PRODUCTION & MANUFACTURING | RESEARCH ARTICLE

Investigation of significant industrial project delay factors and development of conceptual framework

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\textbf{Abstract:} In developing countries, industrial projects play a vital role in achieving sustainable development. The late completion of projects suffers not only in the community but also the owners. The aim of the study is to investigate the main project delay factors and their impact on society, and the project owners. The factors are identified using the answers of 35 respondents, and are taken for a questionnaire. The respondents belong to investment office, commerce and industry office, contractors, clients, consultants, supervisors, and daily workers at the project site. Besides, interviews are taken. The relative importance index (RII) and Pareto analysis rule are used to analyze the data. It is found that among the 23 delay factors, the first 12 factors are significant. Both electric power shortage and finance approval progress contribute to the first top-two delay factors, as the Pareto 80/20 rule-based analysis demonstrates. A conceptual framework is developed to mitigate the impact of the delay. The major finding of the proposed framework can be used as a general framework to mitigate the impact of delay in all kinds of industrial projects.

\textbf{Subjects:} Industrial Engineering & Manufacturing; Manufacturing Engineering; Engineering Management; Production Engineering

\textbf{Keywords:} Delay Factors; Framework; Projects; Relative Importance Index; Pareto Analysis

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\textbf{PUBLIC INTEREST STATEMENT}

Project Delay is an unexpected postponement of projects because of several reasons that impedes the its continuation. This results a negative impact on project activities, and results as a whole. Even though there are some excusable delay factors, letting the work of project tasks for tomorrow not only affect the project owner but it will also limit the opportunities of the local society that they could get. This finding presented a framework so as to construct a roadmap that can enable stakeholders to complete the project on schedule.

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1. Introduction

Industrial projects are engines to spring up the economic growth of countries, especially for developing countries. In Ethiopia, it is shown that project delay is common and one of the most frequent problems (Gebrehiwet & Luo, 2017; Nasir, N. A., 2016). Even though there are scholarly acknowledged delay factors in industrial projects, the construction phase contributes a large proportion (Toor & Ogunlana, 2008; Upadhyay et al., 2016). Project delay does not only result in cost overruns and poor quality but it also creates greater arguments between parties when it is extended (Carvalho et al., 2019; Upadhyay et al., 2016).

The delay can be explained through the late completion of construction work relative to the designed schedule (Upadhyay et al., 2016). Construction facilities, infrastructure, building, and installation are usual delays in most industrial projects. These may occur in the preconstruction stage, in the construction time, and at the completion phase as Upadhyay et al. (2016) categorized. To compensate the completion time, there has to be a need for additional resources besides auxiliary experts’ and stakeholders’ costs. In different countries, scholars are attempted to forwarding the critical causes for delay using the interviewing and questionnaire method. From the investigation, designers, clients, contractors, and financial issues are the top problems, whereas a multicultural and multilingual environment, large numbers of project participants and the involvement of foreign designers are contributed as less significant (Toor & Ogunlana, 2008).

Previous studies, in Ethiopia, shows that the construction stage for industrial projects “counted 70% of time overruns and 76% of contractors and 56% of consultants with average time overrun of 10% to 30% from the basis of schedule that causes 50% cost for overruns” since 2017 (Gebrehiwet & Luo, 2017). As Gebrehiwet and Luo (2017) presented, Ethiopia is one of the fastest-growing and developing countries in Africa which has been focusing on the expansion of infrastructure. But many projects are not completing on schedule. The impact of the late complete project to stakeholders is many-sided. Because the client suffers from the loss of economic benefit for not putting the output to the intended function (Carvalho et al., 2019). If the finance was a loan from financial institutions, the contractor undergoes an added problem of mounting interest on nonperforming capital. The contractor on the other hand, not only gives the penalties of standby costs of non-engaged workers and tools, but it also needs expense on suspended materials in addition to overheads (Ojoko et al., 2016).

