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Empirical Analysis of a Management Function's Failures in Construction Project Delay

Luong Hai Nguyen

Faculty of Construction Management, University of Transport and Communications, No.3 Cau Giay Str., Lang Thuong Ward, Dong Da Dist., Hanoi 100000, Vietnam; hainl.utc@gmail.com

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Abstract: Project schedule delay has been recognized as a significant cause to the failure of a project. A large number of studies on this particular issue have been documented. Mainly, identifying and ranking significant factors that lead to the delay of a project. These studies have relied on generic professionals' viewpoints. Rare studies have been dedicated to the empirical analysis of the influencing factors from the perspective of management and their functions. Using the logistic regression model and 195 completed construction projects' data, this study reveals that construction planning, construction schedule controlling, construction schedule directing, and project finance organizing have significantly positive effects on project schedule. The findings of this study will provide a beneficial approach for construction management to deliver projects on time, improving construction project productivity.

Keywords: project delay; empirical analysis; management function; project schedule

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1. Introduction

For years, the literature on construction management has investigated critical matters of project performance in terms of timeliness [1–4]. Construction schedule delay is defined as a timeline moved beyond the contractual deadline or beyond the milestone that has been agreed upon amongst the involved parties, referring to the completion of the project's tasks. A consequence of both cases is commonly associated with the expenditure of resources [5]. Delay is similarly defined as an act or event that has been extended in time in order to be completed. Compared to the initially required time, the delay time manifests itself as supplementary time of work [6].

A great deal of investigation has been conducted in order to detect the affecting factors of construction projects' schedule that are mentioned as a significant delay factor (SDF) of a project. In fact, these SDFs have received growing study interest from academic over the past several decades within the construction industry. Most recently, Mbala, Aigbavboa and Aliu [7] has made a comprehensive, systematic review of mainstream works published via conference papers, government reports and journal articles, which has influenced the factors of the various causes of delays in construction projects. As noted, the top ten factors of delay are: poor management performance on site [8–12]; scarcity of skilled labor [9,11,13–16]; unrealistic project scheduling [9–12,14,15,17]; labor absenteeism [13,15,18,19]; changed orders due to executing mistakes [9,11–13,15,17–20]; site safety condition [9,14]; delays related to subcontractor work [9,10,15,17]; inaccessibility of materials [18,19]; finance problems [12,15,17]; and poor weather conditions [8,11,14]. Among these SDFs, factors related to site management [8,12], contract management [9,11,21], planning, communication and coordination [10,22], have been considered essential management variables in the success of project schedule performance.

However, the development of delay framework alone cannot guarantee a successful project schedule. There are numerous works regarding the critical problems of construction project delay [1,2,4].

Conversely, it seems unreasonable to identify a collectively caused delay framework of construction; it appears to be a matter of which managerial factors best represent project delay. In addition, multiple previous studies have addressed the formulation of SDFs. Such works [10,11,13–15] have been analyzed based on the professionals' general perspective to which SDFs were compiled and ranked (i.e., the analysis of Relative Importance Index). Hence, these studies, in essence, have yet addressed issues of explaining the relationships between SDFs and project schedule performance, especially with respect to management functions. Nevertheless, questions regarding the influence of SDF related managerial functions remain unanswered. The objective of this study is to determine the functions of construction management and their failures as well as to reveal their impacts on project schedule. Currently, in efforts to quantify managers' diverse perspective on successful managerial behaviors, a nationwide survey involving project managers who were employed at two groups—the client and the contractor—was studied. For academics, this study expands the current body of knowledge of factors affecting construction schedule by deeply investigating construction management functions. For practices, this approach is significant in offering a valuable tool that facilitates construction management professionals to deliver managerial functions in order to maximize project schedule performance. This article is structured in five sections. Section 1 presents the introduction. Section 2 presents the conceptual framework. Section 3 introduces the methods of the research. Section 4 presents the most significant part of the article, the results and discussions. Finally, Section 5 presents the research conclusions.

