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# Underlying causes, effects and mitigation measures of delays in construction projects

Upeksha Madanayake<sup>1\*</sup>, Virginia Toli<sup>2</sup>

**Abstract:** Delays in construction projects are identified as a worldwide issue as it has been addressed in many recent empirical studies. This paper aims to investigate the causes and effects of these delays and analyse whether these delays can be mitigated with a well-managed strategy. This study utilises a qualitative approach by first, conducting a critical review of the literature to analyse the causes and effects of construction delays. The study then conducts in-depth interviews with construction professionals to verify the industry's position on this topic and to make recommendations about the mitigating measures. The interviewees sample represents a cross-section of the industry and its project roles. The key findings of a total of 12 interviews highlighted that 'financial related effects' are the most crucial ones that requires close scrutiny. Among the parties involved in a construction project, 'client' is in the highest risk of being penalized for these financial implications of delays. Although the contractor is generally required to try to prevent or mitigate delay, even where the fault is not their own, clients have the highest level of responsibility in delay-related decision making. However, depending on the procurement route this can vary. In terms of the causes 'communication, coordination and planning' reports as the highest contributor for to delays. The effects of these are mostly lost profit claims and delay and disruption claims. However, Building information modelling possesses a potential to mitigate the latter and. Nonetheless, the interviewees also highlight the need for training and awareness in above digital technology over traditional management practices, to perceive desired value.

**Keywords:** Causes of delays, effects of delays, mitigation measures, construction projects, construction delays

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# 1 Introduction

A construction project is commonly considered successful, if it is delivered on time, within the specified budget, according to the quality required by the client and ultimately to the client's satisfaction <sup>[2]</sup>. When the project fails to meet a particular time schedule, this is commonly known as a 'delay'<sup>[1]</sup>. Globally, the construction industry has been confronted with criticisms of delays that have an extremely negative effect on construction projects <sup>[1]</sup>. There are two kinds of delays in construction: (a) excusable and (b) non-excusable. Specifically, excusable delays are those which are unforeseeable or beyond the control of the parties involved. Non-excusable delays are those caused by the contractor or supplier and considered to be foreseeable.

Marzouk and El-Rasas, <sup>[3]</sup> argued that poor time management affects productivity and profitability as a result of insufficient planning and resource management and ineffective site management. It also creates issues with contractor funding and client compensation for completed works. Gebrehiwet and Luo<sup>[4]</sup> discussed the delays that can occur in the preconstruction stage, which affect the design being delivered on time and, therefore, the construction starting date. Internal and external delays can occur at any stage of the project life cycle and seem to be an enduring problem. Nonetheless, in every country, the construction industry is considered to be a fundamental contributor to the country's economy helping to maintain financial growth and attain economic objectives <sup>[2]</sup>. The construction industry also impacts on a society's quality of life, as it creates the built environment that sustains the needs and values of the community <sup>[5]</sup>.

The aim of this research is to investigate the causes and effects of construction project delays worldwide and measures to mitigate them. To achieve the aims, the resultant objectives are as follows:

1. To establish the extent of delay as an issue in the construction industry through a thorough review of literature
2. To identify and examine the underlying causes of delays
3. To appraise the effects of these delays in terms of time, cost and quality

This research attempts to answer the following research questions:

1. What are the underlying causes and effects of delays in the construction industry and the measures employed to mitigate them?
2. Are the current mitigation measures effective and applied in all situations by experienced stakeholders?

## 2 Underlying causes, effects and mitigation measures

### 2.1 Causes of construction delays

Construction project delays can be initiated by any of the project's stakeholders and can be allocated to a range of causes. A critical review of 27 studies was conducted with regard to the underlying causes of delays in construction and 11 themes of causes were identified. In order to identify the most important causes of delay in construction projects, an evaluation tool consisting

of 2 criteria was designed (i. level of impact; and ii. frequency of occurrence in the project life cycle), The twenty causes of delay proposed by the literature were filtered into an 11, and their respective significance as reported in the literature is illustrated in Table -1.

