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Effect of Pre-Construction on Construction Schedule and Client Loyalty

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***Abstract*—**Pre-construction is essential in achieving the success of a construction project. Due to the early involvement of project participants in the construction phase, project managers are able to plan ahead and solve issues well in advance leading to the success of the project and the satisfaction of the client. This research utilizes quantitative data derived from construction management projects in order to identify the relationship between pre-construction, construction schedule, and client satisfaction. A total of 65 construction projects and 93 clients were investigated for this research in an attempt to identify (a) the relationship between pre-construction and schedule reduction, and (b) pre-construction and client loyalty. Based on the quantitative analysis, this research was able to establish a negative correlation based on 65 construction projects between pre-construction and project schedule existed. This finding represents that the more pre-construction is performed for a certain project, the overall construction schedule decreased. Then, to determine the relationship between pre-construction and client satisfaction, Net Promoter Score (NPS) of 93 clients from the 65 projects was utilized. Pre-construction and NPS was further analyzed and a positive correlation was found between the two. This infers that clients tend to be more satisfied with projects with higher ratio of pre-construction than those projects with less pre-construction.

***Keywords*—**Client loyalty, NPS, pre-construction, schedule reduction.

I. Introduction

SUCCESS of a construction projects, in general, have been evaluated based on the criteria of how well the construction project adhered to the project plan [2], [3], [5], [14]. Extensive research has been conducted by other scholars to highlight the importance of project planning for the success of a construction project. Furthermore, it has been proven that early involvement of project participants in the pre-construction (pre-con) phase, where planning occurs, leads to the success of the project [1], [2], [4], [5]. There was also a number of research which links client's loyalty with the project success [6], [9], [11]~[14]. However, the relationship between pre-construction and project success in terms of the client's perspective have not been established by previous studies.

Generally, construction schedule for tall buildings are estimated based on, but not limited to, the number of days required for a single floor [10]. The total amount of time required to complete a building can be easily estimated by multiplying the number of floors with the time it takes to complete a floor. However, as buildings gain height, repetitive work increases as each floor is equivalent with the task from the previous floor, resulting in accelerated schedule. This research, however, attempts to utilize actual construction data provided by a construction management company in Korea in order to prove the relationship between pre-construction and decrease in construction schedule. Also, survey results from an official organization in Korea are utilized to establish a relationship between pre-construction and client loyalty.

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II. Background

A. Pre-Construction and Schedule

Pre-construction is proven to improve the quality of the overall construction project [5], [7]. Also, efficiency of construction tasks is further improved during the pre-construction phase [7], [8]. However, although decrease in construction schedule can be inferred due to pre-construction, there is little evidence which strongly links the relationship between the two. Furthermore, it is possible to assume that the amount of pre-construction performed in a project can influence the effect pre-construction has on the project schedule. Hence, the more pre-construction is performed can yield to a construction schedule that is shorter than that of an identical project with little or no pre-construction services performed. As a result, the following hypothesis can be established:

- *Hypothesis 1:* Pre-construction has an effect on reducing schedule: higher ratio of pre-construction will yield to reduction in construction schedule

B. Pre-Construction and Client Loyalty

Many researches in the past have identified project success as how well the construction project adheres to the construction schedule. In other studies, finance, relationship between stakeholders, etc. can be the factor in a project success. Regardless of which factor is important for the project owner, or the client, ultimately, a project is completed in order to satisfy owner.

Client satisfaction has been a subject that has been researched in depth by a number of researchers. One of the most common tools used to evaluate client loyalty is called the Net Promoter Score (NPS), which is widely used by corporates in order to determine how much a client is willing to suggest their service/products to another person/organization. [6].

Pre-construction service, on the other hand, is one of the

major factors in achieving a successful project. However, considering research on pre-construction and its effects on client satisfaction have not been found, a hypothesis on the relationship between the two can be established as the following:

- *Hypothesis 2:* Pre-construction will affect the client loyalty: there will be a difference in NPS between construction projects that have or have not performed pre-construction

III. Research Method

This research utilized the NPS results for office/mixed-use construction projects that were completed between 2007~2014 (8 years) by the Construction Management (CM) company, HanmiGlobal Co. Ltd (HG), located in Seoul, Korea. HG had previously requested clients to complete the NPS assessment at the completion of the construction project and accumulated data for the past eight years. NPS results of 93 clients from 65 projects were sampled as seen in Table I. Also, of the 65 projects, pre-construction service was provided for 49 projects whereas the other 16 projects were not. Furthermore, 17 projects had pre-construction service accounting more than 30% of the construction schedule and 48 projects accounted less than 30% of pre-construction in the schedule. Then, the following information was identified for each construction project in order to evaluate the relationship between pre-construction and project schedule, and NPS.

