

# Project Delay Factors Ranking Analysis Towards The Project Dynamics Stage Cycle And Pmbok 10 Knowledge Areas

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## ABSTRACT

Delay in a project is something that is avoided by every Project Manager in handling construction projects. This paper analyzes the results of a construction project delay factor ranking study, where these factors are then analyzed their effects on each stage in the dynamic project process and the Project Management Body of Knowledge (PMBOK-Project Management Institute Fifth Edition, 2013) with 10 Knowledge Areas. Based on the results of the study the top 3 delay factors are: "Frequent design changes"; "Financial difficulties of owner"; "Delay in progress payment by owner". When viewed from the dynamics of the project cycle process "Implementation Stages" and "Definition Stage" are stages that have the most delay factor. As for grouping based on PMBOK 10 Knowledge Areas, "Project Integration Management" and "Project Cost Management" are PMBOK Knowledge Areas which have the most factors causing project delays. Based on the above analysis, it is expected that the results of this study can become a guide for a Project Manager in mapping delay factors in carrying out construction project activities.

**Key Words:** Delay Factor, PMBOK, Construction

## INTRODUCTION

At the beginning of the implementation of a construction project always has a planning and scheduling of project activities (González, González, Molenaar, & Orozco, 2014). When the project starts and when the project will end or run according to the plan and contract agreement. In the planning, implementation, until the final stage of a construction project many things must be considered. How to provide resources, how the project is carried out, design, completeness of the file, costs to be incurred, to the availability of equipment and materials (Bizon-Gorecka & Gorecki, 2019). The implementation of a construction project always refers to the plan and contract agreement as a guideline for the desired construction project owner. However, in the course of planning, implementation and control of construction projects there are many mistakes and negligence made by contractors, consultants and owners that cause discrepancies between plans and reality during the construction process is running.

This mismatch results in increased processing time, increased costs and even improper quality. While a construction project is successful if the time, budget and quality can be in accordance with the

plan. The delay in construction projects continues to occur repeatedly which is influenced by many factors. However, project delays are often underestimated so there has not been any assessment of the factors that influence these delays and make them a learning guide in order to avoid delays in construction projects.

Some researchers have made an agreement regarding the delay of the construction projects (Asmi, Djamaris, & Ihsan, 2019). (Haseeb, Bibi, & Rabbani, 2011) conducted an investigation into the delay in construction projects in Pakistan (Haseeb, Bibi, & Rabbani, 2011). Research studies were carried out using a questionnaire consisting of 42 factors showing that the 10 main factors in delay were fluctuations in “material prices”; “high costs for engine maintenance”; “too low supply”; “procedures for procurement of goods and materials”, “procurement phase”, “methods of improper cost estimates”, “additional work”, “improper planning”, “inadequate government policies” (Azhar, Farooqui, & Ahmed, 2008).

Investigated the causes of delays in construction projects in Vietnam using questionnaire surveys. Investigations involved 21 factors and 5 general factors including “field management and poor supervision”; “poor project management”; “financial difficulties from the owner”; “financial difficulties from contractors and design changes” (Le-Hoai, Lee, & Lee, 2008).

A questionnaire study survey conducted resulted 42 factors to investigate the main causes of delays in construction projects in Gaza among contractors, consultants and clients. The results of the study show that the 10 main factors that cause delays received by 3 parties (contractors, consultants and clients) are increases in material prices, late construction, material and equipment supplies by contractors, fluctuations in construction material prices, exchange rates against the US dollar, monopoly of project material by several material providers, source constraints: funding and lack of preparation from related parties, lack of funds in planning or supervision during the contract stages before and after, improvements to drawings during the construction phase, design changes and lack of accuracy in taking quantities material (Enshassi, Al Najjar, & Kumaraswamy, 2009).

A study to determine the contributors to the late construction of flat road construction projects in Zambia. The results of the study show that the main cause of delays is the change in construction costs caused by weather caused by heavy rains and floods, changes in the scope of work, protection of the environment and mitigation of costs, schedule delays, strikes from labor, technical challenges, inflation and local government pressure (Kaliba, Muya, & Mumba, 2009).