2. Conceptual Framework

2.1. Theoretical Background

Project timeliness is defined when actual project schedule meets the expected timetable as planed [23] and is determined by various contributors over the course of a construction project. Potential risks to the project timeliness could originate from early phases such as design and pre-construction [12,14,16]. Poor design [11,15] is the source of change orders during the project execution, resulting in cost exceed and time expanded [3]. In addition, at the pre-construction, a comprehensive project planning acts as a navigation through which project teams are aware of their required roles and responsibilities for works to achieve the overall schedule. As such, a poor construction plan can lead to uncertainty amongst project members in managing works during the execution, affecting the timeliness of project delivery, while project stakeholders and contributors work together for executing the plan over the course of construction phase. In this stage, the management function of directing [24] is performed, by which joint efforts of project members to fulfill project-specific tasks are determinants of the successful execution, in order to achieve project goals. Apart from the management-related factors as mentioned, the negative effect of nature conditions such as project complexity [25] and availability of project fund [14,26] can lead to project delay. Therefore, having considered the causes of delay due to subjective and objective perspective, project managers not only need to take into account the project management aspects, but also take into consideration the potential nature of project, so as to make sound judgments and mitigate causes' effect on the timeliness effectively.

2.2. Identifying the Factors

The significant management delay factors are commonly illustrated from the perspective the management functions (i.e., project planning, project directing and organizing, and project controlling) that play vital roles in determining project performance in terms of project timeliness, cost and quality [27]. Construction project management must confront with the monumental activities, tasks and phases to accomplish final deliverables of a project, which places pressure on the project managers to properly design an effective project plan that enables all involved participants communicate well and work together toward the common goals. The appropriate planning is the initiative approach to the successful performance of a project [28–30], which helps with improving performance in regard to project cost, project schedule, and operational characteristics [31]. Morris [32] similarly argued that "The decisions made at the early definition stages set the strategic framework . . . . get it wrong here and the project will be wrong for a long time". Blomquist, Hällgren, and Nilsson et al. [33] state that "Plans are a cornerstone of any project; consequently, planning is a dominant activity within a project context." The project directing is a sequence of the project planning. This is the "doing" phase to which the project will be visible to outsiders. Thus, the project directing phase is not only constructed using a well-designed plan, but also accomplished through an operative control procedure in order for the project scope to not creep during the execution of the plan. Extra requests and additional scope can straightforwardly strain resources and can affect the focus of the project outcome orientation, severely affecting the success of the construction project. Thus, the development of a proper project control scheme is a significant role of the project management function [34] in ensuring project success.

In addition, construction projects are getting bigger and more complex, which raises some difficulties in organizing and technological delivery that will have negative influence on the project schedule performance [25]. Furthermore, design performance under that nature of the project can also yield potential risks to the project schedule. Therefore, the tentative SDFs derived from above discussions are associated with project complexity, design document, construction plan, project schedule directing, and project schedule controlling.

In order to verify selected factors, a Focus Group Discussion (FGD) was carried out. The FGD is known as a viable technique for studying professionals' experiences and opinions [35]. These groups were conducted using professionals in Vietnam. The participants in the FGD were selected from construction professionals who have been working for clients and contractors with various backgrounds, including architects, designers, surveyors, engineers, and project managers. The purpose of the FGDs were to discuss the common causes of project delay related to management function behaviors in the industry. Discussions were performed using a semi-structured technique. After the participants provided their brief experiences, the interviewer asked a prepared list of questions, and any necessary extra questions were subsequently added. To facilitate interviewees in clarifying the notion of project management and the causes of delay, the current literature on these topics was initially provided. They were then requested to answer specific questions related to the topics discussed. A range of primary inquiries is recorded as follows: (1) In your experience, what common causes of delay occur over the course of a project? Could you clarify those causes in detail? (2) What do you understand about causes of delay that pertain to project management aspects and nature of project aspects? (3) In your experience, what should key factors be analyzed in considering key contributors to project delay? The FGDs' result came up with an agreement of the five tentative SDFs and additional suggestions that the prompt of project finance organizing should be included in the analyses. Due to the insufficient of financial resource for the development of new construction projects, particularly public infrastructure sectors in Vietnam, many construction projects have been approved without complete accessibility to funding and/or the financial resource was conceivably shared to other priority undertaking projects. As a result, historical records of the project delay are significant due to this problem. Furthermore, the clients' commitment of payment to the contract is also largely concerned and familiar within Vietnamese professionals' experiences in the construction industry. This cause of payment delay has been worldwide indicated as one of the top ranked SDFs in literature [12,15,18,19].

Finally, six SDFs were selected for further analyses: project complexity, design document, construction planning, project schedule directing, project schedule controlling, and the project finance organizing.

