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## **ANALYSING CAUSES OF DELAY IN SARAWAK'S CONSTRUCTION INDUSTRY**

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### **Abstract**

Construction delays are recurring issues in the construction industry. In Malaysia, numerous studies on construction delays have been conducted. However, studies specifically focused on Sarawak, the largest state in Malaysia, remain limited, despite the issue being common in the state. Therefore, the present study aimed to analyse the causes of delay from the perspectives of construction stakeholders in Sarawak. Two objectives were set to achieve the aim: (i) to prioritise the causes of delay and (ii) to examine if there are statistically significant differences in the rankings of causes of delay between clients, consultants, and contractors. A quantitative research method was adopted to collect research data by sending semi-structured questionnaires to the respondents. Eventually, 79 valid responses were collected. The data was analysed using the Descriptive Statistics method for ranking causes of delay and the Kruskal-Wallis test for examining the differences between groups. The results showed that the top three significant causes of delay are labour shortages, increases in material prices, and material shortages. The Kruskal-Wallis test revealed that there is consensus among the construction stakeholders for 65 causes, but differences also exist for 11 causes. The present study provides a comprehensive assessment of 76 causes of delay across different respondent groups. Therefore, the findings could provide valuable insights for the construction stakeholders. Mitigation strategies can be planned before project implementation to reduce the delay issues in Sarawak's construction industry.

**Keywords:** Delay, Construction Industry, Kruskal-Wallis Test, Sarawak, Malaysia

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## **INTRODUCTION**

Delay is a common issue in the construction industry; Malaysia is no exception (Adeleke et al., 2021; Bano et al., 2023; Faizal et al., 2025). According to Aziz and Prasetijo (2022), delay has become a major issue over the past few decades. Delay can bring many unfavourable consequences, including time and cost overruns, stakeholders' dissatisfaction, and negative reputation of the construction industry (Bano et al., 2023). The project's success is commonly tied to its timely completion; therefore, delays can affect the overall success of a project (Zagia et al., 2025). Additionally, these issues also affect the economic growth, long-term development of Malaysia, and the standard of living of the populace (Aziz et al., 2025; Zagia et al., 2025). In Malaysia, numerous studies have been conducted to examine the causes of delay and/or their prevention strategies (Adeleke et al., 2021; Aziz et al., 2022; Faizal et al., 2025; Sa'ad et al., 2022; Sharuddin et al., 2024). However, the delay issues persist. Additionally, a comprehensive literature review uncovers that previous studies mostly focused on West Malaysia. Similar studies on delay issues in Sarawak remain limited. Therefore, the present study aimed to analyse the causes of delay from the perspectives of construction stakeholders in Sarawak. To the best of the authors' knowledge, the present study is among the first to comprehensively examine 76 causes of delay across different respondent groups. Apart from bridging the gap of literature, it is also anticipated that the findings of the present study could provide valuable information to Sarawak's construction industry in reducing project delays.

## **LITERATURE REVIEW**

### **Construction Delay and Its Impacts**

According to Radmman et al. (2021), "delay" can be defined as "extra time required or incurred either beyond the stipulated completion date or beyond the project stakeholders' date to complete the project". Tariq and Gardezi (2023) noted that it refers to a project's deviation from its targeted schedule, which is a common problem in the construction industry. The common impacts of delay in includes cost & schedule overruns, scope creep, low quality, and customer dissatisfaction (Amoah et al., 2020). Furthermore, if not properly monitored, delay can also cause project abandonment and construction disputes (Aminorlah et al., 2023; Hoque et al., 2021). Additionally, if a project is delayed and necessitates work acceleration, this may increase weariness and the level of stress among the workers, thus increasing the risk of accidents (Sharuddin et al., 2024).

### **Causes of Delay**

Delay can arise from various factors involving clients, consultants, contractors, and external factors (Thorat et al., 2017; Ullah et al., 2018). The common causes involving clients include variation orders, delay in payment, and poor

communication with other parties. Variation order may cause delay because it necessitates temporarily halting the project to allow the contractor to accurately document the changes. Variation order requires project rescheduling, impacts costs, and potentially results in lower quality works (Alshiri et al., 2022). Delay in payment is another common cause of delay. Contractors often rely on the payment from the client to fund the projects. In case of late payment, the contractors may be unable to afford the labour and material costs, which result in delay (Masrom et al., 2021; Shahron et al., 2023). For poor communication with other parties, this issue often stems from unclear information provided to the consultants and contractors by the client (Hasib & Al-Kilidar, 2021). This can lead to slow in decision making and poor design documents (Assaf et al., 2018).

The causes involving the consultants commonly include poor communication, delay in consultant's performance, mistakes and discrepancies in design and contract documents. Poor communication may result in design discrepancies and reworks, thus leading to delays (Aminorlah et al., 2023). Timely provision of drawings is a key responsibility of consultants; delayed in this aspect can cascade into project delays (Thorat et al., 2017). Delay in consultant's performance such as slow in providing feedback or crucial decision can also affect project timelines (Aldammark et al., 2025). Besides, design mistakes can lead to inaccurate project estimates, necessitating redesign, re-estimation and rework, thereby extending project timelines (Tahmasebinia & Song, 2022).

Delay can also be caused by contractors. The common causes include skill deficiency & low productivity of labour, poor management, and difficulties in financing projects. The Malaysian construction industry relies on foreign workers excessively (Bariono & Kamaruding, 2025; Hoo et al., 2024). However, most of the foreign workers do not possess sufficient skills to meet the local demands. Low level of skills often lead to substandard works and low productivity (Bariono & Kamaruding, 2025; Hoo et al., 2024). Effective site management is essential to ensure projects are completed on schedule by determining, planning, organizing, and controlling the use of resources (Aforla, 2016; Hasib & Al-kilidar, 2021; Tahmasebinia & Song, 2022). Poor management often caused low quality works which subsequently result in reworks (Aforla, 2016). Difficulties in financing projects can be due to poor cash flow management of the contractor, which include managing too many tasks at a time, underbidding a project, and inconsistent cash flow forecasting (Shahron et al., 2023).

Another type of delay is caused by external factors, which include severe weather conditions, national labour shortage, and changes in government requirements and regulations. Severe weather conditions, such as rain can lead to flooding, cause infrastructure failure, and impact site equipment and material transportation (Adeleke et al., 2021). Additionally, rainy, hot or dry conditions

can also cause physical discomfort among labours, thus affecting labour productivity (Gashahun, 2020). According to Hailu et al. (2023), labour related factors such as labour shortage are the most significant contributors to project delays. This issue is often stemmed from workplace hazards and low wages, prompting local workers to seek better-paying opportunities elsewhere (Theng & Techapeeraparnich, 2020). Changes in government regulations include restrictions on building material importation, inflation and interest rates (Opeyemi et al., 2022). The projects become more complicated where there is a change in regulations (Alshihri et al., 2022), and the project stakeholders will need to modify their initial plan to suit with the new regulations (Arantes & Ferreira, 2020).

### **Research Gap**

Numerous studies have been conducted in Malaysia to study the causes of delay, including those by Aminorlah et al. (2023), Hisham & Yah (2016), Memon et al. (2014), Mydin et al. (2014), Othman & Ismail, (2014), Shehu et al. (2014), and Yap et al. (2021). However, these studies primarily focused on Peninsular Malaysia. Studies specifically focused on Sarawak, the largest state in Malaysia, remain limited, despite the issue being common in the state. Some delayed projects include the construction of new classrooms and hostel at SK Metalun, which recorded a 785 days delay (Free Malaysia Today, 2025a), construction of multi-purpose hall at the Institute for Rural Advancement, which recorded an approximately 23 % behind the schedule (Borneo Post Online, 2025a), Dalat road project, which experienced 70 days delay (Borneo Post Online, 2025b), and Sejingkat Bridge project (Sarawak Tribute, 2025). Additionally, sick housing projects (DayakDaily, 2025a; Sarawak Tribute, 2025) and rural development projects (DayakDaily, 2025b) were also reported. Therefore, more studies focusing on Sarawak are necessary.

### **RESEARCH METHOD**

The present study adopted a quantitative research method as the authors intended to collect information from geographically dispersed respondents in Sarawak. Targeted respondents include clients (both public and private sectors), consultants (architects, engineers, and quantity surveyors), and G7 contractors, because they are the key stakeholders in the construction industry. Structured questionnaires were physically delivered to the targeted respondents and also sent to them via email. Each set of questionnaire consists of two sections. Section A was used to collect general information of the respondents including gender, group, and working experience. Under Section B, the respondents were requested to rank the 76 causes of delay based on a 5-point Likert scale, where 1 = Not significant, 2 = Slightly significant, 3 = Moderately significant, 4 = Significant, 5 = Very Significant. All the causes of delay were identified and compiled based

on a comprehensive literature review. Next, the similar or overlapped causes were reviewed and consolidated to prevent duplication. Subsequently, a content validation process was carried out with 5 experts, comprising 2 academicians, 1 client, 1 consultant, and 1 contractor, to assess the appropriateness and relevancy of the refined list of delay causes. Based on the experts' comments, further modifications were made. Eventually, the total number of delay causes was fixed at 76.

Convenience sampling method was adopted in the present study. This is because the respondents were geographically dispersed and it was difficult to access a comprehensive sampling frame (Memon et al., 2025). It is also a cost effective and less time-consuming method (Golzar et al., 2022). Questionnaires were distributed to conveniently available respondents (Ahmed, 2024), including through personal delivery to facilitate participation. In addition, snowball sampling method was also adopted to recruit respondents through referrals from initial respondents to improve response rate (Ting et al., 2025). The collected data were analysed using Descriptive Statistics in SPSS to calculate the mean values and standard deviations of each cause of delay. Thereafter, a nonparametric Kruskal Wallis test was run to examine whether the distributions among different groups differ significantly. The significance level was set at 0.05, while the confidence interval was set as 95%. The effect sizes were calculated using epsilon squared formula (Tomczak & Tomczak, 2014), where  $H$  = Kruskal Wallis  $H$  statistics, and  $n$  = total sample size. The formula is as follows:

$$E^2_R = \frac{H}{(n^2 - 1)/(n + 1)}$$

Additionally, K independent samples test under the legacy dialogs was also run to examine the mean ranks of different groups for each cause of delay.

