A STUDY ON DEVELOPMENT OF A MANAGEMENT SYSTEM FOR COST CONTROLLING IN CONSTRUCTION PROJECTS

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ABSTRACT:

In the management of building projects, planning is not more significant than the role of controlling, which is one of the most crucial responsibilities. It is possible that a project will not be successful according to its original plans if it is not continually and thoroughly managed throughout the whole of the project. Planning is done on the basis of data from estimate, forecast, and the planner's own judgements, while controlling is done on the basis of real data collected from the building site. Therefore, managing anything involves persistent effort as well as a significant amount of data that has been acquired. It is performed under the time constraint in order to synchronise with the progress that is currently being made on site. A cost control for a project is any effort made to keep the project's actual expenses within the parameters of the budget. On each cost centre, the variances that exist between the actual costs and the budgeted expenses need to be measured. When any instance of cost overrun is discovered, the appropriate course of action will be taken to fix the situation. All expenditures that take place on the building site are included in the total project expenses; this includes both direct and indirect costs. The number of separate cost centres, broken down into the structure of the project's expenses, is directly proportional to the degree of control exercised over those costs. The most granular level of control is at the cost centre level. Any cost centre that you have must be handled in a consistent manner. Over the course of time, the real costs associated with each cost centre are accumulated. An unexpectedly large cost overrun that was just found could be impossible to fix.

A critical management duty that is essential to the success of an enterprise is ensuring that a building project's costs are kept under control. During the whole of the building period, it needs a variety of data inputs that are always brought up to date. Small and medium-sized contractors (SMCs) often are unable to manage and control the expenses of their projects since they have a restricted number of employees and capital. Many times, the sources of the real cost data are dispersed throughout the several invoicing papers. The efficiency of the control work is directly influenced by a number of factors, including the correctness and timeliness of the incoming data. The actual collecting and compilation of the data on the costs become significant disadvantages. The spreadsheet software used by SMCs is used to construct the Barcode-based Cost Control System, also known as the BCCS. The Bills of Quantity and Common Cost Account Structures are used as the basis for the budgets that are compared by BCCS against the actual costs that have been incurred to this point. When compared to the manual technique, the results of the system development and verification using construction project scenarios indicate that BCCS has the potential to help minimise the amount of time, effort, and input mistakes. Small and medium-sized businesses will find that this expense management tool is not only simple to use but also very effective.

I. INTRODUCTION

The control of cost and time in construction projects is one of the most important issues in construction since the emergence of the construction industry. A successful project should meet not only quality output standards, but also time and budget objectives. The management and control of cost and time in construction is fundamental in every project. An effective cost and time management and control technique for construction projects is important in managing risk of cost overrun and delay in completion of projects. Construction projects are becoming more complex as they now involve many stakeholders from different disciplines. The emergence of Building Information Model (BIM), an alternative technology is believed to solve issues related to project cost and time control as it efficiently increases collaboration between stakeholders. The aim of this paper is to review and summarise the causes of delay and cost overrun in construction industries, which are the main causes of disputes and abandonment of projects in the industry. It was found that delays and cost overrun eat deep into the industry and leave the construction industry with a bad image for decades even with rapid advancement in technology. The review of the applications of BIM showed that most of the

applications are geared towards minimising construction cost and time spent on projects. This means that the use of BIM in the management of construction projects has great impact on project cost and time.

CONSTRUCTION COST CONTROL

Construction cost control helps project managers avoid cost overruns by providing guidelines for estimates and forecasts of labor, material, and overhead costs. The purpose of a cost control plan is to help ensure the project is delivered on time, within scope, and on budget. Cost reporting is typically based on factors such as future cash flows, anticipated final costs, and current project costs.

CONTROL OF PROJECT CASH FLOWS

The development of information for the control of project costs with respect to the various functional activities appearing in the project budget. Project managers also are involved with assessment of the overall status of the project, including the status of activities, financing, payments and receipts. These various items comprise the project and financing cash flows described in earlier chapters. These components include costs incurred (as described above), billings and receipts for billings to owners (for contractors), payable amounts to suppliers and contractors, financing plan cash flows (for bonds or other financial instruments), etc.