Gebrehiwet and Luo (2017) and Zarei et al. (2018) validated the investigation studied by Upadhyay et al. (2016) and it was found that the delay penalties put an impact in three stages. The critical factors were corruption, unavailability of utilities at site, inflation of material cost, lack of quality materials, late design, design documents, slow delivery of materials, late in approving and receiving of complete project work, poor site management & performance, late release budget, ineffective project, and planning. Gebrehiwet and Luo (2017) concluded by the relation performed in between delay factors and its impact in the project such that the overall average in preconstruction stage is highly related, the ongoing stage is the second related, postconstruction stage is the third related and preconstruction stage is far apart of all stages.

As far apart, it is tried to review research works forwarded by different scholars in different cases to present the significant impact of project delay in Ethiopia. Yearly, the government of Ethiopia has launched many grand, medium, and small projects. Though it is unethical to announce several projects that are not completed on time and planned budget, the complete performance is too low. This results poor-in-trust between people and the government because its contribution economically and politically is great. Hence, the delay of the industrial project got scholars’ attention to providing collaborated action so as to minimize its impact.

2. Impact of project delay in Ethiopia and related studies

Industrial projects are vital in creating sustainable growth for developing countries. But the late completion or termination of projects suffer social welfare in different circumstances. In this
related case studies are considered to reflect the impact of delayed projects and its performance as (Amir Hossein and Aurum, 2012; José Roberto, et al., 2018) in the community besides the project owner and participants.

For example, in Nigeria, the expected budget to complete the master plan was 36,000,000 USD and it took 15 years, but the continuous rise of inflation increased the cost of implementing the plan. Not only this, but time overrun and disputes were also negative impact (Sunjka, 2013; Aibinu, A. A., & Jagboro, G. O., 2002). Project delay, in the Brazilian wind energy, caused financial risk to drop the calculate net present value (NPV) over 30% in the first year and over 75% in the second year (Carvalho et al., 2019). In addition, in Cambodia, cost overruns in residential projects influenced the financial issue since the author (Durdyev et al., 2017) presented the research work.

Similarly, in Ethiopia, the influential effects of project delay are investigated as cost overrun, time overrun, termination of the contract, arbitration, and litigation (Gebrehiwet & Luo., 2017). From the investigation, cost and time overrun contributed the largest importance index proportion sequentially. However, the government is getting difficult to identify the significant delay factors that majorly retard the projects. The previous study was focused on the project stages where delay factors were involved. But this study is attempted to identify the significant delay factors using the relative importance index (RII) and Pareto analysis chart together that any of the selected scholars had not used. Finally, a conceptual framework is developed that is found capable to reduce its impact.

Generally, the main objective of this study is about investigating delay factors that significantly affect the due date of the project. The study is focused in local projects but related research-works are referred. This study used relative importance index and Pareto analysis rule together that the previous research output didn’t consider. The Pareto analysis provides vital few factors that are potential in causing the delay of projects when remedial action is not provided. But the previous scholars tried to solve the problem by considering many factors rather selecting the critical factors. Hence, these authors believed such approach as a research gap. Besides, the critical sub-causes are briefly listed and discussed in the final finding as shown in Figure 1 and 2.

**3. Research method**

The study adopts a quantitative survey method by identifying delay factors into categories, which makes it sustainable with the investigative nature of the research objective as supported by Durdyev et al. (2017). To achieve the desired objective of the research, empirical data are collected
from respondents that consists of the investment office, commerce and industry sector, contractors, clients, consultants, supervisors, and daily workers.

Before conducting the survey, three industry supervisors in investment office are invited for interview about “why most local industry projects aren’t completed on schedule?” which was first stage interview. In the second stage data collection the supervisor statements, collectively, helped the author to develop closed-ended questionnaire. The questionnaire was prepared in local language (“Amharic”) and presented for respondents so as to assure its relevance and clarity as R F. Aziz (2013). Not only the questionnaire but the interview is also held for groups who were not able to read and write for the given questions. Daily labors and technical supporters are the major part of the second stage interview.