## **DATA ANALYSES AND DISCUSSIONS**

### **General Information of the Respondents**

Out of 350 questionnaires sent, 79 valid questionnaires returned, representing a response rate of 22.6%. Table 1 shows the general information of the respondents. Most of the respondents were male (73.4%), whereas female respondents accounted for 26.6%. As for the respondent's group, most of them were contractors (54.4%), followed by client (25.3%) and consultant (20.3%). There was an unequal distribution of respondents due to differences in willingness to participate in the survey and respondent accessibility. To address this issue, the responses were also analysed according to the three respondent groups, as shown in Table 3, 4, and A1. Regarding the working experience, the majority of respondents possessed more than 10 years of working experience. 20.3% of respondents had more than 20 years of experience.

**Table 1:** General Information of the Respondents

|                    | Category           | Frequency | Percentage |
|--------------------|--------------------|-----------|------------|
| Gender             | Male               | 58        | 73.4%      |
|                    | Female             | 21        | 26.6%      |
| Group              | Client             | 20        | 25.3%      |
|                    | Consultant         | 16        | 20.3%      |
|                    | Contractor         | 43        | 54.4%      |
| Working experience | Less than 5 years  | 7         | 8.9%       |
|                    | 5 to 10 years      | 22        | 27.8%      |
|                    | 11 to 15 years     | 26        | 32.9%      |
|                    | 16 to 20 years     | 8         | 10.1%      |
|                    | More than 20 years | 16        | 20.3%      |

### Reliability Analysis

The reliability of the questionnaire was analysed using Cronbach Alpha. As shown in Table 2, the Cronbach Alpha values for all categories exceeded the recommended threshold of 0.70, indicating good internal consistency (Hair et al., 2016, Taber, 2018).

**Table 2:** Cronbach Alpha Values of the Delay Categories

| Category                                    | Cronbach Alpha |
|---------------------------------------------|----------------|
| Causes of delay related to clients          | 0.907          |
| Causes of delay related to consultants      | 0.944          |
| Causes of delay related to contractors      | 0.957          |
| Causes of delay related to external factors | 0.933          |

### Descriptive Statistics and Ranking of Causes of Delay

The overall rankings of the 76 causes of delay are presented in Appendix A (Table A1). The rankings were based on responses from (i) all parties (N = 79), (ii) clients (N = 20), consultants (N = 16), and contractors (N = 43). Based on Table A1, the top five rankings of the causes are summarized in Table 3.

As shown in Table 3, the most critical cause of delay is “labour shortage”. From the consultant’s perspective, this cause ranked first, whereas from the client’s and contractor’s perspectives, this cause ranked fourth. This finding is consistent with the current issue faced by Sarawak. According to the Sarawak Deputy Premier, contractors in Sarawak are facing a severe shortage of skilled workers due to the implementation of numerous infrastructure projects and strict immigration rules, which render the employment of foreign workers difficult (Department of the Premier of Sarawak, 2025a; Free Malaysia Today, 2025b). Sarawak’s construction industry remains relying heavily on foreign labours, especially from Indonesia. A comprehensive analysis conducted by the Dayak Chamber of Commerce and Industry (DCCI) revealed that many construction-related jobs are unattractive to the locals due to limited benefits, low

wages, and physically demanding conditions (Borneo Post Online, 2025c). Furthermore, Indonesia has tightened the immigration policy so that local projects, particularly Nusantara's new capital development, can be prioritized (Borneo Post Online, 2025c).

**Table 3:** Top Five Rankings Based on Overall 76 Causes of Delay

| All parties<br>(N = 79) |                                            |      | Client<br>(N = 20)                   |      | Consultant<br>(N = 16)                                   |      | Contractor<br>(N = 45)                     |      |
|-------------------------|--------------------------------------------|------|--------------------------------------|------|----------------------------------------------------------|------|--------------------------------------------|------|
| Rank                    | Causes                                     | M    | Causes                               | M    | Causes                                                   | M    | Causes                                     | M    |
| 1                       | Labour shortage (C15)                      | 3.91 | Poor management and supervision (C4) | 3.95 | Labour shortage (C15)                                    | 4.13 | Increase in material prices (D1)           | 4.00 |
| 2                       | Increase in material prices (D1)           | 3.79 | Unforeseen ground conditions (D4)    | 3.95 | Inaccurate estimate of the project (C19)                 | 3.94 | Material shortage (D2)                     | 3.95 |
| 3                       | Material shortage (D2)                     | 3.79 | Material shortage (D2)               | 3.90 | Skill deficiency and low productivity among workers (C6) | 3.88 | Variation order (A3)                       | 3.91 |
| 4                       | Subcontractors' or suppliers' issues (C12) | 3.72 | Labour shortage (C15)                | 3.90 | Subcontractors' or suppliers' issues (C12)               | 3.87 | Labour shortage (C15)                      | 3.84 |
| 5                       | Variation order (A3)                       | 3.72 | Severe weather conditions (D5)       | 3.80 | Late delivery of materials to the site (C2)              | 3.81 | Delay in the consultant's performance (B2) | 3.79 |

Note: N= number of respondents; M = mean value

The cause ranked second is “increased prices of materials”. From the contractor’s perspective, this is the most critical cause, ranking first. According to the data released by the Department of Statistics Malaysia (DOSM, 2025), on a year-on-year basis, the steel prices showed a declining trend in 2025, while cement and sand showed an increasing trend. This suggests that construction costs remain under pressure. According to Sarawak Housing and Real Estate Developers’ Association (SHEDA) (Borneo Post Online, 2025d), the construction industry has been experiencing rise of materials cost as well as construction service due to the expanded SST and e-invoicing system.

“Material shortage” ranked third within the all parties category, whereas from the clients’ and the contractors’ perspectives, it is ranked third and second, respectively. In recent years, some reasons of materials shortage include shortage of cement due to rapid infrastructure development (Office of the Premier of Sarawak, 2023), delays in importing materials (MalayMail, 2023), and constructing projects in remote areas, where building materials are limited (DayakDaily 2025c; Department of the Premier of Sarawak, 2025b).

“Subcontractors' or suppliers' issues” ranked fourth (3.722) in the present study. Similarly, in a study conducted by Yap et al., (2021) in Malaysia,

“incompetent subcontractors” ranked second. Previous studies also reported that incompetent subcontractors and suppliers often cause poor performance and lead to project delays (Aldammark et al., 2025; Romzi and Doh, 2022; Sarpin and Ramesh, 2024; Yap et al., 2021). According to Yap et al. (2021), the successful project completion in Malaysia depends on the competency of the project team and the performance of the subcontractors and suppliers. Therefore, to ensure the project success, main contractors should build a reliable subcontractors and suppliers pool and have good communication with them (Sarpin and Ramesh, 2024). According to Faizal et al. (2025), ensuring clear communication with the suppliers and collecting data from them regularly can help mitigate the issue of material shortage (ranked third in the present studies).

“Variation order” ranked fifth within the all parties category, and ranked third from the contractors’ perspective. Variation orders are not only a common cause of delay globally (Ismail & Sobaih, 2024; Romzi and Doh, 2022), but also frequently occur in the Malaysian industry, commonly leading to cost and time overruns (Mohammad et al., 2022). This finding is consistent with the study conducted in Malaysia by Yap et al. (2021), who reported that “too many change orders by clients” ranked second of the leading causes of delay. In a study conducted by Sharuddin et al. (2024), “design changes during construction” ranked fourth among the factors causing delay. According to Amzafi et al. (2024), some of the most common causes of variation orders include errors and omission in designs, change in design by consultants, lack of coordination between the consultant and the contractor, and unforeseen site conditions.

Apart from the overall ranking based on the 76 causes delay, the top three barriers within each category of delay are presented in Table 4.

**Table 4: Top Three Rankings of the Causes of Delay (Based on Category)**

| All parties<br>(N = 79)                       |                                                          |      | Client<br>(N = 20)                           |      | Consultant<br>(N = 16)                               |      | Contractor<br>(N = 45)    |      |
|-----------------------------------------------|----------------------------------------------------------|------|----------------------------------------------|------|------------------------------------------------------|------|---------------------------|------|
| Rank                                          | Causes                                                   | M    | Causes                                       | M    | Causes                                               | M    | Causes                    | M    |
| <b>Causes of delay related to clients</b>     |                                                          |      |                                              |      |                                                      |      |                           |      |
| 1                                             | Variation order (A3)                                     | 3.72 | Type of project bidding and award (A14)      | 3.60 | Type of project bidding and award (A14)              | 3.50 | Variation order (A3)      | 3.91 |
| 2                                             | Slow decision-making (A6)                                | 3.56 | Large project size and complex project (A19) | 3.60 | Variation order (A3)                                 | 3.38 | Slow decision-making (A6) | 3.67 |
| 3                                             | Delays in obtaining approval from the municipality (A18) | 3.49 | Variation order (A3)                         | 3.60 | Unrealistic contract duration and requirements (A11) | 3.31 | Delay in payment (A2)     | 3.61 |
| <b>Causes of delay related to consultants</b> |                                                          |      |                                              |      |                                                      |      |                           |      |
| 1                                             | Change in design and                                     | 3.56 | Delay in the consultant’s                    | 3.60 | Change in design and specification                   | 3.38 | Delay in the consultant’s | 3.79 |

