

# FACTORS AFFECTING CONSTRUCTION TIME PERFORMANCE IN HIGH-RISE BUILDING PROJECTS IN SRI LANKA

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## ABSTRACT

*On-time completion is one of the most important criteria for recent successful construction projects. High-rise building projects face significant risks and time constraints due to the complexity and dynamic nature of their environments. Demand for high rise buildings has been fuelled by economic advancements, rapid suburbanization, and increased consumer spending in Sri Lanka. High-rise building developments require a large amount of funding, permissions and procedures, advanced construction methods, and collaboration between many project participants. Delays have been observed regularly in high-rise buildings, yet studies on factors affecting construction time performance (CTP) are scarce in the Sri Lankan context. Therefore, this study focused on the factors affecting CTP in high-rise building projects in Sri Lanka. If the factors were identified at early stages, they could be minimised or even mitigated and the chance of future occurrences can be minimised. The study used a qualitative approach. Factors affecting CTP were identified through the literature review. The required data were collected from a series of semi-structured interviews identified from purposive sampling. The data were analysed using manual content analysis and validated for high-rise building projects using semi-structured interviews. Fifty-four factors were identified under six categories, including owner, contractor, consultant, contract, contractual relationships and external factors. New additional factor mismatches between the design and budgets are identified. Further, interviewees endorsed 49 factors that were considered as factors that significantly affect CTP. The study would help raise awareness to improve CTP in high-rise building projects.*

**Keywords:** *Construction Time Performance (CTP); Factors affecting CTP; High-Rise Building Projects.*

## 1. INTRODUCTION

Time is a traditional metric for project success that is usually measured using schedules (Gonzalez, et al., 2013). On-time completion is one of the most important criteria for recent successful construction projects (Hamzeha, et al., 2020). Construction time performance (CTP) is the rate of construction expressed as the ratio of the period planned for completion to the actual time taken to complete the project (Walker and Shen, 2002).

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If a project is delayed, time extensions will be required consequently, resulting in litigation, fines, increased costs due to inflation, and delayed damages (Dolage and Pathmarajah, 2015).

Sri Lanka's construction industry has grown significantly in recent years, notably in the property development sector (Saparamadu and Kumanayake, 2021). Demand for construction in the forms of housing, high rise buildings and condominiums has been fuelled by economic advancements, rapid suburbanization, and increased consumer spending in Sri Lanka (Saparamadu and Kumanayake, 2021). High-rise buildings are still the most common type of buildings in urban areas as land scarcity promotes high-rise building construction (Leung and Tam, 2003). Citizens have also moved from single houses to apartments, single workplaces to commercial buildings, and so on, to save up land space and make better use of resources (Saparamadu and Kumanayake, 2021). As a result, the number of high-rise building projects being built in Sri Lanka has increased (Saparamadu and Kumanayake, 2021). High-rise buildings will continue to be an inevitable housing trend in the real estate market of large cities (Nguyen, et al., 2020). High-rise building projects face significant risks and time constraints due to the complexity and dynamic nature of their environments (Basari, 2017; Perera, et al., 2020). Further, high-rise building developments require a large amount of funding, permissions and procedures, advanced construction methods, and collaboration between many project participants (Santoso, et al., 2003). In addition, the financial and economic risks associated with high-rise building projects can jeopardize the success of the project of time, cost and quality (Perera, et al., 2020).

According to Widowati and Rachmawati (2020), it is crucial to identify factors that influence project cost and schedule performance, which influence the overall project performance. A lot of studies have been focused on project completion time (Le-Hoai, et al., 2013). In addition, several studies have analysed CTP in building projects and multi-unit residential projects in different developing countries (Durdyev, et al., 2017). The resources, environment, and management are the major factors that affect construction time performance (Widowati and Rachmawati, 2020). Contractor-related delay factors have for long been identified as one of the main causes of schedule delays in construction projects (Famiyeh, et al., 2017). Some factors are outside the control of construction participants (Fashina et al., 2020). Despite the above-identified factors, factors affecting CTP have rarely been investigated in the case of high-rise building projects in Sri Lanka. According to Dolage and Pathmarajah, 2015, if delays are avoided, the contractor's revenues may increase, allowing them to expand their business and contribute to the country's economic growth. Delays have been observed regularly in high-rise buildings, yet factors affecting CTP have not been analyzed in the Sri Lankan context. Therefore, this study focused on the factors affecting CTP in high-rise building projects in Sri Lanka.

