Daily Report Module for Construction Management Information System

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ABSTRACT: The profit of Construction Industry has been tremendously reduced for recent years in Taiwan. In order to survive in this difficult environment, "Management" becomes the key issue to achieve company's target. We need a powerful tool that can help us to handle complicate process such as estimation, bidding, purchasing and site-management in the life-circle of a construction project. In this research, we develop a Daily Report Module for Construction Management Information System. In this module, we use Object Oriented concept to mimic project schema by dividing each item into building-floor-room hierarchy. In this system, all constructed items will be calculated and converged into money request data. This will heavily save the key-in time and prevent human mistakes from multiple-input. Through the help of this tool, we can effectively calculate the cash flow for a construction project and accurately control the amount that we can claim from owner and pay to subcontractors. It can also provide warning message to prevent overcharge or overpayment in construction operation. Through the help this system, we can integrate construction data and transport site information to the head quarter through world-wide-web immediately. This can help us to improve administrating capabilities, increase competition and make profit for construction companies.

KEYWORDS: Cash Flow, Construction Management, Daily Report, Object Oriented, and Site-Management

1. INTRODUCTION

The poor atmosphere of the construction business in recent years is putting a lot of local contractors into severe competition; improvement of management so as to uplift competitiveness is necessary for survival. While on the construction site side, there are indeed a lot of improvements that can be reached by refining the managing layers and cutting down costs; such as, via computer, a lot of manpower and man-hours can be saved. In welcoming the information-prompt age of networks, the construction industry must be able to follow the pace so as to compile a great amount of information into useful information in a short time, and so that competitiveness can be created. Therefore it is a necessary trend that the construction industry be informationized.

2. OBJECTIVE

In [1], we have constructed the Basic Database, Budget Module, Procurement Module, Price Calculation Module, and Settlement Management Module for CMIS-I. In this research, we use Object Oriented concept, Visual Modeling techniques with Delphi and ER/Studio environment to develop following modules for CMIS-II.

This study is mainly aimed for developing the Daily Report Module, Estimation And Pricing System, Design Modification Control System and Project Accounting System so as to compile the daily site management information into the current engineering value estimation, for the solution of problems of inaccurate input of site logs, repetitive works, high human errors in typing, over estimates or under estimates of engineering value etc. It is also for recording work items and quantities resulting from the design modification activated by the client or designer, as well as the finalizing quantity and amount of each project, so as to control the actual costs of projects.

3. FUNCTION REQUIREMENTS

The System Structure of CMIS consists the following items (Fig. 1):

1. Basic data structure for building up the system: database used is categorized into large, medium and small items.
2. To develop a Budget System program, to be able to generate project budget automatically.

3. To develop a Purchasing And Contracting System program, to be able to screen subcontractors and execute contracting.
4. To develop a Fund Auditing System program, to be able to place alarm for items exceeding the budget. (Above items have been completed in 2001.)
5. To develop a program of Daily Report System, to be able to record daily site work items, quantities and use of manpower and materials.
6. To develop a Estimation And Pricing System program, to be able to compile, from site daily log, quantities of the current finished items.
7. To develop a Design Modification Control System program, to be able to record items and quantities of every design change.
8. To develop a Project Accounting System program, to be able to control the finished items, costs and income, and expenditure for each project. (Items 5-8 are for the study of the present year.)

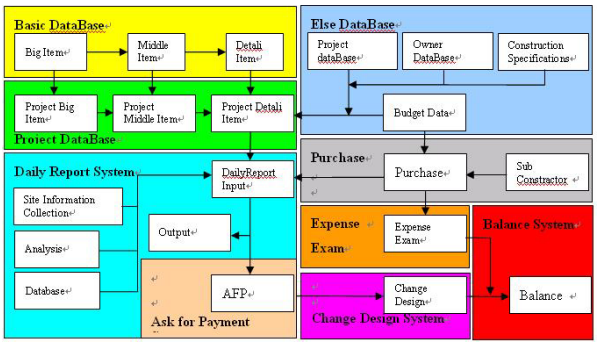

Figure 1. System Structure Diagram of CMIS

4. DATABASE STRUCTURE

4.1 Analysis of Database Structure

The structure of the database is the core of the whole system, should the structure be wrong, or the database be insufficient to meet the need, the whole data flow will cause error and result in outputting unexpected data, therefore it is extremely important to build up a suitable database structure.

