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A Conceptual Model of Delay Factors affecting Government Construction Projects

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ABSTRACT

The delay in construction is the challenge often faced in the course of executing construction projects. It has attracted the interest of many researchers and practitioners. Earlier studies only conducted on ranking the causes of delay and analyzed the overall construction project. The main purpose of this study is to develop a conceptual model of delay factors and to analyze the level of impact of the delay groups on the completion of the government construction projects which could be related more to the legislation, the administrative procedures. This study identified 28 delay factors and 6 core groups of factors affecting the project completion in the final conceptual model. The results of the study show that the three most influential factors of project completion are: information delays and lack of information exchange between the parties; incompetent owner; and incompetent supervision consultant. The bulk of control of the delay depends on the groups of factors relating to contractor and owner because they have the strongest impact on the project completion. The findings of the study can help the parties involved the government construction projects to give out appropriate solutions for countering the delay.

Keywords: *Conceptual model, Delay factors, Government projects, Vietnam*

1. INTRODUCTION

The delay is a common problem in the global construction industry affecting development of the construction industry in particular and of the overall economy of countries in general. Especially in developing countries, the construction industry has some shortcomings such as poor understanding of the project, lack of modern equipment, incompetent contractors, etc. This problem can easily occur and lead to a negative impact on the result of the project as cost overrun, poor quality and lack of safety. Vietnam, is known as a fast developing country in South-East Asia, does not escape the problem of delay in construction.

The construction industry is one of the most booming industries in economic growth of Vietnam. Many construction projects have completed, going on and many future ones. The delay in construction is the challenge often faced in the course of executing construction projects. Moreover, with the government projects relating the road and bridge projects, the hydropower projects, the thermal power projects, or the low income housing projects; the delays become more serious. This problem directly affects the lives, social welfare of the people as well as the other negative social impacts.

In Vietnam, it is very few cases that government construction projects are completed on the time or deadline specified in the contract. There are many large construction projects suffered delay, suspension or abandonment include: the thermal power plant of Uong Bi, Ho Chi Minh City Metrol rail system, National Highway of Ha Noi-Hai Phong, Nhat Tan Bridge, Tan Rai project for bauxite mining, etc.

Based on the above discussion, the main objectives of this study include the following:

- To identify factors affecting the delay in the government construction projects in Vietnam.
- To assess the level of impact of the delay factors by ranking them.
- To develop a conceptual model of delay factors and to analyze the level of impact of the delay groups on project completion.

2. LITERATURE REVIEW

2.1 Delays in Construction

Delay in construction could be defined as the time overrun, happening at a later completion date than planned or expected, specified in the contract or beyond the date of the agreement between the parties for the delivery of the project. (Assaf and Al-Hejji, [5]). A project that is not completed within the predetermined time often happens because the construction process is subject to many conditions and unpredictable elements, which result from many sources such as the performance of contractors, material procurement, site conditions, coordination between the parties, finance, contractual relations, and etc. According to Assaf and Al-Hejji [5], seventy percent of construction projects experienced time overrun and the average time overrun was between 10% and 30% of the original duration.

From the contractor's perspective, delay is simply an additional responsibility as: the construction period becomes longer, increasing overhead costs and expenses for the longer period of the project, the total

working capital of the contractor can be trapped in one project and they cannot participate in other projects (Al-Kharashi and Skitmore, [10]). To the owner's perspective, delay is loss of yield and revenue due to lack of production facilities and lease space or a dependence on present facilities [5].

2.2 Studies on causes of delay

Many researchers and practitioners have studied the causes of delay in construction projects. Most of the previous studies only conducted on ranking the causes of delay according to the separate perspectives of different parties, and then for a whole. Ranking of delay factors was based on the relative importance index or their means. However, these studies did not mention the level of impact of the delay components or groups of factors on project completion. Moreover, a large number of studies analyzed the overall construction project as covering all the types of projects in the construction industry, they did not conduct a deep analysis of each individual case for private projects, public projects or government projects which could be related more to the legislation, the administrative procedures.