Table-1 Causes of delay in construction industry in ranked order

<b>Themes of Causes of delay in construction industry</b>
1. Weather/climate conditions
2. Communication and coordination
3. Planning
4. Construction materials
5. Rework
6. Project finance
7. Construction equipment
8. Experience and qualifications
9. Construction labour
10. Site management
11. Project management

Most studies classify weather or climate conditions as a substantial cause of delay which has a relatively higher impact and frequency of occurrence. Studies related to infrastructure projects have primarily researched the causes of delays in project schedule performance and have suggested that the effect of climate conditions needs to be considered throughout the planning stage of the project <sup>[6;7;8]</sup>. Several stakeholders participate in all the stages of the completion of a facility, from the initiation to the handover to the client. Khoshgoftar et al., <sup>[9]</sup> indicated that there is a lack of communication throughout the design construction collaboration. Project stakeholders have many disagreements that are related to the information flow from one organisation to another during the project's life cycle and to appropriate coordination between the stakeholders. These internally related delays have a negative effect on the project's schedule performance. Poor communication, coordination and disagreements are the second most cited cause of delays in the literature <sup>[10]</sup>. Ineffective/improper planning is the most likely cause of delays in construction <sup>[10; 11;12]</sup>. In this study, it was agreed that delays are caused by both consultants and clients. The PMI describes planning as the preparation of a plan of action to lead a construction project to completion. During the project's lifecycle, a definite operational plan and milestones must be formed and potential complications should be taken into account. Durdyev and Hosseini <sup>[10]</sup> have argued that construction delays in the project's milestones certainly impede project schedule performance. This is not excusable since the planned milestones are managed by the contractor. It has also being argued that the cause of ineffective/improper planning was that the client arranged a rushed or unviable project schedule or because of delays in the performance of the project <sup>[13]</sup>.

One other important global cause of delay is a lack of materials for projects. Without the appropriate materials, a design cannot be converted into a physical reality. Causes associated with construction material delays are design changes, supply delays, modifications in material prices, supply management, political issues, theft and material damage, testing failures and untrustworthy suppliers<sup>[10]</sup>. It has been cited 'material delivery delays' as one of the causes of construction delays <sup>[7; 12]</sup>, while Fallahnejad, <sup>[11]</sup> cited imported materials, client-related materials and order change as the causes of delay in his study. Consequently, progressive cash flow management is advised to ensure a continuous supply of materials in construction projects <sup>[13]</sup>. Pourroostam and Ismail <sup>[14]</sup> and Memon, <sup>[15]</sup> argued that the client as well as the design team cause delays in construction by requiring variations (e.g. changes in the scope of the contract) during the

construction stage. These changes result in rework and extra costs, which affect the management of the project and the relationships between the stakeholders. Many studies mentioned deficient project management as a substantial cause of construction delays <sup>[1]</sup>. Fallahnejad [11] argued that poor project management can be exposed when the client fails to meet scheduled payments to the contractor as per the contract or generally postpones payments. Kog, <sup>[16]</sup> on the other hand purported that clients may also set impracticable deadlines for design and construction teams. Consequently, effective project management must be considered in the planning and scheduling stage to foster successful communication and meet the client's expectations. In this regard, a construction schedule is vital to avoid causing further delays.

Overall, there is agreement within the literature that all the project stakeholders are liable for delays in construction projects but mostly the clients and contractors. The client is accountable for creating changes in the design during the construction stage without satisfying the contract agreement regarding payments for the completed work. A contractor is liable for delays due to poor site management, a poor-quality workforce, and a lack of expertise in the supply chain. There was also consensus within the literature that construction projects are constantly failing. #

## **2.2 Effects of construction delays**

An effect is a condition, occurrence, or result generated by one or more above causes. As a cause instigates an effect, delays in construction become the basis for several negative effects that impact upon the project and its stakeholders. While the causes are explored in depth through interviews, it is also explored the extent to which the causes have resulted in certain conditions. Some of such results mostly mentioned in the literature include lost profit claims, disputes, arbitration, litigation and, in certain situations, total abandonment <sup>[12]</sup>.

Project finances are the basic cause of construction claims <sup>[17]</sup>. For example, the 6<sup>th</sup> variable above-issues with financing has been reported as a major cause for construction claims. The construction sector is heavily influenced by domestic economic cycles, and macroeconomics. Damages to these economic cycles have left construction projects in the past couple of years with funding cuts, not being able to keep up with the promised payment cycles. Along with on-going price inflation, the projects have been on-hold for some long periods with long-standing disputes and claims. Interviews with construction professionals helped exploring these effects in-depth and they are discussed in section 4.

