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Delay Factors in Building Construction Projects in Rwanda

Umuhoza, Esperance[1] An, Sung-Hoon[2*]

Master's course, Department of Architectural Engineering, Daegu University, Gyeongsan-si, Gyeongsangbuk-do, 38453, Korea [1]

Professor, Department of Architectural Engineering, Daegu University, Gyeongsan-si, Gyeongsangbuk-do, 38453, Korea [2]

Abstract

Delay is one of the most critical issues for construction projects and leads to huge losses in both developing and industrialized countries. The construction sector in Rwanda, a rapidly-developing nation, is no exception. Delays can be mitigated only once we have identify their primary causes, and these may not be the same in each region. This study aims to ascertain the main critical factors responsible for delays in building construction in Rwanda through an intensive literature review and questionnaire survey. A total of 40 delay causative factors were obtained from a literature review and were further classified into nine major categories. The questionnaire survey was distributed to about 80 respondents from clients, contractors, and consultants. From the list of 40 different factors, the top twelve most critical causes were identified as stoppage of work due to cash flow constraints, delay in approving design documents, confidentiality of physical plan, price fluctuations and delay in approving significant change, change orders, delay in performing inspections, Ineffective project planning, inadequate drawing details, unqualified labor, lack of materials on the market and dishonesty.

Keywords : delay factors, rwanda, risk assessment, risk management

1. Introduction

Delay is a ubiquitous issue for construction projects in both developing and industrialized countries [1]. As countries differ from each other in terms of their geographical, political, social, and financial situations, their reasons for the causes of late completion of projects may vary, let alone their magnitude on delay duration.

In particular, construction time overrun situations are most severe in developing countries due to their limited resources and lack of project management skills. Moreover, construction works are mostly performed by small and local companies that rely heavily on the skills of the workers rather than project management [2-4]. As such, a considerable number of projects are delayed, and others are finally abandoned. For this reason, it is imperative to examine the critical causes affecting delays in the Rwandan context, as a step toward providing ways to mitigate the issue and benefit the construction industry in the process.

As in many developing nations, construction project delay has been an ongoing issue in Rwanda, with proposed and current projects either delayed or postponed. Rwanda is a developing country located in East Africa, which began to develop its economy following the genocide in 1994. Although the Rwanda's construction industry is expected to account for the majority of its gross domestic

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* Corresponding author: An Sung-Hoon
[Tel: 82-53-850-6518, E-mail: shan@daegu.ac.kr]

product (GDP) growth at average annual growth of almost 4% since 2020[5], many construction projects are posing delay-related risks such as cost overruns and conflicts or claims. According to the findings of Amandin and Julius[6], 65,7% of public construction projects in just one district of Rwanda were delayed during 2012-2015. An example of the delayed projects is the Kigali convention center, which was initially scheduled to be completed in 2011, but was postponed until 2016. Another example is the Bugesera international airport construction project of Rwanda, which was expected to be completed by 2016, whose ground has not been broken [7].

According to Rwanda's annual report in 2018[8], building projects were one of the project types subject to significant delays in Rwanda. If these projects are delayed, it will increase government expenditure as well as slow down the urbanization of the country, which is one of the main goals of vision 2020 in Rwanda [9]. Besides, the delay would give investors a negative perception of the country, which may result in making investors reluctant and reducing competition in the local construction industry.

As Rwanda has recently had a great many investors and projects with foreign construction companies including Korean companies. For this reason, it is high time to conduct this research to help the practitioners to identify exact causes or sources of delays and to resolve the delay problems.

Even though many researchers have studied construction delay in different countries over the years, there are insufficient studies on the causes of delays in building construction in Rwanda. To be more specific, this study is considered to be the first research investigating the factors that may affect delays in building construction project in Rwanda.

This study is to find out the key factors contributing to the causes of delays in building construction in Rwanda. Delays in residential, mix-use and commercial buildings in Rwanda are researched. A literature review of the related studies was conducted, and survey questionnaires were distributed to contractors, consultants and clients to get their opinions regarding the key factors affecting the delays in building construction in Rwanda. The top key factors were assessed and ranked by analyzing the chance of occurrence of all possible delay factors in the Rwandan context and their relative impact on delay duration.

2. Literature review

The most relevant empirical studies covering 20 countries, including both developing and developed countries across the five continents were initially reviewed to uncover possible causes of delay in construction projects. Among them, we chose some of them, focusing on the ones most cited or most recent. From the studies we chose, we categorized nine types of delay causative factors: financial/economy-related, managerial-related, design-related, labor-related, material-related, equipment-related, environment, and site-related, information and communication-related, and government/local authorities-related factors [10-14].