The core of this study is to develop a conceptual model of delay factors and to analyze the level of impact of the delay groups on project completion. Although this study concentrates on Vietnam, the findings should be relevant to many developing countries, as they face similar problems in terms of preventing the delay in the government construction projects. A summary of the literature review related to studies on causes of delay is shown as Table 1.

Table 1: Summary of the literature review related to studies on causes of delay

Authors	The key delay factors highlighted
Chan and Kumaraswamy [1]	• 83 potential delay factors in Hong Kong construction projects • Five principal factors: poor risk management and supervision, unforeseen site conditions, slow decision making, client-initiated variations, and work variations.
Kaming et al. [2]	• The most important factors causing delays are design changes, poor labor productivity, inadequate planning, and resource shortages.
Al-Momani. [3]	• The main causes of delay were related to designer, user changes, weather, site conditions, late deliveries, economic conditions and increase in quantity.
Ubaid. [4]	• The performance of contractors as one of the major causes of delay • Thirteen major measures related to contractor resources and capabilities were considered.
Assaf and Al-Hejji [5]	• 73 causes of delay were identified through research. • Only one cause of delay is common between all parties, which is ''change orders by owner during construction''. • Many causes are common between two parties, such as delay in progress payments, ineffective planning and scheduling by contractor, poor site management and supervision by contractor, shortage of labors and difficulties in financing by contractor.
Frimpong et. al. [6]	• The result of the study revealed the main causes of delay and cost overruns in construction of groundwater projects: monthly payment difficulties from agencies; poor contractor management; material procurement; poor technical performance; and escalation of material prices.
Odeyinka and Yusif [7]	• Client-related delays included variation in orders, slow decision-making and cash flow problems. • Contractor-related delays identified were: financial difficulties, material management problems, planning and scheduling problems, inadequate site inspection, equipment management problems and shortage of manpower. • Extraneous causes of delay identified were: inclement weather, acts of nature, labor disputes and strikes.
Ogunlana and Promkuntong. [8]	• The main causes of delay could be: (a) shortages or inadequacies in industry infrastructure (mainly supply of resources); (b) caused by clients and consultants and (c) caused by contractor's incompetence/inadequacies.
Mansfield. [9]	• 16 major factors that caused delays and cost overruns in Nigeria. • The causes of delay and cost overruns in Nigerian construction projects were attributed to finance and payment arrangements, poor contract management, and shortages in materials, inaccurate estimation, and overall price fluctuations.
Al-Kharashi and Skitmore. [10]	• The main cause of delay in Saudi Arabia construction sector for public projects is the lack of qualified and experienced personnel.

Sambasivan and Soon. [11]	• Ten most important causes of delay in Malaysian construction industry: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage.
Haseebet al. [12]	• The most common factors of delay are natural disaster in Pakistan like flood and earthquake. • The study also acknowledged others which are: financial and payment problems, improper planning, poor site management, insufficient experience, and shortage of materials and equipment.
Sweis et al. [13]	• The causes of delay in residential projects in Jordan and concluded that financial difficulties faced by the contractor and too many change orders by the owner are the leading causes of construction delay.
Abd El-Razek et al. [14]	• The most important causes of delay are financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction, and non-utilization of professional construction/contractual management.
Odeh and Battaineth. [15]	• The top ten most important causes of delays in construction projects with traditional type contracts in Jordan were, from the view point of contractors and consultants: owner interference, inadequate contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and subcontractors.
Fugar and Agyakwah-Baah [16]	• The top ten most important factors causing delay in Ghana are: delay in honoring certificates, underestimation of the cost of project, underestimation of complexity of project, difficulty in accessing bank credit, poor supervision, underestimation of time for completion of projects by contractors, shortage of materials, poor professional management, fluctuation of prices/rising cost of materials, poor site management.

