

# ( VI – 35 )     STUDY ON THE OPTIMUM CONSTRUCTION PERIOD OF CONSTRUCTION PROJECTS

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## **Introduction**

Construction period of construction projects is one of important problems, which has been concerned by both owners and contractors. However, the reduction of construction period of construction projects is limited, and it does not necessarily give the best efficiency. The study is planned to examine and to quantify influences of the construction period on the desired efficiency in order to determine the optimum construction period for construction projects in both public sector and private sector by adopting the viewpoints of owners of construction projects.

### **Construction period of construction projects and effect of factors on efficiency of the reduction construction period of construction projects**

The relevant construction period of construction projects is understood as the execution period of construction projects from the moment of starting the execution until the moment of being available for operation of construction projects. The reduction of construction period of construction projects is limited, and this limit is caused by requirements of applied construction technology and by limited available working space. It is explicit that, with each construction project corresponding to each applied construction technology, we can always determine the corresponding minimum required construction period. It is the period we can not reduce any more unless we change the applied construction technology.

The reduction of construction period of construction projects as much as possible runs to the minimum required construction period is not always giving the best efficiency in all cases. The problem is that there always exist two impact factor groups that oppositely influence efficiency of the reduction of construction period. They are included:

1. The impact factor group which increases efficiency of the reduction of construction period. For example, those factors are :

- . reducing loss from stagnated capital,
- . obtaining benefit or getting social or political benefits thanks to early project operation,
- . reducing construction costs depending on construction period and so on.

2. The impact factor group which decreases efficiency of the reduction of construction period . For example, those factors are :

- . increasing costs to reduce construction period of construction projects (example : service cost for night working time, loss caused by slowly turned-over concrete forms and so on)
- . reducing productivity and working time of equipment-machines and labors caused by limited working space and other reasons.
- . increasing costs caused by costs concerning the reduction of construction period. (example : costs caused by required working stop to reduce the construction period in case of factory repair projects...) and so on.

### **Optimum construction period and efficient evaluation criteria of the reduction of construction period.**

The optimum construction period of a construction project corresponding to a certain execution plan is understood as the construction period corresponding to the best efficiency of the execution plan.

Generally, the above mentioned efficiency must reflect comprehensively the final goal of investment objective of construction projects. However, to quantify final goal of investment objective is very difficult and in many cases is extremely difficult. Alternative approach to this problem is to use efficient evaluation criteria of the reduction of construction period. This is the first key point of the study. These efficient evaluation criteria must reflect not only efficiency concerning the construction but also efficiency concerning the operation of projects. Furthermore, they must reflect not only economical benefits but also social benefits (if any). It is explicit that these efficient evaluation criteria depend on not only each kind of construction projects but also each concrete situation. The second key point of the study are to identify the above mentioned impact factors for each concrete case and to quantify influences of construction period on these factors in order to determine influence of construction period on the chosen efficient evaluation criterion of the reduction of construction period.

### Mathematical model of the study

A mathematical model of the study is proposed as follows :

Let us denote impacts of factors of the 1st group and 2nd group on the relevant efficient evaluation criterion by  $X_1, X_2, \dots, X_n$  &  $Y_1, Y_2, \dots, Y_m$  respectively. Let us denote an efficiency evaluation function of the reduction of construction period by  $F$ . Let us define  $A$  as an index for efficiency that does not depend on construction period. We have an efficient evaluation function of the reduction of construction period  $F$  as follows :

$$F = f(X_1, X_2, \dots, X_n, Y_1, Y_2, \dots, Y_m, A) \quad (1)$$

Because  $X_i$  &  $Y_j$   $i=1, \dots, n$ ,  $j=1, \dots, m$  depend on the construction period,  $X$  &  $Y$  are functions of construction period variable,  $t$  :

$$X_1 = g_1(t), X_2 = g_2(t), \dots, X_i = g_i(t), \dots, X_n = g_n(t). \text{ \& } Y_1 = h_1(t), Y_2 = h_2(t), \dots, Y_j = h_j(t) \dots Y_m = h_m(t).$$

Thus, equation (1) can be written as :

$$F = f\{g_1(t), g_2(t), \dots, g_i(t), \dots, g_n(t), h_1(t), h_2(t), \dots, h_m(t), A\} \quad (2)$$

Construction period of construction projects is optimum when  $F$  reaches the maximum or the minimum. Thus, we can obtain the optimum construction period by solving the equation :

$$\partial F / \partial t = 0 \quad (3)$$

### Conclusion

Formulating equation (2) and solving (3) would contribute toward increasing efficiency of investment for construction projects. With each execution plan for a construction project, it is easy to formulate some efficiency evaluation functions. One of the future tasks is to develop a method of formulating efficiency evaluation functions which are difficult to quantify. In actual situation we have to deal with multiple efficiency evaluation functions. The theory of multi objective programming would be one of the methods. Development of a method of dealing with multiple efficiency evaluation functions is also needed.

### References

- 1- Donald G. Newnan. Engineering Economic Analysis, 3rd ed. California, Engineering Press, Inc. 1983.
- 2- Moder, J., C. Philips & E. Davis Project Management with CPM, PERT and Precedence Diagramming, 3rd ed., Van Nostrand Reinhold Co., New York 1983.
- 3- Shamil G. Naoum. Critical Analysis of Time and Cost of Management and Traditional Contracts. Journal of Construction Engineering and Management. ASCE, Vol. 120 No 4, 1994.