Identifying Project Delay Factors in the Australian Construction Industry

Syed Sohaib Bin Hasib, Hiyam Al-Kilidar

***Abstract*—** Meeting project deadlines is a major challenge for most construction projects. In this study, perceptions of contractors, clients, and consultants are compared relative to a list of factors derived from the review of the extant literature on project delay. 59 causes (categorized into 8 groups) of project delays were identified from the literature. A survey was devised to get insights and ranking of these factors from clients, consultants & contractors in the Australian construction industry. Findings showed that project delays in the Australian construction industry are mainly the result of skill shortages, interference in execution, and poor coordination and communication between the project stakeholders.

***Keywords*—** Construction, Delay factors, Time delay, Australian construction industry

I. Introduction

The construction industry plays a vital role in boosting the economies of developing countries [1]. Improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for a country's GDP [2]. As successful construction project management require meet triple bottom lines including time constraints, project delays have become a habitual hurdle for timely completion of construction projects. The term delay in construction means not meeting the criteria of completing the project on time as given in the contract. Many researchers in the past have identified that delays in construction project can be detrimental in many ways and can lead to various cost, quality and time problems [3]. [4] also explains that time delays and cost overruns usually lead to adverse effects on the growth of national economies, contribute to major financial losses, and hold back the development of the construction industry.

A construction project can be delayed due to several factors. Although, some of the factors are arguably defensible such as poor weather conditions, many factors are preventable i.e. poor planning and workmanship. The aim of this paper is to find the primary factors that cause project delays in the Australian construction industry. Different causes of delays that usually occur in construction projects have been identified and shortlisted by means of different reports and research conducted on this topic. A survey is then devised and used to investigate these delays by the help of field professionals in the Australian construction industry. The analysis of the data using RII (relative importance index) will help to rank different causes of delays identified by stakeholders i.e. client, consultant and contractor. Recommendations for the principal causes of delay will be provided in order to minimize or overcome these delays in the future. Procedure for Paper Submission

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II. Literature Review

Delay in construction projects is a global phenomenon affecting not only the construction industry but the overall economy of countries [5]. Research conducted on this topic have been conducted by different authors in various parts of the world. In his research for Indonesian construction projects [6] found that 38% of the projects were running late and only 47% of the project were completed on the planned dates whereas, only 15% were completed ahead of schedule. [5] and [7] conducted a survey for the primary causes of project delays for Malaysian construction industry. The respondents that included contractors, consultants and clients ranked various causes of delays that were extracted by different literatures. The root causes of delay analyzed by the use of relative importance index method (RII) were found to be contractors' improper planning, poor site management and lack of finance to complete the project.

In their survey of 130 public projects in Jordan [8] found the main causes of delay to be poor design followed by change orders by clients. Whereas, the site and economic conditions were found to be least affected factors for project delays. The study suggested that special attention should be given for the design of drawings in the initial stages otherwise risking significant delays in project.

[9] studied the main causes of delay in the Hong Kong construction industry. The study identified 83 causes of delay spread across 8 groups. The outcome of the study showed that the contractor, client and owners tend to blame each other in their respective domains. The use of relative importance method (RII) showed that poor site management, lack of decision-making and client variations in drawing are the main causes of delays in projects. The study also gave a recommendation that good co-ordination between the contractor, client and owners can reduce these delays and contribute to the overall success of the project.

[10] conducted a literature review sample for papers related to construction delays in the period 1985-2014. He used Kiviat diagram to explain the rankings of each delay. The findings of different papers on the average rank showed that financial issues were the main problem in the period 1985-1990. However, this trend shifted in the period 1997-2002 where based on the average mean it was found to be fourth most important cause for time delays. The most prominent factor taken on average of all the papers was found to be management related issues.