The questionnaires were prepared in the form of closed-ended form that allowed the target respondents to voice their feeling to rate the importance of delay factors with a scale of 1 to 5 as many scholars used in their work (Aziz, 2013; Gebrehiwet & Luo, 2017). Before conducting the questionnaire, possible delay factors are identified and grouped into five categories as shown in Table 1. The respondents were males and females who were working in investment office, commerce and industry office, contractors, clients, consultants, supervisors, and daily workers. The weight of each questionnaire is developed to measure the relative importance thereafter its percentage contribution is translated into Pareto principle. Then, the top 80% of delay factors are identified. The sub-causes in each factor are also mentioned and developed by the framework.

3.1. Sampling design
RII is used to determine the relative importance of delay factors in industrial projects, in which the highest value indicates the critical factor that needs an immediate course of actions for the accomplishment of the project as related studies discussed (Aziz, 2013; Doli et al., 2012). The analysis is performed through a Likert five-point scale method such that Gebrehiwet and Luo. (2017), Doli et al. (2012), and Aziz (2013) applied. The relative important index (RII) ranges from 0 to 1 but 0 is not inclusive. The RII is formulated as:
\[ RII = \sum_{i=1}^{N} WiFi_{AN} \]  

where:

| Delay factor category | Delay factor description                  | Significance levels |
|-----------------------|-------------------------------------------|---------------------|
|                       |                                           | 1  | 2  | 3  | 4  | 5  |
| **Project owner**     | Inactive follow-up                        | 3  | 10 | 19 | 2  | 1  |
|                       | Sector/Position change                    | 21 | 10 | 3  | 1  | 0  |
|                       | Sell investment land                      | 8  | 11 | 9  | 2  | 5  |
|                       | Wrong feasibility study                  | 12 | 13 | 8  | 2  | 0  |
| **Government**        | Approval of finance statement in progress | 1  | 6  | 8  | 12 | 8  |
|                       | Electric power shortage                   | 0  | 2  | 6  | 7  | 20 |
|                       | Water availability                        | 3  | 7  | 16 | 6  | 3  |
|                       | Late in loan approval                     | 11 | 13 | 8  | 3  | 0  |
|                       | Road                                      | 12 | 9  | 7  | 4  | 3  |
|                       | Land clearance from 3rd subject           | 9  | 3  | 9  | 9  | 5  |
|                       | Interruption of corruption                | 13 | 7  | 4  | 6  | 5  |
| **Contractor**        | Lowest bid when win                       | 1  | 6  | 10 | 12 | 6  |
|                       | Incomplete scheduling                     | 11 | 9  | 7  | 5  | 3  |
|                       | Design wrong understanding                | 10 | 11 | 8  | 3  | 3  |
|                       | Wrong understanding for project constraints| 6  | 9  | 8  | 9  | 3  |
| **Consultant**        | Knowledge gap between design and consultant| 12 | 9  | 3  | 6  | 5  |
|                       | Late inspection building progress         | 4  | 7  | 11 | 10 | 3  |
|                       | Late approval of design                   | 15 | 9  | 4  | 5  | 2  |
| **Other factors**     | Material price inflation                  | 14 | 11 | 9  | 1  | 0  |
|                       | Material availability                     | 16 | 10 | 5  | 2  | 2  |
|                       | Political stability                       | 16 | 8  | 9  | 2  | 0  |
|                       | Productivity of labor and engineers       | 3  | 6  | 10 | 9  | 7  |
|                       | Technology                                | 11 | 8  | 13 | 3  | 0  |
3.1.1. Sampling size
The total number of respondents, “N”, are determined by sample size technique (Kothari, 2004). Respondents were demanded to mark the significance level for 23 identified delay factors. The measurement scale was designed as less significant 1, slightly significant 2, moderately significant 3, significant 4, and very significant 5. For doing this, 35 respondents are taken as shown below; herewith all responses were collected effectively.