Accompanying advances of information technology, the database system has developed from the conventional Relational Database to the Object-Oriented Database (OODB), which is now the mainstream of the development of database control systems [2]. This study uses ER/Studio tools to establish an ER Diagram, then, in the same mode, according to user need, makes the data flow chart and establishes the E-R (Entity-Relationship) Model; by defining the relationship between the databases, the substantial database is then built up and becomes the actual relationship database (Fig. 2)

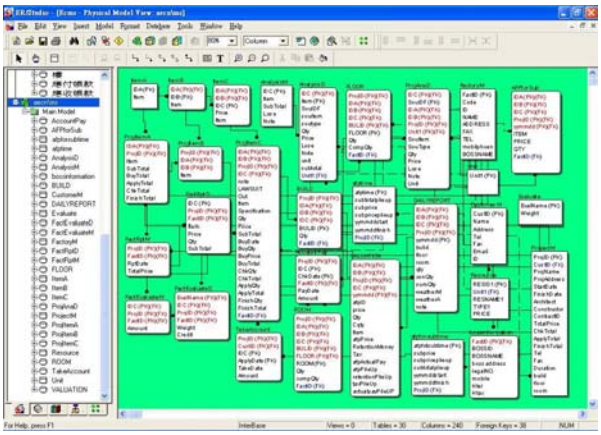

Figure 2. Database Structure Diagram

After establishing ER/Model, the user can, with the tools provided by the program, translate the database structure into a Script File which can be retrieved by the general database systems (Fig. 3) so that Database Console loads the data list of the system, fields of the data list and the attributes of each field, as well as the relationship between the Primary Key and Foreign Key needed for the system database.

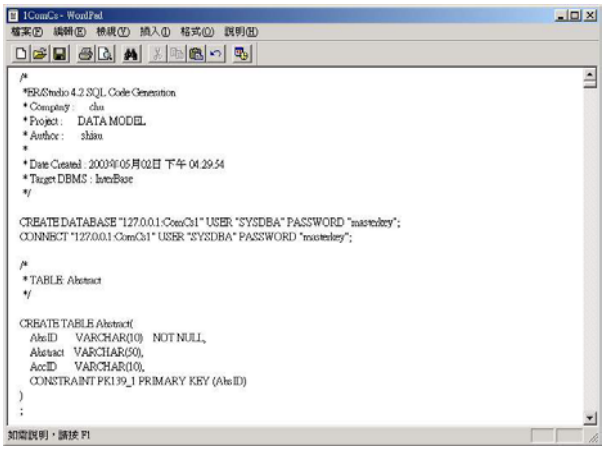

Figure 3. Script File of the Database Generated by ER/Studio

4.2 Construction Site Daily Log Flowchart

Site Daily Report, the record of daily work done and events occurred on the site, is the center of site managing. Information gathered through daily events, by proper compiling and analyzing, can deliver reports on the cost, progress and quality of the construction [3].

Site Daily Report, the record of daily site events, records a variety of occurrences around the site; this study categorizes the event information into engineering info, engineer info, manpower, equipment, material, quantity accomplished, location of work, test item, site event, and form filling etc.

The site daily report is not only a daily report sheet; it shall be used together with other forms such as climate record, engineer progress schedule, daily work-hour, equipment use record, steel bar use quantity, concrete poring quantity, quantity of form, earthwork quantity etc., and most importantly, the engineering progress schedule and the work flowchart.

4.3 Process of Daily Report

This system constructs data structure of the daily report [4] as shown in Fig. 4. The system retrieves items from the basic database and translates them into "Project Work Items"; by combining with the daily activities logged in the report system and other related data -such as "manpower and material analysis database" and "contractor basics"-, information for project work items are compiled; in a building-floor-room format, the work items are entered according to their work site locations and are compiled and output as the site daily report. This log can be further compiled for set period of dates as the monthly log that provides information for pricing the estimation system.

