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Establishment of Change Order Database for Reducing Change Order in Construction Phase

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***Abstract:** As uncertain factors are latent in a construction project by nature, a change order occurs frequently. The occurrence of change orders in construction projects conducted during construction phase is known to cause unexpected negative impacts such as cost overrun, schedule delay, quality problem, and claims in the post-process. Thus, an efficient management method is necessary to prevent and minimize change orders during construction phase when they occur frequently. This paper analyzed the causes of change orders and the impact factors that occur during the construction phase of a construction project and suggested a direction for change order database building.*

***Keywords:** Change order, Change Order Database, Case Study*

I. INTRODUCTION

The occurrence of change orders in construction projects conducted during construction phase is known to cause unexpected negative impacts such as cost overrun, schedule delay, quality problem, and claims in the post-process. Especially, the occurrence of change orders during construction period entails not only schedule delay but also cost overrun, etc. Design errors account for 47.7% of the causes of change order occurrence during construction phase of domestic construction projects. The resultant rework cost is very high with 2.5% of the contract price[6]. As BIM design has been made mandatory in a construction project worth more than 50 billion won since 2012, efforts have been made to find out the errors and omissions in the documents utilizing BIM and the interference between progresses, before the commencement of construction, and to prevent a change order[4],[7]. However, the time and cost spent on the utilization of BIM, the shortage of manpower capable of the utilization of BIM, and the failure of BIM design to be made mandatory in a construction project worth less than 50 billion won make it difficult to utilize BIM for all the construction projects[5]. An efficient management method is necessary to prevent and minimize change orders during construction phase when they occur frequently. For an proactive efficient management of unexpected change orders, this study intends to suggest a direction for building change order database through the analysis of the causes of change orders and the impact factors during construction phase.

This study intends to conduct a study within the scope limited to the construction phase of Design-Bid-Build construction project. This study also intends to analyze change order causes and impact factors through a case study of a real construction project.

II. LITERATURE REVIEW

According to studies by Idoro and Aluko(2012) and Suther(1998), inappropriate and inadequate design and documents have a direct impact on the efficiency of the design and construction phase by causing project delay, rework and change orders, which can have an impact on project schedule and cost overrun. Andi et al.,(2003) pointed out that problems according to design errors and omissions should be identified as early as possible in a construction project life cycle before design errors change into failure cost. A diversity of domestic studies have been conducted on the negative effect of a change order.
Shin et al. (2010) suggested a support process to utilized change order database. Kim(2008) and Heo et al.(2011) suggested a method to utilize BIM for a change order error. Commonly, previous studies have suggested a variety of ways to utilize change order database, but study on change order database building is not enough. This method is available only for limited site, it is necessary to efficiently manage a change order through change order database building.

III. CASE STUDY ON CHANGE ORDER

Ten change order causes were derived through domestic papers on a change order and case studies of five domestic construction projects aiming at deriving change order causes and impact factors. Based on these, an analysis was conducted on the change order cases of five Design-Bid-Build construction projects(Table 1).

The change of master plan among change order causes was excluded from this analysis because its project plan was deemed to be flawed from the beginning. As a result of the case study, it is found that a total of 79 change orders and the cost overrun amounting to 881,884,474 won occurred. This amount accounts for about 6 % of the

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total cost. The change order cost is not always increase. Sometime, it is no change or decrease. In this case, change order indicate positive effects.

The change orders caused by the errors and omissions in design documents number 24, which account for 30% of all the change orders. This is represents a large portion. Thus, it is necessary to intensively manage such impact.