Objective of the study

The main objective of this study is to find the various activities to causes time and cost overruns:

To identify the different factors responsible for the time and cost overruns on the construction project.

To study the effect of delays on construction projects.

To study the differences in opinions of the project engineer, contractor, site engineer, clients.

Analysis of data collected from various construction professionals and clients regarding delays of activity.

To identify the causes that lead to cost overrun and to evaluate their relative importance.

To get opinion on these causes from major players in the construction industry namely contractors, clients and consultants.

Rank the factors based on the impact on delays and cost.

To compare the findings of this study with the findings of research based on other countries.

II. LITERATURE REVIEW

S. C. Tandale and Mohan M. Kumaraswamy explained “A comparative study of cost and time overruns in Indian construction projects”. They concluded that poor site management, unforeseen site conditions, poor supervision lead to delay of a project and subsequently lead to cost overruns. The relationship between success on site and 'strong' management teams underlines the need for effective site management and supervision by contractor’s and consultants. They found that there was a difference in perceptions as to causes of delays and cost overruns by different groups of participants in building and civil engineering works.

Akinci & Fischer (1998) according to them even a marginal cost overburden can sweep away the profit of a job, and continuous cost overburdens in most of the projects of a firm can lead to bankruptcy. Projects can be delivered within the budget but that requires a good starting estimate, project management discipline and an awareness of factors that can cause cost escalation.

Dr. A. W. Dhawale studied “Construction delay: a quantitative analysis”. He concluded that, time and cost overrun in construction is a critical function in public projects construction. They also found that the main causes for time and cost overruns are related to designers, user changes, site conditions, weather, late deliveries and increase in quantity.

Chalabi and Camp found that delays and cost overruns of construction projects occur entirely in the very early stages of the project i.e. during the planning stages of project development. The project owners may be responsible for the time overrun when delays, suspensions or interruptions to all or part of the work are caused by an act or failure to act by the owner resulting from breaches of owner’s obligations, stated or implied in the contract. These include the failure of the owner or his representative to provide the contractor with relevant information, details etc. for which the contractor has specifically requested in writing.

Chan, et al. created a framework after a review of more than 43 articles, which were found in seven major management journals. They considered that project success depends on different factors, such as “project-related factors, project procedures, project management actions, human-related factors and external environment.” For instance, the framework would help to select the members of the team identifying the level of development that team members need to have for a good performance in the project.

Frimpong et. al., conducted a study to recognize and assess the relative significance of huge variables adding to postpone and cost invades in Ghana groundwater construction projects. A survey with 26 elements was painstakingly outlined from preparatory examinations led in groundwater boring projects somewhere around 1970 and 1999 in Ghana. The survey was coordinated towards three gatherings in both open and private associations: proprietors of the groundwater projects, counseling workplaces, and contractual

workers working in the groundwater works. The poll was dispersed to an arbitrary specimen of 55 proprietors, 40 temporary workers and 30 specialists. The consequence of the study uncovered the fundamental driver of deferral and cost invades in construction of groundwater projects: regularly scheduled installment troubles from organizations; poor contractual worker management; material acquisition; poor specialized execution; and heightening of material costs.

Al-Momani investigated reasons for deferral in 130 open projects in Jordan. The primary driver of deferral were identified with configuration, client changes, climate, site conditions, and late conveyances, financial conditions and increment in amount. The study proposed that extraordinary regard for elements will help industry specialists in minimizing contract question. Delays have solid association with disappointment and in powerful execution of contractual workers.

III. METHODOLOGY

ESSENTIAL FEATURES OF PROJECT COST MANAGEMENT TOOLS

The cost management software to increase work productivity, reduce risk, and measure costs through the full life cycle of a project.

