

Analyse Factors Affecting the Delay in Building Construction Projects in Sri Lanka; Through the Interaction of the Project Team

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Abstract: *Constructions are undergoing with an unfavourable situation with their cost overruns due to the delay issues and are exposed into the risk because of the inappropriate identification and minimizing of the factors. Fulfilling this gap, the research has been undergone to analyse factors affecting the delay in building construction projects in Sri Lanka; through the interaction of the project team with an adequate understanding on the practical solutions for minimizing. The study has used a mixed approach of qualitative and quantitative techniques for the identification of factors, review of literature was undergone. To assess the factors affecting for delays, questionnaire was distributed among 40 professionals in Sri Lanka and with the analysis under the Relative Important Index (RII) and it was identified that client related factors, contractor related factors, consultant related factors and other related factors and assessment of the factors affecting to the building construction industry. The significant factors of building construction delays were identified as poor communication and coordination, delay in obtaining approvals from government regulated bodies and delays in subcontractor activities, inexpedient scheduling and project planning, inefficient contractor work and unexpected subsurface conditions and unforeseen circumstance. The study identified that contractor related category had the highest affect to the delays of construction industry in Sri Lanka. To identify the practical solutions for minimizing, interviews were conducted by selecting 10 professionals with more than 10 years of experience as the sample. Concerning more on the effective performance of the key*

stakeholders under a better management system is recommended in minimizing the arising delay problems which will help to ameliorate the performance of the industry.

Keywords: *Delays, Building Construction, Sri Lanka*

1. Introduction

Delay is the number one challenge facing the construction industry (Cülfik et al., 2014). Delays happen in almost every construction project and it is regarded to be a recreating problem in the construction sector (Gardezi et al., 2014). It is undergone within an extremely common occurring factor affecting the complete of construction projects within the approved budget, time and cost achieving its quality specifications. Due to this uncertainty, most development construction projects are facing many problems in achieving the objectives with a successful completion by fulfilling the scope of the project (Sha et al., 2017).

Among those problems, the considerable uncertainty and risk in the building projects is higher than in other industries. Construction processes and methods are also subject to unprecedented events and conditions, in addition to the complicated and time-consuming designs. As a result, the construction sector has been facing considerable issues, and impact risk management has emerged as a leading issue (Gardezi et al., 2014).

Delay occurs that whenever a project is not completed by the agreed-upon delivery of a project due to factors involving the contractor,

client, client's consultant, or others. Delays are stealthy, resulting in time overrun and cost overruns, litigation, disputes, and complete project abandonment (Afshari et al., 2011). Many building projects have been plagued by major issues, preventing them from being completed on time. Furthermore, when new tools, equipment, technology, and innovation become available, building projects get more challenging. Delays are frequently caused by inadequate project planning of numerous components (Haq et al., 2017). Main focus of this paper is to analyse factors affecting the delay in building construction projects in Sri Lanka; through the interaction of the project team.

2. Literature Review

There are numerous reasons for delays, as each building project seems to have its own unique characteristics and surroundings. Hence, many researchers have endeavoured to recognize the highly important factors in the delay of construction projects. For decades, researchers have done several studies on construction project delays, with researchers identifying various causes and combinations of factors that contribute to delays. The literature reviewed indicates different factor classifications (Muhwezi et al., 2014). In this study, time overrun factor group into four main categories of client-related factors, contractor-related factors, consultant-related factors and others-related factors.

A. Client related delay factors

Several studies have identified client related delay factors to cause schedule delays. As per Aladayleh, (2020); Arantes & Ferreira, (2020) both examined that suspension of work, owner delay in paying for finished work, nature of project tendering and awarding, impractical project duration, ineffective delay charges, and client involvement having greatest effects to delays.

According to State, (2019); Wang et al., (2018) both concluded that corruption tendencies, occasional work suspension due to cash flow limitations, and changes in material types and

specifications throughout construction, of client in construction projects were ranked.

In separate study, Kesavan, (2015, 2017) both identified the factors of delay in progress payments, variation orders and changes of scope of work by owner during construction, delay throughout the decision-making process, suspension of work by client, delay throughout the decision-making process, slowness in certifying shop drawings and sample materials, delay in reviewing and approving design documents, poor coordination and communication, and problems among joint ownership of the as causes of delay during Sri Lankan construction process.