In his survey of Thailand construction industry [11] found design and inexperienced contractors were the main problem for project delays. [2] for the Indonesian construction industry found change orders by client and poor planning are the prime issue for delays

[12] conducted a similar study for the western part of Australia. They highlighted 48 delay factors in 10 different groups and found skill shortage and difficulties in financing projects to be the main causes of project delays. This study also highlighted additional factors of delay given by the respondents in their feedback to be investigated in the future research. These factors included contractors excessive workload, contractors limited resources to carry out the work , political issues, limited detail from client, lack of environmental or heritage permits , poor quality management, non-existent or poor risk management plan, delay in inspections, sub-contractor issues.

We summarise the ranking of delay factors synthesized from literature in Table 1.

Table#1 Main causes of project delay identified by various authors

Country	1	2	3	4	Author
Malaysia	Contractor improper planning	Contractor poor site management	Inexperienced Contractors	Late payment from client	[5]
	finance problem by contractor	Poor planning from contractor	Late payment from clients	Bureaucracy in government	[7]
Jordan	Change orders by client	Weather conditions	Poor site management	Late deliveries of material	[8]
Hong Kong	Poor site management	unforeseen ground conditions	Low speed of decision making	Client initiated variation	[9]
Thailand	Improper design	Inexperienced Contractors	Inexperienced staff	Inexperienced subcontractors	[11]
Indonesia	Change orders by client	Poor planning from contractor	Wrong estimation of material	Poor labour productivity	[2]
Egypt	Type of project bidding	Poor planning from contractor	Change orders by client	Approval of drawings	[13]
	Delay in progress payments	Different tactics for bribe	Shortage of equipment	Poor planning from contractor	[14]
Nigeria	Poor contract management	Lack of payment from client	changes in site condition	Shortage of materials	[15]
Ghana	Late payment from client	Unrealistic contract duration	Poorly defined project scope	Client initiated variation	[16]
Ethiopia	Corruption	Unavailability of utilities on site	Inflation in material prices	Lack of quality materials	[3]
Iran	Change orders by client	wrong estimation for time	wrong estimation for cost	Delay in delivering site to contractor	[17]
Saudi Arabia	Late payment from client	Change orders	poor project scheduling	Slow decision by owners	[18]
Western Australia	Skill shortage	Financial difficulties	Shortage of labour	Unrealistic deadlines	[12]

III. RESEARCH METHODOLOGY

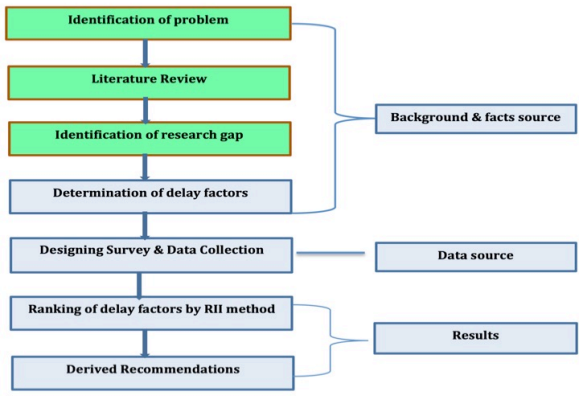

Figure 1 Research methodology

The research was conducted by the approach given in the flow chart above. Analyzing and syntheses of existing literature and identification research gap based on existing facts was conducted and followed by the design of a survey and collection of data. The data was analyzed using the relative importance index method (RII) to identify the causes and ranking of delays in the Australian construction industry and derive recommendations.

3.1 Determination of delay factors:

[19] developed a framework for different construction delays and divide them into two groups of excusable and non-excusable delays. The framework was established based on previous research and case studies conducted on this topic.

[14] also categorized 99 factors of delay into 9 categories. The factors were shortlisted by conducting interviews of field experts. [3] also Listed 52 main causes of project delays divided into 4 main categories by the help of six field experts. Using the above three model which include all the main factors for construction project delays, we have identified various causes of project delays divided into 8 groups and consisting of 52 delay factors. Also, 7 additional factors as identified by [12]

in his research for western Australia are included in the list which makes it a total of 59 factors .The field experts from client, consultant and contractor will rank these delays as per their expertise. Table2 shows the 59 factors of delay categorized into 8 groups.