| All parties<br>(N = 79)                            |                                            |      | Client<br>(N = 20)                                   |      | Consultant<br>(N = 16)                                             |      | Contractor<br>(N = 45)                                             |      |
|----------------------------------------------------|--------------------------------------------|------|------------------------------------------------------|------|--------------------------------------------------------------------|------|--------------------------------------------------------------------|------|
| Rank                                               | Causes                                     | M    | Causes                                               | M    | Causes                                                             | M    | Causes                                                             | M    |
|                                                    | specification (B7)                         |      | performance (B2)                                     |      | (B7)                                                               |      | performance (B2)                                                   |      |
| 2                                                  | Delay in the consultant's performance (B2) | 3.52 | Poor contract management (B1)                        | 3.55 | Mistakes or discrepancies in the design and contract document (B5) | 2.88 | Poor design leads to redesigning (B8)                              | 3.70 |
| 3                                                  | Poor design leads to redesigning (B8)      | 3.44 | Change in design and specification (B7)              | 3.50 | Insufficient or improper data collection or survey (B6)            | 2.88 | Mistakes or discrepancies in the design and contract document (B5) | 3.65 |
| <b>Causes of delay related to contractors</b>      |                                            |      |                                                      |      |                                                                    |      |                                                                    |      |
| 1                                                  | Labour shortage (C15)                      | 3.91 | Poor management and supervision (C4)                 | 3.95 | Labour shortage (C15)                                              | 4.13 | Labour shortage (C15)                                              | 3.84 |
| 2                                                  | Subcontractors' or suppliers' issues (C12) | 3.72 | Labour shortage (C15)                                | 3.90 | Inaccurate estimate of the project (C19)                           | 3.94 | Subcontractors' or suppliers' issues (C12)                         | 3.74 |
| 3                                                  | Poor management and supervision (C4)       | 3.71 | Unrealistic or improper planning and scheduling (C1) | 3.65 | Insufficient skill and low productivity among workers (C6)         | 3.88 | Insufficient skill and low productivity among workers (C6)         | 3.63 |
| <b>Causes of delay related to external factors</b> |                                            |      |                                                      |      |                                                                    |      |                                                                    |      |
| 1                                                  | Increase in material prices (D1)           | 3.79 | Unforeseen ground conditions (D4)                    | 3.95 | Increase in material prices (D1)                                   | 3.50 | Increase in material prices (D1)                                   | 4.00 |
|                                                    |                                            |      |                                                      |      | Labour shortage (external factors) (D6)                            | 3.50 |                                                                    |      |
| 2                                                  | Material shortage (D2)                     | 3.79 | Material shortage (D2)                               | 3.90 | -                                                                  | -    | Material shortage (D2)                                             | 3.95 |
| 3                                                  | Unforeseen ground conditions (D4)          | 3.68 | Severe weather conditions (D5)                       | 3.80 | Unforeseen ground conditions (D4)                                  | 3.38 | Severe weather conditions (D5)                                     | 3.70 |

Note: N= number of respondents; M = mean value

Within the “causes of delay related to clients” category, the most critical cause is “variation order”. It is ranked first, second, and third from the perspectives of contractors, consultants, and clients, respectively. In a study conducted by Goh et al. (2023), it was discovered that variation order is one of the key causes of disputes in Sarawak construction industry. Client-initiated variation orders can be reduced by establishing client requirement early, involving the client in the design stage, informing the client of the design before bidding, and improving communication between all parties (Albtoosh & Alkhamis, 2021). In addition, a formal change control mechanism can be designed to evaluate, approve, and implement changes (Ismaeil & Sobaih, 2024). From the perspectives of clients and consultants, “type of project bidding and

award” was another critical cause of delay. Tenders are commonly award to the lowest tenders (Bohari et al., 2021). However, selecting the contractor who submitted an unrealistic low price may lead to project delay, quality compromise, and disputes (Azlan et al., 2024). Therefore, apart from cost consideration, the client should also consider other contractor selection criteria such as technical capabilities, past experience, and project management expertise (Abedin et al., 2021).

The rankings within the “causes of delay related to consultants” category reveal that design issues remain a critical cause contributing to delay, with “change in design and specification” ranked first and “poor design leads to redesigning” ranked third. In addition, “mistakes or discrepancies in the design and contract document” ranked second and third from the perspectives of consultants and contractors, respectively. Therefore, the designers should place greater emphasis on design completeness before construction. Collaborative review can be conducted by an assembly of stakeholders at the preliminary stage for early detection of errors (Zhang et al., 2025). There is also a need for professional growth and the implementation of best practice in design management (Lim et al., 2025). Moreover, BIM can be adopted to improve designs and reduce inconsistencies by enabling clash detection and better coordination (Rahim et al., 2025). However, BIM adoption in Sarawak remains low (Razali et al., 2025). Furthermore, the findings also indicate that there is a need to improve consultants’ response time and the administration of contracts.

Within the “causes of delay related to contractors” category, the most critical cause is “labour shortage”, ranking either first or second from the perspectives of clients, consultants, and contractors. “Insufficient skill and low productivity among workers” ranked third from the perspectives of consultants and contractors. According to Dayak Chamber of Commerce and Industry (DCCI) Sarawak (Borneo Post Online, 2025c), labour shortage can be mitigated by diversifying labour sources (such as hiring workers from India, Nepal and East Timor), enhancing labour supply planning, investing in mechanism and technologies to reduce reliance on labour, and improving workers’ wages and benefits to attract local workers. Another measure is to offer job opportunities to villagers in rural areas who are skilled (Rubin et al., 2024). In addition, workers development programme and training opportunities can also be provided to workers to improve their skills and productivity (Rubin et al., 2024). The findings also reveal that the clients opined that contractors’ poor project management and improper planning were critical causes of project delays. Therefore, the contractors should give greater emphasis to project planning and construction progress monitoring. Performance indicators should be developed to ensure timely project delivery.

Within the “causes of delay related to external factors” category, the critical causes are related to materials, with “increasing prices of materials” and

“material shortage” ranked high by of all parties. In Sarawak, many essential materials, such as aluminium frames, tiles, roofing, fire-rated doors, are sourced from peninsular Malaysia due to limited local suppliers, which may lead to higher cost and slower project delivery (Borneo Post Online, 2026). To mitigate this issue, it is recommended that the contractor should adopt a more proactive approach by incorporating risk management into supply chain management. Implementing time and inventory buffers would be an efficient preventive measure to address material disruptions (Kouvelis et al., 2023). The contractor should also adopt supplier diversification approach by establishing relationships with multiple suppliers, especially local suppliers, to maintain stability of material supply (Chen et al., 2024). Moreover, applying flexible contractual terms such as alternative sourcing terms and price fluctuation clauses can help mitigate the impacts of cost escalations (Joharudin et al., 2026). Furthermore, digital technologies such as BIM and Artificial Intelligence can also be adopted for real-time monitoring and demand prediction (Joharudin et al., 2026). From the perspective of the clients, “unforeseen ground conditions” is also critical. Therefore, thorough site investigations should be carried out during the tender stage to identify potential ground conditions (Albtoosh & Alkhamis, 2021).

### Kruskal-Wallis Test

Table 5 shows the Kruskal-Wallis test statistics and effect sizes. The sig. values or p-values that are less than 0.05 (bold text) denote significance differences. For the effect sizes, values of  $\geq 0.01$ ,  $\geq 0.06$ ,  $\geq 0.14$  represent small, medium, and large effects, respectively (Tomczak & Tomczak, 2014). Out of a total of 76 causes, 11 show statistically significant differences in the rankings. For further comparison, the mean ranks and pairwise comparisons of the 11 causes are presented in Table 6.

**Table 5:** Kruskal-Wallis Test Statistics & Effect Sizes

| Causes | H     | df | p-value      | Effect size    |        |
|--------|-------|----|--------------|----------------|--------|
|        |       |    |              | $\epsilon^2_R$ | Effect |
| A1     | 5.817 | 2  | 0.055        | 0.075          | Medium |
| A2     | 9.185 | 2  | <b>0.010</b> | 0.118          | Medium |
| A3     | 3.542 | 2  | 0.170        | 0.045          | Small  |
| A4     | 2.326 | 2  | 0.313        | 0.030          | Small  |
| A5     | 1.140 | 2  | 0.565        | 0.015          | Small  |
| A6     | 2.143 | 2  | 0.342        | 0.027          | Small  |
| A7     | 0.590 | 2  | 0.745        | 0.008          | Small  |
| A8     | 0.047 | 2  | 0.977        | 0.006          | Small  |
| A9     | 0.564 | 2  | 0.754        | 0.007          | Small  |
| A10    | 1.210 | 2  | 0.546        | 0.016          | Small  |
| A11    | 1.776 | 2  | 0.411        | 0.023          | Small  |
| A12    | 1.116 | 2  | 0.572        | 0.014          | Small  |
| A13    | 2.217 | 2  | 0.330        | 0.028          | Small  |

| Causes | H      | df | p-value      | Effect size    |        |
|--------|--------|----|--------------|----------------|--------|
|        |        |    |              | $\epsilon^2_R$ | Effect |
| A14    | 0.118  | 2  | 0.943        | 0.002          | Small  |
| A15    | 3.155  | 2  | 0.207        | 0.040          | Small  |
| A16    | 0.696  | 2  | 0.706        | 0.009          | Small  |
| A17    | 1.414  | 2  | 0.493        | 0.018          | Small  |
| A18    | 0.854  | 2  | 0.652        | 0.011          | Small  |
| A19    | 2.973  | 2  | 0.226        | 0.038          | Small  |
| B1     | 14.597 | 2  | <b>0.001</b> | 0.187          | Large  |
| B2     | 11.480 | 2  | <b>0.003</b> | 0.147          | Large  |
| B3     | 8.853  | 2  | <b>0.012</b> | 0.114          | Medium |
| B4     | 5.836  | 2  | 0.054        | 0.075          | Medium |
| B5     | 8.172  | 2  | <b>0.017</b> | 0.105          | Medium |
| B6     | 0.893  | 2  | 0.640        | 0.011          | Small  |
| B7     | 1.374  | 2  | 0.503        | 0.018          | Small  |
| B8     | 7.810  | 2  | <b>0.020</b> | 0.100          | Medium |
| B9     | 4.341  | 2  | 0.114        | 0.056          | Small  |
| B10    | 4.779  | 2  | 0.092        | 0.061          | Medium |
| B11    | 6.357  | 2  | <b>0.042</b> | 0.082          | Medium |
| B12    | 3.779  | 2  | 0.151        | 0.048          | Small  |
| B13    | 2.494  | 2  | 0.287        | 0.032          | Small  |
| B14    | 1.872  | 2  | 0.392        | 0.024          | Small  |
| B15    | 6.599  | 2  | <b>0.037</b> | 0.085          | Medium |
| C1     | 0.742  | 2  | 0.690        | 0.010          | Small  |
| C2     | 1.755  | 2  | 0.416        | 0.023          | Small  |
| C3     | 1.159  | 2  | 0.560        | 0.015          | Small  |
| C4     | 1.964  | 2  | 0.375        | 0.025          | Small  |
| C5     | 0.423  | 2  | 0.810        | 0.005          | Small  |
| C6     | 1.752  | 2  | 0.416        | 0.022          | Small  |
| C7     | 0.498  | 2  | 0.780        | 0.006          | Small  |
| C8     | 1.420  | 2  | 0.492        | 0.018          | Small  |
| C9     | 0.375  | 2  | 0.829        | 0.005          | Small  |
| C10    | 1.339  | 2  | 0.512        | 0.017          | Small  |
| C11    | 4.323  | 2  | 0.115        | 0.055          | Small  |
| C12    | 1.010  | 2  | 0.604        | 0.013          | Small  |
| C13    | 3.091  | 2  | 0.213        | 0.040          | Small  |
| C14    | 1.850  | 2  | 0.397        | 0.024          | Small  |
| C15    | 0.949  | 2  | 0.622        | 0.012          | Small  |
| C16    | 0.589  | 2  | 0.745        | 0.008          | Small  |
| C17    | 1.873  | 2  | 0.392        | 0.024          | Small  |
| C18    | 0.216  | 2  | 0.897        | 0.003          | Small  |
| C19    | 2.857  | 2  | 0.240        | 0.037          | Small  |
| C20    | 2.623  | 2  | 0.269        | 0.034          | Small  |
| C21    | 0.361  | 2  | 0.835        | 0.005          | Small  |
| C22    | 0.055  | 2  | 0.973        | 0.001          | Small  |
| C23    | 1.651  | 2  | 0.438        | 0.021          | Small  |
| C24    | 0.637  | 2  | 0.727        | 0.008          | Small  |
| C25    | 1.830  | 2  | 0.401        | 0.023          | Small  |