## **2. LITERATURE REVIEW**

### **2.1 IMPORTANCE OF CONSTRUCTION TIME PERFORMANCE IN HIGH-RISE BUILDINGS**

High-rise buildings face more risks than conventional buildings (Perera, et al., 2020). A high-rise building is one of the most complicated projects, involving many stakeholders over a long period (Basari, 2017). These projects reflect the most modern industrial and technological advancements, making their design and construction difficult and time-

consuming (Dwijendra, et.al., 2021). They are also beset by time and expense overruns as a result of their unique characteristics and massive investment demands. (Shoar, et al., 2022). Leung and Tam (2003), stated that completing the structural frameworks is vital to the overall program's success. The number of critical routes available in high-rise buildings is higher than in horizontal buildings (Fedorov, et al., 2018). If there is any delay in one floor or particular area, it will automatically impact the remaining floors and lead to an overall project delay (Fedorov, et al., 2018). High-rise construction projects require intricate services, security, vertical circulation systems and construction logistics more than low-rise construction projects (Juan, 2018). In addition, high-rise buildings are associated with heavy machinery, and vertical MEP works (Fedorov, et al., 2018).

Time Performance is one of the key measures of the project's success in a high-rise building project, as they are the operating platforms of other forms of businesses (Zhang and Zuo, 2016). Further, extensive pre-planning and effective project management are required to make a high-rise building project successful. All construction industry stakeholders have recognized the need to improve construction project performance and are increasingly seeking efficiency in project execution (Meeampol and Ogunlana, 2006). Due to the dynamic nature of the construction industry, the stakeholders of the high-rise building projects are exposed to more risks than ever before, which have a significant impact on the projects' success (Perera, et al., 2020). CTP will be crucial to any construction project (Olawumi and Chan, 2019). Several elements emerge during the project implementation process, many of which have an impact on the project timeline (Le-Hoai, et al., 2013). Further, the repercussions of building delays are not limited to the construction industry; they can have an impact on a country's total economy.

## **2.2 FACTORS AFFECTING CONSTRUCTION TIME PERFORMANCE**

It is not simple to complete a high-rise building project (Do, et al., 2021). Numerous factors can contribute to project delays. Fifty-four project delay factors were identified and categorised as those caused by the owner, contractor, consultant, contract, contractual relationships and external factors (Haslinda, et al., 2018). It is heavily reliant on human elements in addition to science and technology (Do, et al., 2021). Further, Organizations and individuals involved in the project must be fully aware of their roles and responsibilities, as well as have the essential knowledge and competence to perform a specific role. Many high-rise building projects have been proven to be inefficient, with delays, cost overruns, poor quality, lack of safety, unsatisfactory aesthetics and negative reputations of contractors and subcontractors (Basari, 2017).

Many previous researchers have identified that financing and payments made for completed work, slow decision-making on the part of owners, variations and unrealistic contract durations are the major owner-related delay factors affecting CTP in high rise buildings (Famiyeh, et al., 2017; Haslinda, et al., 2018). The majority of owners seek a quick project completion; nonetheless, they must carefully undertake appropriate research to determine the contract duration (Zidane and Andersen, 2018). Another major cause of delay is the owner's failure to hand over the construction site to the contractor at the inception of the (Assaf and Al-Hejji, 2006). Furthermore, the owner must ensure that funds are made available on schedule (Assaf and Al-Hejji, 2006; Hwang and Low, 2012). Furthermore, consultants and contractors must ensure that the site is given over on schedule for the parties' cooperation to be successful (Do, et al., 2021).