Table2 Main factors of project delay

S#	Delay Group	Causes of delay
1.1	Client related issues	Change orders
1.2		Interference on execution
1.3		delay in progress payment
1.4		Late in revising and approving design documents
1.5		Improper project feasibility study
1.6		Lack of owner experience in construction projects
1.7		Delay in handing over the site to contractor
1.8		Type of project bidding (lowest bidder)
1.9		Poor co-ordination between owner and other parties
1,10		Limited details given by owner
1.11		conflict between joint ownership (poor co-ordination)
2.1	Consultant related issues	Inadequate experience of consultants
2.2		Late in approving and reviewing design documents
2.3		Poor supervision and testing
2.4		Delay in inspection
2.5		Poor co-ordination between consultant and other parties
2.6		Conflict between consultant and design engineer
3.1	Contractor related issues	Difficulties in financing project by contractor
3.2		Frequent change of sub-contractors
3.3		Unexperienced sub-contractors
3.4		Delay in mobilization
3.5		Inadequate contractor experience
3.6		improper planning and scheduling
3.7		Poor site management and supervision
3.8		Use of improper construction methods and technology
3.9		Delay in preparation of shop drawings
3,10		incompetent project team
3.11		Contractor excessive workload
3.12		poor risk management plan
3.13		Poor quality management
3.14		Poor co-ordination between contractor and other parties
4.1	Design related issues	Complexity of project design
4.2		Mistakes in design documents
4.3		Unclear and inadequate details in drawing
4.4		Misunderstanding of owner requirement by design engineer
4.5		Lack of design team experience
5.1	Labour related Issues	Labors absenteeism
5.2		Shortage of unskilled labors
5.3		Low productivity of labor
5.4		Labor strikes due to revolution
5.5		Labor injuries (health and safety issues)
6.1	Equipment related issues	Equipment allocation problem
6.2		Equipment breakdown
6.3		Inadequate modern/old equipment (low efficiency)
6.4		Shortage of equipment
7.1	Material related issues	Shortage of construction material in market
7.2		Change in material needs during construction
7.3		Delay in material delivery
7.4		Poor procurement of materials (purchase of cheap material)
7.5		Increase in material prices
7.6		Unreliable suppliers
8.1	External factors	Change in regulation and laws by government
8.2		Unfavorable weather conditions
8.3		Natural disasters
8.4		Global financial crisis
8.5		Issue of permit by councils and concerning authorities
8.6		Political issues
8.7		Lack of environmental or heritage permits
8.8		Corruption

IV. Questionnaire and Research Set-up

The questionnaire was divided into two parts. Part A had general information about the respondents and part B included all the list of 59 causes of project delays.

The questionnaire was distributed to field professionals to rank these delay factors as per their experience and knowledge. The ranking of these delays will be analyzed using relative importance index.

The questionnaire was sent to 50 respondents to have a clear point of view from all the major stakeholders of the local construction industry. Since the data collection was done during the COVID-19 pandemic, we have only used online ways to collect data. The respondents were contacted by different online means such as Email, LinkedIn, and other professional platforms and forums.

A. Limitations of Study

The main limitations of the study:

- The study is restricted to the construction projects only.
- The study will be conducted for the Australian construction industry.
- Due to limited time and social distancing measures because of COVID-19 pandemic, the data will be collected from limited number of respondents.

V. Analysis

To meet the main objectives of our research, an analysis by engaging the professionals from Australian construction industry was done using questionnaire.