| Causes | H     | df | p-value      | Effect size    |        |
|--------|-------|----|--------------|----------------|--------|
|        |       |    |              | $\epsilon^2_R$ | Effect |
| C26    | 0.499 | 2  | 0.779        | 0.006          | Small  |
| D1     | 6.287 | 2  | <b>0.043</b> | 0.081          | Medium |
| D2     | 6.262 | 2  | <b>0.044</b> | 0.080          | Medium |
| D3     | 9.689 | 2  | <b>0.008</b> | 0.124          | Medium |
| D4     | 3.345 | 2  | 0.188        | 0.043          | Small  |
| D5     | 1.696 | 2  | 0.428        | 0.022          | Small  |
| D6     | 0.543 | 2  | 0.762        | 0.007          | Small  |
| D7     | 2.814 | 2  | 0.245        | 0.036          | Small  |
| D8     | 3.361 | 2  | 0.186        | 0.043          | Small  |
| D9     | 3.411 | 2  | 0.182        | 0.044          | Small  |
| D10    | 4.761 | 2  | 0.092        | 0.061          | Medium |
| D11    | 1.648 | 2  | 0.439        | 0.021          | Small  |
| D12    | 0.987 | 2  | 0.611        | 0.013          | Small  |
| D13    | 0.796 | 2  | 0.672        | 0.010          | Small  |
| D14    | 1.087 | 2  | 0.581        | 0.014          | Small  |
| D15    | 1.189 | 2  | 0.552        | 0.015          | Small  |
| D16    | 0.144 | 2  | 0.931        | 0.002          | Small  |

Note: H = Kruskal-Wallis test statistics; df = degrees of freedom;  $\epsilon^2_R$  = epsilon squared

**Table 6:** Mean Ranks by Groups and Pairwise Comparisons

| Table of Mean Ranks by Groups and Pairwise Comparisons |                                                               |            |    |           |                                    |
|--------------------------------------------------------|---------------------------------------------------------------|------------|----|-----------|------------------------------------|
| Causes of delay                                        |                                                               | Group      | N  | Mean Rank | Pairwise Comparison<br>(Adj. Sig.) |
| <b>Causes of delay related to clients</b>              |                                                               |            |    |           |                                    |
| A2                                                     | Delay in payment                                              | Client     | 20 | 29.33     | Client-Consultant: 1.000           |
|                                                        |                                                               | Consultant | 16 | 35.19     | Client-Contractor: <b>.012</b>     |
|                                                        |                                                               | Contractor | 43 | 46.76     | Consultant-Contractor: .234        |
| <b>Causes of delay related to consultants</b>          |                                                               |            |    |           |                                    |
| B1                                                     | Poor contract management                                      | Client     | 20 | 49.83     | Client-Consultant: <b>.001</b>     |
|                                                        |                                                               | Consultant | 16 | 22.66     | Client-Contractor: .531            |
|                                                        |                                                               | Contractor | 43 | 41.88     | Consultant-Contractor: <b>.008</b> |
| B2                                                     | Delay in the consultant's performance                         | Client     | 20 | 40.85     | Client-Consultant: .063            |
|                                                        |                                                               | Consultant | 16 | 23.97     | Client-Contractor: 1.000           |
|                                                        |                                                               | Contractor | 43 | 45.57     | Consultant-Contractor: <b>.002</b> |
| B3                                                     | Poor communication and coordination                           | Client     | 20 | 41.18     | Client-Consultant: .107            |
|                                                        |                                                               | Consultant | 16 | 25.75     | Client-Contractor: 1.000           |
|                                                        |                                                               | Contractor | 43 | 44.76     | Consultant-Contractor: <b>.009</b> |
| B5                                                     | Mistakes or discrepancies in the design and contract document | Client     | 20 | 36.58     | Client-Consultant: .788            |
|                                                        |                                                               | Consultant | 16 | 28.34     | Client-Contractor: .344            |
|                                                        |                                                               | Contractor | 43 | 45.93     | Consultant-Contractor: <b>.018</b> |
| B8                                                     | Poor design leads to redesigning                              | Client     | 20 | 38.33     | Client-Consultant: .434            |
|                                                        |                                                               | Consultant | 16 | 27.50     | Client-Contractor: .706            |
|                                                        |                                                               | Contractor | 43 | 45.43     | Consultant-Contractor: <b>.017</b> |
| B11                                                    | Delay in certifying interim certificates                      | Client     | 20 | 30.90     | Client-Consultant: 1.000           |
|                                                        |                                                               | Consultant | 16 | 36.69     | Client-Contractor: <b>.045</b>     |
|                                                        |                                                               | Contractor | 43 | 45.47     | Consultant-Contractor: .527        |
| B15                                                    | Absence of the consultant's site staff                        | Client     | 20 | 46.38     | Client-Consultant: <b>.038</b>     |
|                                                        |                                                               | Consultant | 16 | 28.22     | Client-Contractor: 1.000           |
|                                                        |                                                               | Contractor | 43 | 41.42     | Consultant-Contractor: .115        |

| Causes of delay                                       | Group      | N  | Mean Rank | Pairwise Comparison (Adj. Sig.)    |
|-------------------------------------------------------|------------|----|-----------|------------------------------------|
| <b>Causes of delay related to external factors</b>    |            |    |           |                                    |
| D1 Increasing prices of materials                     | Client     | 20 | 33.53     | Client-Consultant: 1.000           |
|                                                       | Consultant | 16 | 32.97     | Client-Contractor: .121            |
|                                                       | Contractor | 43 | 45.63     | Consultant-Contractor: .143        |
| D2 Material shortage                                  | Client     | 20 | 40.95     | Client-Consultant: .235            |
|                                                       | Consultant | 16 | 28.16     | Client-Contractor: .1.000          |
|                                                       | Contractor | 43 | 43.97     | Consultant-Contractor: <b>.038</b> |
| D3 Changes in government requirements and regulations | Client     | 20 | 48.63     | Client-Consultant: <b>.007</b>     |
|                                                       | Consultant | 16 | 25.88     | Client-Contractor: .654            |
|                                                       | Contractor | 43 | 41.24     | Consultant-Contractor: .053        |

Note: N= number of respondents; Adj. Sig. = adjusted significance. The significant level is 0.05.

Based on Table 6, there is a significant difference between the opinions of clients and contractors in terms of “delay in payment” (A2). The contractors thought that this issue occurred frequently, whereas the client did not think so. This is also supported by pairwise comparison between the clients and contractors (adj. sig. = 0.012).

Within the “causes related to consultants” category, the participants have significantly different responses on seven causes of delay. Out of the seven causes, the clients and contractors have close or similar responses in four causes, namely, “poor contract management” (B1), “delay in consultant’s performance” (B2), “poor communication and coordination” (B3), “mistakes or discrepancies in the design and contract document” (B5), “poor design leads to redesigning” (B8), and “absence of consultant’s site staff” (B15). These causes received high mean ranks (occurred frequently or very frequently), indicating that both the clients and contractors expect the consultants to play a more important role in construction projects to minimize delays. However, the consultants thought differently, opining that these causes happened rarely or occasionally (all mean ranks are below 30). Interestingly, regarding “delay in certifying interim certificates” (B11), the mean rank by the consultants is higher (36.69), indicating this cause occurred occasionally or frequently. The mean rank of the contractors is the highest (45.47) among the three groups. The pairwise comparison shows that there are statistically significant differences between consultants and contractor for most of the causes, including B1, B2, B3, B5 & B8. Although there are differences in mean ranks between the clients and consultants, the differences are not statistically strong after accounting for the difference in mean rank, sample size, and comparison adjustment (Dunn, 1964).

As for the “causes related to external factors” category, the contractor opined that “increase in material prices” (D1) occurred frequently. In contrast, neither the clients nor the consultants thought that this is a critical cause of delay. However, this difference is not statistically significant after adjustment for comparisons. About “material shortage” (D2) and “changes in government requirements and regulations” (D3), both clients and contractors have different

responses from the consultants, who thought that these two causes do not frequently occur. The pairwise comparison reveals that there is a larger difference between consultants and contractors (adj. sig. = 0.038) for D2, and between clients and consultants (adj. sig. = 0.007) for D3.

## **CONCLUSION**

A quantitative research method was adopted to collect research data by sending semi-structured questionnaires to the respondents. The data was analysed using the Descriptive Statistics method and Kruskal-Wallis test. All the 76 causes of delay within 4 main delay categories were ranked. The top three significant causes of delay based on overall rankings are labour shortages, increases in material prices, and material shortage. Additionally, the rankings based on four different categories showed that variation orders, change in design and specification, labour shortage, poor management, and increase in material prices are among the critical causes of delay. The findings provide several practical implications for construction stakeholders. Clients should minimize the variation orders by establishing design requirement early where applicable. Consultants should improve their performance by ensuring design completeness and proper preparation of contracts. Contractors, meanwhile, should improve project management and ensure an adequate labour supply. Impacts caused by material shortage and increase in material prices could be mitigated by implementing inventory buffers and supplier diversification approaches.