Useful elements of project cost management

- Cost Estimation
- Budgeting
- Project performance measuring
- Easy reporting
- User-friendly interface
- Affordability

Questionnaire Response Rate

As state before, for the purpose of getting information on the perception on causes of time and cost overrun, questionnaires were distributed to clients, consultants and contractors. A total of 42 questionnaires were distributed to representatives of client, consultant and contracting organizations in the construction sector. The valid response rate was 56% , which is a high percentage. Table shows the number of questionnaires distributed to the stakeholders and the number of questionnaires returned along with the response rate % for each stakeholder category

Questionnaire Response from constructional professionals

Category	No of Questionnaire sent	No of Questionnaire received
Client	09	06
Consultant	08	04
Contractor	06	03
Total	23	13

Cost management plan

A cost management plan defines how you manage, control, and communicate a project's costs—so you complete the project on budget. Project cost management software often makes it easier to create these plans. Although you can customize a cost management plan to fit your unique needs, it generally follows a standard format, which includes items like these:

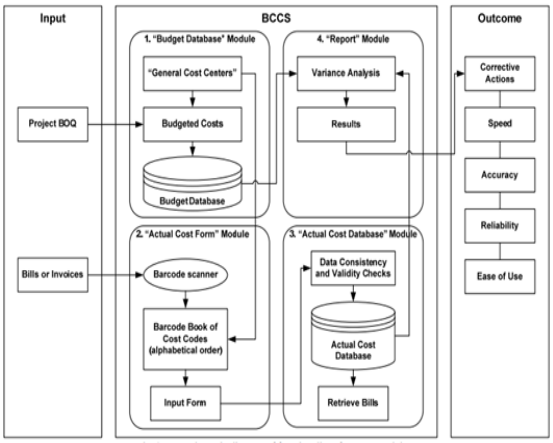
- Cost variance plan
- Cost management approach
- Cost estimation
- Cost baseline
- Cost control and reporting process
- Change-control process
- Project budget

IV. EXPERIMENTAL ANALYSIS DEVELOPMENT TOOLS

Barcode is a symbol system that represents characters. It can be read by an optical reader and results in electronic data. One-dimensional barcode use symbols including parallel solid lines and line spacing with different widths. Symbology of one-dimensional barcode has several standards. In this study, the Code 39 standard is chosen because it is very widely used and can be read by any common reader. It is a discrete, bi-directional, self-checking, and variable-length code. Code 39 can also encode alpha-numeric characters. A Code 39 tag can be easily prepared using a special font type. Spreadsheet software, Microsoft Excel, is used to develop the BCCS model. From the survey study, the SMCs have already owned and been familiar with it while the database management software is not commonly used as much. Previous research has also used the spreadsheet software to develop simple and practical information systems for construction companies. Microsoft Excel supports embedded programming. It features Data Validation which can be used to check the format and type of data input, and to maintain data consistency and integrity. It also provides the user access management for data protection and security

Functionality

BCCS includes four modules, namely 'Budget Database", "Actual Cost Form", "Actual Cost Database" and "Report". They are used for preparing budgeted costs, inputting actual costs, recording actual costs, and reporting results, respectively. Each module works on a separated Worksheet. These modules can retrieve and share some information each other. Fig. shows the connections and the working processes of these four modules of BCCS



A schematic diagram of functionality of BCCS' modules.

AUTOMATED DATA COLLECTION IN CONSTRUCTION

Numerous and various information is required to successfully manage a construction project. Some of it is required immediately or quickly in real time. This includes information relating to the tracking and controlling the project. Since real-time data are critical in speed, accuracy, and reliability; the collection, inputting and analyzing processes must be in very high efficiency. If this real-time system relies on people, it will be limited. The AIDC technology has been deployed in many other businesses but not yet widespread enough in construction. It has the potential of higher capacity and lower prices. AIDC is applied to the construction industry particularly on project management. RFID has an ability to identify the moving objects and it is a wireless system so that it is suitable to use in construction work site. RFID was used to trace large fabricated pipe spools on their transportation. RFID had a potential to manage the information of every individual building component which has been moved to many locations during the construction process. GPS has been brought to trace on the shipment of construction materials and equipment and help reduce losses and increase efficiency. The video recording was used to recognize work patterns of construction workers, analyze them, and result on the project progress. Barcode has a special advantage over the other AIDC because it is inexpensive and easy to use. It is the most widely used AIDC. It has been implemented on construction by some research. Barcode has been applied to check the use of construction materials by workers and accurately calculate incentives for workers from saving materials