TABLE 1
CASE STUDY ON CHANGE ORDER

Pro-jects	Change order cause	Impact factors							Frequency	Cost(won)	
		Co	Sc	Qu	Sa	En	Re			Increase	Decrease
A	Owner requirement	√	√	√		√			10	106,278,371	448,896
	Design errors, omission	√	√	√			√		8	23,335,346	-
	Safety assurance	√	√		√		√		1	287,100	-
	Site condition errors	√	√	√	√				2	2,071,377	-
B	Change of master plan	√	√	√		√			5	14,121,676	3,329,722
	Statement errors, omission	√	√						3	11,069,196	513,820
	Owner requirement	√	√	√					3	29,013,078	-
	Design errors, omission	√	√			√			3	-	-
	Site condition errors	√	√	√	√				4	19,983,680	3,018,015
C	Change of master plan	√	√	√	√	√			3	4,138,000	-
	Statement errors, omission	√	√	√					6	143,238,000	-
	Public resentment				√	√	√		1	3,392,000	-
	Design errors, omission	√	√	√					2	22,362,000	-
	Safety assurance	√	√		√		√		1	2,434,000	-
	Site condition errors	√	√	√					4	4,375,000	-
D	Change of master plan	√	√	√		√	√		8	242,956,000	16,552,000
	Public resentment	√	√	√	√				3	124,325,000	27,143,500
	Owner requirement	√	√	√					1	8,842,000	-
	Design errors, omission	√	√		√	√	√		6	117,002,710	324,782,000
	Safety assurance	√	√		√	√	√		3	87,175,000	-
	Site condition errors	√	√	√	√				3	442,607,000	44,513,500
E	Change of master plan	√	√	√	√	√			5	23,505,000	7,659,000
	Statement errors, omission	√	√	√					1	-	2,256,000
	Design errors, omission	√	√			√			6	12,153,000	1,062,000
	Safety assurance	√	√		√		√		3	4,985,000	-
	Site condition errors	√	√			√			5	76,218,700	9,422,249

Co:Cost Sc:Schedul Qu:Quality Sa:Safety En:Environment Re:Rechtssatz

IV. DIRECTION OF CHANGE ORDER DATABASE BUILDING

The causes of change orders and the impact factors vary according to the characteristics of each project, and the incurred change order cost represents a considerable portion in a construction work. Thus, it is important to minimize change orders in advance. In order to minimize the occurrence of change orders, it is necessary to analyze the information about the occurrence of change orders by phases and to build a data system to select alternatives accordingly.

The following figure illustrates the direction of change order database building. It is necessary to classify the information of change order in construction project in order to using this information in various ways. In general construction project, information of change order should be segmented by analyzing influence factors to change order and project phase information. And, this segmented information should be linked to project phase informations such as process and activities of a construction project. If an object-based database be constructed through the method mentioned above, it will be possible to find specific check points and their management plans when similar change orders incurred.

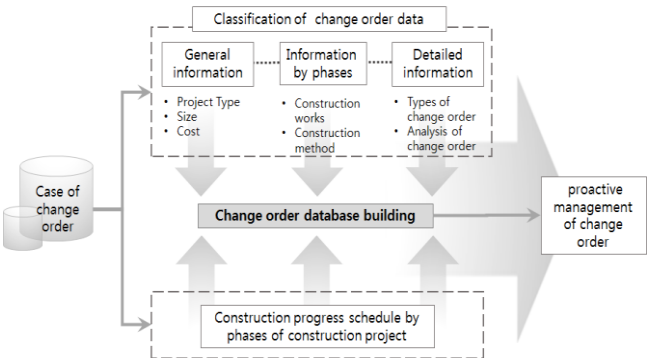

FIGURE 1
DIRECTION OF CHANGE ORDER DATABASE

V. CONCLUSIONS

After analyzing a case of a construction project in consideration of the causes of change orders occurring during construction phase and the impact factors on a project, this study suggested the direction for building change order database in terms of management. This is expected to contribute to the mutual understanding among project personnel, the development of an on-site efficient management method and the improvement in its utilization. And, the change order information will be easily and diversely available even to the construction projects not utilizing BIM. But, It is not easy to collection of change order data and quantitative analysis of change order impact factor. Thus, It is necessary for a further study to conduct the study of effect of change order and analysis of between cost, schedule, quality and change order. Also, it is necessary to development of change order model and change order database building.

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