Furthermore, the Kruskal-Wallis test revealed that there is consensus among clients, consultants, and contractors for 65 causes, but differences also exist for 11 causes. Given the differing responses from the construction stakeholders, a uniform approach to address the causes may not be appropriate. It is suggested that tailored mitigation strategies should be considered for different groups of construction stakeholders. Future studies can include more responses from clients and consultants.

## **LIMITATION AND FUTURE DIRECTION**

Non-probability sampling carries a risk of selection bias, which may reduce the representativeness of the present study. Future studies could adopt probability sampling, provided that sufficient resources are available. In addition, the present study has an unequal distribution of respondents. The responses from the client (25.3%) and consultant (20.3%) are lower than contractor (54.4%). Although responses were also analysed according to the three respondent groups, caution should be exercised when interpreting the different opinions among the construction stakeholders reported in the present study. It is recommended that future studies can include more balanced samples to improve the result generalisability.

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## REFERENCES

- Abedin, M. S. Z., Nasir, S. R. M., & Basri, A. (2021). Contractors selection criteria framework for construction project in Klang Valley. *Journal of Project Management Practice*, 1(1), 22–34. <https://doi.org/10.22452/jpmp.vol1no1.2>
- Adeleke, A. Q., Adeniti, A. W., & Muuka, G. N. (2021). The influence of delay factors on Pahang Malaysian construction industry: A PLS-SEM approach. *International Journal of Industrial Management*, 11(1), 205–216. <https://doi.org/10.15282/ijim.11.1.2021.6120>
- Aforla, B., Woode, A., & Amoaj, D. K. (2016). Causes of Delay in Highway Construction Projects in Ghana. *Civil and Environmental Research*, 8(11), 69–76.
- Ahmed, S. K. (2024). How to choose a sampling technique and determine sample size for research: A simplified guide for researchers. *Oral Oncology Reports*, 12, 100662. <https://doi.org/10.1016/j.oor.2024.100662>
- Albtoosh, H. A. M., & Alkhamis, T. M. (2021). Administrative policies to reduce the negative impact of variation orders on Jordanian construction projects. *American Journal of Industrial and Business Management*, 11, 329–340. <https://doi.org/10.4236/ajbm.2021.114021>
- Aldammak, M. M., Hamzah, N., & Khoiry, M. A. (2025). Delay in construction offices building: A systematic review. *Jurnal Kejuruteraan*, 37(5), 2453–2467. [https://doi.org/10.17576/jkukm-2025-37\(5\)-33](https://doi.org/10.17576/jkukm-2025-37(5)-33)
- Alshihri, S., Al-Gahtani, K., & Almohsen, A. (2022). Risk Factors That Lead to Time and Cost Overruns of Building Project in Saudi Arabia. *Buildings*, 12(7), 902. <https://doi.org/10.3390/buildings12070902>
- Aminorlah, A. I., Rahim, N. A., Mohamed, Z., & Mazlan, A. N. (2023). Critical delay factors in typical physical projects: The case of the Ministry of Home Affairs in Malaysia. *Journal of Construction in Developing Countries*, 28(2), 57–59. <https://doi.org/10.21315/jcdc-01-22-0014>
- Amoah, K. B. O., Okere, G., & Deshpande, A. (2024). Construction delay analysis: Causes, impacts, and mitigation strategies. *Journal of Civil Engineering Research*, 14(1), 1–9. <https://doi.org/10.5923/j.jce.20241401.01>
- Amzafi, N. H., Ishak, S. A., Rahim, M. A., Amlus, M. H., Rani, H. A., Syammaun, T., Mokhtar, H., & Ayob, A. (2024). A systematic review of the causes and effects of variation orders in sustainable construction in developing countries. *International Journal of Integrated Engineering*, 16(4), 188–203. <https://doi.org/10.30880/ijie.2024.16.04.023>
- Arantes, A., & Ferreira, L. M. D. F. (2020). Underlying causes and mitigation measures of delays in construction projects: An empirical study. *Journal of Financial Management of Property and Construction*, 25(2), 165–181. <http://dx.doi.org/10.1108/JFMPC-03-2019-0029>
- Assaf, S., Hassanain, M. A., & Abdallah, A. (2018). Review and assessment of the causes of deficiencies in design documents for large construction projects. *International*

- Journal of Building Pathology and Adaptation*, 36(3), 300–317.  
<https://doi.org/10.1108/IJBPA-10-2017-0050>
- Aziz, M. K. A., & Prasetijo, J. (2022). The cause and effect of delay in LRT3 depot construction project. *Progress in Engineering Application and Technology*, 3(2), 783–789.
- Azlan, H. Z., Khaderi, S. S., & Bakri, A. S. (2024). Critical factors influencing bid mark-up decision in public street project – A review. *Built Environment Journal*, 21(1), 30–44. <https://doi.org/10.24191/bej.v21i1.480>
- Bano, B., Shakimon, M. N., & Roslan, S. N. A. (2023). Investigation of the factors influencing the construction delays in Klang Valley Malaysia. *International Journal of Infrastructure Research and Management*, 11(2), 108–116.
- Bariono, N. S. E., & Kamaruding, M. (2025). Initiatives to overcome the issues and negative impacts on the involvement of foreign laborers in the Malaysian construction industry. *Jurnal Kejuruteraan*, 37(2), 855–867.  
[https://doi.org/10.17576/jkukm-2025-37\(2\)-24](https://doi.org/10.17576/jkukm-2025-37(2)-24)
- Bohari, A. A. M., Ikau, R. A., Budin, H., Hadi, N. A., & Chan, V. S. L. (2021). The key criteria in deciding to tender for construction projects. *International Journal of Integrated Engineering*, 13(3), 229–235.  
<https://doi.org/10.30880/ijie.2021.13.03.028>
- Borneo Post Online. (2025a). *RM5.68 mln S'wak Infra hall project faces delay, ministry steps up monitoring*. Borneo Post Online.  
<https://www.theborneopost.com/2025/06/06/rm5-68-mln-swak-infra-hall-project-faces-delay-ministry-steps-up-monitoring/>
- Borneo Post Online. (2025b). *RM74 mln Dalat road project faces delay, meeting set for April 30*. Borneo Post Online. <https://www.theborneopost.com/2025/04/23/rm74-mln-dalat-road-project-faces-delay-meeting-set-for-april-30/>
- Borneo Post Online. (2025c). *DCCI: Labour shortage in Sarawak linked to local labour gap, ageing population*. Borneo Post Online.  
<https://www.theborneopost.com/2025/01/09/dcci-labour-shortage-in-sarawak-linked-to-local-labour-gap-ageing-population/>
- Borneo Post Online. (2025d). *Sheda advisor: Developers brace for higher costs as SST expansion hits Sarawak's construction sector*. Borneo Post Online.  
<https://www.theborneopost.com/2025/07/03/sheda-advisor-developers-brace-for-higher-costs-as-sst-expansion-hits-sarawaks-construction-sector/>
- Borneo Post Online. (2026). *Shortage of construction materials in Sabah, Sarawak needs private sector support, says Ahmad Maslan*. Borneo Post Online.  
<https://www.theborneopost.com/2026/04/09/shortage-of-construction-materials-in-sabah-sarawak-needs-private-sector-support-says-ahmad-maslan/>
- Chen, Z., Hammad, A. W. A., & Alyami, M. (2024). Building construction supply chain resilience under supply and demand uncertainties. *Automation in Construction*, 158, 105190. <https://doi.org/10.1016/j.autcon.2023.105190>
- DayakDaily. (2025a). *Three 'sick' housing projects in Kuching finally completed after years of delay*. DayakDaily. <https://dayakdaily.com/three-sick-housing-projects-in-kuching-finally-completed-after-years-of-delay/>
- DayakDaily. (2025b). *All delayed, 'sick' Rural and Regional Dev't projects in Sarawak must be implemented under 13MP – DPM Zahid*. DayakDaily.

- <https://dayakdaily.com/all-delayed-sick-rural-and-regional-devt-projects-in-sarawak-must-be-implemented-under-13mp-dpm-zahid/>
- DayakDaily. (2025c). *Cabinet paper to tailor Sarawak projects to State-specific needs, says DPM Fadillah*. DayakDaily. <https://dayakdaily.com/cabinet-paper-to-tailor-sarawak-projects-to-state-specific-needs-says-dpm-fadillah/>
- Department of Statistics Malaysia. (2025). *Special release for building and structural works*. Department of Statistics Malaysia. [http://www.statistics.gov.my/uploads/release-content/file\\_20251209155001.pdf](http://www.statistics.gov.my/uploads/release-content/file_20251209155001.pdf)
- Department of the Premier of Sarawak. (2025a). *Sarawak faces shortage of skilled workers*. Department of the Premier of Sarawak. [https://premierdept.sarawak.gov.my/web/subpage/news\\_view/15258/UKAS](https://premierdept.sarawak.gov.my/web/subpage/news_view/15258/UKAS)
- Department of the Premier of Sarawak. (2025b). *Federal government discusses solutions to delayed projects in Sarawak*. Department of the Premier of Sarawak. [https://premierdept.sarawak.gov.my/web/subpage/news\\_view/15205/UKAS](https://premierdept.sarawak.gov.my/web/subpage/news_view/15205/UKAS)
- Dunn, O. J. (1964). Multiple comparisons using rank sums. *Technometrics*, 6(3), 241–252. <https://doi.org/10.1080/00401706.1964.10490181>
- Faizal, N. F., Kasim, N., Ang, P. S. E., Ismail, Z., & Namara, I. (2025). Decision support system of project delay for improving project performance in construction project. *Journal of Technology Management and Business*, 12(1), 137–155.
- Free Malaysia Today. (2025a). *Education ministry tops list of critically delayed projects under 12MP, says A-G report*. Free Malaysia Today. <https://www.freemalaysiatoday.com/category/nation/2025/10/06/education-ministry-tops-list-of-critically-delayed-projects-under-12mp-says-a-g-report>
- Free Malaysia Today. (2025b). *Sarawak needs more skilled workers, says Deputy Premier*. Free Malaysia Today. <https://www.freemalaysiatoday.com/category/nation/2025/03/25/sarawak-needs-more-skilled-workers-says-deputy-premier>
- Gashahun, A. D. (2020). Causes and effects of delay on African construction projects: A State of the Art Review. *Civil and Environmental Research*, 12(5), 41–53.
- Goh, K. Z. H., Wong, S. Y., & Low, W. W. (2023). Factors causing dispute in construction industry: Contractor's perspectives. *Journal of Surveying, Construction and Property*, 14(1), 14–26. <https://doi.org/10.22452/jscp.vol14no1.2>
- Golzar, J., Noor, S., & Tajik, O. (2022). Convenience sampling. *International Journal of Education and Language Studies*, 1(2), 72–77. <https://doi.org/10.22034/ijels.2022.162981>
- Hailu, A. Y., Mohammed, I., Alemu, D., & Gesese, A. (2023). Construction project delay factors of public universities in Ethiopia: A structural equation modeling approach. *Journal of Economics, Management and Trade*, 29(3), 16–34.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.
- Hasib, S. S. B., & Al-Kilidar, H. (2021). Identifying project delay factors in the Australian construction industry. *World Academy of Science, Engineering and Technology International Journal of Structural and Construction Engineering*, 15(3), 135–141.