Therefore, the causative factors in both developing and developed countries are analyzed, and the findings are summarized in Table 1.

2.1 International studies

2.1.1 Developing countries

Internal causes of delays may arise from all the participants in a construction project (e.g. contractor, client and consultant) [11]. These include financial -related, managerial-related, design-related, labor-related, material-related, equipment-related, and information/communication-related causes. Several

studies in developing countries particularly in African countries have also discovered those causes. Frank and Adwoa[11] found the main delay causes in building construction in Ghana to be financial group factors, which included delays in honoring payment certificates, and difficulty in accessing credit and fluctuation in prices. Material group factors are second followed by Managerial factors. Muhwezi et al. [12] in Uganda, Geraldine[13] in Tanzania, and Odeyinka and Yusif[14] in Nigeria added in their studies (1) managerial factors in the area of delays when assessing work' s changes and as inadequate site investigation by the consultants, (2) design related factors including design errors by designers and information related factors, and (3) resource supply related factors as major construction delay factors in those countries, respectively.

Table 1. Previous studies on delay factors worldwide

	Continents	Countries	Authors
Developing countries	Africa	Uganda	Muhwezi et al [12]
		Tanzania	Geraldine [13]
		Ghana	Frank and Adwoah [11]
		Nigeria	Odeyinka and Yusif [14]
	Asia	Malaysia	Sambasivan and Soon [4]
		Vanuatu	Kim and Chi [2]
		Cambodia	Durdyev et al [15]
		Vietnam	Long et al [3]
		Iran	Towhid et al [16]
		India	Arya and Kansal [17]
Developed Countries	America	USA	Balduin et al[19]
		Florida	Ahmed et al[18]
	Europe	Norwegian	Zidne and Andersen [20]
		U.K	Elhag et al [21]
	Asia	Hongkong	Chan&Kumaraswamy [22]
		Turkey	Aynur et al [1]
		South Arabia	Adel and Martin [23]
		UAE	Bekithemba et al [24]
	Oceania	Australia	Kenny and Vanisorn [25]

Studies conducted in Asian developing countries have also uncovered a similar list of delay factors. From a list of 28 different delay causes in Malaysia through a survey questionnaire, Sambasivan and Soon[4] concluded that the main causes of delays were poor planning, poor management, inadequate supervisory skills of the contractor, delay payments, material shortage, labor supply, equipment availability and failure, poor communication, and reworks. In their studies on building construction delays in Vanuatu, Kim and Chin[2] highlighted the complexity of projects and labor absenteeism as the factors included in the most important delay cause, while bad weather was cited by Durdyev et al[15] in Cambodia. Other studies about construction delays that found almost the same causes as those illustrated above include Long Le-Hoai et al in Vietnam[4], Towhid et al[16] in Iran and Arya and Kansal[17] in India.

2.1.2 Developed countries

According to Ahmed et al[18], who investigated causes of delays in construction projects in Florida, revealed that code-related, design-related, construction -related, financial/economical, management /administrative and acts of God are the most critical delay categories. And across those categories, building permit approval, requests for changes, change in drawings, incomplete documents, inspections, change in specifications, decision during development stage, and shop drawing approval are the ten most critical causes. By using the relative importance index method, Balduin et al. [19] identified three similar major delay factors in the U.S.

In European countries, Zidne and Andersen[20] conducted a study of delay and their remedies in Norwegian projects, identified sponsor/owner/ client, lack of commitment and or clear demands (goals and objectives) as a major cause of delay and added to those found in the above developed countries. In their studies of construction cost and time attributes in U.K., Elhag et al.[21] also identified project characteristics

and contract procedures as new categories of delay causative factors.

From other previous studies in developed countries of Asia and Oceania [1,22-25], the discovered top major delay factors are not different from those identified in the above studies.

2.2 Local studies

Amandin and Kule[4] researched project delays on cost overrun risks in Gasabo district, one of the 30 districts in Rwanda using an open-ended questionnaire. They found that the top five causes of delays for public construction projects from 2012 to 2019 were delayed payment, financial deficiencies on the part of client and contractor, material procurement and poor supervision. Meanwhile, in their study about causative factors leading to cost overrun in dam construction projects in Rwanda, Gasasira et al[26] found that slow decision making, poor schedule management, poor cost estimation, poor contract management, poor design and delay in providing design, problem in land acquisition, and poor soil investigation were the top main causes.

3. Research Methods

From the literature review, a total of 40 delay factors were selected according to their frequencies and their fitness in the Rwandan context. These were generalized into nine types of delay causative factors, which were financial/economy-related, managerial-related, design-related, labor-related, material-related, equipment-related, environment and site-related, information and communication -related, and government/local authorities-related. Based on these, the questionnaire was made.

