THE INTEGRATED CONSTRUCTION MANAGEMENT INFORMATION SYSTEM APPLICATION FOR CONSTRUCTION SUPERVISION PROJECTS

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Abstract: The purpose of this paper is to introduce the Integrated Construction Management Information System (CMIS) application to typical construction supervision projects. Even though some of the engineers working at the job site have computers to compile their data or handle their documents, it is still not easy for them to transmit their engineering data to other workers due to the fact that the information is being stored separately or in different places without any management and integration. Therefore, this type of situation not only impedes the entire working efficiency, but also increases the cost and manpower. However, by using the Integrated CMIS, the Inspector has the ability to input the required data of daily reports into a database called the Personal Digital Assistant (PDA), and through internet transmission, all of the data input into the PDA can be linked into an integrated system. This integrated system will automatically handle the daily reports, monthly reports, interim payments, etc., and includes other functions, such as effective management of a large number of design drawings and data, and the ability to enhance the entire working efficiency during the construction supervision period.

1. INTRODUCTION

Taiwan's major public works projects over the years, including the first and second national freeway projects, Taipei's rapid transit system, urban area railway underground projects, incinerator plants, etc, have been rather large-scaled and complicated, and carried out by the general and traditional types of construction supervision methods. Besides executing the required inspection and testing tasks, the inspectors of these projects have to prepare numerous documents and data and table sheets; such as, daily reports, monthly reports, interim payments, construction schedules, change orders, settlement accounts, final reports, etc. Although some of the engineers assigned to the site use computers to compile their data or handle these documents, it is still not easy for them to share or transmit the engineering data to other workers since data is being stored separately or in different places without any management and integration. Therefore, this situation not only affects the entire working efficiency, but also increases the cost and manpower. However, because of the vigorous development of the Internet, the operation and management of today's traditional construction methods and the construction industry is undergoing a major revolution. Nowadays, staff members of the enterprise group can use Internet technology to distribute the engineering data, perform tasks by division laborers, aid coordination with co-workers and innovate the existing methods of operation and work flow. Hence, in order to suit the rapidly changing market and satisfy the requirements of the client, the enterprise group needs to seek ways to build up their competitive strength by providing more elasticity and economic benefits.

Answering to this situation, by using the Integrated Construction Management Information System (CMIS), the Inspector can input the required data of daily reports into a database called the Personal Digital Assistant (PDA). And through internet transmission, all of the data input into the PDA can be linked into an integrated system, which will automatically handle the

daily reports, monthly reports, interim payments, etc. Furthermore, this integrated system also includes other functions, such as the efficient management of a large number of design drawings and engineering data, and the ability to enhance the entire working efficiency during the construction supervision period. Sample functions of the system are listed as follows:

*The ability to integrate various data that is stored in the Sybase Database.

*The ability to satisfy the requirements of the client and provide the functions of browsing, management and printing of data.

*The ability to provide reports to relevant engineers periodically or at any time.

*The ability to monitor the related design drawings and display progress by colored graphs and photographs.

*The ability to find information about related attributes.

*The ability to search related figures or design drawings from key words.

2. HARDWARE AND SOFTWARE

● *HARDWARE*

■ PC : 2 Sets (suggested to have Pentium II 450MHz or above).

These two sets are to be used as the Sybase Database and Web & Report Server, respectively.

■ PC : 1 or more sets (suggested to have Pentium II 450MHz or above)

This set is to be used as the working station.

● *THE OUTLINE*

This system mainly includes "The User Interface", "The Installation of Sybase Database ", "The Installation of Internet Web Server " and "The Installation of Java Report Server and Java Reports ".

■ THE USER INTERFACE

■ PDA : 1 or more sets (suggested to have a memory of at least 500K and 1MB Hard Disk space or above)

This set is for inspectors to collect and record data at the job site.

● *SOFTWARE*

■ Window CE

■ Window NT Server

■ Sybase

■ AutoCAD 2000

■ Java Report

■ Visual C++, Delphi & VB (Visual Basic)

3. THE CONCEPT STRUCTURE OF SYSTEM AND THE OUTLINE

● *THE CONCEPT STRUCTURE OF SYSTEM*

The concept structure of the system is shown in figure 1. At the job site office, by using PDA, the inspectors can link P3 data and the related basic data, such as project ID, project name, contract period, activities, payment items, etc., into the Sybase Database which is lodged in the PC Window NT server. Meanwhile, the inspectors can also download the related data from the Sybase Database.

This system adapts Java Report software to develop the various required reports or table sheets, which are stored in the enterprise report server for the authorized person to browse at any time. In the process of the construction supervision, the system, via a password or authorization, allows the related person(s) to browse or inquire the design drawings, reports, etc. Therefore, some part of the engineering data at the job site can be opened and synchronized. This type of situation not only reduces the time to transmit documents between two parties, but also enhances the entire working efficiency since the data can be transmitted quickly through the Internet.

*The browsing interface of reports is designed by Java Report and web server, and the user can easily browse the related reports in a friendly environment through the Internet.