The causes of construction delays in 53 telecommunication projects in Nigeria investigated through questionnaire surveys. The survey results show that 7 main factors are “inexperienced contractors”; “material prices”; “fluctuations in material prices”; “repeated design changes”; “economic stability” and “high interest rates on loans imposed on contractors”; “types of payments”; “loans and payments” (Ameh, Soyngbe, & Odusami, 2010).

Based on the analysis of Ade Asmi et al 2019, a research study has been conducted on the ranking of delays in construction projects in Jakarta, Indonesia, as shown in Table 2.

**Table 2.** Overall Project Delay Factor

Delay Factor	Total			Ranking
	Mean 4	N	Std. Deviation	
Frequent design changes	3.93	88	1.11	1
Financial difficulties of owner	3.86	88	1.23	2
Delay in progress payment by owner	3.76	88	1.07	3
Incompetent subcontractors	3.70	88	1.00	4
Schedule delay	3.69	88	1.10	5
Poor design and delays in Design	3.65	88	1.08	6
Late delivery of materials and equipment	3.61	88	1.09	7
Labour productivity	3.60	88	1.10	8
Cash flow and financial difficulties faced by contractors	3.59	88	1.14	9
Lack of coordination between parties	3.58	88	0.93	10
Delay preparation and approval of drawings	3.58	88	0.94	11
Delay in material procurement	3.57	88	1.17	12
Mistakes and errors in design	3.56	88	1.21	13
Equipment availability and failure	3.56	88	1.09	14
Mistakes during construction	3.55	88	1.07	15
Changes in material specification and type	3.52	88	1.05	16
Impractical and complicated design	3.52	88	1.02	17
Incomplete design at the time of tender	3.51	88	1.07	18
Rework	3.50	88	1.14	19
Shortage of technical personnel (skilled labour)	3.49	88	1.01	20
Delay payment to supplier / subcontractor	3.48	88	1.02	21
Unrealistic contract duration and requirements imposed	3.47	88	0.99	22
Owner interference	3.43	88	1.01	23
Inaccurate time and cost estimates	3.42	88	1.05	24
Poor project management	3.41	88	1.07	25
Slow information flow between parties	3.40	88	0.84	26
Insufficient numbers of equipment	3.38	88	1.06	27
Lack of experience of technical consultants	3.38	88	1.00	28
Lack of communication between parties	3.36	88	0.91	29
Obsolete or unsuitable construction methods	3.35	88	0.99	30
Poor financial control on site	3.31	88	1.11	31
Shortage of site workers	3.30	88	1.12	32
Contractual claims, such as extension of time with cost claims	3.30	88	0.97	32
Poor contract management	3.30	88	1.12	32
Delay in inspection and approval of completed works	3.30	88	0.95	35
Delays in decisions making	3.28	88	1.02	36

Delay Factor	Total			Ranking
	Mean 4	N	Std. Deviation	
Inadequate monitoring and control	3.26	88	0.95	37
Lack of constructability	3.26	88	1.11	38
Change in the scope of the project	3.25	88	0.95	39
Labour absenteeism	3.24	88	1.17	40
Inadequate planning and scheduling	3.23	88	1.03	41
Unforeseen ground condition	3.22	88	0.96	42
Mode of financing, bonds and payments	3.22	88	1.02	43
Inaccurate site investigation	3.20	88	1.02	44
Poor site management and supervision	3.18	88	1.05	45
Shortages of materials	3.18	88	1.11	46
Omissions and errors in the bills of quantities	3.18	88	1.09	47
Severe overtime	3.09	88	0.92	48
Additional works	3.08	88	1.01	49
Fluctuation of prices of materials	3.06	88	1.20	50
Effect of weather	3.05	88	1.13	51
Inaccurate quantity take-off	3.00	88	0.83	52
Lack of experience	2.99	88	1.02	53
High cost of labour	2.97	88	1.10	54
Number of construction going on at same time	2.91	88	0.89	55
High cost of machinery and its maintenance	2.85	88	1.00	56
Bureaucracy in tendering method	2.80	88	1.03	57
Waste on site	2.63	88	0.97	58

Then from Table 2 Regarding the whole Project Delay Factor, it can be grouped according to four stages in project dynamics and a table of 10 items the Project Management Body of Knowledge (PMBOK).