BCCS is tested with two construction projects of a SMC. These projects have already been completed in 2008. They had total budgets of 40.7 and 41.5 million baht (Project A and B, respectively). They are selected as test cases because cost data of these projects have been well recorded and this SMC is willing to participate. The cost data including the project BOQs and bills are carefully kept and they are manually re-written on expense journals by the company owner herself. Each project has about 300 bills and about 700 billing items. The aspects of speed, accuracy, and reliability of BCCS are put to the test. The experiment is designed to re-input all cost data of the projects using BCCS and to compare the results from BCCS with the manual method one project at a time. The project cost data are re-inputted twice for each project. This is to check the reliability of the inputting process of BCCS. Firstly, the project BOQs are modified into the General Cost Centers as the project budgeted costs and their data are stored in the "Budget Database". The project bills are inputted through the "Actual Cost Form" using barcodes of the cost centers. The actual costs of these projects then are transformed and saved into the "Actual Cost Database". Time required for the data inputting process is obviously faster and it is more pleasurable than of the manual method. There is no discrepancy between the two inputting sessions for both projects.

This means the inputting process of BCCS is reliable. For Project A, as recorded on the expense journal, it had the overall actual cost 24.3% less than the budget (underrun) while the result from BCCS shows the overall actual cost is 17.9% less than the budget (underrun). There is a 6.4% difference between the two methods. For Project B, there is also a 4.1% difference between the two methods. The further investigation discovers the items causing mistakes in the expense journals. These mistakes come from manual calculations and numerical typos. This difference can mislead the true performance (profit/loss) of the project. This test case indicates that the company actually gains gross profit from Project A less than it has realized. The company owner admits that some errors might occur on her recordings because there are a number of data and figures. BCCS can efficiently handle these data and reduce human mistakes.

V. CONCLUSION

In many nations, SMCs make up a significant portion of the construction sector as a whole. However, they are not very technologically advanced and have several limitations on future growth. Even though these SMCs are aware of the need of a cost control system and the fact that the expenses of the projects may have an immediate impact on the earnings of the company, the cost controls that they use are mostly manual and ineffective. This is an issue that is considered to have very high importance and has to be addressed. The accumulation of a significant number of paper

invoices makes the project managers feel overwhelmed. Their budgetary restrictions are not able to keep up with the pace of the project. This research focuses specifically on identifying the reason why their attempt to control their costs was unsuccessful, which ultimately led to the creation of the Barcode-based Cost Control System (BCCS). SMCs may profit from using barcodes, which are not just widespread in other sectors but also in the construction industry. BCCS acts as a facilitator for the acquisition of real cost data. It assists in cost management on a degree of granularity that has never been seen previously in relation to projects. It is able to continue monitoring the overrun status of the cost centres all the way up to the second level, also known as the "material types." It is helpful for making judgements and taking remedial steps in a timely manner. When compared to the manual process that is currently used, BCCS is capable of providing more accurate results while also improving the correctness of the data. Within the scope of the research, the General Cost Centres conceptual framework is presented. In order to facilitate the sharing of "material items" across various projects, the General Cost Centres have been established. Because the users do not need to categorise any expense items received, they can make the process of preparing the project budget and collecting the actual costs of completing the project more simpler. In the future, research and development may be able to expand BCCS to include both the prior and subsequent duties, such as working together with vendors, managing inventory of goods, and keeping track of the hours worked by employees.

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