Quantifying Monetary Value of Float

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Abstract: Floats are used by the parties involved in a construction project. The owner may use float by changing order(s) or by executing risk avoidance plan; the contractor may use it for leveling resources or substituting activities' construction methods to reduce costs. Floats are accepted either just as by-product obtained by critical path method(CPM) scheduling or as asset having significant value. Succinctly, existing studies involved in float value does not consider its' changes on project time domain. It is important to identify float ownership and to quantify its' corresponding values. This paper presents a method that quantifies float value of money that changes over project execution. The method which accurately computes the monetary value of float may contributes to resolve conflicts relative to float ownership and/or delay issues among project participants. It compares the difference between the monetary value of total float - on non-critical path in each and every schedule update. It makes use of critical path method (CPM) and commercial software with which practitioners are already familiar.

Keywords: float value, critical path method(CPM), quantification, commodity of float

I. INTRODUCTION

1. Research background and purpose

The ownership of float is brought up after the critical path method (CPM) is applied to the litigation of construction at 1970s. In the beginning, the answer to a question 'who is the owner of the float?' is determined by the rationale of "first come first served" (Popescu and Anamaria 2009). However, as being known as the float ownership could be used to settele the litigation caused by construction delay, 'who owns the float?' has become an important issue (Loulakis and McLaughlin 2004).

The delay on non-critical path does not matter, because the delay can be recovered via corresponding float within the contracted completion time until the activity changes to the critical one (Williams 2003; Kraiem and Diekmann 1987; Yogeswaran et al. 1998). Actually, the occurred delay and the used float may redefine the relationship between the construction activities. That may increase the construction cost (Williams et al. 2003; Williams 2003).

Also, the float is used by project participants each other for their own interests. Contractors use the float for the resource allocation by means of cost stabilization. Meanwhile, owners tend to use the float to avoid the potential risk or minimize the risk by changing orders (Al-Gahtani 2009).

As stated before, the purpose of the float application totally differs according to the participants. Thus, the decrease of allowable floats means missing a chance to deal with the schedule change and/or to save project budget (Lo and Kuo 2013). If unpredictable float consumption is occurred, then the project cost and the risk of project delay may be increased. However, the studies concerning the float analysis are lacking due to the since the practical ways to use the monetary value of floats is not provided.

Therefore, this study aims to develop and present a quantitative assessment method involved in the consumption of floats.

2. Methods and procedures

In this paper, methods that quantify the monetary value of floats and estimate the amount of consumed floats on activities are proposed.

The scheduling and resource planning by utilizing CPM have been widely used in construction projects (Sakka and El-Sayegh 2007). CPM is used for calculating early time (ES/EF), late time (LS/LF), and floats from the construction network. CPM computation requires activity attributes (e.g., duration, cost, and predecessor/successor of each activity). Upon the completion of forward and backward computation early start time (ES), late start time (LS), early finish time (EF) and late finish time (LF) are calculated. These time values are used for compute early start fund (ESF), and late start fund (LSF). ESF is the cumulated cost when all activities are activated in early start time. LSF is the cumulated cost when all activities are activated in late start time. After all steps are completed, the values are plotted in a graph where x- and y- axis indicate time and fund, respectively.

The area between ESF-curve and LSF-curve is proportional to the total sum of floats that exists on all activities. Thus, the area refers to the latent float value corresponding to monetary value at that time. The mean latent value of float is computed by dividing the area by remained construction time. The mean value is allocated in each float. Then above mentioned steps are executed repeatedly. As the project is completed, multiply additional cost which occurred each time by the ratio of the used float value. Consequently, the monetary value of float is calculated.

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Above mentioned steps can be summarized as follows.

Step 1. Calculating CPM
Step 2. Calculating ESF and LSF
Step 3. Calculating the mean latent value of float
Step 4. Allocating the mean value in each float
Step 5. Repeating above steps each time and finding the ratio of the used float value
Step 6. Multiplying additional cost by the ratio
Step 7. Calculating the monetary value of float

II. LITERATURE REVIEW

1. Existing studies concerning float quantification

De La Garza et al. (1991) suggest the time value of floats. The float can be traded as commodity between contractors and owners as an exchangeable to incentive or the provisional money value. Sakka and El-Sayegh (2007) point out the problem that the traditional study of the delay analysis method cannot consider the effect of floats in non-critical activity. Also, they assert that a little increase of total cost of the project may crucial effect on the benefit of participants. Ammar (2003) developed a system for computing each float of activity. Lo and Kuo (2013) discover that existing associated studies have used the fixed activity duration and fixed activity cost. They develop a method for minimizing the cost effect with consideration of the idle cost and mobilization/ demobilization cost. Al-Gahtani (2009) propose a method to distribute the ownership of float into owners and contractors with risk factor. Zhong and Zhang (2003) , to address the uncertainties inherent in the construction industry, integrate PERT into the CPM system.

Analysing existing literatures, the method to address the monetary value of float does not existed.

2. Characteristics of float

The concept of float may be classified by different four variables as follows: 1) consumed float; 2) deprived float; 3) expired float; and 4) completed float.

Consumed float means the used floats by contractors or owners to accomplish their need. *Deprived float* means that used floats in successor activity caused by predecessor activity's delay. *Expired float* means that floats used for resource allocation adjustment or changing order or floats abandoned as time passed. Although participants does not use floats at all and they completed with no delay, existed floats on an activity disappear without consideration upon the maximum completion time of the activity. This is because the float only exists between the start and the end of activity. This float is defined as *Completed float*. These characteristics make difficult to calculate the values of each float.