2.3. Research Hypotheses

Construction planning involves establishing project goals in terms of cost and time [36], setting a realistic and usable schedule [9,15] for all tasks that must ensure work is done in a sequence and within time and cost allowed, determining resources needed to perform project tasks as scheduled, and predicting reasonable cash flows to support all tasks done. All of those elements are preconditions that support for delivering the project well-fitting with the baseline and vice versa. Therefore, this study could argue the following hypothesis:

Hypothesis 1 (H1). *Construction projects with poor construction planning are more likely to be delayed.*

Project directing concerns with executing related activities, by which the project plan must be clearly and effectively communicated with project members and is only well-implemented by a team leaders that was given the responsibility prior to the project [36]. This team leader must motivate team members, coordinate with his superior and subordinates, and be excellent at resolving problems. When project participants integrate well with the project plan, they know the when, what and how regarding task progressions. As a result, project milestones can be accomplished swiftly. Therefore, this study concludes with the following hypothesis:

Hypothesis 2 (H2). *Ineffective construction schedule directing will result in delivering the project in an untimely manner.*

Project controlling is performed to deliver timely project tasks, allowing project managers to take steps to ensure the assigned tasks are going as intended and the project goals are met. This means that project managers must continuously monitor the task progression and compare them with the original plan, corrective actions must be taken with any significant deviations or things go astray to bring the job back on track, or revision must be taken to fit plan with new situation. This task emphasizes on the role of project managers whose competencies are an indispensable component for project success [37]. Moreover, the success or failure of a project is *influenced by who manages that project* [38,39]. Thus, this study could argue the following hypothesis:

Hypothesis 3 (H3). *A poor construction schedule control system can negatively influence the project timeliness.*

A construction project operating as any organization is directly related to its financial situation. The construction funding availability is critical to guarantee not only that a project will be constructed and completed within the committed budget in place, but also to guarantee that a project meets its contractual schedule committed. The available finance enables management provides sufficiently operated cash flows [11,13] that fulfil any scheduled debt service and any other financing commitments [14]. The availability of capital guarantees the flow of cash into which ever channel the project manager sees fit, in accordance with the flow of project schedule [22]. Thus, a well-managed project cash flow consequently contributes to assure the project's schedule performance. Hence, this study is to construct the following hypothesis:

Hypothesis 4 (H4). *A well-organized financial structure can positively influence the project timeliness.*

In addition, the conceptual research models also consider control variables, including project complexity and project design document [17,19], which are indicated as the critical success factors of construction project schedules. A project's complexity associated with novelty, pace, team multidisciplinary, and geographic dispersion [40] and poor design performance [41] can be fully transferred to the contractual clauses as a turnkey contract, which means all those risks are wholly transferred to the construction phase, decreasing the likelihood of achieving completion performance. Thus, it is suggested that: there factors positively influence project schedule when controlling for project complexity and project design document.

3. Research Methods

3.1. Sampling and Data Collection

Case-specific data were collected by practitioners involved in construction projects in Vietnam who served as project managers for client and contractor organizations, to which the respondents were being responsible for each project as project leaders within these project teams. The targeted respondents were selected among the members of the Vietnam Federation of Civil Engineering Association (VFCEA), Construction Project Units (PMUs) and the Vietnam Association of Construction Contractors (VACC). A pilot study was also conducted to validate the appropriately selected respondents of the survey. The official questionnaires (Appendix A) were randomly sent out to 239 different project managers, to which 195 valid samples were obtained for further analyses. All of the project managers were also involved in the organization of their individual projects; and of these, 79% of them have had over ten years as construction professionals. Of the surveyed projects, 106 of them were infrastructure facilities (i.e., roads, bridges, and water supply structures); 62 were building facilities; and the final type of surveyed projects was industrial facilities, of which there were 27.

3.2. Variable Specifications

Dependent Variables

The dependent variable was specified as the schedule delay of construction projects, which was measured on the basis of binary measurement that was set to a value of 1 if the schedule was delayed compared to its baseline and was set a value of 0 otherwise.

Independent Variables

The variables representing construction planning, project schedule controlling, project schedule leading, and project finance organizing were measured on a five-point Likert scale, to which the variable measurement was set to a value of 1 if its statement was strongly disagreed and to 5 if it was strongly agreed. Table 1 shows the data that would be derived from the questionnaire survey.

Table 1. Items on the Questionnaire.