## **2.3 Mitigation measures**

Delays in construction projects have damaging outcomes (losses). For this reason, it is essential to find the right solutions to resolve or mitigate this issue. Khoiry et al., <sup>[18]</sup> classified four key criteria for mitigating delays: management, interpersonal, technical and technological criteria. Management criteria involves the proper manage of time, and financial and control systems to mitigate construction delays. Interpersonal criteria encourage good relationships among the construction parties, employing knowledgeable workers and experts, and the accountability of the client for preventing delays. The technical criteria guarantee the project's quality and the most appropriate technology may progress the development in the particular construction area. With the qualitative information gathered from interviews, this research aims provide meaningful recommendations of mitigating some of these causes and effects.

# **3 Methodology**

## **3.1 Overview of methodology**

This research is predominantly qualitative seeking to respond to the research questions previously mentioned. Several strategies were considered and the researcher decided that the optimal strategy

was semi-structured interviews conducted with 12 international professionals currently located in the United Kingdom, Greece and Norway from different sized organisations representing a cross-section of the industry to understand the real-life experiences of each area. Two forms of data were collected: primary and secondary data. The secondary data consisted of a literature review (2006-2020) to ascertain the findings of peer-reviewed studies investigating the causes and effects of construction delays and evaluating the mitigation measures taken with their effectiveness. The secondary data provide background information against which the findings from the interview responses can be compared.

### **3.2 Semi-structured interviews**

Semi-structured interviews were conducted using a questionnaire with 12 professionals located in the United Kingdom, Greece and Norway from different sized organisations who represent a cross-section of the industry and have performed project roles worldwide (United States, Chile, Europe, India, Africa, Middle East). A qualitative method was selected to review the real-life experiences of delays in construction. The following types of professionals were selected:

### **3.3 Method of data analysis**

Within the literature review, the results of many of the studies on construction delays have been determined using the ratings of random respondents; however, these have seldom been verified by interviewing the specialists who are practically involved in construction projects and who recognise the real-life problems in the industry. Consequently, the preferred method to obtain information about the causes and effects of construction project delays and measures to mitigate them was through in-depth interviews. For this research, the results were examined in a descriptive way accompanied by histograms and charts, and this also allowed the particularities of each individual's experience and their disciplines within a construction project to be accommodated. The qualitative method is typically the most exploratory method of researching issues <sup>[19]</sup> and was selected to accumulate and analyse the data from the industry's professionals.

In the interviews, several questions were designed to be responded to with short answers. Other quantitative questions included a rating scale that accorded with the participant's experience. The responses were followed with open-ended questions using coding to ascertain the main argument in the responses accompanied by descriptive analysis. The closed-ended questions followed the same pattern followed by a more descriptive than statistical analysis. The analysis emphasised on the research objectives of this study.

## **4 Data Analysis**

### **4.1 Demographic data**

Based on the demographic data, among the main stakeholders presented in this research, 50% of the participants work in or own a consulting firm, while the remaining respondents are equally divided between working for a client, designer or contractor. Many of the participants have prior education and experience in civil construction and along with their consulting experience were able to provide valuable opinions regarding the delays in construction in the next section of this research.

## 4.2 An overview of the issue of delays in the construction industry

In the second section of the questionnaire, it was asked respondents to consider the implications of delays on construction projects. All the participants interviewed agreed that the first implication is a higher financial cost. Participant A, who works on the client side, stated that 'it's always about time, budget and quality'. Participant G agreed and added 'the relationship between the main stakeholders'. Participant I agreed with the latter statement. A noteworthy statement was offered by Participant H concerning cost implications:

*You cannot capitalise all the asset until it's complete. So, you're missing out not only on your post-phase increase but, also, your revenue is being delayed...The delays of actually completing the project, the cost increases and then the delays are the chain of all the capital.*

With regard to the financial implications, Participant A stated, 'probably the contractors are more affected because in my contracts you have liquidated damages that you can apply if the scheme is late or for the rent loss that you would suffer'. Participants E and J agreed with this statement, with Participant E adding, 'delays are most likely going to incur an additional cost that could be proved penalties, then you've got your resources that are going to be tied up in projects'. Participant G agreed with E by mentioning resource implications. An interesting statement was offered by Participant C about the budget.

## 4.3 Responsibility for delays

Question 5 asked participants to share their opinions of the main stakeholders who are primarily responsible for construction delays on a scale ranging from 1-5.