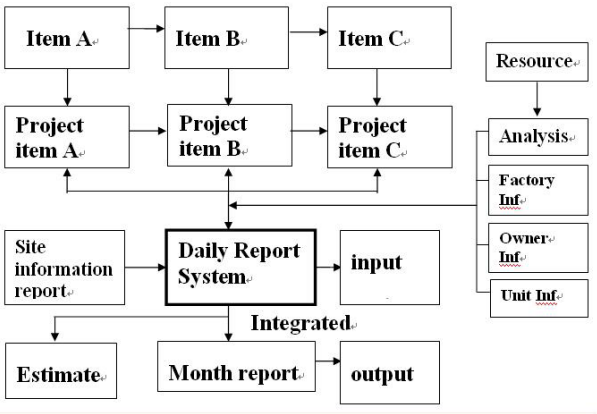

Figure 4. Daily Report Data Structure

4.4 Process of Pricing Estimation

Pricing Estimation is closely related to procurement and tender process as well as the daily log. The study finds that items of the procurement programs in popular software on the market are base on work items; therefore the item in the pricing system derives directly from the work items compiled into the pricing list. Yet in reality, some projects are subdivided into several subcontracts and are separately carried out by different subcontractors in different scheduling. If this is done in terms of work items, the quantity in the log will not be able to combine with the item, and this can cause disputes when the subcontractor applies for payment. This is the reason that in this study we add the building-floor-room structure, so that subcontracting is done according to work item and work location, and the work accomplished can combine with the work item input and can be translated into pricing and estimation.

4.5 The Building-Floor-Room Structure

The study incorporated the Building-Floor-Room Structure [5], as described above and that is shown in Fig. 5, and combined with items in the project database. Items in the system contain work locations, in case of different subcontractors with different prices, this system is able to simulate the actual fulfillment by the said structure, which makes the information control more appropriate for work items. Formulas 1 to 3 are the relationships between building-floor-room and the work item; room works are compiled into floor work, and floors into building. Final summation is indicated as the accomplished quantity of the work item.

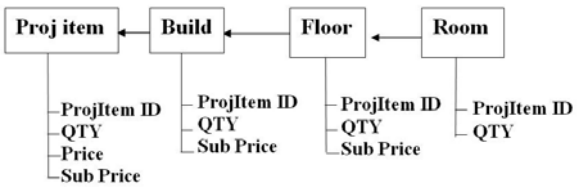

Figure 5. Room-Floor-Room Structure Diagram

$$V_{floor} = \sum_{i=1}^{n1} V_{room} \quad \text{(Formula 1)}$$

$$V_{building} = \sum_{i=1}^{n2} V_{floor} \quad \text{(Formula 2)}$$

$$V_{Sum\ of\ work\ item} = \sum_{i=1}^{n3} V_{building} \quad \text{(Formula 3)}$$

V_{room}: Quantity of work of each room, n1: number of rooms on the floor.

V_{floor}: Quantity of work of each floor, n2: number of floors in the building.

$V_{building}$: Quantity of work of each building, n3: number of buildings in the project.

$V_{\text{sum of work item}}$: Quantity of the work item in the project

5. SYSTEM STRUCTURE AND CONTENT OF WORK

Following completion of the Basic Database, Budget System, Procurement and Subcontracting System, and Cost Accounting System of the "Object Oriented Visualization-Simulated Structure of Constructional Information Compiling System (I)", this study continues to develop the following subsystems:

A. Daily Report System
B. Estimation And Pricing System
C. Design Modification Control System
D. Project Accounting System

