtual facilities management.

The ABFM Application is the first prototype of Building Management tool by using the real case study reference. The experiments of this research can be applied to used in other buildings and easily for building manager to adjust by himself but we still got some bug from this experiment about transfer file from CAD file to FLC file that got some error in Thai language.

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