According to Gunduz et al., (2015); Sha et al., (2017) both conducted client inexperience in building projects, a lack of skilled representatives, and inaccurate information provided by the client during the project feasibility study are the factors that cause the most delays. Unclear and uncapable drawings, client inexperience in building projects, a lack of skilled representatives, and inaccurate information provided by the client during the project feasibility study are the factors that cause the most delays for the client and other stakeholders (Aziz & Abdel-Hakam, 2016).

B. Contractor related delay factors

Several studies have identified contractor related delay factors to cause schedule delays. In a separate study, Kesavan, (2015, 2017) both examined the factors of difficulties in project financing, conflicts in subcontractors schedules during project execution, conflicts among contractor and other stakeholders, delays in sub-contractors task, poor coordination and communication, supervision and rework due to mistakes throughout construction, inadequate project planning and scheduling, delays in site mobilization, implementation of unsuitable construction, insufficient contractor's work, sudden changes of subcontractors and poor qualification of the contractor's technical staff as effects of time overruns during construction process in Sri Lanka.

As per Muhwezi et al., (2014) observed the major factors on delays are improper

construction methods, inaccurate time and cost estimating, poor site management and supervision, inept project team, inadequate contractor experience, subcontractor turn-over unreliable subcontractor, and obsolete technology are all major contributors to this category of delay factors.

Alzara et al., (2016); Mydin et al., (2014) examined the contractor's related delay in construction projects poor contractor competence, delay in preparation of shop drawings and material samples inadequacy of contractor qualifications, construction errors and defective work were ranked highly.

There are a variety of other causes that might cause delays in the project, which can be classified into three categories:

- Materials
- Equipment
- Manpower

In separate study, Kesavan, (2015, 2017) both examined the factors of changes in material types and specifications during construction due to a shortage of construction materials on the market, late delivery of materials, damage to selected materials when they are sorely needed, delays in manufacturing unique building materials, and delayed procurement of materials for Sri Lankan construction projects are all indications of delays in material delivery. Gunduz et al., (2015); Sha et al., (2017) both observed the factors that material related imported of construction materials and unreliable suppliers were critical.

In separate study, Kesavan, (2015, 2017) both examined the factors of equipment breakdowns on a frequently, a scarcity of equipment, lack of high-technology mechanical equipment, low equipment productivity and efficiency, and a lack of equipment operator experience were the causes of the equipment related delays.

According to Gunduz et al., (2015); Sha et al., (2017) both observed that shortage of equipment part, slow mobilization of equipment, unsuitable equipment, equipment allocation issue and equipment allocation problem were the major causes equipment related delays.

In a separate study, Kesavan, (2015, 2017) both concluded the factors of work permits for workers, labour shortages, low labour productivity, and personal conflicts among workers the highest impact in Sri Lankan context.

According to Gunduz et al., (2015); Sha et al., (2017) both using factors analysis conducted that slow labour mobilization, supply of labour, strike, absenteeism, and poor morale and motivation are the leading reasons of labour-related difficulties under contractor related section.

C. Consultant related delay factors

Several studies have identified consultant related delay factors to cause schedule delays. In separate study, Kesavan, (2015, 2017) both identified the factors of inadequate experience of the consultant in the construction project, discrepancies and faults in design documents, inadequate and unclear information in drawings, and poor communication and coordination with other parties as the main causes under the consultant related delay category.

As per Muhwezi et al., (2014); Sha et al., (2017) is concluded that delay in, inadequate site investigation, conflicts between consultants, insufficient estimation of initial contract duration, delays in obtaining interim payment certificates, delays in examining and approving design changes, delays in executing testing and inspection, contract clauses that are unfavourable, and an unclear definition of "Substantial Completion" had greatest impact for the time overruns.

As per the Alzara et al., (2016); Marzouk & El-Rasas, (2014) as inaccurate site investigation, quality assurance/control, a delay in progress payments, an incorrect project feasibility assessment, a delay in site delivery, a lack of skilled representatives, an inability for the contractor to finish ahead of schedule, and the owner suspending work examined that having greatest effects to consultant related delays. According to J. Gardezi et al., (2013); Mydin et al., (2014) identified the causes of factors contract modifications, change orders,

slowness in decisions making, financial problem and lack of experience as key consultant related factors.

Gardezi et al., (2013) identified that design related delays inadequate data collection and survey prior to design, design changes made by the owner or his agent throughout construction, errors and delays in producing design specifications, design mistakes made by designers, lack of experience of design team in building projects, design engineer's misunderstanding of the owner's requirements improper usage of advanced engineering design software and unclear and insufficient details in drawings are factors that contribute to delays under consultant related category.