The analysis of the results shown reveals an interesting finding. It demonstrates that 75% of the participants rated clients with a score of 3, while only Participants C and E evaluated clients, with a score of 5, as the most responsible for delays in construction. Specifically, Participant C stated,

*The client is the most responsible for managing the whole process from procurement, to design, to delivery and handover. So, at the end of the day they are at the top of the chain, so they are responsible for the successes and also for the delays.*

However, Participant A stated that 'clients ask for changes but usually give extensions of time', while Participant B added 'clients lead to a lot of delays...we would make these decisions earlier and not contribute to causing delays'. Participant H and I both agreed that 'it depends how experienced the clients are', with H adding 'it depends how sophisticated the client's product is in terms of design'.

Conflicting attitudes regarding the contractor's responsibility were noted. Participants A and B, who both work on behalf of clients rated contractors with a score of 5 as the most responsible for delays. Participant B stated, 'But contractors have more responsibility because obviously they carry more risk in terms of procurement, labour, materials, all the machines, so they're more likely to cause delays so they have a tougher job'. Participant C agreed with B that 'the contractors have a large role to play depending on how the contract is procured'. Participant H added that contractors are 'very optimistic by nature...there are delays among the trends'.



#### 4.4 Causes of delays in construction

Question 7 asked the participants about the causes of construction delays using the key categories found in the literature review. An open question was used to compile the participants' knowledge on this issue. This resulted in a broad. A median was used when an answer received was more than one score, which was usually when delays in two different countries were compared.

Participant H, who is located in the United Kingdom, was the only respondent who rated weather and climate conditions as very high contributing causes to construction delays:

*If it's too windy, you can't put up your crane, if it's too wet you can't mix water sufficiently and apply plaster for example. The weather has a huge impact, the more there are changes in the weather patterns, the more it affects developers.* Participant C stated, 'it depends where you are...in London for instance I would say very little', which conflicted with H's answer. Participant L stated, 'It depends on the project. If it's civil or what the activity is but sometimes the weather can be the major factor in doing the job'.

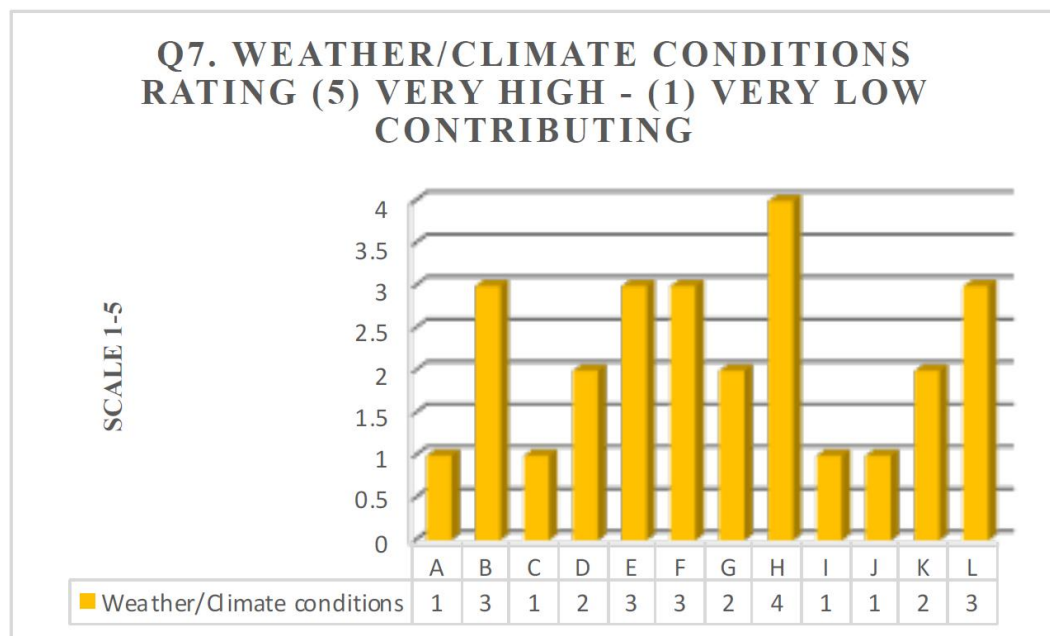


Figure 1 Responses to Question 7: Rating for weather and climate conditions

50% of the participants rated communication and coordination as very high contributors to delay while 42% rated them as high contributors. This indicates that the participants are concerned that communication and coordination are primary causes of construction delays. Participant C stated, 'It depends on the way the contract is procured'. Participant G and D rated rework as a very high and high contributor to delay, respectively. The other respondents (42%) rated it as a low contributor. Participant H in the United Kingdom stated, 'I haven't had a lot of developments where rework had to be carried out acceptably enough to be considered, even loosely, to delay the projects'. Participant L contradicted the above stating, "In the U.K. I would score 4. It happens very often. In Greece I would score 2. Usually, they don't do the same job twice because they can't afford it'.