Contractor performance is critical to the success of any construction project because contractors are responsible for transforming the design into practical reality (Juan, 2018). Improved contractor performance leads to higher customer satisfaction, a boost in contractor reputation, and hence increased market competitiveness (Ajibade, 2006). Contractor-related delay factors have long been acknowledged as a primary cause of construction delays (Famiyeh, et al., 2017). A project contractor has to complete the project within the allocated time and budget (Fashina, et al., 2020). Contractor-related delay factors can be grouped under four categories: materials, equipment, workforce and project management performance. The contract type and scope of work heavily influence how a contractor responds to various events (Gebrehiwet and Luo, 2017). Similarly, a contractor's ability to finish a project on time is contingent on resource availability and decision-making capacity (Ibironke, et al., 2013). Furthermore, the contractor's personnel are sourced through subcontracting or direct employment. It is critical for the contractor to regularly oversee the work performance of subcontractors to maintain a balance between the various construction activities (Zidane and Andersen, 2018). Contractor-related delay factors include improper project planning and scheduling, inexperienced contractors, frequent changing of subcontractors, outdated technologies, unsuitable construction methods, insufficient staff strength, poor communications and misunderstandings, mistakes made during the preliminary stages and rework due to errors (Zidane and Andersen, 2018).

Consultant-related delays do arise in the ideal situation during the preparation of drawings, acceptance of design drawings, endorsing designs from contractors and clients, verifying payment, and carrying out inspection procedures (Famiyeh, et al., 2017). These types of delays can be caused by a variety of factors, including unskilled consultancy staff, insufficient qualifications, the absence of consultant site staff, underestimation of project costs, insufficient communication and coordination skills, and poor planning (Brammah, 2013; Zidane and Andersen, 2018;). Some experts believe that during the construction process, consultant inquiries and inspections typically slow down the project's progress (Brammah and Ndekugri, 2009). The need to improve project performance has become apparent to all parties involved in the construction sector, and all stakeholders are increasingly seeking efficiency in project execution (Meeampol and Ogunlana, 2006). Further, the authors also stated that each project participant is expected to identify and implement effective management techniques that will help them achieve better results in their respective construction roles.

Some factors are beyond the construction participants' control including legal factors, weather conditions and external factors (Omar, et al., 2020). In harsh conditions, contractors may face several complications, which generally result in the declination of the construction process (Sheikh, et al., 2020). Also, building codes and regulations will affect the construction time performance of high-rise buildings (Fakunle, et al., 2020). Inflation in raw material prices or the exchange rate can also have a detrimental impact on a building project because it is a factor that is beyond the control of the owner and contractor (Durdyev, et al., 2017). External factors can also cause disagreements among construction stakeholders, increasing the project's cost and duration (Rauzana, 2016).

### **3. METHODOLOGY**

Qualitative research is a process of understanding and exploring facts based on inquiry methodology, used to study a single environment or a small number of individuals or

projects (Maxwell, 2005). The qualitative approach, focusing on a specific group of people, can be used for an in-depth study of a broad topic, and it allows broad latitudes in topic selection and represents the ideas and perspectives of people (Austin and Sutton, 2014). In this study, data on factors affecting CTP were collected and investigated. Recommendations are provided on how to increase the CTP in high-rise building projects considering the factors affecting CTP. Thus, the study had to use a fact-finding approach with the research question starting with the word “how.” The study, therefore, selected the qualitative approach because it would encourage experienced industry professionals to share their construction knowledge with the researchers.

The interview is a guide for defining the direction of data collection and validating the results of the literature (Yin, 2011) and is one of the most common data collection methods used in a qualitative approach (Bacon-Shone, 2015). This research mainly focused on analysing the factors affecting the CTP. In order to focus Semi-structured interviews with purposive sampling, were used as the research technique in the study. It allows the researchers to control the sample size and provide a scope for discussing and recording the interviewee’s opinions and views. Fifteen semi-structured interviews were conducted face-to-face with professionals, who had both theoretical and practical knowledge, employed in contractor organizations. The professionals were selected based on purposive sampling adhering to the criteria given in Table 1. Identified potential respondents were invited to the interviews via emails and telephone conversations, and then the interviews were conducted through online zoom meetings. The interview respondents had to have more than five (5) years of working experience in the construction industry and more than two (2) years of experience in high-rise building projects or should have at least two-year experiences in a similar research area and everyone should satisfy with C9. Also, the interviewee must satisfy at least three additional qualifications from Table 1. This sample has variant exposure levels to the areas which are related to that study. Importantly, the selected sample contended with different levels of industry practices also, therefore it helped necessary moments to increase the Contractor’s construction time performance.