Construction Management Factors	Descriptions
■ Construction Planning has a significant effect on the project schedule performance. ■ Construction schedule directing has a significant effect on the performance of project schedule. ■ Construction schedule controlling has a significant effect on the project schedule performance. ■ Project finance organizing has an important effect on the project schedule performance. ■ Project complexity ■ Design document performance.	■ Construction planning is synonymous with the work schedule, to which an overall strategy was designed. It is used to achieve the schedule goals, and a comprehensive set of procedures in order to integrate and coordinate activities. ■ Construction project schedule directing means the management must direct and coordinate project members by motivating participants, leading their actions, deciding the most productive communication methods, and/ or to resolve conflicts that occur during the project delivery. ■ Construction project schedule control involves ensuring that the work is performing as it was scheduled. This represents management's ability to monitor the schedule progress and compare it with the baseline, discovering any substantial deviations, correcting errors and getting the schedule back on track. ■ Finance organizing presents availability, sufficiency and timelines of project cash flow to the project management. This determines the tasks' schedule being financed, who is financially responsible for specific tasks, how much the tasks are to be financed, who reports to whom in terms of finance needs, and where financial sources are to be made. ■ Project complexity is evaluated based on the extent of its difficult multifaceted construction processes such as technology, innovation, pace, and geographic conditions that affect the actions taken to accomplish the tasks' schedule. ■ Design performance involves the quality of design documents that capture the extent to which the design of the architects, structures and productions used can result in unexpected variations during the construction phases, affecting the schedule performance as a result.

Control variables

The two control variables are operationalized in a nominal manner—project complexity and design document performance. These control variables functioned as dummy variables in the regression model, a 1 (one) was assigned to the projects residing in the majority classification, and a 0 (zero) was assigned to the remaining projects. [42]. Indeed, we chose project complexity category medium since this control variable was classified into three categories: low (59), medium (119) and high level complexity (17), to which the highest number of project belonged to medium category. Similarly, the design document performance category medium was selected as its measurement of three categories: low (30), medium (138) and high performance (27). Due to the medium category being so drastically different in both project complexity and document performance, it was assigned the majority, while the low and high groups were combined into the minority.

3.3. Research Model: Proposal and Measures

The research model and hypotheses for the construction management's functional failures in regards to the project schedule delay are proposed in Figure 1.

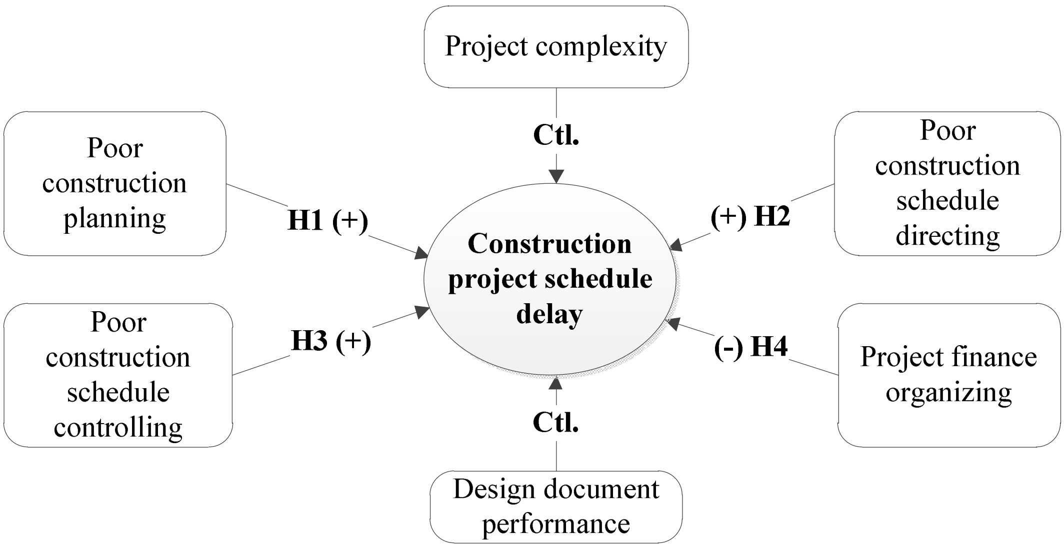

Figure 1. Research model for failures to project schedule delay.