*The interface of the management of documents & design drawings is designed by VB (Visual Basic) language. Under window configurations, by using ADO (ActiveX Data Objects) and ODBC, the user can obtain data from the Sybase Database.

*The interface of displaying progress by colored graphs

is devised by Visual C++ language. Under AutoCAD 2000 configurations, Autodesk provides API (Application Interface) to join the required data together. The user can use this interface to create the elements of graphs as needed.

■THE INSTALLATION OF SYBASE DATABASE

*UltraLite is used as the PDA port and Visual C++ language is used as a development tool.

*Sybase SQL Anywhere is used as the NT Server port. All of the basic engineering data is stored in the Sybase Database and all of the data of reports is obtained directly from the Sybase Database through JavaReport software and designed programs.

■THE INSTALLATION OF INTERNET WEB SERVER

* The browser of an Internet Web Server is used by the user to communicate between the user and system for supporting smooth operation of the Internet/Intranet.

■THE INSTALLATION OF JAVA REPORT SERVER AND JAVA REPORTS

*The Java Report Server provides the functions of the storage of reports and system management. The contents of designed reports include format design and the linkage of data in the Sybase. Usually, each report is independent.

*The Java Report software assists the inspectors in the creation and management of all reports which have been computerized, and also solve problems which may be incurred during the construction period.

4. AN INTRODUCTION OF THE MAIN FUNCTIONS

● *WITH RESPECT TO THE PDA*

■ The PDA acts as a tool for helping inspectors collect data, record situations at the site, and easily link data into the Sybase Database.

■ It also provides inspectors immediate access to store clauses of specifications, or pay items and activities that are often used.

● *WITH RESPECT TO THE PROGRESS DISPLAY*

■ Editing graphs

* The user can easily obtain the activities ID stored in the Sybase Database and match it with related elements of graphs with convenient and highly efficient editing tools.

* The related elements of graphs for concerned activities can be added, deleted or corrected in case there is a change order.

*A detective tool displays on screen whether or not the matched data of the elements of the graph is missing information or has been duplicated.

■ Progress display

* There are different colors to indicate and display the different progress percentages during the construction period.

* The user can inquire if the related drawings have been converted into *.dwf files from *.dwg files by using browsers which can read *.dwf file,.

* The user can enlarge or reduce the scale and remove and print the graphs at will by using the browser.

* There is hyper-linking to related documents; such as, design drawings, construction specifications, the clauses of contracts, site photographs, etc., to display the related information at the job site.

* From the figures, the user can find information about related design drawings, progress display graphs and photographs.

* From the figures, the user can find information about related attributes.

* From key words, the user can search related figures or design drawings.

● *WITH RESPECT TO THE MANAGEMENT OF DOCUMENTS/DRAWINGS*

■ The system provides the function of addition, deletion, editing, and inquiry for documents and drawings.

■ Besides providing the efficient management of various versions of drawings and the newest version, the user can store the old versions for recognizing the difference between different versions.

■ The system provides the function of previewing drawings, such as *.dwg, *.dwf, *.dxf.

■ The system links the elements of graphs with engineering data, such as drawings, photos, attributes, etc.

● *WITH RESPECT TO DAILY/MONTHLY REPORTS*

■ By using the interface of the workstation or using the

PDA that has downloaded the contract payment items from the Sybase, the user can input daily report data and link into the Sybase.

■ Through the Web Server and Java Report Server, the user can inquire, read and print daily reports or monthly reports that have been programmed by Java Report software.

● *WITH RESPECT TO INTERIM PAYMENT REPORTS*

■ Through the Web Server and Java Report Server, the user can inquire, read and print interim payment reports that have been programmed by Java Report software.

■ By reviewing the quantities and total amount of interim payment reports that have been submitted by the contractor, the system not only reduces the manpower for checking the data, but also increases the working efficiency and accuracy.

● *WITH RESPECT TO CHANGE ORDERS*

■ Through the Web Server and Java Report Server, the user can inquire, read and print the table sheets of change orders that have been programmed by Java Report software.

■ The user can trace and understand the change of quantities and pay items between the old and new versions of change orders.

● *WITH RESPECT TO FINAL RPORTS*

■ Through the Web Server and Java Report Server, the user can inquire, read and print the final reports that have been programmed by Java Report software.

■ The existing recorded data from the Sybase can be retrieved and summarized to become the final report and save a significant amount of time needed for preparing the final reports.

5. THE OUTLINE OF THE ILLUSTRATIVE FIGURES

As attached Figures(Figure 2 ~ Figure 9)

6. CONCLUSION

■ The usage of PDA equipment and the Integrated Construction Management Information System (CMIS) along with Internet technologies can reform the existing types of management and working flow for construction methods.

■ In order to suit the rapidly changing market and satisfy the requirements of the client, enterprise groups need to build up more competitive strength by offering more elasticity and economic benefits.