3. RESEARCH MODEL AND HYPOTHESES

Based on the literature review and pilot study, 31 delay factors were extracted and divided into 6 groups of factors, as shown in Table 2 and Figure 1. They were identified as major groups of delay causes and were categorized as owner-related, consultant-related, contractor-related, project conditions-related, contract-related, and external factors. An initial conceptual model of delay factors based on these 6 groups was then proposed in Figure 1.

The hypotheses of the above model are described as follows:

H1: The more negative owner related factors are, the more delay project completion is

H2: The more negative consultant related factors are, the more delay project completion is

H3: The more negative contractor related factors are, the more delay project completion is

H4: The more negative project conditions related factors are, the more delay project completion is

H5: The more negative contract related factors are, the more delay project completion is

H6: The more negative external factors are, the more delay project completion is

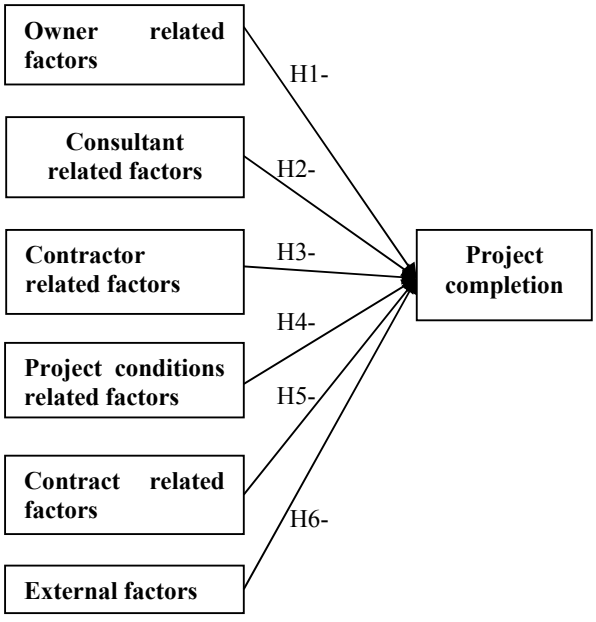

Fig 1: Initial conceptual model

4. RESEARCH METHODOLOGY

The research methodology contains two phases. The first phase includes a literature search, questionnaire design and pilot test, and data collection. The literature review was conducted through books, conference proceedings, internet and international journals. Subsequently, a questionnaire was developed to assess the perceptions of the parties involved in the government project on the impact of delay causes in the Vietnamese construction industry. The questionnaire was divided into three parts.

The first part of the questionnaire introduces the participants to the origin, the purpose of the survey. The second part focuses on causes of construction delay. The respondents were asked to assess the degree of impact of the delay factors. At the end of the second part of the questionnaire, open-ended questions were provided for the respondents to list any other delay factors. They could also list other comments for improvement, suggestions or recommendations to prevent the delays, if any. Eventually, the third part of the questionnaire requests background information about the respondents (types of organization of the respondents, respondent's years of experience, and types of project involving by respondents) for identifying whether the respondents are suitable targets. A five-point Likert scale ranging from 1 (not impact) to 5 (extremely impact) was used to measure the impact of the delay factors. In order to encourage participation of respondents, the questionnaire conveyed that the findings of the study could be shared with the respondents.

Before distributing the questionnaire to respondents, a pilot study was carried out with five experts who had at least twelve years of experience in the construction industry. The basic purpose of the pilot study was to test the relevance and comprehensiveness of the questionnaire; explaining the study intents and questions to validate the contents for accurate translation of the questionnaire's overall structure. The experts possess the requisite knowledge and skills that would enable them to check the adequacy and appropriateness of the factors for conditions of Vietnam. Based on the feedback received, the questionnaire was finalized, and the formal survey was carried out in Vietnam.

As the outcome of this phase, 31 causes of delay for the government construction projects were identified and then a conceptual model of delay factors impacting on project completion is developed. A total of 220 questionnaires were mailed out and hand delivered to carefully pre-identified target participants involved mostly in the members list of the Construction Management Association. Based on these facts, it is believed that the sample is reasonably random. Out of 220 questionnaires that were distributed, 169 respondents returned their questionnaires. Four responses were eliminated because of a high degree of incompleteness. Consequently, this study was based on 165 valid replies, representing a response rate of 75%. The valid data set was then analyzed on Statistical Package for Social Sciences (SPSS) software.