5.1 Daily Report System

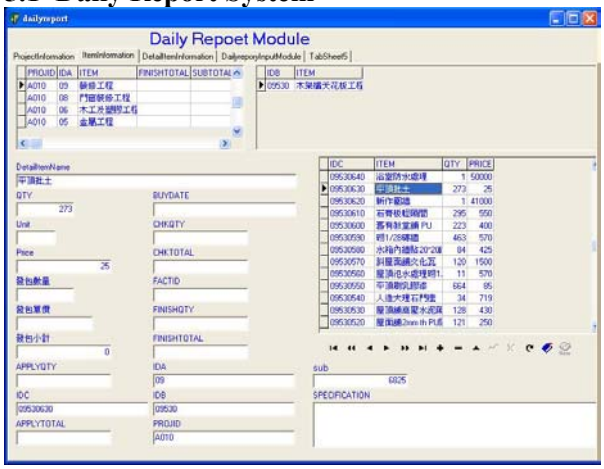

Figure 6. Daily Report System Dialog

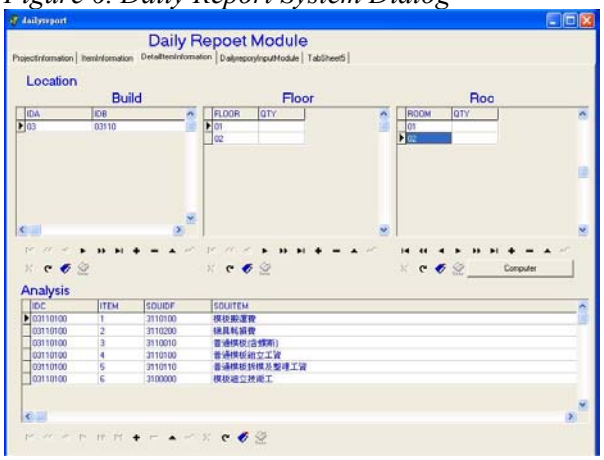

Figure 7. Daily Report Input -- Building-Floor-Room Screen

Daily Report System consists of 3 modules- Project Info (Fig.6), Work Item Info (Fig. 7), and Daily Report Input module (Fig. 8) –to record site events and work items accomplished; it also provides input of work location info. Besides, through company intranet via Client/Server structure, input can also be made by way of the browser input to upload daily log info to the main system at the headquarters.

System developed in the study provides 2 input methods: Direct Input (Intranet, shown as Fig. 8) and input through browser (Internet, as in Fig. 9)

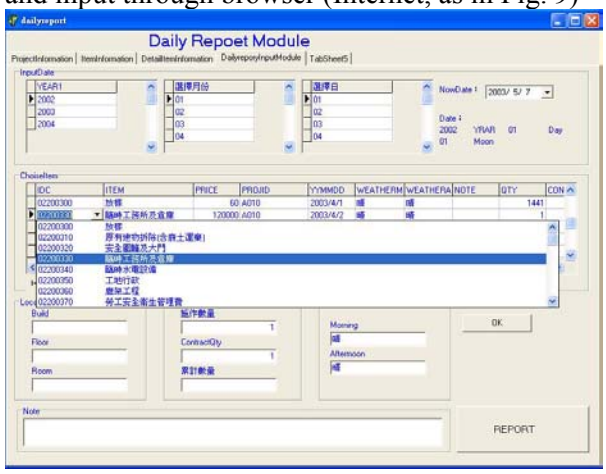

Figure 8. Daily Report Input Screen (Client/Server Version).

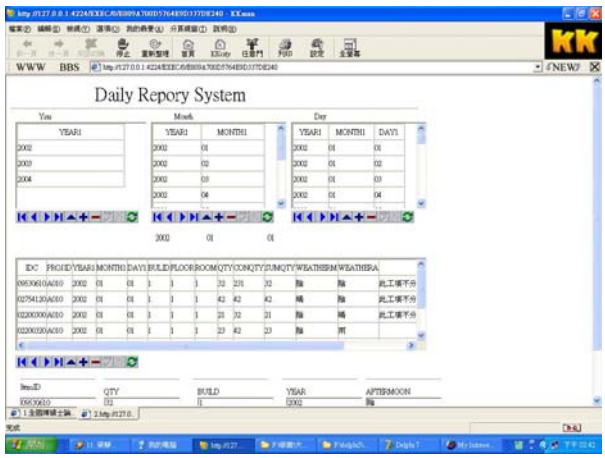

Figure 9. Daily Report Input Screen (Browser Version)

5.2 Estimation and Pricing System

Estimation and Pricing System compiles info collected in the Daily Report, sums up to be used as the info and amount for pricing and estimation. By setting up the building-floor-room structure, the study handles work item quantity by summing up room work quantities in the floor and floor work quantities in the building, so as to get the compiled quantity of the work item.