\[
N = \frac{Z^2 \cdot P(1 - P)}{e^2}
\]  
(2)

where:

- \(N\) = sample size
- \(Z\) = \(Z\) value (1.96 for 95% confidence level, from \(z\)-distribution table)
- \(P\) = percentage of choice in decimal (0.3 recommended for the defined sample size)
- \(e\) = margin of error (better to take 10% since respondents are small in number rather taking smaller margin of error)

\[
N = \frac{1.96^2 \cdot 0.3(1 - 0.3)}{0.1^2}
\]

\[N = 34.57\]

\[N = 35\]

Given the required sampling size, data are collected from the respondents according to five delay factor categories. The survey presents twenty-three (23) delay factors according to related research works that riched with delay description. For doing so, identifying the delay factors in category sounds the accomplishment of projects (Alsharif & Karatas, 2016; Hamzaha et al., 2011; Shebob et al., 2012). Accordingly, the following results in the table are obtained. The table illustrates the number of marked values with significance level and its relative importance index value, which is obtained from the respondents. After doing the RII, the Pareto analysis chart is also used to identify the 80% significant delay factor.

4. Results discussion
After collecting the responses, data are fed into equation 1 so that the relative importance index weight was investigated. The results are then put into rank, from largest to smallest as shown in Table 2.
Table 2. The result of Relative importance Index, sorted from largest to smallest values. The first twelve factors are found significant

| Rank | Delay factor                                      | Relative importance Index (RII) |
|------|--------------------------------------------------|--------------------------------|
|      | Electric power shortage                          | 0.857                          |
|      | Approval of finance statement in progress        | 0.714                          |
|      | Lowest bid when win                              | 0.691                          |
|      | Productivity of labor and engineers              | 0.663                          |
|      | Late inspection building progress                | 0.606                          |
|      | Land clearance from 3rd group                    | 0.605                          |
|      | Water availability                               | 0.594                          |
|      | Wrong understanding for project constraints      | 0.565                          |
|      | Inactive follow-up                               | 0.531                          |
|      | Sell investment land                             | 0.514                          |
|      | Knowledge gap between design and consultant      | 0.503                          |
|      | Interruption of corruption                       | 0.502                          |
|      | Incomplete scheduling                            | 0.485                          |
|      | Design wrong understanding                       | 0.474                          |
|      | Road                                             | 0.468                          |
|      | Technology                                       | 0.446                          |
|      | Late approval of design                          | 0.428                          |
|      | Late in loan approval                            | 0.417                          |
|      | Wrong feasibility study                          | 0.400                          |
|      | Material availability                            | 0.394                          |
|      | Material price inflation                         | 0.383                          |
|      | Political stability                              | 0.382                          |
|      | Sector/Position change                           | 0.308                          |

The RII value of each factor measures the significance of project delay. But the stakeholders usually get difficulties to take action for all factors. Thus, the researcher suggested that presenting the most critical delay factors using Pareto analysis sounds the investigation (Stojcetovic et al., 2015). In the Pareto analysis, 80% of significant delay factors can minimize the impact of the remaining 20%’s as Stojcetovic et al. (2015) applied it in quality management. The RII results are then taken through using the Pareto analysis method. The following Pareto chart, developed by excel 2016, shows the percentage contribution of each delay factor with the 80/20 rule.

5. Development of conceptual framework based on results discussion

The importance of attributes for each factor is considered as significant if the RII value is greater than 0.5 (Khair et al., 2018). Based on the fact, the first twelve factors are being considered significant as shown in Table 2. However, due to time and resource limitation, only the two factors are considered, and it is believed that these factors are found capable to dominate the remaining 21 delay factors using the Pareto analysis rule. As it can be seen from Table 2, the factors are electric power shortage that contributed (0.857), and the approval of the financial statement in progress contributed (0.714).