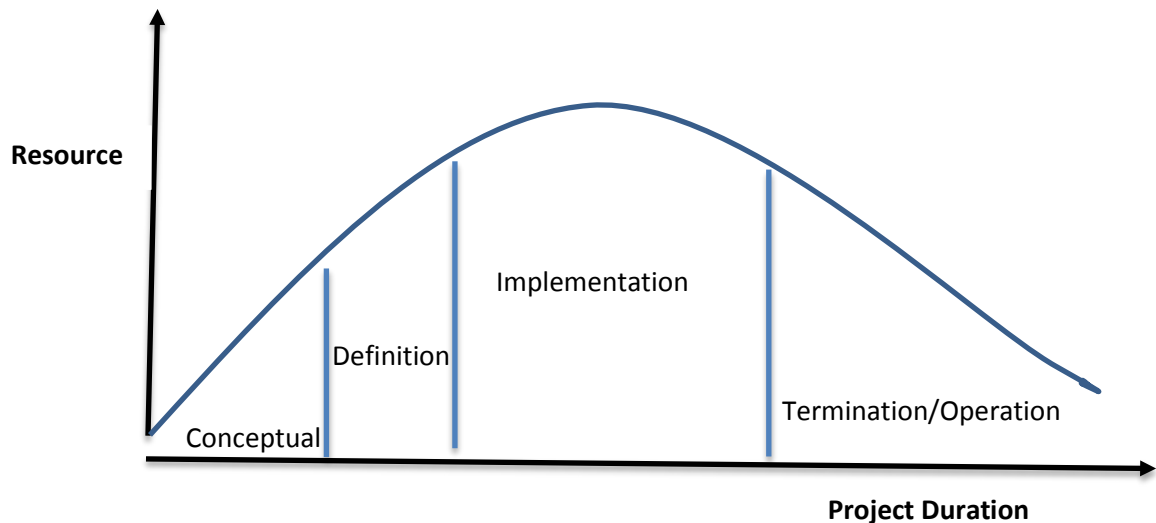
## PROJECT DYNAMICS

Although construction projects vary, but in terms of size, complexity, resources and others, when viewed from their behavior tend to have the same cycle as Figure 1 below.

Based on Figure 1, there are several stages in the dynamics of a construction project where:

### 1. Conceptual Stage:

The end of the conceptual stage is the package or documentation of the results of the feasibility study. The document usually contains an analysis of various aspects of eligibility such as marketing, financial, socio-economic, environmental impact analysis, technical, production, management and organization and Also involves an outline of project costs and schedules



**Figure 1.** Project Dynamics

2. Definition Stage:

- Documentation contains continuation of project feasibility study
- Documentation contains project strategic and operational plans
- Documentation contains the definition of the scope of the cost budget, master schedule, and an outline of the project's quality criteria
- RFP (Request Before Proposal) or auction package
- Documentation of the results of evaluation of proposals from bidders

3. Implementation Stage:

- Carrying out detailed engineering design, material and equipment procurement, manufacturing, installation and construction activities.
- Controlling cost and time schedules, mobilizing workforce, training and supervising
- The end result of this stage is the technical completion of the project

4. Termination Stage:

Preparing the installation or product to operate, such as a start-up trial, performance test

- Administrative and project financial settlement such as insurance and claims
- Carry out demobilization and reassessment of personnel
- Deliverables from this activity are: installations or products that are ready for use or ready for operation, marked by the issuance of "operational acceptance"

Based on the description above, there will be 4 stages that will be passed in the implementation of construction projects. From the explanation of the construction stages, the factors of project delay can be grouped based on the Dynamics or Cycle Stage of a project. So it can be found out at what stage the causes of project delays often occur. We can see these groupings in Table 3.