- Hisham, S. N. A., & Yahya, K. (2016). Causes and effects of delays in construction industry. *Construction Management, Geotechnics and Transportation*, 2, 78–89.
- Hoo, B. X., Khalid, Z., Saarani, P. S. N., Sarpin, N., & Omar, R. (2024). Study on the factors to improve productivity and efficiency of construction workers in Klang Valley. *Research in Management of Technology and Business*, 5(1), 1534–1551. <https://doi.org/10.30880/rmtb.2024.05.01.101>
- Hoque, I., Safayet, A., Rana, J., Bhuiyan, A. Y., & Quraishy, G. S. (2021). Analysis of construction delay for delivering quality project in Bangladesh. *International Journal of Building Pathology and Adaptation*, 41(2), 401–421. <https://doi.org/10.1108/IJBPA-03-2021-0032>
- Ismail, E. M. H., & Sobaih, A. E. E. (2024). A proposed model for variation order management in construction projects. *Buildings*, 14, 726. <https://doi.org/10.3390/buildings14030726>
- Joharudin, N. F. M., Makmor, M., Zulkifly, U. K. Z., Ahamad, A. H., & Nasir, M. F. M. (2026). Managing supply chain disruptions in private construction projects: Insights from Malaysian contractors. *Built Environment Journal*, 23(2), 608–621. <https://doi.org/10.24191/bej.v23i2.11338>
- Kouvelis, P., Chen, X., & Xia, Y. (2023). Managing material shortages in project supply chains: Inventories, time buffers, and supplier flexibility. *Production and Operations Management*, 32, 3717–3735. <https://doi.org/10.1111/poms.14059>
- Lim, Z. Q., Mohd-Rahim, F. A., Mahdzir, M., Mustafa, M. H., & Alashwal, A. (2025). Design errors' impact on construction project costs. *Journal of Construction in Developing Countries*, 30(2), 25–47. <https://doi.org/10.21315/jcdc.2025.30.2.2>
- MalayMail. (2023). *Health clinic construction delayed in Sarawak due to raw material shortage, says deputy health minister*. MalayMail. <https://www.malaymail.com/news/malaysia/2023/11/20/health-clinic-construction-delayed-in-sarawak-due-to-raw-material-shortage-says-deputy-health-minister/103138>
- Masrom, M. A. N., Chong, B. Y., Mohamed, S., Yassin, A. M., Seow, T. W., Haron, R. C., & Chan, M. (2021). Determining critical contributory factors of payment default in residential construction projects. *International Journal of Integrated Engineering*, 13(5), 200–210. <https://doi.org/10.30880/ijie.2021.13.05.021>
- Memon, A. H., Rahman, I. A., Akram, M., & Ali, N. M. (2014). Significant factors causing time overrun in construction projects of Peninsular Malaysia. *Modern Applied Science*, 8(4), 16–28. <https://doi.org/10.5539/mas.v8n4p16>
- Memon, M. A., Thurasamy, R., Ting, H., & Cheah, J. H. (2025). Convenience sampling: A review and guidelines for quantitative research. *Journal of Applied Structural Equation Modeling*, 9(2), 1–15. [https://doi.org/10.47263/JASEM.9\(2\)01](https://doi.org/10.47263/JASEM.9(2)01)
- Mohammad, N., Hamzah, Z., & Mokhtar, N. A. (2022). Control of variation orders in the construction of residential projects in Malaysia. *Planning Malaysia: Journal of the Malaysian Institute of Planners*, 20(2), 14–21.
- Mydin, M. A. O., Sani, N. M., Salim, N. A. A., & Alias, N. M. (2014). Assessment of influential causes of construction project delay in Malaysian private housing from developer's viewpoint. *Emerging Technology for Sustainable Development Congress (ETSDC 2014)*, 3. <https://doi.org/10.1051/e3sconf/20140301027>

- Office of the Premier of Sarawak. (2023). *Premier: No cement shortage in S'wak, just rapid infrastructure dev.* Office of the Premier of Sarawak. [https://premier.sarawak.gov.my/web/subpage/news\\_view/5528#:~:text=Source%20of%20News:%20The%20Borneo,cement%20supply%20chain%20in%20Sarawak](https://premier.sarawak.gov.my/web/subpage/news_view/5528#:~:text=Source%20of%20News:%20The%20Borneo,cement%20supply%20chain%20in%20Sarawak).
- Opeyemi, B. A., Sunday, I. K., Abdullahi, I., Abiodun, S. M., & Agada, D. I. (2022). An assessment of the factors influencing time performance of educational building projects in Ondo State, Nigeria. In *Proceedings of the 5th International African Conference on Current Studies* (pp. 167–178). Cairo, Egypt.
- Othman, A., & Ismail, S. (2014). Delay in government project delivery in Kedah, Malaysia. *Recent Advances in Civil Engineering and Mechanics*, 248–254.
- Rahim, F. A. M., Ling, K. G., Zainon, B., & Yusof, N. S. M. (2025). Minimizing the risk of cost overrun in building construction project during pre-contract stage. *Planning Malaysia: Journal of the Malaysian Institute of Planners*, 23(6), 105–118. <https://doi.org/10.21837/pm.v23i39.1899>
- Razali, N. K., Yong, N. H., Yong, N. F., & Hasim, N. (2025). Government initiatives to promote BIM adoption in Sarawak: A systematic literature review. *Journal of Advanced Research in Social and Behavioural Sciences*, 41(1), 124–141. <https://doi.org/10.37934/arsbs.41.1.124141>
- Romzi, N. A., & Doh, S. I. (2022). Underlying causes of construction project delay: A review. *Construction*, 2(2), 7–11. <https://doi.org/10.15282/construction.v2i2.7775>
- Rubin, U., Sarpin, N., Shafii, H., Masrom, M. A. N., & Ismayatim, N. (2024). The issue of labor shortage affecting the delay in the Sarawak Pan Borneo Highway construction project. *Research in Management of Technology and Business*, 5(1), 1415–1427. <https://doi.org/10.30880/rmtb.2024.05.01.093>
- Sa'ad, M. H. B. M., Herman, S. S. B., & Azlan, A. B. (2022). The delay issues in the Malaysian construction industry and benefits of industrial revolution 4.0 (I.R 4.0) to mitigate issues for project managers. In *Proceedings of the 9th International Conference on Management and Muamalah 2022* (pp. 416–424).
- Sarawak Tribune. (2025a). *Delayed Sejingkat Bridge targeted for completion by June 2026*. Sarawak Tribune. <https://www.sarawaktribune.com/delayed-sejingkat-bridge-targeted-for-completion-by-june-2026/>
- Sarawak Tribune. (2025b). *Ministry resolves seven-year delay in sick housing project*. Sarawak Tribune. <https://www.sarawaktribune.com/delayed-bintulu-housing-project-back-on-track-after-ministrys-intervention/>
- Sarpin, N., & Ramesh, S. (2024). The contribution of subcontractor's performance towards project success: Main-contractor perspective. *Journal of International Business, Economics and Entrepreneurship*, 9(1), 12–23. <https://doi.org/10.24191/jibe.v9i1.893>
- Shahron, S. A., Basher, M. A., Musa, S., & Mohamed, O. (2023). Financial issues and impacts on construction industry in Kedah and Perlis. *PaperASIA*, 39(6b), 58–62. [https://doi.org/10.59953/paperasia.v39i6\(b\).34](https://doi.org/10.59953/paperasia.v39i6(b).34)
- Sharuddin, N. M., Azman, M. A., Samad, Z. A., & Rodzi, R. M. (2024). Relationship between schedule delay factors and project performance in civil engineering works. *Built Environment Journal*, 21(Special Issue), 23–26. <https://doi.org/10.24191/bej.v21iSpecialIssue.2424>

- Shehu, Z., Endut, R., & Akintoye, A. (2014). Factors contributing to project time and hence cost overrun in the Malaysian construction industry. *Journal of Financial Management of Property and Construction*, 19(1), 55–75. <http://dx.doi.org/10.1108/JFMPC-04-2013-0009>
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48, 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Tahmasebinia, F., & Song, V. (2022). Significant factors causing delay in the Cambodian construction industry. *Sustainability*, 14, 3521. <https://doi.org/10.3390/su14063521>
- Tariq, J., & Gardezi, S. S. S. (2023). Study the delays and conflicts for construction projects and their mutual relationship: A review. *Ain Shams Engineering Journal*, 14(1), 101815. <https://doi.org/10.1016/j.asej.2022.101815>
- Theng, S., & Techapeeraparnich, W. (2020). Ranking of Risk Factors Causing Delays on Building Construction Project in Cambodia. In *Proceedings of RSU International Research Conference* (pp. 919–928). Rangsit University, Thailand.
- Thorat, S., Khandere, M. A., & Kanase, A. K. (2017). Exploratory study of causes and effects of delay in Indian residential projects. *International Research Journal of Engineering and Technology*, 4(6), 2302–2311.
- Ting, H., Memon, M. A., Thurasamy, R., & Cheah, H. W. (2025). Snowball sampling: A review and guidelines for survey research. *Asian Journal of Business Research*, 15(1), 1–15. <https://doi.org/10.14707/ajbr.250186>
- Tomczak, M., & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *Trends in Sports Sciences*, 1(21), 19–25.
- Ullah, K., Khan, M. S., Lakhari, M. T., Vighio, A. A., & Sohu, S. (2018). Ranking of effects of construction delay: Evidence from Malaysian building projects. *Journal of Applied Engineering Sciences*, 8(21), 79–84. <https://doi.org/10.2478/jaes-2018-0011>
- Yap, J. B. H., Goay, P. L., Woon, Y. B., & Skitmore, M. (2021). Revisiting critical delay factors for construction: Analysing project in Malaysia. *Alexandria Engineering Journal*, 60(1), 1717–1729.
- Zagia, F., Kajewski, S., Omrani, S., & Motamedisedeh, O. (2025). Prioritizing the key causes of construction project delay in different countries: A cross-sectional analysis of different project types. *International Journal of Construction Management*, 1–26. <https://doi.org/10.1080/15623599.2025.2568103>
- Zhang, S., Sunindijo, R. Y., Wang, J., Su, Z., Ke, Y., & Liu, X. (2025). The causation of design error in the construction industry: A multistakeholder perspective. *Journal of Performance of Constructed Facilities*, 39(1), 04024055. <https://doi.org/10.1061/JPCFEV.CFENG-4862>