Based on the analysis of the results and from deeply thinking on the actions proposed to minimize the delays in industrial projects, a framework is developed to improve the project management from start to completion time. The development of the framework emphasized the
two dominant factors. As Gebrehiwet and Luo (2017) studied, projects in Ethiopia mainly passed through three basic phases called preconstruction, in the construction time and completion phase. This study took these categories and the survey showed that the approval of financial statements in progress is needed (especially in the construction time) in each phase whereas electric power shortage is very essential at the completion time.

5.1. Pre-project phase
The pre-project phase is an essential basement so as to accomplish the right project at the right time as previous studies suggested (Hosein & Ray, 2020). This needs an in-depth understanding about the project nature interims of financial and technical aspects for delivering complex and challenging projects successfully else decision can fail to achieve the goal (Cook & Mo, 2018).

Under this phase, all possible project guidelines and requirements are listed. The phase needs that all financial and legal issues should be completed earlier. Electric power shortage and approval of finances in progress didn't matter the project delay. This is assured from the collected, Table 2, and the possible delay factors are categorized as the pre-project phase. A summary of these factors are mentioned as follows:

(1) Relatively lowest bid  
(2) Sector change (before construction)
(3) Sell investment land
(4) Wrong feasibility study
(5) Land clearance from 3rd subject
(6) Interruption of corruption
(7) Late approval of design
(8) Late in loan approval (agreement with financial aid agents)

5.2. In the construction time
In the construction time, the industrial projects are custom-built and handed for performing the activities. In this phase, the approval of the financial statement in progress starts impacting the completion of the project. There are identified delay factors, Table 2, that cause the formal movement of construction in time to be delayed. Here, the project manager, clients, and the stakeholders should ensure that all required commissioning activities have been progressed in a planned timeframe. The followings are those identified delay factors in the construction time.

(1) Productivity of labor and engineers
(2) Late inspection building progress
(3) Wrong understanding for project constraints
(4) Inactive follow-up
(5) Knowledge gap between design and consultant
(6) Interruption of corruption
(7) Incomplete scheduling
(8) Design wrong understanding
(9) Material availability
(10) Material price inflation
(11) Approval of finance statement in progress
   (i) Late in cash payment
Poor money cashflow management

Inadequate finance resource

Poor market forecasting (finance instability)

The sub causal factors for approval of financial statements in progress are depicted in the conceptual framework as shown in Fig.

5.3. Project completion
In the project completion, from Table 2, electric power shortage, water availability, road, technology, interruption of corruption, and political stability are causes of delay. From these factors, the electric power shortage is contributed to the first top rank. By this phase, the project managers should ensure that all the required activities are completed satisfactorily. The summary of power shortage causes related to project closing are mentioned as follow:

(1) Electric Power shortage
   (i) Insufficient electric power shortage
   (ii) Storms (wind associated with rain)
   (iii) Trees (during high rain, when trimmed)
   (iv) Lightning
   (v) Vehicles (during collision)
   (vi) Animals
   (vii) Thieves (for making traditional jewelry)

5.4. An assessment and suggestion of proposed conceptual framework
The development of framework not only for developed, but it also helped for stakeholders in developing countries in order to complete the project as per schedule (Khodeir & Nabawy, 2020). The framework can also be used to identify the significant causal factors for project delay (Alsharif & Karatas, 2016).

In this study, the initial conceptual framework was developed and presented for the selected team that is brought from each project site. The assessment was made in between the team so that good review and evaluation were recorded. The framework was developed based on the questionnaires, analysis, from the team discussion, and related research findings. This makes the developed conceptual framework reliable. In line with project phases, the major input factors (electric power shortage and approval of finance in progress) are described in the framework.

