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THE IMPACT OF CONSIDERATION OF PAYMENT CONDITIONS IN CASH FLOW FORECASTING ON FINANCING COSTS IN CONSTRUCTION

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ABSTRACT

Financing costs have been considered to have effects on profit of business, especially when carrying out a construction project. The contractors always desire to minimize the financing costs which are determined basing on factors including the interest rate and penalties accrued on unused portions of credit limit. The establishment of bank overdraft calculated by forecasting project cash flow has been used as the method of financing construction projects. Generally, the cost-schedule integration (CSI) technique has been employed to estimate projects cash flow, but it has still indicated that it does not reflect reality. The payment conditions comprising payment time lags, frequency, and components suggested that they should be modeled in cash flow forecasting. However, there has been no simulation of cash flow forecasting through considering these conditions to examine the impact on project financing costs. This paper is a result of three experiments comprising the experiments calculated according to CSI approaches, simulated by varying payment conditions, and by uniform payment conditions. Data to the simulation was obtained from surveying two projects. Comparison of financing costs incurred among three experiments was performed. The results showed that the consideration of the payment conditions in cash flow forecasting of both projects made a significant difference in financing costs. It made a considerable difference between CSI models and uneven payment conditions. The difference lies in 95% and 71% of total interest charges in projects A and B, respectively. This study pointed out the importance of the terms of payment which may have an impact on forecasting profits and providing overdrafts to financing cash requirements of projects.

Keywords: Payment conditions, financing cost, cash flow, construction project, cost-schedule integration (CSI).

1. INTRODUCTION

A crucial procedure for construction contractors is the financing procurement to run a profitable business. Most general contractors often procure funds from external sources such as financial

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institutions (e.g.banks) for funding the project (Elazouni and Metwally, 2005). The establishment of bank overdrafts has been one of the widespread methods of financing construction projects (Ahuja, 1976). The cumulative cash flow is calculated by balancing between cash inflows and outflows in order to determine bank overdrafts. In case of negative balance, financing cost for borrowing from banks, so called internal interest, would be charged to the project in accordance with corporate policy or decisions. In addition, fluctuation of cash requirement at any period causes a penalty fee which is charged by bankers for unused portions on allocated credit. Thus, contractors need to concern about the project financing costs incurred on cash flow forecasting.

The cost-schedule integration (CSI) technique has extensively been used for estimating the project cash flow. CSI approaches assume that cash flows realized on a project are a function of the project schedule (Sears, 1981). In 2002, Chen's research indicated that the approaches did not reflect reality in a project environment, he also suggested that payment conditions comprising payment time lags, frequency, and components need to be included in CSI models to provide sufficient cash flow models (Chen et al., 2005). However, there has been no simulation of cash flow forecasting including the extend CSI approaches to examine the impact on project financing costs. Moreover, it is unclear to what extent simulation of uniform distribution of the payment conditions over the project time will make a difference from simulation uneven one as well as an impact on financing costs.

This paper aims to point out the differences between the cash flow forecasting calculated by the distribution of the terms of payments based on in practice and the cash flow forecasting calculated by the existing CSI. The study does not cover all factors of the terms of payments, but does study certain types of payment conditions including payment time lags, frequency, and components indicated that should be modeled to accurately reflect reality by Chen's research (2002). In addition, this study not only indicates the differences in the results of two experiments, but also any further experiment which is calculated by the uniform distribution of the payment conditions is performed.

2. CONSIDERING PAYMENT CONDITIONS IN CASH FLOW MODELS

Cash flow in this paper is defined as cash flows generated by operating activities since they reflect the financial health of a business and its value (Barth et al., 2001). Operating cash flows comprise the inflows and outflows of cash. Cash inflows are the flows of money in the form of progress payment realized on contractual agreements with project's owners relating to accomplished works and project completion. Cash outflows are disbursement payment of costs of project activities as a function of time. From a modeling perspective, cost flows are defined as forecasts of disbursement payment flows and have proven to be more difficult to generate than that of cash inflows for reasons of complexity (Chen, 2002). However, progress payment flows determined by evaluations of the percentage of total contract completion in the lump sum contract are also difficult to forecast a receipt from the owner because they depend on the accomplished works specified in contract. Therefore, this research focuses on considering the payment conditions in both inflows and outflows of cash flow forecasting. The following two sections address the formulation of the modified equations complying with payment conditions for predicting the cash flows and the details of the payment conditions provided for simulating cash flows forecasting.