In this model, the dependent variable for the schedule delay is presented in a form of binary choice, a 1 (one) or a 0 (zero). To test the research hypotheses within binary dependent variable form, the binary logistic model has been widely applied in the literature [43,44]. The multiple logistic regression model addresses the mater of nonlinear relationships in predicting the value of the binary dependent variable Y from the values of the dependent X variables [45,46]. The Y variable represents the probability of obtaining an event of the nominal value. For the study example, the nominal value variables are "project delayed" and "project on time." Thus, the Y variable represents the probability of project delay. The range of the probability could be from 0 to 1. The odds ratio, $Y/(1-Y)$, is used to resolve the problems that the limited range of the probability would create, if directly applied. Taking the corresponding natural logit function from the odds ratio, the result of a multiple logistic regression can be calculated as the following: Equation (1), Equation (2), and Equation (3):

$$\text{Logit (Y)} = \ln\,[Y/\,(1-Y)] \tag{1}$$

$$\text{Logit (Y)} = \ln\left[\frac{\frac{e^{\beta 0+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta nXn}}{1+e^{\beta 0+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta nXn}}}{1-\frac{e^{\beta 0+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta nXn}}{1+e^{\beta 0+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta nXn}}}\right] \tag{2}$$

$$\text{Logit (Y)} = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3\ldots+\beta_nX_n \tag{3}$$

Instead of using the least-squares technique in multiple linear regression, the maximum-likelihood approach is used to derive the unknown β coefficients (β_1, β_2, etc.) and the intercept (β_0) to explore a best-fitting model of the multiple logistic regression.

To measure the goodness-of-fit model selected, similar to the R^2 of multiple linear, several pseudo-R^2 values are applied, to which larger numbers are considered the better fit. In addition, the logistic regression model integrates the advantages of the Bayesian Model Averaging (BMA) approach in a binary form, this could help limit the probability of false confident interval, a lower standard of deviations and increase the frequency of selection [36]. Hence, this study used a binary logistic regression model using a BMA technique in order to study the construction management's functional failures in accordance with the project schedule delay. To facilitate the integrated calculations, the programming language R was used to analyze the research model.

4. Results and Discussions

4.1. Analysis of Variance

The Analysis of Variance (ANOVA) specified that at a 99% confidence interval (Table 2), the mean values of the four independent predictors judged between two groups of respondents are comparable. This finding suggests that despite their diverse involvement in the construction project, their judgments of management's functional failures show no significance between the two types of the construction professionals, resulting in an agreement with the four dimensions of construction management functions' assessment. This result may well explain the reality that despite the fragmentation and complication of the industry production, the practitioners appear more jointed in their efforts to deliver project management functions towards common goals. It can be inferred from these findings that there is a shared knowledge between key stakeholders attempting to deliver effective management functions toward productive project schedule.

Table 2. Analysis of variance (ANOVA) between respondents' professions.

Respondents	Statistics	Construction Planning	Construction Schedule Directing	Construction Schedule Controlling	Project Finance Organizing
Client	Mean significant score	3.82	3.24	3.46	3.47
	SD	0.63	0.82	0.79	0.71
Contractor	Mean significant score	3.75	3.33	3.51	3.31
	SD	0.69	0.81	0.76	0.74
Non-parametric tests	Chi-squared	0.8776	1.5878	0.5966	3.1789
	P-value	0.7789	0.6779	0.8816	0.2109

Due to the similar understanding between the two contractual sides, it is inferred that despite their different roles in the construction project organizations, construction professionals share the same perception of construction management's functions to deliver appropriate capabilities in order to archive the final goal. However, this finding varies from earlier works, which have claimed that the diverse contractual teams tend to have divergent objectives, trade aims, accountabilities and work patterns, resulting in the stakeholders possessing a diverse recognition of the affected factors. [47,48]. It can be noted that in general, the professionals in the construction management field are aware of the practical problems regarding project delay that have been present in the industry for years.

4.2. Evaluation of the Research Model: Hypotheses Testing

Multiple logistic regression analysis was carried out to test the research hypotheses. The BMA method was employed to enhance the selection of predictors of the possible repressors. The results present the fitness of the selected logistic regression model (Table 3); the very highly significant χ^2 ($p < 0.0001$), the highest absolute value of the Bayesian Information Criteria (BIC) and the highest value of post-probability (post prob), indicating a good fit with the data in the selected models amongst other possible models.

Table 3. Logistic regression goodness-of-fit measures.