For the approval of finance issues, it is suggested to apply the mentioned points that are used as input in the second decision module. And to improve the electric power shortage, four basic requirements are considered as shown in Figure 2. When the framework developed, a similar research finding approaches are considered, that are referred in section 5 (previous paragraphs).
Then, the conceptual framework was reviewed after referring the inputs obtained from the team discussion and the results brought with the final framework as shown in Figure 2.

The results indicated that within the construction time, the electric power shortage contributed a large effect on delay in industrial projects, followed by approval of finance in progress. The proposed conceptual framework of this investigation can provide a new measurement metric in industrial projects. Not only this but it can also serve as a guideline for stakeholders to facilitate the completion time. In general, the framework can minimize the effect of delay factors. As shown in Figure 2, delay factors above 80% represent vital few whereas the remaining are trivial many and they can be minimized when the vital few are getting resolved. In this study, the vital few do not mean the significant factors are few instead it identified which delay factors contribute above 80%.

5.5. Conclusion
This study identified a set of delay factors affecting the completion time of industrial projects in the case study. By considering both the relative importance index and Pareto analysis rule, significant delay factors are identified. For instance, among the 23 selected delay factors, the first 12 are found significant. But the electric power shortage and approval of finance in progress are found the first top two significant delay factors using the Pareto rule.

The two factors contributed 80% referred to as vital few since they are capable to dominate the trivial many delay factors. In the vital few techniques, four sub causes that delay the project are identified and comparatively seen with the previous studies in accordance with the selected team so that the conceptual framework is proposed. The proposed conceptual framework can provide an eye-opening project measurement and serve as a guide for stakeholders to minimize the impacts.

The framework is found to minimize the delays, facilitate the finance approval process, provide a monitoring map, a pre-cautionary system for impending the budget. And it also gives timely decisions where the problem happens. In general, the use of the relative impotence index and Pareto analysis rule together makes this study unique the proposed conceptual framework. Thus, it is concluded that the proposed framework is of great significant for similar industrial projects.

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References
Albinu, A. A., & Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigerian construction industry. International Journal Of Project Management, 20(6), 593–599. https://doi.org/10.1016/S0263-7863(02)00028-5
Alishari, S., & Karatas, A. (2016). A framework for identifying causal factors of delay in nuclear power plant projects. International Conference On Sustainable Design, Engineering And Construction (pp. 1486–1492). Elsevier.
Amir Hossein, G., & Aurum, A. (2012). The impact of project capabilities on project performance: Case of open source software projects. International Journal Of Project Management, 30(6) 407–417. https://doi.org/10.1016/j.ijproman.2011.10.002
Aziz, F. (2013). Factors causing cost variation for constructing wastewater projects in Egypt. Alexandria Engineering Journal: Elsevier, 52(1), 51–66. https://doi.org/10.1016/j.aej.2012.11.004
Aziz, R. F. (2013). Ranking of delays in construction projects after Egyptian revolution. Alexandria Engineering Journal, 52(3), 387–406. https://doi.org/10.1016/j.aej.2013.03.002
Carvalho, Bárbara L. Pinto, Eduardo C., Guardia, Marangoan Lima. (2019). Economic impact of anticipations or delays in the completion of power generation project in the Brazilian energy market. Elsevier: Renewable Energy, 147(1), 1312–1320. https://doi.org/10.1016/j.renene.2019.09.074
Cook, M., & Mo, J. P. T. (2018). A systems approach to life cycle risk prediction for complex engineering projects. Cogent Engineering: Mechanical Engineering, 5(1)1–13. https://doi.org/10.1080/23311916.2018.1451289
Doloi, H., Sawhney, A., Iyer, K. C., & Rentala, S. (2012). Analysing factors affecting delays in Indian construction projects. International Journal Of Project
Abebe & Germew, Cogent Engineering (2021), 8: 1938936
https://doi.org/10.1080/23311916.2021.1938936

Management: Elsevier, 30(4), 479–489. https://doi.org/10.1016/j.jproman.2011.10.004