D. Other related delay factors

Several studies have identified other related delay factors to cause schedule delays. In separate study, Kesavan, (2015, 2017) both stated that as the major courses of external delays, according to the factors of effects of unexpected subsurface conditions and unforeseen ground conditions, delays in getting approvals from municipalities, traffic control and restriction at the job site, accident during building projects, delays in performing final inspection and certification by a third party, changes in government laws and regulations, delays in providing services from utilities, and weather condition effect on construction activities.

As per the Muhwezi et al., (2014); Sha et al., (2017) both identified that unexpected geological condition and regional stability, inflation/price fluctuations, neighbour issues, war, conflict, strike, riot, and the public enemy as key contributors to delays. According to Alzara et al., (2016); Mydin et al., (2014) both revealed that poor site conditions, delay in manufacturing building material, transportation delay a scarcity of materials on the market, tender system, a lack of tools and equipment on the market the most important factor in this category. In separate study, J. Gardezi et al., (2013); Muhwezi et al., (2014) both examined that global financial crisis,

issues with neighbours, natural disasters, delay site clearance as key causes under this category. According to Muhwezi et al., (2014) identified that environmental and social factors, escalation of local material prices, unreliable suppliers, legal disputes among project participants, shortage of construction materials, delay in getting approvals from the local authority, ineffectual delay penalties, and poor communication between the parties as key causes as a delay. Rising raw material prices can significantly affect a construction project but they are beyond the client's and contractor's control. These external factors can lead to conflicts or disputes between the construction stakeholders. Moreover, increasing the production cost and duration (Olawale, 2002).

3. Methodology

The goal of this study is to discover out what are the causes of delays in building construction projects in Sri Lanka. To properly meet research objectives, the study used a mixed approach of qualitative and quantitative techniques. Using a mixed approach will enhance the reliability, quality, and accuracy of the findings of the study, rather than using a single method because of the capability to avoid the lapses that could occur due to use of a single technique either qualitatively or quantitatively separately (Amaratunga et al., 2002).

Literature review was used to identify the factors and qualitative and quantitative methods were followed using the questionnaire survey and interviews with the identified client, contractor, consultant and other related factors respectively. The outcomes of the questionnaire survey were subjected to the analysis techniques, relative important index analysis and content analysis.

Sample of 40 professionals was randomly selected to send the questionnaire. Out of the sample used, 35 number of respondents were responded with their responses and five were not responded. Considering the number of respondents as a percentage, 87.5% can be taken from the sample showing that it is sufficient for the analysis to confirm the

satisfactory representation of the research population.

Purposive sampling was used as the sampling technique to select the sample of 10 respondents from the professionals currently working construction industry in the Sri Lanka as the population of the interview. Selection was done based on their in the construction industry experience.

The following formula was used in analysing the severity of the factors using the RII analysis.

$$RII = \frac{\sum_{i=1}^5 wix_i}{A * \sum_{i=1}^5 x_i}$$

Equation 1: Relative Importance Index

Source: (Muhwezi et al., 2014)

Table 2 - Client related category

Factors	Code	Frequency					RII	Rank
		SA	A	N	D	SD		
Client Related Factors								
The owner issues change orders and changes the scope of work.	C1RF1	8	22	5			0.817143	2
Delay in progress payments	C1RF2	4	26	5			0.794286	3
Late in revising and approving design documents	C1RF3	12	18	4	1		0.834286	1
Tendering issues	C1RF4	5	23	7			0.788571	4

4. Analysis And Discussion

Relative Important Index techniques were used to determine the most significant causes of construction project delays in Sri Lanka with a view to performing quantitative analysis. Identification was done by prioritizing factors ranging from the highest to the lowest.

Further the analysis was evaluated with the group basis by giving a classification-based rating taking the average of each category separately. The questions used were Likert Scale questions and the data was obtained under five scale in according to the degree of the severity.