Each interview lasted for 60-75 minutes. The interviews were used to validate for high-rise building projects the information collected from the literature. The number of interviews was limited to 15 because data saturation was reached after 13 interviews. The data collected from the interviews were analysed using manual content analysis. The primary goal of content analysis is to correctly identify the data collected and highlight important opinions, features or findings (Hsieh and Shannon, 2015). Content analysis can be done manually or by using the software. In this study, the interview findings were analysed manually.

## **4. RESEARCH FINDINGS**

### **4.1 IMPORTANCE OF CONSTRUCTION TIME PERFORMANCE IN HIGH RISE BUILDING PROJECTS**

In any type of construction project, time is important. According to **II**, time performance is a key measure of the success of a high-rise building project because the buildings are the operating platforms for businesses, for example, a delayed office complex will lose its potential lessees, while a delayed apartment complex will lead to liquidated damages. **I4** mentioned that CTP is crucial in the construction industry because the clients require

on-time delivery. **I2** believed CTP was crucial in the construction industry because the work has to be completed within the contract period and milestones met as per the approved programme. **I3** stated that CTP will create a win-win situation for the parties involved.

Table 1: Interviewee profiles and selection criteria

Coding for Interviewees	Designation	Criteria								
		Compulsory qualifications (C1 and C2 or C3)			Additional qualifications (Interviewee must possess at least three qualifications)					
		C1	C2	C3	C4	C5	C6	C7	C8	C9
		Should possess at least 5 years of experience in contracting organization	Should possess at least 3 years of experience in high-rise building projects	Should possess at least two years of experience in the similar research area	Should possess a degree in quantity surveying	Should be employed as a high-level manager in a contracting organization	Should possess knowledge about construction time performance	Should be willing to provide services within a given time frame	Should be interested in construction time performance	Should be accessible
I1	Deputy Manager - Projects Monitoring	√	√	√	√	√	√	√	√	√
I2	Contract Administrator	√	√	√	√	√	√	√	√	√
I3	Senior Quantity Surveyor	√	√	√	√	√	√	√	√	√
I4	Senior Quantity Surveyor	√	√	√	√	√	√	√	√	√
I5	Chief Quantity Surveyor	√	√	√	√	√	√	√	√	√
I6	Chief Quantity Surveyor	√	√	√	√	√	√	√	√	√
I7	Quantity Surveyor	√	√	√	√	×	√	√	√	√
I8	Senior Quantity Surveyor	√	√	√	√	√	√	√	√	√
I9	Quantity Surveyor	√	√	√	√	×	√	√	√	√
I10	Senior Quantity Surveyor	√	√	√	√	√	√	√	√	√
I11	Contract Manager	√	√	√	√	√	√	√	√	√
I12	Quantity Surveyor	√	√	√	√	×	√	√	√	√
I13	Contract Manager	√	√	√	√	√	√	√	√	√
I14	Quantity Surveyor	×	×	√	√	×	√	√	√	√
I15	Senior Quantity Surveyor	√	√	√	√	√	√	√	√	√

According to **I3, I4, I6, I8, I9** and **I12**, the number of critical paths is comparatively high in high-rise buildings (vertical buildings) than in horizontal buildings. **I15** stated that in high-rise buildings, the time of completion of structural work on a floor has a direct impact on the time of initiation of the structural work on succeeding floors. In high-rise buildings, the number of simultaneous tasks that can be accomplished is limited. Thus, in high-rise buildings, time performance is becoming increasingly important. According to **I7**, among the three pillars in construction project management, namely cost, quality and time, time is the most critical element. Completing construction, of a project on time is a key factor that has to be satisfied to ensure the success of the project because otherwise the cost and quality of the project will be adversely affected and the overhead or prolongation cost of the project will increase. Endorsing the opinion of **I7, I1** stated, *“Time performance is the most critical component in a construction project because it cannot be compensated. Although cost can be reimbursed and quality issues rectified, any time elapsed cannot be compensated except through an extension”*.

#### 4.2 FACTORS AFFECTING CONSTRUCTION TIME PERFORMANCE

From the literature, 54 delay factors that could affect the time performance of a construction project were identified under six categories. During the interviews, respondents identified highly affecting factors among those 54 factors, and additional factors were given in bold letters. Table 2 implied the interviewee’s opinion about the factors affecting the Contractor’s construction time performance. The interviewees wanted the factors endorsed by more than 50% of them (approximately more than 8 interviewees) considered the most significant factors. Accordingly, 49 factors were considered as factors that significantly affect CTP which are highlighted in the table.