Model Fit Statistics	Selected Model
Likelihood ratio χ^2	148.26(significance < 0.0001)
−2Log likelihood	88.921
Pseudo R^2	0.733
Sample	195
nVar	6
BIC	−824.2192
Post prob	0.126

Table 4 shows the results of the multiple logistic regression analysis for the project delay. The positive coefficient values indicate that variables can predict the increase in the project delay probability, and vice versa. Accordingly, the three predictors (i.e., poor construction plan, poor project directing and poor project schedule control) are favorable to growing project delay, while the prompt finance organizing is beneficial to project timeliness. The recommended models explained 73.3% of the variation in project delay ($p < 0.000$). A Variance Inflation Factor (VIF) for each of the independent variables was tested and did not indicate any issues for multicollinearity, (VIF < 2.23 that is a much lower result than the threshold of 10), suggesting that that multicollinearity or small standard errors are not a concern.

Table 4. Logistic regression results.

Dependent Variables	Models	Variables	Selected Model	
			B	Exp(B)
Project' schedule delay	Model1 Model2 Model3	Project complexity		
		Design document performance		
		Intercept	2.9782	19.652
		Poor construction plan	0.6368 [c]	1.890
		Poor construction schedule control	0.9861 [b]	0.373
		Poor construction schedule directing	4.0998 [a]	60.328
		Project finance organizing	−0.8918 [b]	0.410

[a] Significance level of 0.001; [b] Significance level of 0.01; [c] Significance level of 0.05.

This research extends previous works by empirically modeling the factors related construction management functions that affect the construction schedule. With regard to the poor construction plan variable, the correlated value was positive and significant ($p < 0.05$), which specifies that each 1%

growth in the poor construction plan enlarged the odds of project delay by 1.89 times, this finding verifies hypothesis H1. As for the poor project schedule directing, the correlation is highly significant or positive for project delay ($p < 0.001$), and thus it accepts hypothesis H2. Regarding the poor project schedule control, the correlated value is noticeably positive and significant ($p < 0.01$), which shows that the odds of projects with poor project schedule control is approximately one time greater compared to project delay probability than that with an appropriate schedule control, and it supports hypothesis H3. The research shows that the correlated value of the project financial organizing is significant ($p < 0.01$), which specifies that project organizations, without well-organized cash flows, are 2.4 times (1/0.410) more likely to fail in terms of project timeliness, and it also supports hypothesis H4.

The two control variables, project complexity, and design document performance, have no effect on construction schedule delay, which indicates that the hypothesis of these control variables', having a positive influence, is not proved by the sample data in this model.

These studies' findings extend previous works by investigating SDFs that influence project success in respect of timeliness. The findings suggest that project management functions play a significant role in ensuring the project timeliness. Specifically, it is noted that a poor initial construction plan is an essential cause of decreasing project on time. This result is not surprising in the project management and was to be expected in the FGDs. An effective project plan in terms of resource, finance, risk, acceptance, communications and procurement will reduce mistakes and errors emerging on the sequence stages, and therefore less time and costs will be consumed for the development of the project. The results are also in line with previous studies that note that a poor project plan is impossibly accomplished by even good project teams [49], and projects that commit with the wrong route early, lead to the most likely probability of failures [50]. More quantitatively investigated, Pinto and Prescott [51] revealed that planning was noted as the greatest influence on project success with respect to "perceived value of the project" and "client satisfaction". Similar to the work of Dvir and Lechler [29], who found that good planning had given a positive value of 0.35 influence R^2 for efficiency and a positive value of 0.39 influence R^2 on "customer satisfaction", Zwikael and Globerson [52] noted a high correlation (i.e., r = 0.53) between planning quality and schedule. More specifically, Dvir, Raz and Shenhar [53] revealed a significant correlation between planning and project success, in which the project planning, in terms of well-defined functions and the availability of technical inputs, have a positive correlated values of 0.297 and 0.256 with project success, respectively.

The impact of construction schedule directing is rarely examined in the literature; however, what is intriguing is the fact that this study reveals a poor project schedule directing significantly account for the delay of project. This result is to be expected and was validated by practitioners within the FGDs. When project teams communicate well with the project plan, by which project leaders effectively support and motivate all members over the course of the plan, and vice versa, project members are kept well informed of their responsibilities to perform works productively toward achieving project schedule performance and other objectives as well. The result, to some extent, shows the compatibility with previous works that ranked poor site management [8,11,12] and poor contract management [9] as the top ten cause of project delay.

