International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online)
Vol. 10, Issue 1, pp: (119-124), Month: April 2022 - September 2022, Available at: www.researchpublish.com

A review of studies on Causes of Delays and Mitigation Strategies

Sultan Zaeem Al-Khaldi

DOI: https://doi.org/10.5281/zenodo.7022633

Published Date: 25-August-2022

Abstract: **Delays in Construction Projects are one of the major challenges faced by all Projects Stakeholders. Therefore, it is important to review and analyze the published papers in the leading construction management journals. The objective of this paper is to compare the findings of the published papers based on the causes of delays from different geographical locations. The Severity Index (SI), Relative Important Index (RII), and Spearman rank correlation factor had been used across all these published papers to measure and rank the impact of each causal factor. The findings of this paper intended to provide summarized causes of delays in construction projects which already have been provided.**

Keywords: **Delays; Delays on Construction Projects; Causes of delays in Construction; Severity Index; Relative Important Index.**

1. INTRODUCTION

Most contractors and owners believe that the delays on construction projects are one of the biggest challenges faced during the project life cycle. All around the world many construction projects face one of the biggest construction problems which is the delay, delays differ from one country to another, from one construction project to another, and from construction type or cost to another due to every project circumstance Sullivan and Harris [20]. Therefore, the aim of this paper is to provide an insight into highlighting the major causes of delays from different geographical locations

2. RESEARCH METHODOLOGY

The methodology that has been used in this review paper is based on the use of publicly available digital databases such as Google Scholar. In addition, these papers have to be published in the leading construction management journals such as the International Journal of Project Management (IJPM), Alexandria Engineering Journal (AEJ), Procedia Computer Science (PCS), Malaysian Construction Research Journal (MCRJ), Journal of Civil Engineering and Management (JCEM), Journal of Management in Engineering (JME) and Procedia Engineering (PE).

The selection of these papers had to go through a gate of primary filtration. Specifically, any papers written earlier than 2011 were not considered in this paper. In addition, the category of these journals must be checked, and it should be at least in a Q1 or Q2 category. Moreover, a syntax was used to find specifically the topic for instance “Causes of Construction delays,” and “Analyzing factors affecting construction delays.”

3. CAUSES OF DELAYS

The cause of delays is gathered through literature review and of several resources and categorized then in three common themes between papers as follows:

3.1 Causes identified as the risk of project delays

Exploring Delays in Victoria-based Australian Pipeline Projects Paper discusses the delays on the pipeline project in Victoria Australia and identifies the causes and the risk and suggests a risk mitigation plan and how to control the outcomes of the project with no impact.

First, they conducted a detailed literature review and key persons interview to obtain all causes of project delays which could result in cost or time overruns. Thus, the identified root causes of delays in pipeline works are design changes, design errors, poor communication, customer/ end-user related issues, subsurface investigation inadequacies, issues regarding permissions/ approvals, weather conditions, procurement delays, site management problems, subcontractor issues, rework, cultural and heritage management issues.

The risks are mapped with their mitigation or control measures as follows Local Opposition, planning permissions, Design risks, Late design changes, Construction - Bore Failures 1, Disputes with Subcontractors, Equipment - Supply Risk, Site Access, Ground Conditions, and Services.

Cause of Construction Delay in Malaysia addresses the construction delays in Malaysia projects and categorizes them into excusable delays and no excusable delays and concurrent.

The excusable delay causes are the causes that are compensable and are ordered by the owner or client. While no excusable are defined as caused by the contractor and finally the cause of the concurrent delay cause which neither by client or contractor such as the environmental reasons or governmental reasons.

Time Extension Factors in the Construction industry of Pakistan address the delay causes of construction projects across all of Pakistan. The study identified twenty-seven reasons for the delays and shared a questionnaire with the key person from all project parties i.e., client, contractor, and consultant to assess the most effective cause which was domestic issues in the country.

The twenty-seven causes were categorized into seven categories which are client-related factors, contractor-related factors, consultant-related factors, material-related factors, labor and equipment-related factors, Contract related factors, and External factors.

Client-related factors are Slow decision-making by the Client, payment delays, unrealistic time durations, design changes, improper availability of funds to the Client, and political/ bureaucratic influences.