The second phase includes data analysis and discussion. In this phase, there are three main statistical analyses, namely, ranking the delay factors, exploratory factor analysis (EFA) and multiple regression, were undertaken on the data. EFA in this study was used to identify final conceptual model before the research hypotheses and the level of impact of the groups in the model were tested and assessed by multiple regression.

5. DATA ANALYSIS AND DISCUSSION

5.1 Profiles of Respondents

A frequency analysis was conducted for the profiles related to the general information about the respondents and projects. This information includes the organization of respondents, years of experience, and types of project involving by respondents. The highest number of questionnaires received was from the owners (46%). Thirty-four percent (34%), and 20% of questionnaires were received from the contractors, and the consultants, respectively. The number of respondents having experience from 5 to 10 years, 10 to 15 is 43%, 14%, respectively and more than 15 years as 7%. They account for a large rate of the respondents. Thus, the collected data are relatively reliable and valuable. The respondents with less than 5 years of experience account for only 36%. About the types of project, the majority of the project is traffic works (37%); the other projects are civil works (31%), infrastructure works (16%), irrigation works (14%) and industrial works (2%).

5.2 Ranking of the Delay Factors

Table 2 shows the ranking of the delay factors according to the value of their means. The factors with means exceeding to 3.5 present a fairly high agreement of the respondents. Based on the ranking, the three most influential factors of project completion are: (P1) information delays and lack of information exchange between the parties (mean = 3.82); (O7) incompetent owner (mean = 3.81); (CS1) incompetent supervision consultant (mean = 3.8). It is easy to find that P1 is the factor having the highest value of the means. The information delays and lack of information exchange between the parties are serious problems when the project is running and encountering with deadline or important milestones. These problems lead to the different understanding about the project objectives between the parties. Conflicts can occur when the information is not updated in time to one of the parties. The old information could be done by the contractor. Therefore, the completed works could not meet the owner's requirements, also caused schedule delays and cost overruns.

The two factors that have the lowest means with comparing to other factors are: (E1) price fluctuations of construction materials (mean = 3.07), and (E4) natural disasters (mean = 3.04).

5.3 Reliability Analysis

The Cronbach's coefficient alpha was used to test the reliability of the five-point scale used in the survey. It measures the internal consistency among the factors (Field, [17]). The acceptable lower limit for the Cronbach's alpha is usually considered to be 0.7, although values as low as 0.6 are sometimes acceptable for exploratory research (Hair et al., [18]). The Cronbach's alpha of owner related factors, consultant related factors, contractor related factors, project conditions related factors, contract related factors, and external factors are in turn 0.91, 0.826, 0.775, 0.829, 0.784 and 0.822. Therefore the five-point scale measurement was reliable at the 5% significance level.