With regard to the management function of control, the findings indicate that the projects with a more effective schedule control are less likely being delayed and vice versa. During the project, deliverables are constructing an effective project schedule control mechanism (i.e., time controlling, quality controlling, and risk and change orders managing), which enables project managers and project teams to keep tracking the project's progression, ensuring project schedule are met. This result is also compatible with previous revelation that the more attention given to the project control, the greater the improvement on project performance [54].

Additionally, project finance organizing is found to be a significant contributor to the project timeliness. This finding is also in the agreement with the findings obtained from the FGDs. Principally, the project financed is considered as the essential precondition for contractors to design the cash flows of the project, ensuring the schedule progresses as planned. This result is also noted in the literature. The delay in a client's payment is widely classified to be in the top ten causes of project delay [10,13,15,19,26].

However, the research findings were unrelated to the control variables included in project complexity and design document performance. Generally, project complexity creates challenges in terms of organizational and technical aspects [25] in executing phases, while the poor design document that is argued as the top ten causes of project delay [13,18] usually results in changed orders and deviations, increasing the probability of project schedule delay. It may well explain that those objective factors are probably not dominant concerns in the consideration within a comprehensive construction management functions.

In short, this study demonstrates the significant roles of construction management functions in ensuring the project timeliness, which reinforced the vital roles of management functions within construction schedule management.

5. Conclusions and Limitations

This study has analyzed empirical evidence of the management functions' failed factors affecting the construction project time. A multiple logistic regression analyses was performed to determine the extent of project delay from the professionals' perspective. It was found that 73.3% of projects were delayed, and six critical management factors were derived through literature review and FGDs. The relationship between project delay and management function factors was examined and validated through the logistic regression model analyses based upon construction projects' specific data, collected in Vietnam. Although both the subjective (e.g., project management functions) and objective factors (e.g., project complexity and design document performance) have proved their impacts on the project timeliness, project management functions appeared to be more pervasive than that of any other factor in the models selected. Therefore, the factors of construction management functions' failures to the project delay must include construction planning, construction schedule directing, construction schedule controlling, and project finance organizing.

Although this study investigated the factors of construction management functions to schedule a delay from the construction practitioners' perspective, this study is also plagued with certain limitations. First, all independent variables were collected by the questionnaire using the Likert scale, the valid data collected may have been suffered from the possibly biased assessment of the respondents on those questions since the scales assume equal distances between each scaled item. Second, construction management functions' behavior may vary according to the project stakeholders' perspectives and may apply distinct perspectives in the research design that can help explain the individual assessments on different dimensions of the management functions' in further research agenda. Furthermore, the logistical model is forced to consider different types of projects and project sectors (i.e., public and private industry); this limitation should be a further consideration. Future works may conduct more specific and precise models of construction management functions' failures by separating the types of projects, project sectors, and adding more control variables, such as project size and diverse culture. Overall, this study has contributed to extending the current body of knowledge by quantitatively clarifying the importance of management functions toward construction schedule performance.

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Appendix A. List of Measurement Items for Each Construct

Management Functions

1. Construction planning (construction planning is synonymous with the work schedule to which an overall strategy was designed and is used to achieve the schedule goals, and a comprehensive set of procedures in order to integrate and coordinate activities) has a significant effect on the project schedule performance.

2. Construction schedule directing (construction project schedule directing means the management must direct and coordinate project members by motivating participants, leading their actions, deciding the most productive communication methods, and/ or to resolve conflicts that occur during the project delivery) has a significant effect on the performance of project schedule.

3. Construction schedule controlling (construction project schedule control involves ensuring that the work is performing as it was scheduled. This represents management's ability to monitor the schedule progress and compare it with the baseline, discovering any substantial deviations, correcting errors and getting the schedule back on track) has a significant effect on the project schedule performance.

4. Project finance organizing (finance organizing presents availability, sufficiency and timelines of project cash flow to the project management, which determines the tasks' schedule being financed, who is financially responsible for specific tasks, how much the tasks are to be financed, who reports to whom in terms of finance needs, and where financial sources are to be made) has an important effect on the project schedule performance.

Control Variables

5. Project complexity (project complexity is evaluated based on the extent of its difficult multifaceted construction processes such as technology, innovation, pace, and geographic conditions that affect the actions taken to accomplish the tasks' schedule) has an important effect on the project schedule performance.

6. Design document performance (design performance involves the quality of design documents that capture the extent to which the design of the architects, structures and productions used can result in unexpected variations during the construction phases, affecting the schedule performance as a result) has an important effect on the project schedule performance.

Project Schedule Performance

1. The project schedule performance was achieved.

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