The data was analyzed by the relative importance index (RII)

method using Likert scale from range of 1 to 5. The factor of delays will be ranked separately and collectively for the client, consultant and contractors to have individual and combine views from the stakeholders. The analysis will reveal the most contributing factors of delay which will be followed by appropriate recommendations to overcome these delays. The formula and use of relative importance index method is shown below.

$$\mathbf{RII = \sum W/A*N}$$

Where, W is the weight given to each of the factor by respondents (ranging from 1 to 5), A is the highest value on scale i.e. 5 in our case and N is the total number of respondents. RII is directly proportional to the cause of delay. The higher the value of RII, the higher is the cause of that delay. The outcome of the survey will help to rank 59 causes of delay from the most to the least important one. The respondents were asked to reflect on their own experience to rate the impact of each on the overall progress of the construction project on a scale from 1 to 5. I.e. from "never to always". These ranking can be used to compare the importance of delay as given by respondents (i.e. Contractors, client and consultant). All 59 factors will be ranked by the respondents using the Likert scale with range 1 to 5 as shown in Table3 below.

Table3: Likert Scale used in this study

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

VI. Results & Discussion

A questionnaire survey was sent through to 50 respondents out of which 28 were received back. The data set consists of 6 clients, 11 consultants and 11 contractors as shown in Fig2 below:

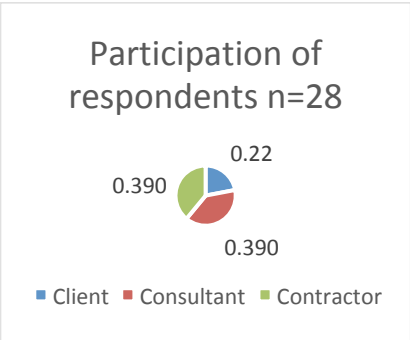

Figure2: Participation of respondents

Table4 Ranking of delay factors from clients

Rank	Client n=6	RII
1	Poor supervision and testing	0.900
2	Improper project feasibility study	0.833
3	Poor quality management	0.833
4	Late in revising and approving design documents	0.833
5	inexperienced sub-contractors	0.767

Table5: Ranking of delay factors from consultants

Rank	Consultant n=11	RII
1	Inadequate contractor experience	0.782
2	incompetent project team	0.782
3	Poor supervision and testing	0.764
4	inexperienced sub-contractors	0.745
=4	Interference on execution	0.745

Table6: Ranking of delay factors from contractors

Rank	Contractor n=11	RII
1	Interference on execution	0.836
2	delay in progress payment	0.836
=3	Delay in handing over the site to contractor	0.818
=3	Poor co-ordination between owner and other parties	0.818
=3	Poor supervision and testing	0.818

6.1 Causes of delay:

Tables 4,5 & 6 rank the top 5 causes of delay in construction projects received from clients, consultants and contractors respectively based on the survey outcome. The clients in the Australian construction industry believe that poor supervision and testing, Improper project feasibility study, poor quality management and late in reviewing and designing documents are the main factors that leads to project delays.

However, consultants seem to have different opinion from clients and ranked inadequate contractor experience as the most significant factor leading to project delay which is followed by incompetent project team, poor supervision and testing, inexperienced sub-contractors and interference on execution by the contractors.

The contractors have ranked interference on execution by other parties as the top ranked factor for project delays. Delay in progress payments, delay in handling over the site to contractor, poor coordination between owner and other parties & poor supervision and testing are the other four that leads to project delays as per the contractor.

This indicates that few factors are ranked in common by all the parties i.e. as shown in Table 4, the clients believe that "Poor supervision and testing" is the most contributing factor for project delays. Also, the same cause of delay is ranked 3rd by both consultants and contractors. This seems to be a most common issue for all the parties and is therefore the most significant factor contributing to project delays in the Australian construction industry. In order to have a combined view from the field professionals we have ranked the top 5 causes of delays from a total sample size of 26 respondents. The top 5 causes of delay as ranked by our respondents is

shown in Table7. These causes of delays will be discussed in detail in the following sections and each factor will be given a suitable recommendation to minimize these delays.