III. CALCULATION OF MONETARY VALUE OF FLOAT

1. Critical path method (CPM)

CPM is the most widely utilized method to analyze the impact caused by delays on the project (Williams 2003). It is computable that ES, EF, LS, and LF by using CPM. Also, the information is used to calculate float and cost that existed in activity.

2. Latent monetary value of float

ESC and *LSC* are obtained by Eqs. (1) and (2) on the basis of CPM computation.

$$\mathrm{ESC}_d^i = \begin{cases} C_i, ES_i \le d-1 < EF_i \\ 0, ES_i > d-1 \; and \; d-1 \ge EF_i \end{cases} \quad (1)$$

$$\mathrm{LSC}_d^i = \begin{cases} C_i, LS_i \le d-1 < LF_i \\ 0, LS_i > d-1 \; and \; d-1 \ge LF_i \end{cases} \quad (2)$$

d is the schedule update time(d=1, 2, … , D); i is the activity number (i=1,2,…, I); C_i is i th activity's cost. ESC^i_d is i th activity's early start cost at time d. LSC^i_d is i th activity's late start cost at time d. Also, the ESF and LSF can be calculated by cumulating the *ESC* and *LSC* in each day.

The estimated the value of cost is plotted by S-curve based on the period as shown in Figure 1. And *CT* is completion time of the project.

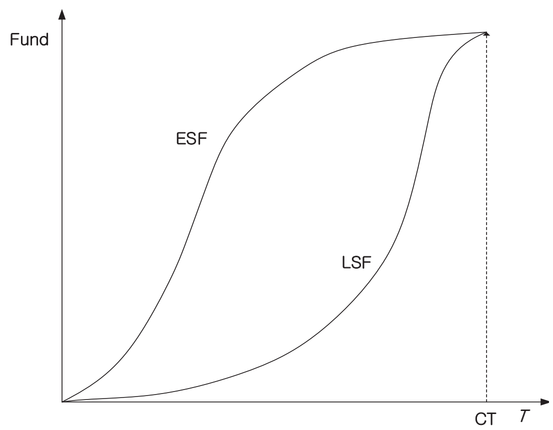

FIGURE 1.

S-curve representing ESF and LSF

S-curve is drawn as the two lines depending on the early commencement or the late one on the baseline schedule. The difference between the two curves is that float is used or not. Thus, the area between ESF and LSF means a potential cost value of float.

When the project was completed, the float which was consumed in the activity is divided the total used float in all activities. Then, the value ratio of used float is calculated. The ratio by multiplying the ratio by extra cost, and the monetary value of float can be obtained.

IV. CASE STUDY

In a case study, a small scale project consisting of 14 activities is used for calculating monetary value of float. Detailed descriptions of the case are as follow:

According to Table 1, Activity D used float 15 days from

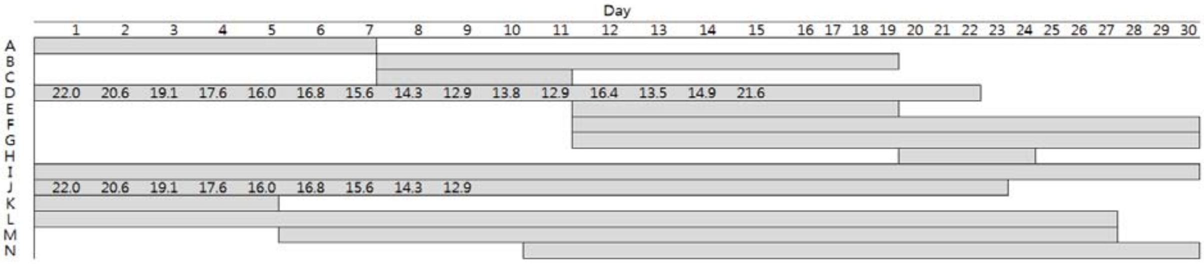

FIGURE 2.

Float values at each day

the planned date. Activity J used float 9 days from the planned date. The extra cost by using activity D is $ 300. The extra cost by using activity J is $ 200. The update time unit is a day. The results obtained from the method are presented in Table 2. Float values at each day that sum of total float value divided by sum of total float at the time presented Figure 2.

TABLE 1.

Project information

Activity	Activity attribute					
	Duration (day)	Unit cost($)	predecessor	Successor	Total float	Used float
A	7	600	-	B,C	-	
B	4	100	A	G,H	8	
C	4	800	A	E,F	-	
D	2	300	-	F	20	15
E	8	700	C	H	-	
F	8	300	D,C	-	11	
G	3	200	B	-	16	
H	5	400	B,E	I	-	
I	6	200	H	-	-	
J	15	500	-	-	15	9
K	5	600	-	M	18	
L	10	300	-	N	17	
M	4	200	K	N	18	
N	3	500	M	-	17	

The value ratios of used float of activities D and J are 0.616 and 0.384 respectively Also, each float monetary value of activity D and J are $307.79 and $192.20 individually. Considering the remained working days i.e., 15 days and 9 days corresponding to each activity D and J, the unit float values of them are $20.52 and $21.36.

TABLE 2.

Results of the method

Activity	Results of the process			
	Total float value($)	Ratio of float used (%)	Calculated total float value($)	Unit float value($)
D	247.91	61.6	307.79	20.52
J	154.81	38.4	192.20	21.36

V. CONCLUSION

This paper suggests the method that allows to quantify monetary values of floats in non-critical activities of a project.

The method is needed to supplement with actual cases and a legal basis in further research.

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