Before making the questionnaire, a small pilot study was conducted through phone interviews with five consultants, five contractors and five clients. The basic aim of this study was to check whether the delay factors captured through the literature review were relevant for Rwanda or not. Ultimately, we did not make any change to the identified delay factors.

A questionnaire survey was conducted to identify the opinions from clients, consultants, and contractors on the relative importance of causes of delays in building projects in Rwanda by assigning a probability of occurrence of the delay factors, assessing the impact of delay factors on construction's duration, and specifying a stakeholder responsible for any delay factors.

The first section of the questionnaire pinpointed the background information about the respondents. The second section contained 40 causes of building delays in Rwanda identified through an intensive literature review and a small pilot survey.

4. Analysis of Data

Data were collected from 80 respondents, and their demographic characteristics are shown in Table 2.

4.1 Analyzing Using International Project Risk Assessment Tool (IPRA)

The IPRA tool is used to rate the degree of risk factors on cost, schedule and quality of an international construction project [27]. It was adapted to this paper as it also helped to identify the ranking of factors affecting construction delays through assessing the degree of critical elements. In addition, this tool is of great significance as it provides a guideline for an assessment team to determine both the level of occurrence and impact of a certain factor. It is an advanced tool for highlighting the degree of factors that may affect the construction schedule.

Table 2. Demographic characteristics of respondents

Categories	Demographic characteristics	Frequency	Percentage (%)
Age	25-30years old	26	32.5
	30-35years old	16	20
	35-40years old	22	27.5
	41-above	16	20
Sex	Male	43	54
	Female	37	46
Type of organization	Project management consultant	25	31
	Design consultants	25	31
	General contractors	20	25
	Clients	10	13
Number of years working experience	Less than 5	15	19
	5-10	20	25
	10-15	20	25
	15-20	25	31
Building type	Residential	25	30
	Commercial	20	13
	Mixed use	10	25
	Institutional	15	19
	Educational	10	13
Project delivery method	Owner direct force	30	38
	General contractor	27	34
	Design build turnkey	13	16
	Build operate transfer	5	6
	Professional construction management	5	6
Type of Contract	Competitive bidding	38	47
	Negotiated cost plus	27	34
	Combination	15	19

For the likelihood of the occurrence section, a 5-point Likert scale is used and each value corresponds to their probability of the occurrences as shown in Table 3.

Table 3. Division of likelihood of occurrence [27]

Sign	Occurrence	Probability
NA	Not applicable to this project	zero
1	Very low chance of occurrence, rare and occurs only in exceptional circumstances	(0~9%)
2	Low chance and unlikely to occur in most circumstances	(10~5%)
3	Medium chance and possible to occur in most circumstance	(35~64%)
4	High chance of happening and will probably occur in most circumstances	(65~89%)
5	Very high chance of occurrence and almost certain and expect in most circumstances	(90~100%)

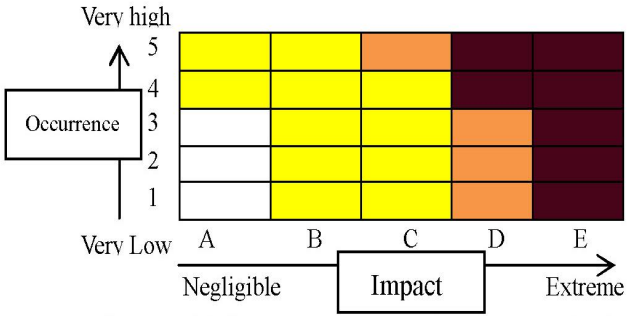

Figure 1. Risk factor assessment matrix of IPRA tool[28]

The relative impact of a factor determines the consequence of the factor occurring. The values used are A-negligible, B-low consequence, C-moderate consequence, D-significant consequence, and E-extreme consequence for the duration.

On the final matrix in Figure1, the two values (likelihood of occurrence and Relative impact) are combined. This gives the relative importance of factor which helps in ranking. The upper right area of the matrix in red represents the greatest risk factor and the lower left area in green is of lesser concern.

4.2 Result of Research

Table 4 indicates the results given to the different delay factors such as (1) likelihood of occurrence in terms of the 5-point Likert scale and their corresponding probability in terms of percentages, (2)the relative impact represented by the letters A-E according to their effect level that is explained in impact definition, (3) the combination of both likelihood and impact gave the IPRA coordinates used for ranking, and (4) each delay factor also corresponds to its responsible construction stakeholder such as Owner(Own),Contractor (Cont), Consultant(Cons) by using the (O) Sign.