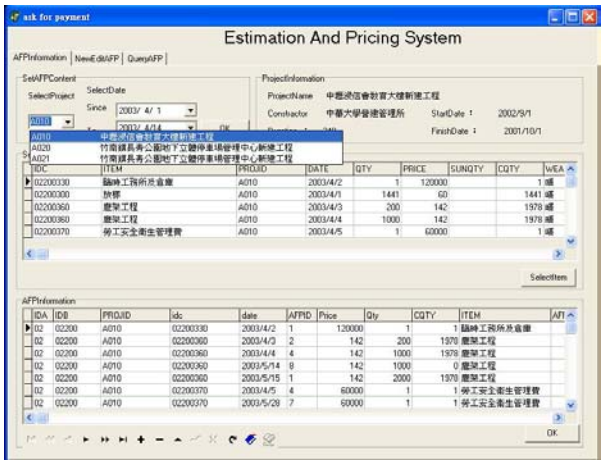

Figure 10. Dialog of Project Estimation And Pricing System

After selecting "Project" and "range of pricing and estimation date", the system compiles daily report info and translates into the Estimation and Pricing Database (as in Fig. 10, Screen Of Project Pricing And Estimation System, and Fig. 11, Project Pricing And Estimation System – add in and change the period of pricing and estimation); after entering the period of pricing and estimation, press the "OK" button and the system will translate the info into and for the use of the Estimation and Pricing System.

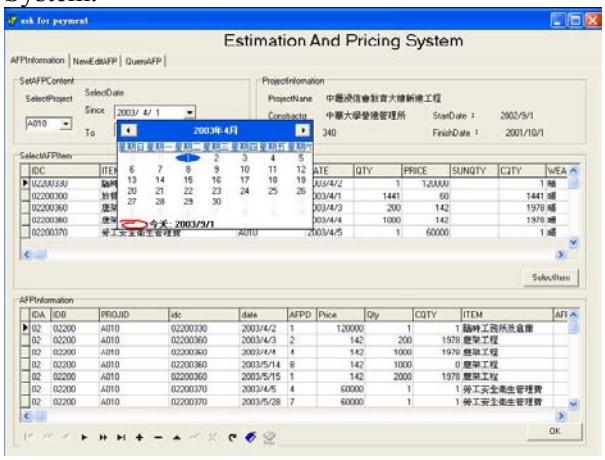

Figure 11. Project Pricing And Estimation System -- add in and change the period of pricing and estimation

5.3 Project Modification Control System

There is always a need to change in every project. Whether due to functional requirements of the client or stipulations of the architectural regulations, because of the need of construction interface or purely due to design requirements, changes on plane setup, height, material, size and equipment etc. are needed. The Project Modification Control Module is meant to record and trace the item, time, quantity, and price and its payment term or every change in complete details, so that a better control of design change can be achieved.

This system added a Version field to the Project Info as one of the Primary Keys. When there is a need of design change being brought up by the client or architect in an Engineering Meeting, a new project version will be added (as in Fig. 12) to alter and record the changed item and quantity of each version.

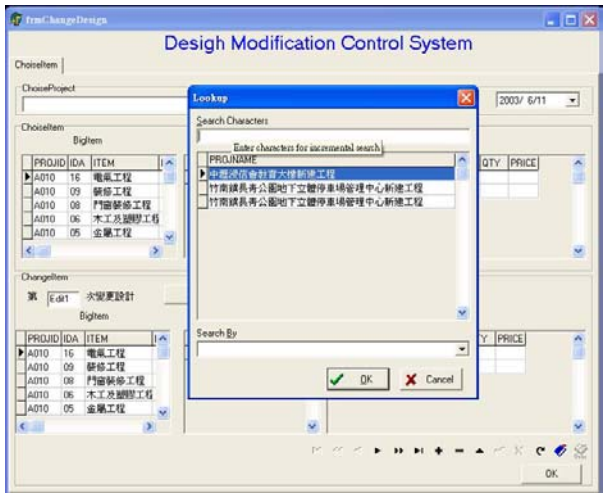

Figure 12. Design Modification Control System

5.4 Project Accounting System

Generally, by the end of the project, the contractor has difficulties in effectively handling the essentials of the project operation, which are the actually accomplished quantities, contract items and contract prices; only rough estimations can be worked out to approximate "tentative" profit or loss; in this environment that is more and more difficult to make a profit, it is truly needed to have complete control of the operation.

The system in this study can, coping with the Design Modification Control Module, control and trace the contracted quantity, subcontracted quantity and the finalized quantity etc., so that the operator can effectively control the relevant info and make necessary adjustments at all stages, as well as present the relative data at the end of the project to be used for project review and as references (as shown in Fig. 13, 14) to future project tenders, in the expectation of improving company managing ability and operating strength.