Contractor-related factors are improper planning, the low financial capability of construction firms, lack of program of work, underestimation of time for completion by Contractors, poor site management, mistakes during construction, and construction methods.

Consultant-related factors are delayed instructions from consultants, delays in the preparation and approval of drawings, and discrepancies between drawings and specifications.

Material-related factors are the instability of the domestic construction market. And labor and equipment-related factors are the least use of high-tech tools/equipment in construction and shortage of skilled manpower.

Contract-related factors are legal disputes and variations. Lastly, external factors are fluctuation in import duties, war, and terrorism, law and order situation, inflation of the local currency, unprecedented price escalation, and bad weather conditions.

The delay caused by road and bridge projects in Saudi Arabia found ten risk factors were identified and were grouped into four categories. The average delay in infrastructure projects in Mecca was found to be 39%. The most severe cause of delay was found to be the land acquisition factor. This highlights the critical land ownership and acquisition issues that are prevailing in the city. Additionally, other factors that contribute to delay include contractors' lack of expertise, re-designing, and haphazard underground utilities (line services). It is concluded that most project delays were caused by the owner's side as compared to contractors, consultants, and other project stakeholders. This finding matched with the research findings of the Gulf Countries Construction (GCC) Industry's literature. This study fills an important practice and research gap for improving the efficiency in delivering infrastructure projects in the holy city of Mecca and Gulf countries at large.

Delays caused in construction projects in Hargeisa also refer to the causes of the delay of the project and analyze them based on their relativity of them and their frequency of occurrence.

The study identifies thirty-seven causes diverted between four sections client-related, contractor-related, consultant-related, and external causes. Then ranks them in total to the highest and most effective causes from the four sections. Contractor-related delays are found to be the most significant category that causes construction delays, followed by the owner-related delays, consultant-related delays, and material-related delays as the second most significant groups, respectively. The least significant categories are labor-related delays, equipment-related delays, and external factor-related delays, respectively.

Analyzing delay factors in construction projects in Malaysia, analyzed fifty-two common causes of delay identified from the literature review, twenty highly cited causes are categorized under client, contractor, consultant, labor and equipment, material, and others related. A field survey was employed to acquire the views of 148 Malaysian construction practitioners from the client, consultant, and contractor organizations.

the five leading causes as lack of proper planning and scheduling, too many change orders by clients, lack of competent site management and supervision, lack of competent subcontractors, and financial problems of contractors.

3.2 Delay causes and mitigation plans

About 75% of public construction projects in KSA exceeded their planned time and were delayed. Since the contractor cannot start on other projects when delays occurred this is equivalent to the loss of output and revenues. In another word, the profit lost by the contractor is equal to the opportunity cost of the projects the contractor misses. A questionnaire filled by a focus group of related construction experts including owners, consultants, and contractors, was used to assess the causes of delays in projects. In the summary list of fifty causes of delay was prepared and ranked based on their impact. Then classified based on the phase of the project, before awarding the tender, during the tender award, after awarding tenders, and general factors. Top-ranked factors to be taken into selecting the contractor are focus on financial analysis and awarding the lowest bidder, awarding contractors projects beyond their financial and technical potential, and contractors having other vacillating projects. The author listed twenty instructions to be considered when selecting a contractor and how to audit the execution to reduce the delay of public project execution.

Project portfolios of nuclear power plants have unique characteristics the plant's planning department develops a long-term and a short-term plan for projects that need to be completed. These plans with special security and safety procedures are used to assure safe operation and compliance with NRC requirements. Inconsistency brings along more fast-track projects, a tight portfolio budget, and more risk. So, analyzing the factors of delay, and considering risk in the project plan is particularly important. Data were collected from live projects and when there is a delay note was taken identifying the cause and the correction action then analyzing the data to find the real cause and its cost impact on the schedule. The below model was used to investigate the cases of delay