## Appendix A

**Table A1: Overall Ranking of the 76 Causes of Delay**

| Code & causes of delay                        |                                                                                            | All parties<br>(N = 79) |      |    | Client<br>(N = 20) |      |    | CA<br>(N = 16) |      |    | Contractor<br>(N = 43) |      |    |
|-----------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------|------|----|--------------------|------|----|----------------|------|----|------------------------|------|----|
|                                               |                                                                                            | M                       | SD   | R  | M                  | SD   | R  | M              | SD   | R  | M                      | SD   | R  |
| <b>Causes of delay related to clients</b>     |                                                                                            |                         |      |    |                    |      |    |                |      |    |                        |      |    |
| A1                                            | Financial difficulties                                                                     | 2.90                    | 1.28 | 61 | 2.55               | 1.23 | 69 | 2.50           | 1.16 | 70 | 3.21                   | 1.28 | 46 |
| A2                                            | Delay in payment                                                                           | 3.22                    | 1.31 | 41 | 2.60               | 1.14 | 67 | 2.94           | 1.34 | 39 | 3.61                   | 1.26 | 15 |
| A3                                            | Variation order                                                                            | 3.72                    | 1.07 | 5  | 3.60               | 1.10 | 13 | 3.38           | 1.15 | 24 | 3.91                   | 1.02 | 3  |
| A4                                            | Difficulty in defining project requirements                                                | 3.17                    | 1.06 | 42 | 3.40               | 1.00 | 30 | 2.88           | 1.15 | 44 | 3.16                   | 1.05 | 49 |
| A5                                            | Delay in providing site possession                                                         | 2.98                    | 1.14 | 57 | 2.90               | 1.25 | 56 | 2.75           | 1.13 | 51 | 3.09                   | 1.11 | 52 |
| A6                                            | Slow in decision-making                                                                    | 3.56                    | 1.17 | 13 | 3.55               | 1.10 | 19 | 3.25           | 1.07 | 29 | 3.67                   | 1.25 | 10 |
| A7                                            | Poor communication and coordination                                                        | 3.25                    | 1.09 | 36 | 3.35               | 1.04 | 33 | 3.13           | 1.20 | 35 | 3.26                   | 1.09 | 37 |
| A8                                            | Conflicts between the joint ownership of the project                                       | 2.60                    | 1.17 | 71 | 2.50               | 0.95 | 70 | 2.63           | 1.36 | 65 | 2.63                   | 1.22 | 71 |
| A9                                            | Lack of incentives for contractors to finish earlier                                       | 2.84                    | 1.29 | 63 | 2.65               | 1.14 | 65 | 2.88           | 1.41 | 48 | 2.91                   | 1.32 | 63 |
| A10                                           | Suspension of work                                                                         | 2.53                    | 1.29 | 73 | 2.75               | 1.21 | 61 | 2.56           | 1.36 | 67 | 2.42                   | 1.31 | 75 |
| A11                                           | Unrealistic contract duration and requirements                                             | 3.01                    | 1.20 | 53 | 3.05               | 1.15 | 51 | 3.31           | 1.30 | 28 | 2.88                   | 1.20 | 66 |
| A12                                           | Lack of knowledge or experience                                                            | 2.92                    | 1.07 | 60 | 2.70               | 0.92 | 63 | 2.88           | 1.09 | 43 | 3.05                   | 1.13 | 55 |
| A13                                           | Inadequate project feasibility study                                                       | 2.96                    | 1.06 | 58 | 2.80               | 0.89 | 58 | 2.69           | 1.14 | 59 | 3.14                   | 1.08 | 50 |
| A14                                           | Type of project bidding and award (the lowest bidder may bring a lower quality contractor) | 3.47                    | 1.15 | 19 | 3.60               | 0.88 | 8  | 3.50           | 0.97 | 15 | 3.40                   | 1.33 | 27 |
| A15                                           | Shortage and late delivery of material (procurement by the client)                         | 3.14                    | 1.15 | 45 | 2.90               | 1.17 | 55 | 2.88           | 1.15 | 44 | 3.35                   | 1.13 | 31 |
| A16                                           | Ineffective delay penalties                                                                | 2.60                    | 1.09 | 69 | 2.70               | 1.13 | 64 | 2.75           | 1.18 | 53 | 2.51                   | 1.06 | 73 |
| A17                                           | Excessive bureaucracy in the administration                                                | 3.00                    | 1.13 | 54 | 3.10               | 0.91 | 48 | 2.69           | 1.30 | 62 | 3.07                   | 1.16 | 53 |
| A18                                           | Delays in obtaining approval from the municipality                                         | 3.49                    | 1.07 | 17 | 3.50               | 0.89 | 21 | 3.25           | 1.44 | 30 | 3.58                   | 1.01 | 18 |
| A19                                           | Large project size and complex project                                                     | 3.39                    | 1.18 | 22 | 3.60               | 1.00 | 11 | 2.94           | 1.18 | 38 | 3.47                   | 1.24 | 22 |
| <b>Causes of delay related to consultants</b> |                                                                                            |                         |      |    |                    |      |    |                |      |    |                        |      |    |
| B1                                            | Poor contract management                                                                   | 3.11                    | 0.93 | 48 | 3.55               | 0.83 | 15 | 2.38           | 0.81 | 73 | 3.19                   | 0.88 | 47 |

| Code & causes of delay                        |                                                               | All parties<br>(N = 79) |      |    | Client<br>(N = 20) |      |    | CA<br>(N = 16) |      |    | Contractor<br>(N = 43) |      |    |
|-----------------------------------------------|---------------------------------------------------------------|-------------------------|------|----|--------------------|------|----|----------------|------|----|------------------------|------|----|
|                                               |                                                               | M                       | SD   | R  | M                  | SD   | R  | M              | SD   | R  | M                      | SD   | R  |
| B2                                            | Delay in the consultant's performance                         | 3.52                    | 1.07 | 16 | 3.60               | 0.94 | 9  | 2.69           | 1.14 | 59 | 3.79                   | 0.97 | 5  |
| B3                                            | Poor communication and coordination                           | 3.37                    | 1.02 | 27 | 3.45               | 0.89 | 25 | 2.69           | 1.20 | 61 | 3.58                   | 0.91 | 16 |
| B4                                            | Insufficient experience of the consultant                     | 2.95                    | 1.02 | 59 | 3.20               | 1.06 | 46 | 2.38           | 1.26 | 74 | 3.05                   | 0.84 | 54 |
| B5                                            | Mistakes or discrepancies in the design and contract document | 3.38                    | 1.00 | 23 | 3.20               | 1.01 | 44 | 2.88           | 0.81 | 40 | 3.65                   | 1.00 | 11 |
| B6                                            | Insufficient or improper data collection or survey            | 3.14                    | 0.94 | 43 | 3.15               | 0.67 | 47 | 2.88           | 0.96 | 41 | 3.23                   | 1.04 | 38 |
| B7                                            | Change in design and specification                            | 3.56                    | 0.98 | 12 | 3.50               | 0.95 | 22 | 3.38           | 0.89 | 19 | 3.65                   | 1.04 | 12 |
| B8                                            | Poor design leads to redesigning                              | 3.44                    | 1.08 | 20 | 3.40               | 0.88 | 27 | 2.81           | 0.98 | 50 | 3.70                   | 1.12 | 8  |
| B9                                            | Complexity of design                                          | 3.13                    | 0.93 | 46 | 3.20               | 0.83 | 39 | 2.69           | 0.70 | 56 | 3.26                   | 1.00 | 36 |
| B10                                           | Rigidity or lack of flexibility                               | 3.28                    | 0.97 | 32 | 3.30               | 0.80 | 34 | 2.81           | 0.75 | 49 | 3.44                   | 1.08 | 25 |
| B11                                           | Delay in certifying interim certificates                      | 3.05                    | 1.14 | 52 | 2.55               | 0.94 | 68 | 2.88           | 1.20 | 46 | 3.35                   | 1.13 | 31 |
| B12                                           | Poor quality control                                          | 2.75                    | 0.93 | 67 | 2.80               | 0.77 | 57 | 2.31           | 0.87 | 75 | 2.88                   | 0.98 | 65 |
| B13                                           | Conflict between consultants                                  | 2.82                    | 0.93 | 64 | 2.70               | 0.87 | 62 | 2.56           | 0.89 | 66 | 2.98                   | 0.96 | 58 |
| B14                                           | Misunderstanding of the client's requirement                  | 2.99                    | 0.98 | 56 | 3.20               | 0.89 | 42 | 2.75           | 1.13 | 51 | 2.98                   | 0.96 | 58 |
| B15                                           | Absence of the consultant's site staff                        | 2.77                    | 1.05 | 66 | 3.05               | 0.95 | 50 | 2.19           | 0.83 | 76 | 2.86                   | 1.10 | 67 |
| <b>Causes of delay related to contractors</b> |                                                               |                         |      |    |                    |      |    |                |      |    |                        |      |    |
| C1                                            | Unrealistic or improper planning and scheduling               | 3.61                    | 0.97 | 10 | 3.65               | 0.81 | 7  | 3.81           | 0.98 | 5  | 3.51                   | 1.03 | 19 |
| C2                                            | Late delivery of materials to the site                        | 3.54                    | 0.96 | 14 | 3.55               | 0.83 | 15 | 3.81           | 0.98 | 5  | 3.44                   | 1.01 | 23 |
| C3                                            | Late delivery of equipment to the site                        | 3.33                    | 1.03 | 28 | 3.40               | 0.88 | 27 | 3.56           | 1.09 | 13 | 3.21                   | 1.08 | 42 |
| C4                                            | Poor management and supervision                               | 3.71                    | 0.95 | 6  | 3.95               | 0.83 | 1  | 3.75           | 1.07 | 7  | 3.58                   | 0.96 | 17 |
| C5                                            | Insufficient contractor experience                            | 3.25                    | 1.02 | 33 | 3.35               | 0.99 | 32 | 3.38           | 1.15 | 24 | 3.16                   | 1.00 | 48 |
| C6                                            | Insufficient skill and low productivity among workers         | 3.65                    | 0.99 | 9  | 3.50               | 0.76 | 20 | 3.88           | 1.03 | 3  | 3.63                   | 1.07 | 13 |
| C7                                            | Difficulties in financing the project                         | 3.47                    | 1.12 | 18 | 3.60               | 0.94 | 9  | 3.31           | 1.20 | 27 | 3.47                   | 1.18 | 21 |
| C8                                            | Conflicts and disputes                                        | 2.99                    | 0.97 | 55 | 2.80               | 0.89 | 58 | 3.13           | 1.09 | 34 | 3.02                   | 0.96 | 57 |
| C9                                            | Rework due to mistakes or defective work                      | 3.25                    | 1.03 | 34 | 3.20               | 0.89 | 42 | 3.38           | 0.96 | 20 | 3.23                   | 1.13 | 39 |