It is evident from the above data of the 11 causes of delays in construction recognised in the literature review, the participants in the sample rated communication and coordination, planning, site management and project management as high and very high contributors to delays. Project finance was rated divergently as a high-medium-low contributor (25%). Construction equipment, experience and qualifications and construction labour were rated as medium contributors. Weather and climate conditions, rework and construction materials rated as low to very low contributors. According to this sample, delays can be accredited to the fact that projects are becoming larger and are usually completed by 2-3 companies, which complicates the communication and coordination among different teams from different companies. Poor communication and coordination and disagreements were the second most cited cause of delays in the literature review [10;7]. It may take 2-3 years to progress schemes through planning, and communication has an important role in this as well. In addition, if the site is untidy and the site and project are being mismanaged by the main stakeholders, there will be severe delays. In Libya, Tumi et al., (2009)

found that financial issues ranked as the chief cause of delay. From the sample, it can be seen that in the United Kingdom financial issues are medium to low contributors of delay but in Greece such issues are considered to be very high contributors.

Question 9 aimed to elucidate the information gathered in the previous questions about causes, by asking the participants to select how often the effects of projects delays listed in the literature review occurred on a scale ranging from 1 to 5. Interestingly, 50% of the participants rated claims to recover lost profits in construction with 'mostly'. Participant J, who is located in Norway and tendering teams, rated this effect as 'always' and stated 'But if you get delayed, all the indirect costs, the people who have to stay there and do this, at least that is a cost. Always. And also, injured parties have liquidated damages that they can apply penalties and that's also a cost and you lose profit. Always'. From the client's side, Participant A also stated, 'if the contractor is not going to be making money then they take a lot of their workforce off and put them on other projects and then end up in a slackening process for weeks'.

Issues with organisational cultures were rated as occurring 'sometimes' by 42% of participants. Participants B, F and J rated these as 'mostly' occurring with J stating, 'This is also a cost; you get a delay for sure and there will be a dissatisfaction from all the stakeholders'. Participant L referred to an interesting example stating, 'At a U.K. airport, there was an expansion to a programme; there were issues with the environmental agencies because this would affect the wildlife'.

#### **4.5 Effects of lost profit and delay claims**

Question 10 explored the participants' views on the underlying causes of delays and whether they would increase, decrease or not change in the light of lost profit claims or delay claims. These views can be related to the consequence arising from construction delays in the industry.

An influential response was given by Participant E who has been dealing with project planning and delay analysis for more than 20 years:

*It's a tricky one because people are aware that if a project gets delayed, it's going to have a cost impact so in theory you know there are going to be lost profit claims, hence, the effects of delay should lessen but they don't tend to. In the United Kingdom contractors put claims in, it's become almost standard practice. So, they will price the project competitively and they know things are*

*going to happen, there will be variations...they can get extensions of time and additional kinds of delay and disruption claims. So, I think it's a bad mindset. There is a kind of "go for the cheapest contractor" rather than pay a bit more and get a good contractor. You've got an architect covering his own back so he's not going to be truly objective. The contractor is likely to benefit if they win the claim.*

The rest maintained a more neutral position on this topic. Participant C agreed with Participant A stating, 'If you work closely with the client and walk in the same direction, the client will help' and added 'it's about keeping relationship healthy'. Participant F stated, 'there will probably be no change. Organisations are quite complex and communication between various departments is not effective. Local site management teams do not pay attention to lost profit claims unless the project is near the end...there is a lack of objectivity, yes'.

## **5 Conclusion**

This research found that delays are abundant in the construction industry and there is an overall tolerance for delays as an acceptable part of the industry. Accordingly, it is evident that the main stakeholders are frustrated with the value offered by the industry, which was mentioned specifically with regard to the processes in the very early stages (planning).