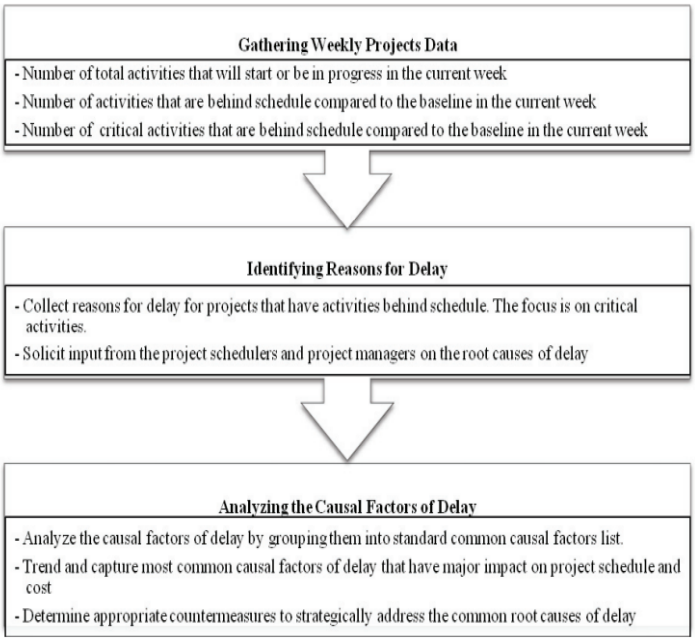

Figure 1: Framework for Identifying Causal Factors of Delay

A case study of fifty-one projects was studied and resulted in thirteen causes listed below. While three are considered the most common causes of delay: Productivity, Plant Support Engineering, and Design Errors/Engineering Change Requests

IN TODAY'S DYNAMIC and competitive world, a project manager's key challenge is coping with frequent unexpected events. Even with careful planning and risk-management processes, a project manager may encounter, on a near-daily basis, a failure of workers to show up at a site, the bankruptcy of a key vendor, and an inconsistency in the guidelines provided by two engineering consultants or changes in scope.1

Such events were classified according to their level of predictability as follows:

1. events that were anticipated but whose impacts were much stronger than expected
2. events that could not have been predicted
3. Events that could have been predicted but were not.

All three types of events can become problems that need to be addressed by the project manager.

Coping with frequent unexpected events requires an organizational culture that allows the project manager to exercise a great amount of flexibility. Listing two examples: twenty-three project managers declared mutiny claiming NASA's standard procedures, were too restrictive for their projects and that they needed more flexibility. As a result, NASA headquarters accepted the group's recommendation to give NASA project managers the freedom to adapt NASA's standard procedures to the unique needs of their projects. Same with Procter & Gamble reduced the number of procedures for capital projects from eighteen technical standards to four and thirty-two standard operating procedures to four.

This study included data collected from more than 150 successful project managers affiliated with more than twenty organizations, indicating that today's successful project managers cope with unexpected events by a combination of the traditional and agile assuming four roles.

Developing collaboration, and integrating planning and review with learning, are performed periodically. The third role, preventing major disruptions, is to be performed occasionally. The fourth role, maintaining forward momentum.

As a typical critical path activity in construction projects, the electrical installation must be completed on schedule in order not to cause project delay. A temporary power supply is needed for testing and commissioning various engineering services during the construction period. A pre-requisite for a building license is satisfactory completion of the electrical installation for the building. According to the Electricity (Wiring) Regulations, any fixed electrical installation shall be, after completion and before it is energized for use, be inspected, evaluated, and certified by registered electrical contractors.

Sixty-four consultants and sixty-eight contractors fill in a survey and data processing resulted in top-ranked delay factors are insufficient labor, late decision making of client, and insufficient electrical contractor. Both the consultant and contractor groups, strongly agree on the importance rankings of the delay factors existed between and the principal factor components were incompetent project team members, lack of skilled labor and poor on-site planning. These often result in the overrun of the construction budget allocated at project inception as well as the delay of potential income that could be obtained within the operation of constructed facilities. Some of the influential factors are lack of on-site coordination and interaction with other trades, subcontractor status, high technical and quality requirements, poor site management and supervision skills, and skilled labor shortage.