5. Discussion of results

Of the 40 delay factors which were classified in

Table 4. List of factors affecting building construction delays in rwanda with results from respondents

Categories	Delay factors	Reponses								
		Likelihood of occurrence	Probability	Relative impact	Impact definition	IPRA Coordinate	Rank	Delay responsibility Own	Cont	Cons
Financial related	1. Delay in payment by owner.	4	65%	C	Moderate	(4,C)	13	○		
	2. Delay in payment by contractors.	3	35%	C	Moderate	(3,C)	16		○	
	3. Slow in interim payment preparations.	2	10%	C	Moderate	(2,C)	28			○
	4. Frequent stoppage of work due to cash flow constraints.	5	90% Greater	E	Extreme	(5,E)	1	○	○	
	5. Price fluctuations.	4	65%	D	Significant	(4,D)	4	○	○	○
	6. Global financial crisis.	1	Less 10%	A	Negligible	(1,A)	37	○	○	○
Managerial related	7. Delay in approving major changes.	4	65%	D	Significant	(4,D)	5	○	○	○
	8. Poor site management	3	35%	C	Moderate	(3,C)	17	○	○	
	9. Change orders.	4	65%	D	Significant	(4,D)	6	○	○	○
	10. Insufficient experience of owner.	3	35%	B	Low	(3,B)	26	○		
	11. Inadequate managerial assistance.	3	35%	C	Moderate	(3,C)	18	○	○	
	12. Inadequate contract estimation.	4	65%	C	Moderate	(4,C)	14			○
	13. Insufficient experience of consultant.	2	10%	B	Low	(2,B)	33			○
	14. Delay in performing inspections .	4	65%	D	Significant	(4,D)	7		○	
	15. Complexity of the projects.	2	10%	C	Moderate	(2,C)	29	○	○	○
	16. Ineffective project planning .	4	65%	D	Significant	(4,D)	8		○	
	17. Inadequate contractor's experience.	2	10%	C	Moderate	(2,C)	30		○	
	18. Person conflicts among labor.	2	10%	B	Low	(2,B)	34		○	
	19. Accident during construction.	1	Less 10%	A	Negligible	(1,A)	38		○	
Design related	20. Design change by owner.	2	10%	C	Moderate	(2,C)	31	○		
	21. Inadequate drawing details.	4	65%	D	Significant	(4,D)	9			○
	22. Mistakes in design.	3	35%	C	Moderate	(3,C)	19			○
	23. Delay in approving designDocument.	5	90% Greater	E	Extreme	(5,E)	2	○		
Labor related	24. Shortage of labor.	1	Less 10%	A	Negligible	(1,A)	39		○	
	25. Unqualified labor.	4	65%	D	Significant	(4,D)	10		○	
	26. Unreliable subcontractors.	3	35%	C	Moderate	(3,C)	20		○	
Material related	27. Shortage of materials.	3	35%	C	Moderate	(3,C)	21		○	○
	28. Change in material types.	3	35%	D	Significant	(3,D)	24	○	○	
	29. Lack of materials on market.	4	65%	D	Significant	(4,D)	11		○	
Equipment related	30. Shortage of equipment.	3	35%	C	Moderate	(3,C)	22		○	
	31. Frequent equipment breakdowns.	2	10%	B	Low	(2,B)	35		○	
Site and environment related	32. Unexpected surface condition.	3	35%	C	Moderate	(3,C)	23		○	
	33. Unfavorable weather condition.	4	65%	C	Moderate	(4,C)	15	○	○	○
	34. Act of god.	1	Less 10%	A	Negligible	(1,A)	40	○	○	○
Communication and Information	35. Poor communication .	3	35%	D	Significant	(3,D)	25	○	○	○
	36. Inadequate information.	2	10%	C	Moderate	(2,C)	32	○	○	○
	37. Dishonesty.	4	65%	D	Significant	(4,D)	12	○	○	○
Government and local authorities	38. Delay in obtaining permit.	3	35%	B	Low	(3,B)	27			○
	39. Geographical and physical factor.	2	10%	B	Low	(2,B)	36	○		
	40. Confidentiality of physical plan.	5	90% Greater	E	Extreme	(5,E)	3	○		

nine groups determined through the literature review and pivot survey, the responses highlighted three factors as the most critical: stoppage of work due to cash flow constraints, delay in approving design document, and confidentiality of physical plan. These were followed by nine other critical factors: price fluctuations, delay in approving major changes, change orders, delay in performing inspections, ineffective project planning, inadequate drawing details, unqualified labor, lack of materials on market, and dishonesty (shown in Table 5 and Figure 2).