Table 2: The ranking of the delay factors

Codes	The delay factors	Mean	Rank
P1	Information delays, and lack of information exchange between the parties	3.82	1
O7	Incompetent owner	3.81	2
CS1	Incompetent supervision consultant	3.80	3
CT2	Inadequate contractor's human resources	3.79	4
O2	Difficulties in financing project by owner	3.78	5
CS2	Incompetent project management consultant	3.75	6
CS3	Incompetent design consultant	3.74	7
CT1	Difficulties in financing project by contractor	3.73	8
CT3	Shortage of equipment of contractor	3.72	9
CO1	Lack of strictness and binding in the contract documents	3.69	10
O5	Lack of understanding of technique and constructional legislation of owner	3.68	11
CO2	Ineffective delay penalties	3.66	12
O12	Long waiting time due to owner's authority decentralization in approving design and cost estimate (complying with legal process)	3.65	13
O3	Delay of owner in acceptance of completed works	3.65	13
P2	Lack of coordination between the parties	3.65	13
O14	Long waiting time due to owner's authority decentralization in approving payment (complying with legal process)	3.65	13
O11	Long waiting time due to owner's authority decentralization in approving the project (complying with legal process)	3.65	13
O4	Delay in payment to contractors of completed works	3.65	13
O1	Bureaucracy of owner	3.64	19
O13	Long waiting time due to owner's authority decentralization in approving bidding results (complying with legal process)	3.64	19
O8	Slowness in decision making process by owner	3.58	21
O10	Long waiting time due to owner's authority decentralization in approving adjustments (complying with legal process)	3.56	22
O6	Delay of owner in solving the arising during the project implementation	3.55	23
P4	Remote location of site	3.47	24
P3	The complexity of project	3.46	25
O9	Lack of continuous updating of the project implementation process by owner	3.42	26
CO3	Unavailability of incentives for the contractor for finishing ahead of schedule	3.39	27
E3	Complex geological condition	3.27	28
E2	Changes in government regulation and laws	3.25	29
E1	Price fluctuations of construction materials	3.07	30
E4	Natural disasters (earthquake, flood, etc.)	3.04	31

5.4 Factor Analysis

Factor analysis was used to group the 31 delay factors into core factors as well as to categorize them under a manageable number of factors. The reliability of the factor model was also checked with the communalities of each variable. The sample size of this study is 165 samples, thus all communalities above 0.5 could be accepted (Field, [17]). In this test, the three delay factors discarded are: (O6) delay of owner in solving the arising during the project implementation, (O9) lack of continuous updating of the project implementation process by owner, and (O14) long waiting time due to owner's authority decentralization in approving payment. Their communalities are 0.227, 0.304 and 0.413, respectively. Communalities of all the other delay factors are found to be much greater than 0.506 that signifies that the factor model is reliable in this study.

The factor analysis was conducted by Principle Component Analysis and Varimax Rotation. In this study, the Bartlett's test of sphericity is significant ($p = 0.000$), and the value of the KMO index is 0.853 (greater than 0.5). Therefore, the data are appropriate for factor analysis. The results identified six factors extracted with eigenvalues greater than 1 according to Kaiser's criteria. These six factors explained 64.784% of the total variance in the data. The results of the EFA are shown as Table 3.

Table 3: Factor analysis of delay factors

Codes	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
O2	0.814					
O7	0.775					
O12	0.752					
O3	0.711					
O11	0.703					
O13	0.701					
O1	0.692					
O4	0.677					
O8	0.674					
O10	0.660					
O5	0.638					
E4		0.802				
E3		0.787				
E1		0.772				
E2		0.770				
P3			0.826			
P2			0.791			
P1			0.770			
P4			0.745			
CS2				0.871		
CS1				0.853		
CS3				0.836		
CT3					0.827	
CT2					0.796	
CT1					0.790	
CO2						0.845
CO1						0.812
CO3						0.743

For further discussion, it is necessary to assign a new name to each of the factors. Based on an examination of inherent relationships among the delay factors under each of the factors. The six extracted factors can be reasonably interpreted as follows:

- Factor 1 represents competence, finance, and approval procedures of the owner.
- Factor 2 represents external elements.
- Factor 3 represents extraneous nature and internal interaction of the project.
- Factor 4 represents competence of the consultant.
- Factor 5 represents competence, finance, and productive forces of the contractor.
- Factor 6 represents contract terms.

After applying EFA, the final conceptual model of the relationship between the extracted delay factors and the project completion is presented as Figure 2. This model includes the 28 delay factors grouped into the 6 core groups of factors.

5.5 Regression Analysis

In this section, the multiple regression analysis was applied to investigate the relationship between the extracted delay factors and the project completion. In the regression model, the dependent variables are a linear combination of the independent variables. The independent variables are the attributes, which contribute to the delay, and the dependent variable is the resulting project completion. Table 4 shows the results of the multiple regression analysis. The findings of the regression analysis showed that the majority of control of the delay depends on the factors relating to contractor and owner about competence, finance, productive forces and approval procedure. The factors relating to contractor and owner have the strongest impact on the project completion with β coefficient as (-.612) and (.0.557), respectively.