In this study, factor analysis was used to identify variability among the delay factors and determine the structure of the correlation between the factors. The frequency index, severity index, and the resultant importance index of each delay factor were calculated using equations (1) to (3)

$$I_F = \frac{\sum_{i=1}^{R} r_i \times n_{F,i}}{R \times T_F}; \quad (1)$$

$$I_S = \frac{\sum_{i=1}^{R} r_i \times n_{S,i}}{R \times T_S}; \quad (2)$$

$$I_M = I_F \times I_S; \quad (3)$$

$$I_{X,G} = \frac{\sum_{j=1}^{J} I_{X,J}}{J}, \quad (4)$$

where $n_{F,i}$ – number of responses for the i^{th} rating for occurrence frequency of each factor; $n_{S,i}$ – number of responses for the i^{th} rating for severity of each factor; r_i – rating of response; I_F – frequency index; I_M – importance index; I_S – severity index; $I_{X,G}$ – factor group index [X = F] (frequency), M (importance), or S (severity)]; J – number of factors in a factor group; R – maximum rating of response; T_F – total number of responses for occurrence frequency; T_S – total number of responses for severity.

Identify the primary causes of delays in the construction phase of building construction projects in China. The questionnaire survey method was used across the four typical cities in China, namely, Beijing, Shanghai, Chongqing, and Shenzhen. Two approaches were developed for comparative analyses (a) evaluate any different views among the respondents on the analyzed data, and (b) compare the findings with the related previous studies.

A literature review was conducted to define the causes of delay and filtered to fit in the questionnaire. Subsequently, certain filtrations of them were conducted through interviewing local experts and a pilot study to prove the accuracy and potential causes of delays to be used for questionnaire surveys. Six experts who have more than 20 years of experience in the subject, reviewed the survey. 115 responses to evaluate seventy-five causes of delay and experience diversity of participants were considered. The Central Limit Theorem, the mean of the samples would approach a normal distribution, was used to confirm the sample size is sufficient. The expected risk created by each cause of delay as perceived by each participant type and all respondents was calculated as the product of its average frequency rating and average impact size rating. Then, seven countries were selected and compared, namely, Hong Kong, Egypt, Malaysia, India, Turkey, and United Arab Emirates.

3.3 Ranking of delays causes

After analyzing those papers, it has been shown that there are three approaches to measure and rank the impact of these delay factors which are using the Severity Index (SI), Relative Important Index (RII), and Spearman rank correlation factor.

Starting with the Severity Index (SI), is used to rank the causes of delays factors based on impact level, and this can be done by following the below formula:

$$\text{Severity index } (\%) = \sum a\,(n/N) * 100/5$$

Where a = constant expressing weighting is given to each response, which ranges from 0 for no influence up to 5 for exceedingly high; n = frequency of the responses; and N = total number of responses.

$$\text{RII(Relative Importance Index)} = \frac{\Sigma W}{AxN}$$

W Weight given to each attribute by respondent
A Highest weight
N Total number of respondents

The attribute with the highest RII indicates that it has the maximum impact on the delay while the attribute with the lowest rank indicates that it has the least impact on delay duration.

After that, Spearman rank correlation is used to find out if there is a relationship between the selected attributes.

$$\boldsymbol{\rho} = 1 - \frac{6\sum d^2}{(n^3 - n)}$$

where $\boldsymbol{\rho}$ = Spearman's rank correlation coefficient; d = difference between the ranks indicated by two parties; and

n = number of records

4. CONCLUSIONS

This paper provided an insight into highlighting the major causes of delays from different geographical locations, the review and comparison the published papers findings based on the causes of delays from different geographical locations and ranking methodology that had been used across all these published papers.

REFERENCES

[1] Exploring Delays in Victoria-based Australian Pipeline Projects. A. ORANGI a*, E. PALANEESWARAN b , J. WILSON c. 14, 2011, Procedia Engineering, Vol. 1, pp. 874-881.

[2] Revisiting critical delay factors for construction: Analysing projects in Malaysia. Jeffrey Boon Hui Yap a, *, Pei Ling Gray a, Yoke Bee Woon a, Martin Skitmore. 60, 2021, Alexandria Engineering Journal, Vol. 1, pp. 1717–1729.