Table 1: Level of Agreement and allocated Weight

Level of agreement	Allocated weight
Strongly agree	5
Agree	4
Neutral	3
Disagree	2
Strongly disagree	1

w_i = Weight allocated for the i^{th} factor or strategy ($i= 1, 2, 3, 4, 5$)

x_i = Number of respondents in each factor

A = Highest weight allocated (i.e. - 5 in this)

The client related factors have been relatively important with the cause of delay on building construction projects. With the RII analysis, the highest late in revising and approving design documentation was ranking first with RII value of 0.834. The most significant factor affecting construction delays is the need for design documents as a direction to the project, which acts as a permit for the contractor not to carry out construction without permission and not to waste money on unnecessary site works. The owner issues change orders and changes the scope of work was identified as the second important factor with RII value of 0.817. Frequent variation orders and changes of scope of work can extend the works on the site and affect the whole project schedule so that the project cannot be completed on time.

The analysis of the contractor related factors under the factors affecting for delays of building

Table 3- Contractor related category

Factors	Code	Frequency					RII	Rank
		SA	A	N	D	SD		
Contractor Related Factors								
Delays in the work of subcontractor	C2RF1	15	16	2	2		0.851429	1
During construction, supervision and rework are required due to errors	C2RF2	8	22	5			0.817143	7
Project planning and scheduling are ineffective	C2RF3	10	23	2			0.845714	2
Difficulties in financing project	C2RF4	6	29				0.834286	4
Ineffective contractor's work	C2RF5	13	17	5			0.845714	2
Frequent change of sub-contractors	C2RF6	8	20	7			0.805714	8
The contractor's technical staff is poorly qualified	C2RF7	12	18	4	1		0.834286	4
Delay delivery and change in material	C2RF8	9	23	3			0.834286	4
Personal conflict and shortage of labours	C2RF9	5	21	9			0.777143	10
Breakdowns and shortage of Equipment	C2RF10	5	23	7			0.788571	9

construction projects. Delays in subcontractor's work has obtained the highest rank with RII of 0.851. Project planning and scheduling are ineffective and ineffective

Considering the factors generating with the actions of the consultant, major changes in the scope of work are being approved slowly has obtained the first with RII value of 0.822. This

Table 4- Consultant related category

Factors	Code	Frequency					RII	Rank
		SA	A	N	D	SD		
Consultant Related Factors								
Major changes in the scope of work are being approved slowly	C3RF1	8	23	4			0.822857	1
Inadequate experience of consultant	C3RF2	7	22	3	2	1	0.782857	5
Errors and delays in the creation of design documents	C3RF3	8	17	5	4	1	0.754286	7
Drawings with unclear and insufficient details	C3RF4	13	12	8	2		0.805714	2
Inadequate data collection and surveying prior to design	C3RF5	10	15	8	2		0.788571	4
Use of advanced engineering design software is inefficient	C3RF6	12	11	9	2	1	0.777143	6
Delay in preparing interim payment certificates	C3RF7	13	12	9		1	0.805714	2

contractor's work were identified as the second important factors. In addition, contractors' select the contractor's technical staff is poorly qualified as the lows contributing to delays on construction industry through all of the contractors' related factors and the consultants prefer the site mobilization delay as the minimum point among the factors. The quality of the subcontractor's work is highly dependent on speeding up construction, otherwise it could delay the construction project. Also, the contractor's inadequate work not only takes time but also costs more.

issue directly affects the scope of work of the contractors, which affects the continuous performance according to the agreed contract. With that, the contractor may have to deal with delay problem. Non-performance with accordance with SBD 2 document and the time it takes to prepare interim payment certificates were identified as the second important factors. This has been identified as a serious issue affecting the cash flow of the contractor. When payment is delayed, the contractor will not be able to execute the work due to improper flow of cashflow, which will cause severe delays to the contractor.

Table 5: Other related category

Factors	Code	Frequency					RII	Rank
		SA	A	N	D	SD		
Client related factors affected to the delay on building construction projects	DV1	7	25	3			0.822857	2
Contractor related factors affected to delay on building construction projects	DV2	10	21	4			0.834286	1
Consultant related factors affected to delay on building construction projects	DV3	12	16	4	3		0.811429	4
Other related factors affected to delay on building construction projects	DV4	10	18	7			0.817143	3

Table 6: Category based rank

Factors	Code	Frequency					RII	Rank
		SA	A	N	D	SD		
Other Related Factors								
Unexpected subsurface conditions and unforeseen circumstance	ORF1	13	17	5			0.845714	3
Delay in obtaining approvals from government regulated bodies	ORF2	18	12	2	3		0.857143	2
Weather condition effect on construction activities	ORF3	14	13	8			0.834286	4
Traffic control and restriction at job site	ORF4	3	21	9	2		0.742857	7
Accident during construction	ORF5	5	18	8	4		0.737143	8
Changes in government regulations and laws	ORF6	4	26	5			0.794286	6
Conflicts with other parties	ORF7	9	22	4			0.828571	5
Poor communication and coordination	ORF8	14	20	1			0.874286	1