- Floors above grade, below grade, side area
- Pre-construction phase: beginning date, ending date
- Construction phase: beginning date, completion date
- NPS: Ratings after project completion

Also, this research defined construction rate and pre-construction rate as the following:

$$Construction\ Rate\ per\ Floor = \frac{Total\ Construction\ Period}{Floors\ Above\ Ground}(days) \quad (1)$$

$$Ratio\ of\ Precon = \frac{A}{B} * 100(\%)\ ;$$

whereas,

Pre-con (A) = Duration of CM during pre-con (months); (2)
Total Schedule (B) = Pre-con (A) + Construction (months)

TABLE I
Construction Project Properties

Number of Floors	Respondents (N)	Number of Projects (EA)
50 + (a)	14	12
30~49 (b)	8	5
11~29 (c)	41	25
< 10 (d)	30	23
Total	93	65

Based on the given information, it is possible to determine if (a) pre-construction has an effect on project schedule and (b) pre-construction has an effect on NPS. Initially, to compare the relationship between pre-construction and construction schedule, analysis of variance (ANOVA) was utilized which was further verified using Dunnett's T3 test for post hoc test. Finally, regression analysis was performed on projects based on the ratio of pre-construction (30%) to determine if the amount of pre-construction performed had an effect on the schedule.

To verify the second hypothesis, the relationship between pre-construction and NPS was established by comparing the ratio of pre-construction and the result of NPS. Then, to further analyze the relationship of the two, descriptive statistics was used to identify the amount of pre-construction needed in order to have a high NPS.

IV. Result

A. Pre-Construction and Schedule

In order to determine whether the amount of pre-construction has an effect on the construction rate per floor, ANOVA analysis was conducted. Based on the analysis result as seen in Table II, its significance value was 0.000 suggesting there were definite distinction among the groups, as the mean difference is significant at the 0.001 level. Also, in order to determine if there is any difference among the group, Dunnett's T3 Test was utilized. According to the post hoc test, group a (50 floors or more) took an average of 23.8 days per floor, group b (30 floors-49 floors) had an average of 32.9 days per floor, group c (11 floors -29 floors) had an average of 46.7 days per floor, and group d (less than 10 floors) had an average of 86.1 days per floor. The result suggests that the taller the building, the construction rate per floor decreases. Also, Pearson's correlation coefficient (CC) showed that the groups had a negative correlation with a value of -0.683, which is also found significant as shown in Table III as the correlation coefficient is significant at the 0.01 level on both ends.

TABLE II
ANOVA Analysis

Variable	Floors (group)	Average (days)	Standard Deviation	F Value/ Significance	Dunnett's T3
Construction Rate per Floor	50 + (a)	23.787	3.2057	29.855/ 0.000**	d > c > b > a
	30~49 (b)	32.949	4.5500		
	11~29 (c)	46.670	11.4845		
	< 10 (d)	86.127	32.0585		

TABLE III
Correlation Coefficient

		Floors (ground level)	Construction rate per floor
Floors (ground level)	Pearson's CC	1	-0.683**
	Significance (ends)		0.000
	N	65	65
Construction Rate per Floor	Pearson's CC	-0.683**	1
	Significance (ends)	0.000	
	N	65	65

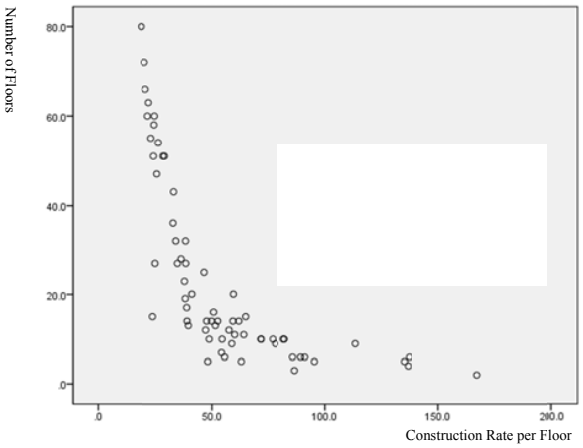

Fig. 1 Construction rate per floor based on number of floors

As shown in Fig. 1 and the coefficient correlation results, there is a negative correlation between the number of floors and construction rate per floor, which translates to a tall building requires less time in constructing each floor compared to shorter buildings. However, to determine how much pre-construction affects the construction rate per floor, regression analysis was used for two groups: projects with more than 30% of pre-construction (17 projects) and projects with less than 30% of pre-construction (48 projects). The summary of the regression model can be found in Table IV.