■ The distribution of data on the web is a future trend in the execution of construction supervision work. In this situation, some of the engineering data at the job site can be opened and synchronized. This will not only reduce the time needed to transmit documents between two parties, but also enhance the entire working efficiency since data can be shared and transmitted quickly through the Internet.
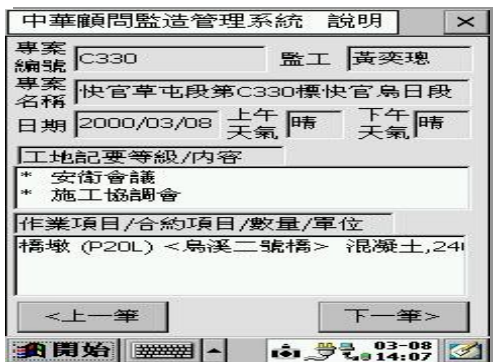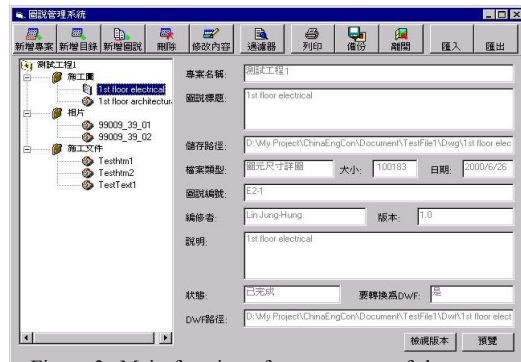

Figure 2 PDA interface

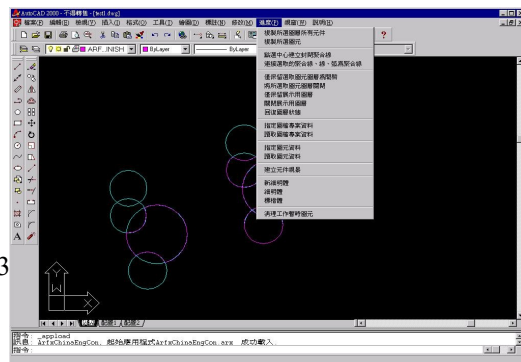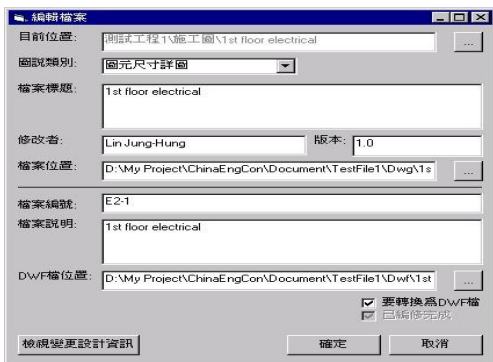Figure 3 Main function of management of document and drawings

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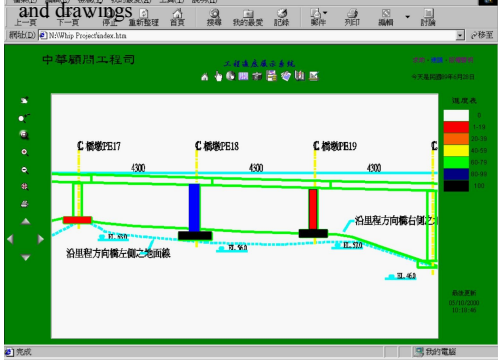Figure 4 Editing function of management of document and drawings

Figure 6 Display progress by colored graphs
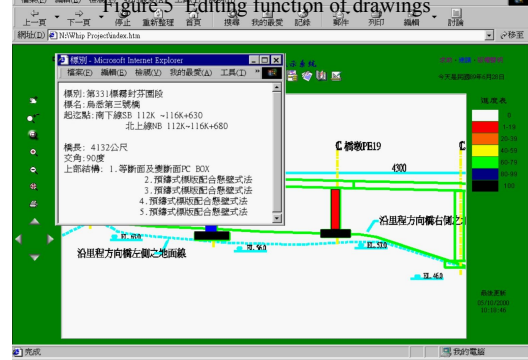
Figure 5 Editing function of drawings

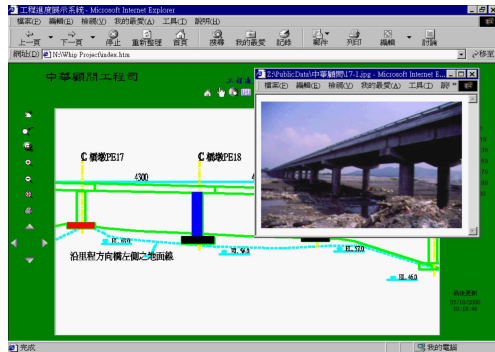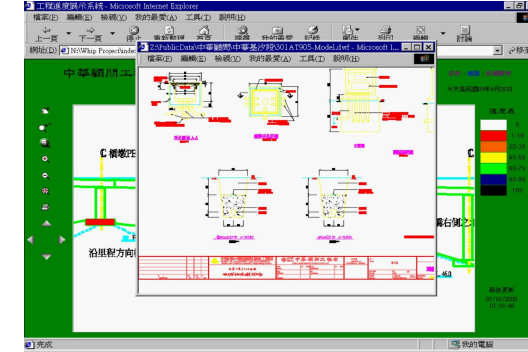Figure 7 Searching the related attributes

Figure 8 Searching the related graphs

Figure 9 Searching the related drawings