Durdyev, S., Maksat Omarov, Syuhaida Ismaili and Mengheng Lim. (2017). Significant contributors to cost overruns in construction projects of Cambodia. Cogent Engineering: Civil & Environmental Engineering, 4(1), 1–10. https://doi.org/10.1080/23311916.2017.1383638

Gebrehiwet, T., & Luo., H. (2017). Analysis of delay impact on construction project based on Rii And. Procedia Engineering:Sciedirect, 196, 366–374. https://doi.org/10.1016/j.proeng.2017.07.212

Hamzah, N. A. Khoiry, I. Arshad, M. Tawil and I. Che Ani. (2011). Cause Of Construction Delay - Theoretical Framework. The 2nd International Building Control Conference 2011 (pp. 490–495). Elsevier.

Hosein, G., & Ray, I. (2020). Priority analysis of pre-investment risks. Cogent Engineering: Civil & Environmental Engineering, 7(1), 1–20. https://doi.org/10.1080/23311916.2020.1757183

José Roberto, D.-R. J. L.-A.-L.-S.-M.-F.. (2018). Impact of infrastructure and production processes on Rioja Wine supply chain performance. Mdpi Sustainability, 7(1), 1–14. https://doi.org/10.3390/su10010103

Khair, K., Hamzah, Z. Mohamed, R. Mohammad, H. Farouk & M. Ahmed. (2018). A management framework to reduce delays in road construction projects in Sudan. Research Article - Civil Engineering: Springer, 1925–1940. https://link.springer.com/article/10.1007/s13369-017-2806-6

Khodeir, L. M., & Nabawy, E. M. (2020). Responsive human resource framework for design and building of Mega housing development projects in Egypt. Ain Shams Engineering Journal: Elsevier, 12(2), 1–13. https://doi.org/10.1016/j.asej.2020.09.025

Kothari, R. (2006). Research methodology. New Age International (P) Publisher.

Nasir, N. A. (2016). Issue of delay in construction industry: Local project participants perspective. Revista De La Facultad De Ingeniería U.C.V. 11–15. https://www.semanticscholar.org/paper/Issue-of-Delay-in-Construction-Industry%3A-Local-Nasir/8fda0f6d2a60e77500ae9f85b30bddd73c05d7e

Ojoko, O. Tanko, M. Jibrin, and L. Enegbuma. (2016). Project Delay Causes And Effects In The Construction Industry. Universiti Teknologi Malaysia, Johor Bahru, Malaysia Jcgesh 2016, 221–223.

Shebob, N. Dowood, R.K. Shah and Q. Xu et al (2012). Comparative study of delay factors in Libyan and the UK construction industry. Engineering. Construction And Architectural Management Emerald Article, 688–712. https://www.emerald.com/insight/content/doi/10.1108/09699981211277577/full/html

Stojcevic, Ž. Šarkočević, D. Lazarevic and D. Marjanović. (2015). The application of pareto nalysis in project management. 9th International Quality Conference, University of Kragujevac (pp. 655–658).

Sunjka, P. (2013). Significant causes and effects of project delays in the Niger Delta region, Nigeria. Soaic25 Proceedings, (pp. 641–655). South Africa.

Toor, R., & Ogunlana, S. (2009). Problems causing delays in major construction projects in Thailand. Construction Management And Economics, 26(4), 395–408. https://doi.org/10.1080/01446190801905406

Upadhyay, A., V. Gupta; Dr. Mukesh Pandey. (2016). A case study on schedule delay analysis in construction. International Research Journal Of Engineering And Technology (Ijret), 3(5), 1312–1315. https://www.ijret.net/archives/V3/I5/IJRET-V3I5269.pdf

Zarei, B., Et, A., & Chaghouee, Y. (2018). Delay causes analysis in complex construction projects: A semantic network analysis approach. Production Planning & Control, The Management Of Operation, 29(1), 29–40. https://doi.org/10.1080/09537287.2017.1376257