This is actually easy to understand because the contractor is the participant directly creating products of the project and the owner is the participant playing a lead role in the project. The factors relating to consultant and contract are also tremendous impacts on the project completion as shown in regression function. The two remaining factors relating to the project and external elements do not significantly affect the project completion. The relationship between the extracted delay factors and the project completion was presented by regression function as follows:

Project completion = 2.897 – 0.612 (competence, finance, and productive forces of the contractor) – 0.557 (competence, finance, and approval procedures of the owner) – 0.541 (competence of the consultant) – 0.421 (contract terms) – 0.346 (extraneous nature and internal interaction of the project) – 0.136 (external elements).

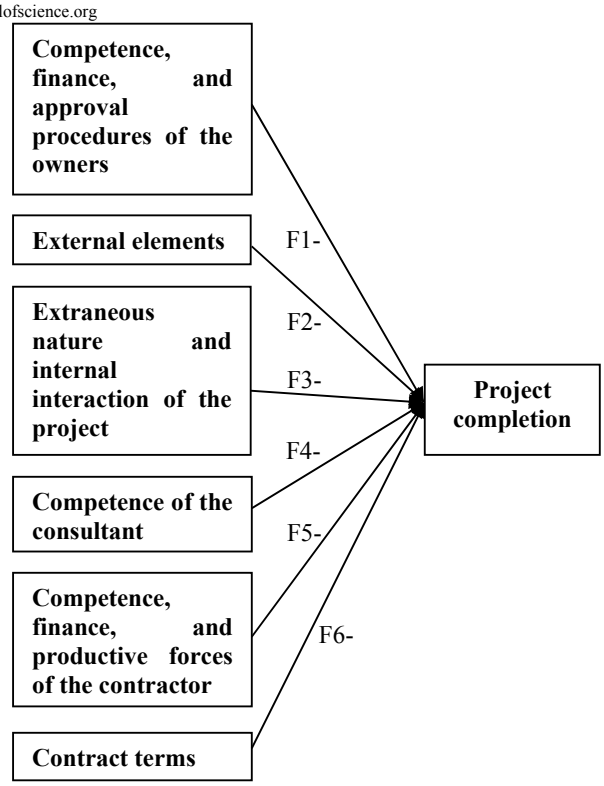

Fig 2: Final conceptual model after applying EFA

6. CONCLUSIONS

This study developed a conceptual model of delay factors affecting the completion of the government construction projects. Based on the literature review and pilot study, the thirty-one delay factors were extracted and divided into 6 groups of factors used to develop the initial conceptual model. The findings of the factor ranking show that the three most influential factors of project completion are: (P1) information delays and lack of information exchange between the parties (mean = 3.82); (O7) incompetent owner (mean = 3.81); (CS1) incompetent supervision consultant (mean = 3.8).

Subsequently, EFA was used to identify the final conceptual model and the results of the six extracted factors affecting the project completion were: (factor 1) competence, finance, and the approval procedure of the owner, (factor 2) external elements, (factor 3) extraneous nature and internal interaction of the project, (factor 4) competence of the consultant, (factor 5) competence, finance, and productive forces of the contractor, and (factor 6) contract terms. By using multiple regression technique, the analysis indicated that the factors relating to contractor and owners have the strongest impact on the project completion in the conceptual model.

Table 4: Results of multiple regression analysis

Variable	β. Co	SE	t-value	Sig.	R^2/adjusted R^2
Constant	2.897	.036	80.958	.000	0.864/0.859 F = 167.132 p = .000
Factor 5	-.612	.036	-17.038	.000	
Factor 1	-.557	.036	-15.524	.000	
Factor 4	-.541	.036	-15.064	.000	
Factor 6	-.421	.036	-11.720	.000	
Factor 3	-.346	.036	-9.641	.000	
Factor 2	-.136	.036	-3.781	.000	

Note: SE = standard error; β. Co = β coefficient

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