TABLE IV
MODEL SUMMARY[A]

Type	Standard deviation	β[c]	t-value	Significance[d]	Statistics
Constant	9.780	-	10.265	0.000	$R = 0.734^b$
More than 30% Pre-con	28.7858	-1.584	-4.189	0.001	$R^2 = 0.539$ Modified $R^2 = 0.508$ F = 17.549 p = 0.001
Constant	4.349	-	16.298	0.000	$R = 0.681^b$
Less than 30% Pre-con	18.9943	-0.852	-6.315	0.000	$R^2 = 0.539$ Modified $R^2 = 0.453$ F = 39.878 p = 0.000

a. Variable: construction rate per floor
b. Estimation: (constant), ground level
c. Non-standardized
d. .p <0.01

Based on the variance analysis, the models for both type of projects had a significance value of 0.001 and 0.000 respectively. Also, for projects that have performed more than 30% of pre-construction was able to decrease construction rate per floor by 1.584 days. On the other hand, projects with less than 30% pre-construction had decreased the construction rate per floor by 0.852 days. The results show that there is an approximately 0.7 days difference in construction rate per floor between the two project types. As a result, it is possible to verify that for projects with higher ratio of pre-construction yields to shorter construction rate per floor, which ultimately decreases the overall construction schedule.

B. Pre-Construction and Client Loyalty

Initially, to establish the relationship between pre-construction and NPS, projects were first analyzed based on whether pre-construction service was performed or not, as well as the average NPS. As seen in Table V, based on the 65 projects, total of 93 clients responded, and there was a significant difference (25.1 points) between NPS for projects with and without pre-construction service. As a result, projects which performed pre-construction had higher NPS than its counterparts.

According to Reichheld [6], NPS, which is evaluated on a 10 point scale, for project type is calculated by subtracting the detractors (%, 0-6 point) from the promoters (%, 9-10 point). For example, NPS results for project with pre-construction service was 52 promoters (76.5%), 11 neutral (16.2%), and 5 detractors (7.4%). According to the formula, NPS for project with pre-construction service is promoters (76.5%) – detractors (7.4%) which yields to NPS of 69.1%.

TABLE V
NPS AND PRE-CONSTRUCTION

Project Type	N	NPS	Remark
With Pre-construction	68	69.1	Δ 25.1 points
Without Pre-construction	25	44.0	

To further analyze the result, pre-construction was subdivided into smaller groups of (1) more than 30%, (2) 10%-30%, and (3) less than 10%. Then NPS was recalculated according to the promoters and detractors, as shown in Table VI.

TABLE VI
NPS BASED ON PRE-CONSTRUCTION RATIO

Ratio of Pre-con	N	Promoter	Neutral	Detractor	NPS
More than 30%	28	92.9%	3.6%	3.6%	89.3
10%-30%	36	66.7%	22.2%	11.1%	55.6
Less than 10%	29	58.6%	27.6%	13.8%	44.8

It was observed that NPS was directly affected by the ratio of pre-construction. Higher the pre-construction ratio resulted in higher NPS. To determine the correlation coefficient between ratio of pre-construction and NPS, descriptive statistics was utilized.

TABLE VII
DESCRIPTIVE STATISTICS RESULTS ON NPS

Group	N	Average	Standard deviation	Standard error	95% confidence Low	95% confidence High	Min	Max
1	9	2.696	3.3991	1.1330	0.084	5.309	0.0	9.4
2	17	5.124	5.5458	1.3450	2.272	7.975	0.0	19.6
3	67	9.346	8.9801	1.0971	7.155	11.536	0.0	43.6
Total	93	7.930	8.3547	0.8663	6.210	9.651	0.0	43.6

Results show that, on average, about 9.3 months of pre-construction service was provided for promoters whereas only 2.7 months of pre-construction service was provided for detractors. The amount of pre-construction provided for the clients directly reflected the loyalty of the client.

V. Conclusion

This research attempts to verify how pre-construction has an effect on (1) project schedule, and (2) net promoter score (client loyalty, NPS). According to the analysis from this research, ratio of pre-construction had a negative correlation with the project schedule, which also pointed out that when for projects with more than 30% of pre-construction service, the construction schedule decreased more than its counterpart. Although the decrease in schedule is partially due to the repetitiveness of the work (floor to floor), there was a direct relationship with the quantity of pre-construction service and construction rate per floor.

Projects and data utilized in this research paper were limited to a single construction management company located in Seoul, Korea. Also, although the level of significance for the analysis was outstanding for this research, increased number of samples in the future can further strengthen the hypothesis verification.

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