O1- There are numerous interlinked and underlying issues which have initiated this lingering problem in the industry, including financial implications, fragmented management from the main stakeholders and ineffective and improper planning that restrains project success in terms of time, cost and quality. It seems that these have implications for the relationships between stakeholders, produce penalties and budgeting and funding that lead to rushed decision, procurement, assurance and handover processes. They also result in loss of income for clients, reputational damage for both the client and contractor, and health and safety risks which are an under-discussed problem. Within the literature, it appears that all the project stakeholders are responsible for these delays. Ineffective and improper planning definitely restrains a project's success in terms of time, cost and quality. There is a strong impetus now for fast track construction, which leads to poor design, which, in turn, equates to more time and lower quality. Accordingly, the literature suggests that delay is indeed a substantive issue in the construction industry.

O2 -There are a range of causes of delays in the construction process. It is evident from this research that communication and coordination, planning, site management and project management are high to very high contributors to delay. More projects now are larger and usually undertaken by 2-3 companies which complicates the communication and coordination among different teams and different companies. It is essential to manage resources otherwise valuable time is lost in the construction process. Sometimes it takes 2-3 years to get schemes through planning, and communication has an important role in doing so. If the site and project are mismanaged by the main stakeholders, there will be severe delays. Project financing is not an issue in the United Kingdom but is a high contributor in other countries. Other contributors to delays are external causes (services); the technical team delaying drawings; poor communication with building control and warranty providers, companies using M&E, which causes clashes in design and miscommunication between members; and temporary joint ventures with different

cultures, behaviours and people. In addition, inadequate coordination, risk allocation and design; a lack of innovation, a lack of communication between managers resulting in time losses and an exhausted workforce; inadequate planning in the early stages; and contractors starting construction without an approved design (D&B) also cause substantial delays. The necessity of redesigning in the construction stage due to material complexity as a result of stakeholder miscommunication at an earlier stage may also cause delays. Finally, stakeholders who lack experience and qualifications also greatly affect project schedule performance and often tender projects to contractors with insufficient experience who, in turn, employ unskilled labour.

O3-From this research, it is evident that the effects of construction project delays are mostly lost profit claims and delay and disruption claims. Some studies have claimed that competitive procurement has the most negative effect on construction delays. In theory if a project is delayed, this will impact on costs and lost profit claims, which means the effects should lessen but this does not appear to be the case. The mindset within the industry is flawed in this respect; contractors know that there will be construction variations and, therefore, price the project competitively, knowing that they will be able to obtain extensions of time and delay and disruption claims. It also appears that the underlying causes of delays are likely to increase in the light of lost profit claims or delay and disruption claims. Most or all projects lead to claims to recover lost profits or delay claims (compensation events) or no claims when the cause is minor or the contractor's incorrect estimations result in unexpected costs that cannot be claimed. It is essential to mention that the level of communication and coordination between the main stakeholders ultimately leads to these effects.

The above three objectives have remarked the achievement of aim of this research by investigating the causes and effects of construction project delays worldwide and the measures to mitigate them.

## **6 Recommendations**

The recommendations below have been developed from the research and should be used to inform future considerations regarding the implementation of mitigation measures for construction project delays.

1. Clients should amend the schedule and the programme when necessary, resequence works, spend time on technical issues, realise a more accurate budget, spend more time on the planning and very early stages to avoid changes in the scope of work in the construction stage. In addition, spending a little more will benefit the project in the long run.
2. An experienced contractor and supply chain should be included in the planning stage and a greater use of D&B and EPC projects where the contractor can see in advance whether the design is realistic to improve the duration, cost and quality of the project.
3. BIM should be included in construction projects to facilitate communication and coordination, and train stakeholders in new knowledge and skills instead of continuing to use traditional management practices. The schedule performance should also be

- monitored from the very early stages, extending the supply chain.
4. Experienced site and project managers should be used in projects with broad mindsets, who are able to communicate and coordinate beyond the organisational culture. Risk management techniques should be used to progress and support an effective and realistic programme of works.
  5. It is suggested that further research in this field should include a quantitative research questionnaire with a much larger sample to enable a statistical analysis to be accomplished.

Firstly, trends in the causes and effects of construction project delays could be examined and how these have affected the response to mitigation measures worldwide. Secondly, the research should explore how specific types of technology and practices are being adopted in the construction industry in terms of the mitigation of delays, and how the industry will respond to the robotic systems being introduced by artificial intelligence in terms of time, materials, labour provisions and procurement.

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