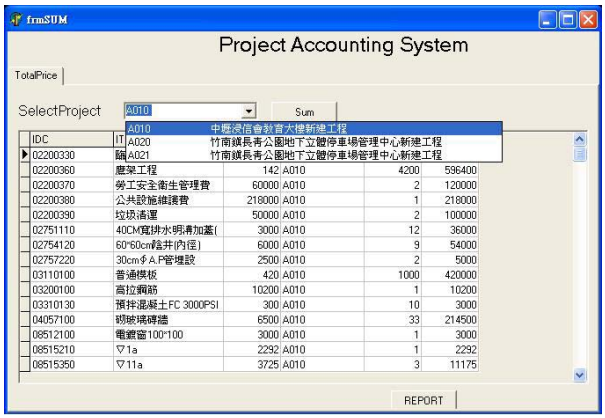

Figure 13. Project Accounting System

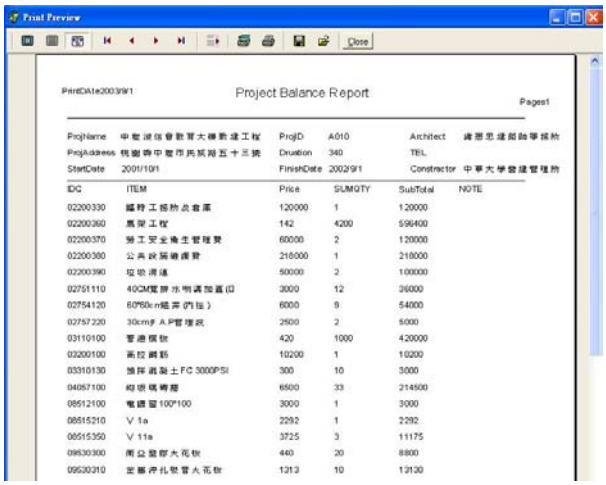

Figure 14. Project Balance Report

6. CONCLUSIONS AND SUGGESTIONS

The domestic construction atmosphere is generally low at the moment and contractors are facing enormous competitive pressure. Reinforcing competitive ability is the one and only method for a construction company to survive. The Construction Management Information System developed in this study has built up a Basic Database, Budget System, Procurement And Subcontracting System, Cost Accounting System, Daily Report System, Estimation and Pricing System, Design Modification Control System and Project Accounting System in the expectation of attaining the following effects:

A. To build up a basic data structure and present the system in the database categorized into large, medium and small items.
B. To develop a Budget System program, to be able to generate project budget automatically.
C. To develop a Purchasing And Contracting System program, to be able to screen subcontractors and execute contracting.
D. To develop a Fund Auditing System program, to be able to place an alarm on items exceeding the budget.
E. To develop a Daily Report System program, to be able to record daily site work items, quantities, and use of manpower and material.
F. To develop a program of Estimation And Pricing System, to be able to compile, from site daily log, quantities of the current finished items.
G. To develop a Design Modification and Control System program, to be able to record items and quantity of every design change.
H. To develop a Project Accounting System program, to be able to control the finished items, cost and income, and expenditure for each project.

6.2 Contributions

Through results of this study, contractors can execute the above mentioned compilation of construction information by using the "Construction Management Information System" and achieve the following effects:

A. By using computer software and log input interfaces, the system simplifies repetitive input tasks to simplify figure inputs.
B. Provides estimation and pricing period selections, which compiles from the Daily Report System and applies payment from the client; it can also serve the subcontractor in the same manner.
C. Builds up the "building-floor-room" structure into the database structure and solves the inconvenience of being unable to subcontract a single itemized work item.
D. Project Accounting System provides control of actually accomplished items in the project; this uplifts site management efficiency.
E. Reduces waste in use of equipment resources by way of resource integration, so as to lower costs and increase competitiveness.

6.3 Suggestions

Subsequent study of this research can extend to combine the "Progress Control Software" (such as MS-Project, P3 etc.) to achieve automatic compilation of the construction progress, update the Daily Report info into the Schedule Control Software so as to achieve real-time integrated construction management.

7. ACKNOWLEDGEMENT

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