Estimating the project cash flows is simplified in order that calculation can be made easily but it does not consider the terms of payments which have indicated that they have an effect on the accuracy of cash flow forecasting (Chen 2002). Therefore, the calculation of cash flows needs to be improved by modifying the Elazouni (2004)'s equations to comply with the payment conditions. In the initial scheme, the cash flow is still estimated to establish an original overdraft of the project. The cash inflows and outflows consist of the payment received from the owners and cost loaded schedule. The model is modified and formulated in cash inflows and outflows by considering the payment conditions during construction. The formulation also complies with the terminology employed by (Chen et al., 2011, Elazouni and Gab-Allah, 2004, Au and Hendrickson, 1986). Let the amount of total direct cost of an activity p performed on any payment date TP_h be denoted by y_{pTP_h}; it represents project direct cost disbursement of an activity p. Thus

$$y_{pTP_h} = \sum_{i=es_p}^{TA_t} y_{pi} \text{ , } p = 1, 2, \ldots, n \tag{1}$$

Subject to: if $es_p \leq TA_{t-1}$, then $es_p = TA_{t-1} + 1$

$$TP_h = TA_t + TL \tag{2}$$

Where y_{pi} is the direct cost disbursement rate of activity p in day i; es_p is early start of activity p; TA_t is time of application submission at any period t; n is number of activities of which duration overlaps with period t; and TL is time between application submission and payment.

A project total cost disbursements during any period t, which is time between previous time of application submission TA_{t-1} and present one TA_t, and on any payment date TP_h is represented by E_{TP_h}. Depending on the progress payment specified in contracts, the amount and timing of receiving a payment P is decided by accomplishment of works specified in a progress payment f, which is determined by evaluation of the percentage of contract price CP_f at any receiving date TR is represented by P_{TR}, where

$$E_{TP_h} = \sum_{p=1}^{n_t} y_{pTP_h} \tag{3}$$

$$P_{TR} = CP_f \text{ , } f = 1, 2, \ldots k \tag{4}$$

$$TR = TB + TLR \tag{5}$$

Where n_t is number of activities of which duration overlaps on payment date TP_h; and k is number of progress payment specified in the contract; TB is time of billing submitted to the project's owner; TLR is time between submitted billing and progress payment.

3. EXPERIMENTATION AND ANALYSIS

Three experiments have been carried out to test the effect of the payment conditions used, in showing the effects of these factors, on the cash flow forecasting of the projects. The cumulative cash flows are figured by experiment on two construction projects. These conditions comprising payment time lags, payment frequency and payment components were gathered by interviewing and documenting from the projects' contractors and the projects' owner.

3.1. Project used for experimentation

Data to support experimentation was gathered on two projects: A and B. The project names have been assumed from the request of the firms involved. The A project was located in the south of Thailand and had a contract price of THB74.9 million (~$2.5 million). This project is an educational building project comprising a six-storey construction of reinforced concrete. The total project duration was twenty months. The other project, the B project, located in the same region, had a contract price of THB58.6 million (~$1.95 million). The project is an educational operating building project comprising five-storey construction of reinforced concrete. The total project duration was eighteen months. The A project was completed on February, 2009 and the other on September, 2010.

The two projects are examples of the simulation of the impact of the payment conditions. The payment conditions to subcontractors and suppliers of each project were gathered by interviewing from the project's contractors and the payment conditions for progress payment were collected by documenting from the projects' owner. For both projects, certain payments to specialist subcontractors were lump sum payments for both labor and materials, such as preparation works, pile works and electrical works, while others paid only for labor wages. Moreover, most materials costs were directly paid by the main contractors to relating suppliers. The progress payment is designated as a schedule of values into the terms of the lump sum contracts. The payments based on actual progress are contingent on a satisfactory completion of pre-specified project activities. Furthermore, the projects used a typical general contracting arrangement which corresponded with the four basic types of conditions of general contracting payment processing (Chen, 2002). Consequently, they can be considered a representative of various other projects globally.