Table 5. Summary of critical delay factors

	IPRA element	IPRA coordinate	Rank
4.	Stoppage of work due to cash flow constraints(Financial related)	(5,E)	1
23.	Delay in approving design document(Design related)	(5,E)	2
40.	Confidentiality of physical plan(Government and local authorities)	(5,E)	3
5.	Price fluctuations (Financial related)	(4,D)	4
7.	Delay in approving major changes(Managerial related)	(4,D)	5
9.	Change orders (Managerial related)	(4,D)	6
14.	Delay in performing inspections (Managerial related)	(4,D)	7
16.	Ineffective project planning (Managerial related)	(4,D)	8
21.	Inadequate drawing details (Design related)	(4,D)	9
25.	Unqualified labor (Labor related)	(4,D)	10
29.	Lack of materials on market(Material related)	(4,D)	11
37.	Dishonesty(Communication and information)	(4,D)	12

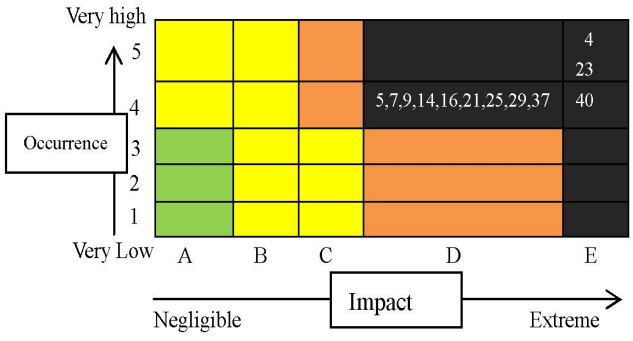

Figure 2. Factors belong to high risk zone

Ranking of the relative importance of the factors that may cause construction delays in Rwanda was determined by the percentage value of the responses through the coordinates of both chance of occurrence and the relative impact of those factors. Therefore, when a factor was checked as a very high or high chance of occurrence and an extreme to significant impact on the construction delay, it was considered and classified in the critical and major causes.

Moreover, the results of the interview with four experts and from previous paper used IPRA tool [27,28] found that the critical risk factors are located in the red area (right) of the risk matrix, which are the ones that must be mitigated first. This concept is also applies to this paper, and we select the critical delay factors from the red area of the matrix.

The first three selected critical delay factors with very high likelihood and extreme impact are stoppage of work due to cash flow constraints, delay in approving design document, and confidentiality of physical plan. The reasons for these factors are respectively considered as financial instability, lack of good management during design, partial development of physical plans, or master plans of some areas by authorities of a local government.

The nine critical delay factors with high likelihood and significant impact are found in the following six categories: (1) in financial related factors, price fluctuation; (2) in managerial related factors, delay in approving major changes, change orders, and delay in performing inspections and ineffective project planning; (3) in design related factor, inadequate drawing details; (4) in labor related factor, unqualified labor; (5) in material related factor, lack of materials on market; and (6) in information and communication related factor, dishonesty. The reasons why these factors are critical in delaying building construction in Rwanda are respectively considered as frequent instability

in the economy of the country, lack of managerial skills for building construction stakeholders, lack of attention and adequate time during designing, lack of attentiveness in selection of labors, buying materials on deadlines or slowness of importing materials from abroad and lack of authenticity of the information.

6. Conclusion

This paper describes the critical causes of delays in construction projects by emphasizing the two fundamental steps of ranking the delays as a way to mitigate their risks such as knowing their chance of occurrence and identifying their impact on the construction duration. The causes responsible for delays in building construction may differ in different regions of the world based on the characteristics of the construction industry, and the rules and regulations in the region where a project is carried out.

Based on this, the main causes of construction delays in Rwanda were highlighted, using a questionnaire survey. The analysis of the data revealed that frequent stoppage of work due to cash flow constraints, delay in approving design document, confidentiality of physical plan, price fluctuation, delay in approving major changes, change orders, delay in performing inspections, ineffective project planning, inadequate drawing details, unqualified labor, lack of materials on market, and dishonesty were among the significant factors that may cause delays.

We believe that the findings of this paper can be useful to all the participants (Clients, Contractors and Consultants) and academics. The list of most critical factors can be used by local or foreign construction stakeholders including Korean construction companies working in Rwanda to better understand the possible risk factors that can be encountered during building construction projects and to make efforts to reduce them. The academics should conduct similar surveys in other regions of the world to find out the construction delay factors different from one country to another.

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ORCID

Esperance Umuhoza, https://orcid.org/0000-0002-7878-5026
Sung-Hoon An, https://orcid.org/0000-0002-0906-3302

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