Table7: Overall ranking of delay factors from respondents

Rank	Overall respondents n=28	RII
1	Poor supervision and testing	0.814
2	Interference on execution	0.771
3	Poor co-ordination between owner and other parties	0.757
4	incompetent project team	0.743
=4	Poor quality management	0.743

6.2 Ranking of project delay causes and recommendations:

1. Poor supervision and testing:

Although the issue of poor supervision and testing was not found to be a leading factor of project delay in the previous literature. it was pointed to be the most contributing factor of project delays in Australia construction industry.

While it is usually considered a consultant related issue, contractors also share responsibility to collectively supervise sites with the help of consultants to achieve project deadlines. The consultants also believed that poor supervision on site are causing project delays. They believe that contractors who do not cooperate with clients to fulfill the requirements of the project potentially lead to project delays. Poor supervision and testing also result from the inexperience consultants that do not have the required expertise to fulfill the project objectives smoothly.

The Report commissioned by the building minister forum BMF [20] who is responsible to establish and maintain the Australian Building Codes Board (ABCB) also suggest that increased requirements for inspection are necessary throughout the phase of the project [20]. There are significant discrepancies across jurisdictions in the number of inspections required and the notification stages. The findings of the report show that in some jurisdictions, inspections are carried out by builders or unqualified council officers who send photos of works to the building surveyor for review. The report suggests that the on-site inspections should be carried out by field professionals only i.e. under the supervision of registered engineers and building surveyors and a standard guideline under the legislation and building code of conduct should be followed. The proper implication of these guidelines will mitigate the risk of time and cost overruns and will eventually help to meet project deadlines.

2. Interference on execution:

With a RII of 0.836, the contractor ranked the interference on execution to be the most common issue that leads to project delays. [16], [18] and [9] also highlighted interference on execution as one of the most common factors that leads to project delays. [21] conducted a study on interference on execution in construction projects and found that the interference affects the construction time and the cost both positively and negatively. They suggested that when client interference occurs on a construction project it is often more negative than positive. The majority cause (72%) of negative interference was due to the client or the Principal Agent on behalf of the client, issuing an instruction to make changes to the design or scope of the works. The authors explained that the further into the project that the interference occurs, the more difficult it becomes to execute that change, eventually a point is reached whereby the feasibility and physical possibility of the project are in question [21].

Therefore, it is required for the clients and consultants to give the contractor a design documentation, construction schedule and all the relevant documents and they should be updated regularly throughout the construction process.

3. Poor coordination between owner and other parties

The poor coordination between the owner and other parties was found to be the 3rd most significant factor overall with a RII of 0.757. Although, the client and consultants have not ranked this issue in the top 5 causes of delay. However, the contractors believe that this issue is the 3rd most contributing factor of project delay. The above explanation on interference on execution clearly shows that client and consultants do not provide the contractors with a clear sight of information which potentially leads to project delays. This clearly is a result of lack of communication and coordination between the project teams. In his study for western Australia [12] also ranked poor co-ordination and communication between project teams as one of the top 5 causes of delay in Australian construction industry.

Lack of communication between project teams was also one of the leading factors of project delays in Hong Kong construction industry where the authors suggested that communication among all project stakeholders need to be maintained throughout the project lifecycle. This necessitates that roles, responsibilities and accountabilities of all relevant stakeholders and decision makers are clearly defined and identified [9].

Also, communication methods and strategies should be followed, improvised and upgraded as required so that all the stakeholders are on the same page throughout the project. Table8 below shows the suggested external and internal communication plan that can be effective if properly implemented and upgraded on regular basis.

Table 8: internal and external communication plan

External and internal communication plan					
Stake-holder	Key information	Method of communication	Frequency of communication	Description of tasks	Person In charge

4. Incompetent project team

The data analysis ranked incompetent project team as the 4th most contributing factor with an overall RII value of 0.743. The incompetent project team is mainly due to the skill shortages in

the Australian construction industry. A Study conducted by [12] for western Australia ranked skill shortage as the major factor for project delays with RII value of 0.8375. The study emphasized that a strategic plan needs to carry out to minimize the impact of this delay. Several actions such as training subsides for employers, training a younger generation of engineers with the aim to develop a core of skilled engineers, continuously providing training on improving management, technical, engineers can be considered [12]. It is therefore necessary for all the stakeholders to closely monitor their project team while making sure they have the required expertise to fulfill the project goals and requirements.