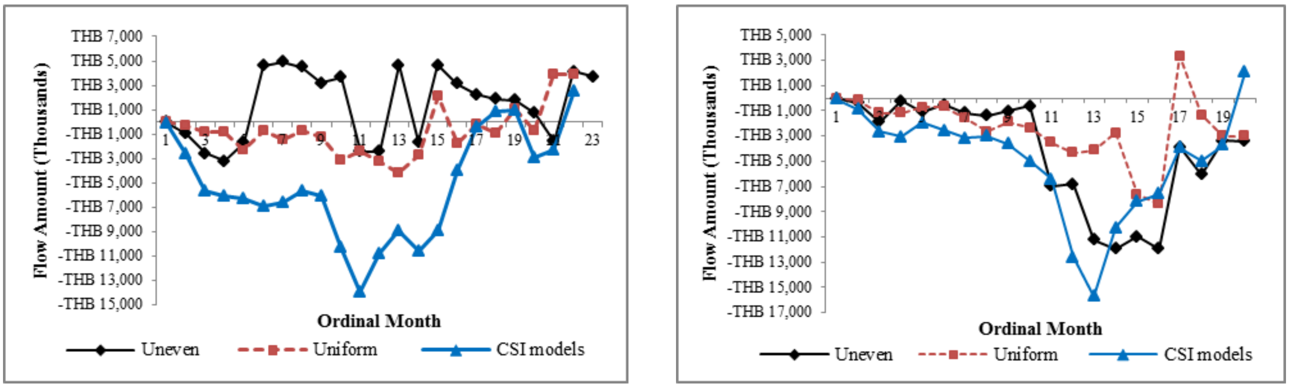
3.2. Simulation of the experiments

In this study, three experiments were set up for each project to demonstrate the differences between them in terms of financing project. One of the experiments was simulated by calculating the cash flows forecasting according to the CSI approaches as based experiment. The other experiments are simulated by calculating the cash flows forecasting on the different distribution of the payment conditions using data from the sample projects. The data comprised the project schedule, the contract price of project and the terms of payments to establish the project cash flows. However, the based experiment also used these data except the terms of payments. Two experiments related to the terms of payment were composed of an experiment simulated by the uneven distribution of the payment conditions and simulated by the uniform distribution of the payment conditions. The former called an uneven experiment which used data of payment conditions obtained from the survey directly, but the later called as a uniform experiment which used data of payment conditions simplified by matching the terms of payment to activities evenly. The payment conditions used for simulation of these experiments were illustrated in Table 1. Simulating the uneven experiment is a representative of a situation in which contractors have quite adequate information of payment condition for forecasting cash flow required accuracy similar in practice, but the uniform experiment is simulated to represent a situation in which contractors do not have data of the terms of payment and want to forecast a related cash flow approximately. Consequently, three experiments are provided for comparison with the maximum cumulative cash flow of each period between them.

Under the procedure for simulating, the foundation of cost schedule integration was used for distributing the cost of a project over time. Based on this, the cost loaded schedule then generated a cost flow projection from the data of the sample projects. The payment progress specified in contracts was used for determining the cost of the activities. The cash inflows and outflows (cost flow) were forecasted for three experiments. But the uneven and uniform experiments required an additional step concerned with the payment conditions. The cash outflows were done by projecting the cost as a function of their usage time and the terms of payments. For all activities, the payment to the percent

Table 1: The payment conditions used for simulation

Project	Experiment	Firms	Billing date of month	Time lags	Frequency	Type of payroll
A	Uneven	Owner	After completion	Contracts	Contracts	Contracts
		Sub.1	15th and 30th	5 days	Twice	Labor& Material
		Sub.2	15th and 30th	5 days	Twice	Labor
		Sup.1	30th	30 days	Once	Material
		Sup.2	30th	60 days	Once	Material
		Sup.3	15th and 30th	60 days	Twice	Material
	Uniform	Owner	After completion	Contracts	Contracts	Contracts
		Sub.1	15th and 30th	5 days	Twice	Labor
		Sup.1	15th and 30th	30 days	Twice	Material
B	Uneven	Owner	After completion	Contracts	Contracts	Contracts
		Sub.1	15th and 30th	5 days	Twice	Labor& Material
		Sub.2	15th and 30th	5 days	Twice	Labor
		Sub.3	1st	7 days	Once	Labor& Material
		Sup.1	5th	25 days	Once	Material
		Sup.2	5th	40 days	Once	Material
	Uniform	Owner	After completion	Contracts	Contracts	Contracts
		Sub.1	15th and 30th	5 days	Twice	Labor
		Sup.1	15th and 30th	30 days	Twice	Material



(a) Project A **(b) Project B**

Figure 1: Cash balance plotted on simulation of the experiments at each period.

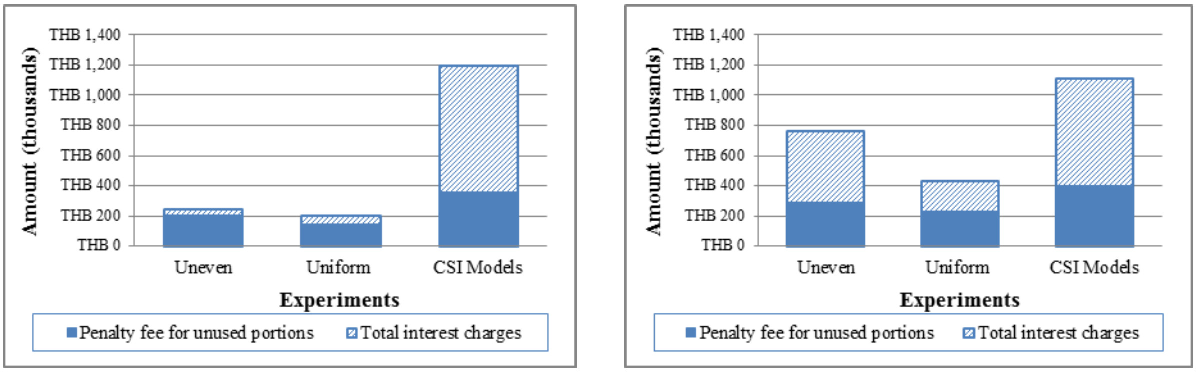
of each activity cost, respectively. The data of subcontractors and suppliers were allocated to the project activities by mapping the activity to its supply chains. The supply chains were categorized into three groups; subcontractors committed to both labor and material, subcontractors committed only to labor, and suppliers committed to materials. Mapping all categories to the project activity was used for the experiments considering the payment conditions, except in the case of uniform experiment which do not use the first group, as detail shown in Table 1.