[3] Cause of Construction Delay - Theoretical Framework. N. Hamzaha*, M.A. Khoirya, I. Arshada, N. M. Tawilb and A. I. Che Anib. 20, 2011, Procedia Engineering, Vol. 1, pp. 490 – 495.

[4] Time Extension Factors in Construction Industry of Pakistan. S. Shujaa Safdar Gardezia, *, Irfan Anjum Manarvia, S. Jamal Safdar Gardezib. 77, 2014, Procedia Engineering, Vol. 1, pp. 196 – 204.

[5] Owners' perspective of factors contributing to project delay: case studies of road and bridge projects in Saudi Arabia. Ghazi Saad A Elawia*, Mohammed Algahtanyb, Dean Kashiwagic. 145, 2016, Procedia Engineering, Vol. 1, pp. 1402 – 1409.

[6] Exploring the significant factors that influence delays in construction projects in Hargeisa. Adebayo Adeboye Fashina a, *, Mustafe Abdillahi Omar b, Ahmed Abdullahi Sheikh c,. 7, 2021, Heliyon , Vol. 1.

[7] Time Delay and Cost Overrun in Qatari Public Construction Projects. Ahmed Senoucia*, Alaa Ismail, Neil Eldina. 164, 2016, Procedia Engineering, Vol. 1, pp. 368 – 375.

[8] Analysing factors affecting delays in Indian construction projects. Hemanta Doloi a, ⁎, Anil Sawhney b, K.C. Iyer b, Sameer Rentala c. 30, 2012, International Journal of Project Management, Vol. 1, pp. 479–489.

[9] Exploring delay causes of road construction projects in Egypt. Remon F. Aziz *, Asmaa A. Abdel-Hakam. 55, 2016, Alexandria Engineering Journal, Vol. 1, pp. 1515–1539.

[10] Causes of delay in Saudi public construction projects. Alsuliman, Jawad A. 58, 2019, Alexandria Engineering Journal (2019), Vol. 1, pp. 801–808.

[11] Morten Weldea and Ingri Bukkesteina. Projects, Overtime, or on time? A study of delays in large government. 196, 2022, Procedia Computer Science, Vol. 1, pp. 772–781.

[12] A Framework for Identifying Causal Factors of Delay in Nuclear Power Plant Projects. Samer Alsharif [1], Aslihan Karatas [2]. 145, 2016, Procedia Engineering, Vol. 1, pp. 1486 – 1492.

[13] The methodology of carrying out empirical research on the cumulative effect of the factors generating construction delays. Kaczoreka*, Krzysztof. 153, 2016, Procedia Engineering, Vol. 1, pp. 256 – 260.

[14] CAUSES OF DELAYS IN THE CONSTRUCTION PHASE OF CHINESE BUILDING PROJECTS.

[15] DELAYS IN CONSTRUCTION PROJECTS: A REVIEW OF CAUSES, NEED, AND SCOPE FOR FURTHER RESEARCH. Venkatesan, Prasad Kudrekodlu Venkatesh and Vasugi. 3, 2017, Malaysian Construction Research Journal, Vol. 23, pp. 89-113.

[16] Causes of Delay in Road Construction Projects. Mahamid1, Ibrahim, Bruland2, Amund and Dmaidi3, and Nabil. 2012, JOURNAL OF MANAGEMENT IN ENGINEERING.

[17] PROJECT DELAY: KEY ELECTRICAL CONSTRUCTION FACTORS IN HONG KONG. Betty W. Y. CHIUa, Joseph H. K. LAIb. 7, 2017, JOURNAL OF CIVIL ENGINEERING AND MANAGEMENT, Vol. 23, pp. 847–857.

[18] Causes and Mitigation Strategies of Delay in Power Construction Projects: Gaps between Owners and Contractors in Successful and Unsuccessful Projects. Jung, Edwin Thomas Banobi and Wooyong. 2019, Sustainability.

[19] Routing in Delay-Tolerant Networks under uncertain contact plans. Fernando D. Raverta, Juan A. Fraire , Pablo G. Madoery , Ramiro A. Demasi , Jorge M.

[20] A. Sullivan, F.C. Harris, Delays on large construction projects, Int. J. Operat. Product. Manage. 6 (1) (1986) 25–33.