**Table 3.** Delay Factor Based on Project Cycle

Factors	Conceptual Stage	Definition Stage	Implementation Stage	Termination Stage	Total	Factors	Conceptual Stage	Definition Stage	Implementation Stage	Termination Stage	Total
1	✓				1	31	✓	✓	✓		3
2		✓			1	32			✓		1
3		✓			1	33		✓		✓	2
4			✓		1	34	✓	✓			2
5		✓			1	35		✓	✓		2
6	✓				1	36		✓	✓		2
7			✓		1	37	✓		✓		2
8			✓		1	38			✓		1
9		✓			1	39	✓	✓	✓		3
10			✓		1	40			✓		1
11	✓				1	41		✓			1
12			✓		1	42			✓		1
13	✓				1	43		✓	✓		2
14			✓		1	44	✓	✓	✓		3
15			✓		1	45	✓	✓	✓		3
16			✓		1	46			✓		1
17	✓				1	47	✓	✓			2
18		✓			1	48			✓		1
19			✓		1	49			✓	✓	2
20			✓		1	50	✓	✓	✓		3
21				✓	1	51			✓		1
22			✓		1	52		✓	✓		2
23		✓			1	53	✓	✓			2
24			✓		1	54	✓	✓			2
25	✓		✓		2	55		✓	✓		2
26	✓		✓		2	56			✓	✓	2
27			✓		1	57	✓	✓			2
28			✓		1	58				✓	1
29	✓		✓		2	Total	8	7	18	1	
30		✓	✓		2						

Then, from Table 3, all cycles have factors that cause delays in a project. However, there is a stage that is the first to have the most delay factor. This can be seen in Table 4.

**Table 4.** Project Cycle with the Most Delay Factor

No.	Project Cycle Stage	Total Delay Factor	Ranking
1	Implementation Stage	38	1
2	Tahap Definition Stage	24	2
3	Conceptual Stage	19	3
4	Termination Stage	5	4

The implementation stage is in the first rank to be the construction stage that has the most project delay factors. This explains that at the implementation stage there are many jobs such as engineering design, material and equipment procurement, manufacturing, installation and construction, time and schedule cost control, labor mobilization, and technical project completion. As well as the second and third ranks, it also has a large number of delay factors so it is necessary to pay attention to it, namely at the "Definition" and "Conceptual" stages.

#### **GROUPING DELAY FACTORS BASED ON PMBOK 5<sup>th</sup>ed.**

Based on the Project Management Body of Knowledge (PMI, 2013), there are 10 Project Management Knowledge Areas as in Table 5.

**Table 5. 10 Project management Knowledge Areas**

Area	Description
Integration	Arranging plans, implementing results, controlling all changes in the implementation of results.
Scope	Project installation, planning and project scope definition, controlling all changes in the implementation of the results.
Schedule	Definisi kegiatan, Urutan kegiatan, Kurun waktu, Penyusunan jadwal, Pengendalian jadwal.
Cost	Resource planning, cost estimates, budgets, cost control.
Quality	Quality planning, quality assurance, quality control.
Resource	Organizational arrangement, Staffing, Formation of project team
Communications	Information distribution, performance reports, communication planning
Risk	Risk identification, risk quantification, control
Procurement	Procurement planning, RFP creation, tender process. Project administration
Stakeholder	Identify and engage stakeholders throughout the project

An explanation of PMBOK 10 is needed to determine the location of the delay factor in each PMBOK 10. This is one thing that can be done to make it easier to analyze and determine the causes of the delay factor in a project. After grouping based on the cycle stages of a project, the following are grouping delay factors based on PMBOK 10 (PMI Fifth Edition, 2013) shown in Table 6.