To demonstrate the difference between the experiments in terms of the financing project, Figures 1(a) and 1(b) illustrate the results from simulation of cash flows forecasting calculated according to three models in the project A and B, respectively. The graphs show plotting of cumulative balance of each experiment at any period. Consequently, the results are analyzed in the following section.

4. ANALYZING THE IMPACT ON PROJECT FINANCING

In this study, the project financing costs were calculated according to equations in the Elazouni (2004)'s research. They comprised total penalty fees for unused portions on allocated credit limit, total interest charges, and consequently overall financing costs. Figures 2(a) and 2(b) show the summary of financing costs incurred on each experiment of project A and B, respectively. The following section discusses the important impact of consideration of payment conditions in cash flow forecasting on the financing cost with explanations of differences between the three experiments.

As can be seen from Figure 2(a), the case of project A, the chart shows that there are differences of financing costs among the experiments. In comparison with the total penalty fees for unused portions on credit limit, the uneven and uniform experiments are very different from the based models which are lower by 42% and 60%, respectively. Besides, the uneven experiment is rather different from uniform experiment which is higher by 31%. The other comparison of total interest charges, it also shows that the uneven and uniform experiments are vastly different from the based models which are lower by up to 93% and 95%, respectively. Moreover, the uneven



(a) Project A **(b) Project B**

Figure 2: Summary of financing costs incurred on the experiments.

experiment is rather different from uniform experiment which is higher by 42%. Finally, overall financing costs incurred of three models are compared. It shows that uneven and uniform experiments are very different from the based models which they are lower by up to 80% and 83%, respectively, while the uneven experiment is slightly different from the uniform experiment which is higher by only 19%.

The results of project B as shown in Figure 2(b), in comparison with the total penalty fees for unused portions on credit limit, the uniform experiment seems very different from the based models which is lower by 44%, but the even experiment appears rather different from based models which is lower by 28%. Besides, the uneven experiment is slightly different from uniform experiment which it is higher by only 21%. The other comparison of total interest charges, it also shows that the uniform experiment seems clearly different from the based models which is lower by up to 70%, but the other appears rather different from based models which is lower by only 32%. In addition, the uneven experiment is markedly different from the uniform experiment which is higher by 57%. Finally, in comparison of overall financing costs, it also shows that the uniform experiment is distinctly different from the based models which is lower by 61% while the other is rather different from the based models which is lower by 31%. And the uneven experiment is also rather different from the uniform experiment which is higher by 44%.

In brief, the results showed that the differences in financing costs between the experiments of two projects were accounted for in the same direction. In addition, it can be noted that the proportion of the differences in project B is lower than that of project A, and the uniform experiment is lowest in the experimentation. This could be caused by the varied supply chains which were mapped onto activities of each project and caused by a different number of progress payments which were determined as cash inflows in an estimation of the project cash flow. Thus, it can also indicate that the differences in considering these aspects can make a vast difference in financing costs, such as the total interest charges in project A which made the biggest difference of 95% from the based or CSI models as shown in Figures 2(a) and 2(b).

Results of the experiments indicated that the consideration of the payment conditions in cash flow forecasting has shown the effects of the different changes on project financing costs. The impact examined on the projects depended upon the mapping of the payment conditions in project's activities, such as mapping the components which vary with time lags in project A, it caused the marked effect which was more than the one in project B, and consequently the vast difference in project A. It also corresponded with the earlier study (Chen et al., 2005) which argued that having different payment components should only affect cash flows when time lags vary between components.

5. CONCLUSION

This paper was written based on the simulation of three experiments to examine the impact of the payment conditions on financing costs incurred from estimating project cash flows. The results of both projects indicated that the payment conditions have the most impact on financing costs when they are distributed uniformly to project activities. Although the results show the lowest financing costs which would be beneficial to reduce project indirect cost, cash flow predictions are likely to remain inaccurate in practice. Thus, the accuracy of cash flow forecasting depends on the data of payment conditions which may have an impact on forecasting profits and providing overdrafts to financing cash requirements of projects.

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