There are eight other related factors that contributed to the delays in grading based on relative important index. The main impact on construction projects is poor communication and coordination. Effective communication and coordination are very important to the success of good team activities that can indirectly give success to the construction project. The second and third factors are the delay in obtaining approval from government regulatory agencies and unforeseen ground conditions and unforeseen circumstances. Substantial surface and ground conditions can be considered as essential other related factor influencing the delay. If the ground condition is unstable, it will be impossible to start the foundation work as there may be settlements in the future. Furthermore, construction activities can be influenced due to weather impact protection considerations such as floods.

To analyse the impact of the factors categorically, category-based rank was obtained by taking an average RII of the factors under each category. With the analysis it was identified that the category on contractor related factors was obtain the first rank with an RII of 0.811. Therefore, as a whole, it can be summarized that the contractor related factors have influenced severely on the delay of building construction projects compared to the other categories. Further, the category of client related factors was ranked second place with RII of 0.823. Client has become of the major source of causing delays mainly due to the variations due to changing requirements, payments delays, and lack of experience within the industry on the procedures to be undertaken.

5. Conclusion

The primary objective of the research was to assess the severity of the factors affecting for delays of building construction projects in Sri Lanka with an adequate understanding of practical solutions to minimize delays as a general objective of research. From the literature review, the theoretical aspects and the past research findings under the state of construction industry in the present context, standards of construction industry in developing countries and Sri Lanka, prevailing procurement systems on procuring construction contracts, factors to be considered under the traditional procurement, construction time and time overruns, impact of delay issues, factors affecting for the delays of the client related, contractor related consultant related and other related, minimizing the impact of delay and identification of the research gap were explained.

In order to bridge the gap identified by solving the research problem, standard techniques of data collection, especially literature survey, questionnaire survey and interviews were used. A literature survey was conducted to identify factors contributing to the delay. Then a descriptive questionnaire survey was then conducted to assess the identified factors for delays in building construction projects. Finally,

a semi-structural interview was conducted to determine the most relevant practical solutions to mitigate the highly influential factors identified in the construction sector in Sri Lanka.

6. Recommendations

To minimize delay problems faced by building construction projects, the primary stakeholders have the major responsibility and following factors can be recommended as guidelines towards the key stakeholders as the guidelines in minimizing the affecting factors for the delays.

A. Towards the client

- Minimize changes, variations during construction to avoid or minimize delays.
- Pay contractors progress payments on time, which weakens the contractor's ability to finance their work.
- Speed up design review and approval.
- Amending bidding documents including clauses, airing, drawing and specifications will be useful to avoid disputes within the contract.
- The qualifications of the bidders to execute the project should be considered strictly without relying on the lowest bidder to execute the project.

B. Towards the contractor

- Improving the knowledge and skills of the technical staff.
- Manage financial resources using progress payments and plan cash flow.
- Planning and scheduling work from the beginning of the project and during the work.
- Improve site management and monitoring to ensure timely completion of work.

C. Towards the consultant

- Avoid delaying the review and approval of design documents.

- Build the skills and knowledge of the technical staff.
- Improving coordination and communication between parties.

The project performance is enhanced by the key stakeholders recognizing their responsibilities and their proper integration, enabling the project to properly integrate with external stakeholders even in the external environment. Furthermore, the parties should always be concerned about the other parties when there is a delay issue to prevent or minimize the impact that the steps, they have taken to reduce the risk may adversely affect the other party. Therefore, it is very important to balance the responsibilities between the parties to minimize the problems of delays in building construction projects. Cooperation between parties with adequate mutual understanding will improve project perspectives while minimizing the financial instability faced by the parties and will also be important for improving the economic condition of the Sri Lanka.

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Abbreviations and Specific Symbols

RII - Relative Important Index

Acknowledgment

I would like to thank to Dr. Sanjaya Jayasuriya and Ms. Nethmi Kawmadi, for their valuable supervision throughout my research from beginning to end and the construction professionals for their immense support given for me by contributing their valuable time and opinions by participating for the interviews.

Finally, I would like to give my heartiest gratitude for Department of Quantity Surveying Faculty of Built Environment and Spatial Sciences, General Sir John Kotelawala Defence University.

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