To overcome the problem of skill shortages, the government in liaison with the construction industry may consider launching a professional graduate program. The program can allow young engineers to gain some in-depth industry knowledge. The professional and experienced engineers should mentor or help young engineers to guide them with the possible barriers and how to overcome them.

Also, the government may consider increasing their cap for professional civil engineers and managers who have the previous knowledge and experience to fulfill the objectives of the project. For example hiring a field professional for a complex commercial project.

5. Poor quality management

Project quality management as the key driver of project management plays a decisive role in the projects [22]. [12] also categorized poor organization by contractor/consultants which is similar to quality management as the 5th most contributing factor of project delays in western Australia.

The issues related to poor quality management not only lead to project delays but also have a significant impact on project cost. Therefore, it is much needed to have a solid quality management plans with clear guidelines and policies. A good quality management plan serves as an internal and external tool for construction companies. The organization must make sure they adhere to the following while formulating a quality management plan.

a) Clear and concise quality objectives
b) Quality policies
c) Required standards (ISO)
d) Regulatory and legal requirements

In addition, the construction companies should also focus on the process and programs that are aligned with their quality management plan. The implementation in the following areas are compulsory to fulfill the quality objectives.

a) Document control
b) Experienced QA/QC manager
c) Quality audits
d) Corrective and preventive measures

The quality management plan should be reviewed, upgraded and monitored closely by the QA/QC manager or any quality controller in order to minimize or eliminate project time and cost delays.

VII. Recommended Treatments

Formulated treatment plans as shown in Table 9 below are developed to address the delays identified. A proper implementation of the risk treatment plan can also be used a tool to mitigate the potential risks related to time, cost and quality delays.

Table9: treatment plan for main causes of construction project delays

Identified risk	Relevant Stakeholder	Possible Consequences	Treatment
Poor supervision and testing	Contractor /client	Time and cost overrun	The supervision and inspections should only be carried out by registered engineers and building surveyors under the guidelines and policies set out by National construction code (NCC) and building code of Australia (BCA)
Interference on execution	Client /Contractor	Time overrun	Comprehensive strategies need to be formulated to minimize variations, whether client-initiated or consultant initiated, wherever possible. A clear and thorough client brief is considered the most useful strategy for reducing variations
Poor co-ordination between owner and other parties	Client /Consultant	Time overrun	Clarity of the project scope have a significant impact on internal communication of the primary project stakeholders. Therefore, a clear internal and external communication plan must be formulated by the clients and consultants and followed by all the stakeholders of the project team.
Incompetent project team	All stakeholders	Time and cost overrun	The government with the help of local construction industries should focus on launching professional graduate program under the supervision of expert field engineers and mentors. Also, the government should consider increasing their cap for professional civil engineering immigrants to overcome skill shortages.

Poor quality management	Consultant /contractor	Time and cost overrun	The construction companies should formulate a comprehensive quality management plan outlining clear objective, quality policies and standards. In addition, the companies should emphasize on improving the process required to achieve the quality objectives. i.e. effective document control, audits and corrective and preventive measures.

CONCLUSION

Delays in construction projects is a global challenge that construction firms face all over the world. This report identified the key causes of project delays in the Australian construction industry and provided some recommendations to overcome these delays.

The small sample size of the research may pose some limitation to the extent in which the results of study may be generalized. However, the study superseded the previous research carried out in Western Australia and provides broader scope of research in the given topic.

This study informs those who are interested to further expand the research on the same topic. Using empirical approach, future research may assist the local Australian construction industry to take these sets of delays into account as a part of their risk management plan. The proposed recommended treatments can be beneficial for all the stakeholders in the construction industry to minimize or eliminate these delays for achieving project deadlines and commitments.

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