| Code & causes of delay                             |                                                                          | All parties<br>(N = 79) |      |    | Client<br>(N = 20) |      |    | CA<br>(N = 16) |      |    | Contractor<br>(N = 43) |      |    |
|----------------------------------------------------|--------------------------------------------------------------------------|-------------------------|------|----|--------------------|------|----|----------------|------|----|------------------------|------|----|
|                                                    |                                                                          | M                       | SD   | R  | M                  | SD   | R  | M              | SD   | R  | M                      | SD   | R  |
| C10                                                | Poor communication and coordination                                      | 3.38                    | 0.98 | 24 | 3.35               | 0.88 | 31 | 3.69           | 1.14 | 10 | 3.28                   | 0.96 | 35 |
| C11                                                | Improper construction methods                                            | 3.11                    | 1.07 | 49 | 3.10               | 0.91 | 48 | 3.63           | 1.20 | 12 | 2.93                   | 1.06 | 61 |
| C12                                                | Subcontractors' or suppliers' issues                                     | 3.72                    | 0.97 | 4  | 3.55               | 0.95 | 17 | 3.87           | 1.03 | 4  | 3.74                   | 0.98 | 6  |
| C13                                                | Ineffective teamwork                                                     | 3.32                    | 0.99 | 29 | 3.20               | 1.01 | 44 | 3.75           | 1.07 | 7  | 3.21                   | 0.94 | 40 |
| C14                                                | Frequent change of subcontractors or suppliers                           | 3.38                    | 1.15 | 26 | 3.55               | 1.05 | 18 | 3.63           | 1.09 | 11 | 3.21                   | 1.21 | 45 |
| C15                                                | Labour shortage                                                          | 3.91                    | 1.09 | 1  | 3.90               | 1.02 | 4  | 4.13           | 1.09 | 1  | 3.84                   | 1.13 | 4  |
| C16                                                | Poor material handling at the site                                       | 3.30                    | 1.13 | 31 | 3.40               | 0.88 | 27 | 3.44           | 1.32 | 18 | 3.21                   | 1.17 | 44 |
| C17                                                | Equipment shortage or breakdown                                          | 3.38                    | 1.00 | 25 | 3.20               | 0.83 | 39 | 3.69           | 1.08 | 9  | 3.35                   | 1.04 | 30 |
| C18                                                | Labour absenteeism or low morale                                         | 3.22                    | 1.07 | 38 | 3.25               | 1.02 | 38 | 3.19           | 1.22 | 33 | 3.21                   | 1.06 | 41 |
| C19                                                | Inaccurate estimate of the project                                       | 3.54                    | 1.00 | 15 | 3.45               | 0.83 | 23 | 3.94           | 1.00 | 2  | 3.44                   | 1.05 | 24 |
| C20                                                | Using improper or low-efficiency equipment                               | 3.06                    | 1.03 | 50 | 3.20               | 0.83 | 39 | 3.38           | 1.36 | 26 | 2.88                   | 0.96 | 64 |
| C21                                                | Delay in submission of drawings, documents, reports, or material samples | 3.41                    | 0.93 | 21 | 3.40               | 0.68 | 26 | 3.56           | 1.09 | 13 | 3.35                   | 0.97 | 29 |
| C22                                                | Delay due to safety and health issues                                    | 2.63                    | 1.00 | 68 | 2.60               | 0.88 | 66 | 2.69           | 1.01 | 57 | 2.63                   | 1.07 | 70 |
| C23                                                | Delay in payment to the supplier, subcontractor or staff                 | 3.25                    | 1.06 | 35 | 3.45               | 0.83 | 23 | 3.38           | 1.02 | 22 | 3.12                   | 1.16 | 51 |
| C24                                                | Improper investigation during the bidding process                        | 3.13                    | 1.03 | 47 | 3.25               | 0.85 | 36 | 3.19           | 0.98 | 31 | 3.05                   | 1.13 | 55 |
| C25                                                | Shortage of materials at the site                                        | 3.24                    | 1.07 | 37 | 3.30               | 0.80 | 34 | 2.94           | 1.12 | 37 | 3.33                   | 1.15 | 33 |
| C26                                                | Accident during construction                                             | 2.44                    | 1.10 | 75 | 2.25               | 0.97 | 75 | 2.50           | 1.21 | 71 | 2.51                   | 1.12 | 74 |
| <b>Causes of delay related to external factors</b> |                                                                          |                         |      |    |                    |      |    |                |      |    |                        |      |    |
| D1                                                 | Increase in material prices                                              | 3.79                    | 0.92 | 2  | 3.55               | 0.76 | 14 | 3.50           | 0.97 | 15 | 4.00                   | 0.93 | 1  |
| D2                                                 | Material shortage                                                        | 3.79                    | 1.03 | 3  | 3.90               | 0.79 | 3  | 3.19           | 1.17 | 32 | 3.95                   | 1.02 | 2  |
| D3                                                 | Changes in government requirements and regulations                       | 3.22                    | 1.09 | 39 | 3.60               | 1.00 | 11 | 2.50           | 1.10 | 69 | 3.30                   | 1.04 | 34 |
| D4                                                 | Unforeseen ground conditions                                             | 3.68                    | 0.97 | 7  | 3.95               | 0.95 | 2  | 3.38           | 0.96 | 20 | 3.67                   | 0.97 | 9  |
| D5                                                 | Severe weather conditions                                                | 3.66                    | 0.99 | 8  | 3.80               | 0.95 | 5  | 3.38           | 1.09 | 23 | 3.70                   | 0.96 | 7  |
| D6                                                 | Labour shortage (external factors)                                       | 3.61                    | 1.07 | 11 | 3.70               | 1.13 | 6  | 3.50           | 0.97 | 15 | 3.61                   | 1.09 | 14 |

| Code & causes of delay |                                                                             | All parties<br>(N = 79) |      |    | Client<br>(N = 20) |      |    | CA<br>(N = 16) |      |    | Contractor<br>(N = 43) |      |    |
|------------------------|-----------------------------------------------------------------------------|-------------------------|------|----|--------------------|------|----|----------------|------|----|------------------------|------|----|
|                        |                                                                             | M                       | SD   | R  | M                  | SD   | R  | M              | SD   | R  | M                      | SD   | R  |
| D7                     | Delay in land acquisition                                                   | 3.22                    | 1.15 | 40 | 2.95               | 1.05 | 54 | 3.00           | 1.21 | 36 | 3.42                   | 1.16 | 26 |
| D8                     | Delay in releasing permits from the municipality                            | 3.30                    | 1.10 | 30 | 3.25               | 0.91 | 37 | 2.88           | 1.20 | 46 | 3.49                   | 1.12 | 20 |
| D9                     | Traffic control and restrictions at the job site                            | 2.79                    | 0.94 | 65 | 2.45               | 0.51 | 71 | 2.88           | 1.03 | 42 | 2.91                   | 1.04 | 62 |
| D10                    | Government authorities and bureaucracy                                      | 3.14                    | 1.12 | 44 | 3.00               | 0.92 | 52 | 2.69           | 1.08 | 58 | 3.37                   | 1.18 | 28 |
| D11                    | Delay in performing the final inspection and certification by a third party | 3.06                    | 1.10 | 51 | 3.00               | 0.92 | 52 | 2.75           | 1.24 | 54 | 3.21                   | 1.13 | 43 |
| D12                    | Political situation or instability                                          | 2.58                    | 1.12 | 72 | 2.40               | 0.88 | 72 | 2.44           | 1.21 | 72 | 2.72                   | 1.18 | 68 |
| D13                    | Economic problems                                                           | 2.87                    | 1.10 | 62 | 2.80               | 0.95 | 60 | 2.69           | 1.30 | 62 | 2.98                   | 1.10 | 60 |
| D14                    | Problem with neighbours                                                     | 2.60                    | 1.04 | 70 | 2.35               | 0.88 | 74 | 2.75           | 1.24 | 54 | 2.65                   | 1.04 | 69 |
| D15                    | Force majeure                                                               | 2.51                    | 1.28 | 74 | 2.25               | 1.25 | 76 | 2.69           | 1.45 | 64 | 2.56                   | 1.24 | 72 |
| D16                    | Corruption                                                                  | 2.41                    | 1.15 | 76 | 2.40               | 1.05 | 73 | 2.56           | 1.46 | 68 | 2.35                   | 1.09 | 76 |

Note: N= number of respondents; M = mean value; SD = standard deviation; R = ranking

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