**Table 6.** Delay Factor Based on PMBOK 10 (PMI Fifth Edition, 2013)

No.	PMBOK	Delay Factor	Ranking	Total no of Delay Factor
1	Project Integration Management	Frequent design changes	1	9
		Poor design and delays in Design	6	
		Mistakes and errors in design	13	
		Impractical and complicated design	17	
		Incomplete design at the time of tender	18	
		Unrealistic contract duration and requirements imposed	22	
		Obsolete or unsuitable construction methods	30	
		Bureaucracy in tendering method	57	
		Poor contract management	32	
2	Project Scope Management	Change in the scope of the project	39	5
		Unforeseen ground condition	42	
		Inaccurate site investigation	44	
		Effect of weather	51	
		Waste on site	58	
3	Project Schedule Management	Schedule delay	5	7
		Mistakes during construction	15	
		Rework	19	
		Inaccurate time and cost estimates	24	
		Contractual claims, such as extension of time with cost claims	32	
		Inadequate planning and scheduling	41	
		Number of construction going on at same time	55	
4	Project Cost Management	Financial difficulties of owner	2	9
		Delay in progress payment by owner	3	
		Cash flow and financial difficulties faced by contractors	9	
		Delay payment to supplier / subcontractor	21	
		Poor financial control on site	31	
		Mode of financing, bonds and payments	43	
		Omissions and errors in the bills of quantities	47	
		High cost of labour	54	
		High cost of machinery and its maintenance	56	



No.	PMBOK	Delay Factor	Ranking	Total no of Delay Factor
5	Project Quality Management	Delay preparation and approval of drawings	11	7
		Equipment availability and failure	14	
		Incompetent subcontractors	4	
		Lack of experience of technical consultants	28	
		Inadequate monitoring and control	37	
		Lack of experience	53	
		Lack of constructability	38	
6	Project Resource Management	Labour productivity	8	6
		Shortage of technical personnel (skilled labour)	20	
		Poor project management	25	
		Shortage of site workers	32	
		Labour absenteeism	40	
		Poor site management and supervision	45	
7	Project Communications Management	Lack of coordination between parties	10	3
		Slow information flow between parties	26	
		Lack of communication between parties	29	
8	Project Risk Management	Severe overtime	48	2
		Additional works	49	
9	Project Procurement Management	Late delivery of materials and equipment	7	7
		Delay in material procurement	12	
		Changes in material specification and type	16	
		Insufficient numbers of equipment	27	
		Shortages of materials	46	
		Fluctuation of prices of materials	50	
		Inaccurate quantity take off	52	
10	Project Stakeholder Management	Owner interference	23	3
		Delay in inspection and approval of completed works	35	
		Delays in decisions making	36	

From Table 6 grouping based on PMBOK 10 above, a total number of delay factors will be obtained for each PMBOK 10 as shown in Table 7 below:

**Table 7.** Ranking delay factor berdasarkan PMBOK 10

No.	PMBOK 10	Total Delay Factor	Ranking
1	Project Integration Management	9	1
2	Project Cost Management	9	1
3	Project Schedule Management	7	2
4	Project Quality Management	7	2
5	Project Procurement Management	7	2
6	Project Resource Management	6	3
7	Project Scope Management	5	4
8	Project Communication Management	3	5
9	Project Stakeholder Management	3	5
10	Project Risk Management	2	6

The table above explains that: "Project Integration Management" and "Project Cost Management" are PMBOK 10 which have the most factors causing project delays. This is because in PMBOK, the explanation of "Project Integration Management" includes the stages of planning, implementation and control, which stages also become the stage that has the most delay factor in the dynamics of the construction cycle based on the results of Table 4 above. Then in "Project Cost Management", there are issues regarding resource planning, cost estimates, budgeting, and cost control.

### Conclusion

Based on the results of the study of Ade Asmi et al 2019 the top 3 delay factors are: "Frequent design changes"; "Financial difficulties of owner"; "Delay in progress payment by owner". When viewed from the dynamics of the project cycle process "Implementation Stage" and "Definition Stage" are stages that have the most delay factor. As for grouping based on PMBOK 10 (Fifth Edition 2013), "Project Integration Management" and "Project Cost Management" are PMBOK 10 which have the most factors causing project delays. Based on the above analysis, it is expected that the results of this study can become a guide for a Project Manager in mapping delay factors in carrying out construction project activities.

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