As Table 2 indicates, most of the interviewees accepted the factors identified in the literature. Most of the respondents have agreed with the factors that are stated in the literature. According to the above table, **I1** to **I15** contractor quantity surveyors agreed that poor communications, inadequate contractor experience, improper planning, poor site management, construction methods, insufficient number of staff, underestimation of project complexity, mistakes in the preliminary stage, financial problems, misunderstanding, poor procurement programming of materials, poor contract management, and problems with neighbours are the highly affecting factors to the Contractor’s construction time performance in high-rise building projects.

Table 2: Factors affecting construction time performance

	<b>Factors</b>	<b>Number of Respondents</b>
	Poor communications	15
	Variations (design changes/extra work)	14
	Unrealistic imposed contract duration	13
	Owner interference	13
Owner	Finance and payment of completed work	12
	Slow decision-making by owners	11
	Poorly defined scope	9
	Poor feasibility and project analysis	7
	Obtaining permits from the municipality	6

	<b>Factors</b>	<b>Number of Respondents</b>
Contractor	Inadequate contractor experience	15
	Improper planning	15
	Poor site management	15
	Construction methods	15
	Underestimation of project complexity	15
	Financial problems (difficulty in accessing credit)	15
	Poor communications and misunderstanding	15
	Poor procurement programming of materials	15
	Mistakes during construction	14
	Mistakes in the preliminary stage (soil investigation)	14
	Shortage in material	14
	Labour productivity	14
	Equipment availability and failure	14
	Sub-contractor	13
	Outdated technology	13
	Low quality of material	13
	Labour supply	13
	Labour disputes	12
	Preparation and approval of drawings	10
	Escalation of material prices	9
Delay of material delivery to site	8	
Rework	7	
Insufficient number of staff	7	
Consultant	Poor contract management	15
	Poor communications	15
	Inadequate experience	14
	Slowness in giving instructions	14
	Delays in preparation and approval of drawings	12
	Absence of consultant's site staff	12
	Waiting time for approval of tests and inspections	10
	Delays in payments	10
	Underestimation of project cost	9
Poor Quality assurance/control	8	
Contract	Mistakes and discrepancies in contract documents	11
	Change orders	10
Contractual relationship	Lack of communication between the parties	12
	Major disputes and negotiations	11

Factors		Number of Respondents
	Inappropriate overall organizational structure linking	9
External factors	Problems with neighbours	15
	Unforeseen ground conditions	14
	Work accidents	13
	Weather condition	12
	Regulatory changes and building Code	12
	Inflation	12
Additional factors	<b>Mismatches between design and the budget</b>	7

Most of the interviewees stated that finance and payment of completed work, slow decision-making by owners, variations, unrealistic imposed contract duration, poorly defined scope, poor feasibility and project analysis, sub-contractor, rework, outdated technology, mistakes during construction, preparation and approval of drawings, Low quality of material, shortage in material, escalation of material prices, labour productivity, equipment availability and failure, labour supply, labour disputes, delays in preparation and approval of drawings, waiting time for approval of tests and inspections, inadequate experience, slowness in giving instructions, delays in payments, mistakes and discrepancies in contract documents, weather condition, unforeseen ground conditions, regulatory changes and building code, work accidents, and inflation also will highly affect the Contractor’s construction time performance in high-rise building projects.

**I1, I5, I6, I7, I8,** and **I15** have stated, that the escalation of material price is not directly affecting the Contractor’s CTP. **I1, I3, I8, I12, I13, I14,** and **I15** mentioned the Mismatches between design and the budget also will highly affect the Contractor’s CTP. **I7** argued that the outdated technology, labour disputes, inappropriate overall organizational structure linking, regulatory changes, and building code and work accidents are not highly affecting the Contractor’s construction time performance in high-rise building projects. Poor financial and business management of the client, delay in valuation and certification of interim payment by the consultant, withholding of payment by the client, the invalid claim of the Contractor, inaccuracy of valuation for work done, insufficient documentation and information for valuation and delayed work by the sub-contractors are the main causes of delay by owners in finance and payment of completed work. The respondents clearly stated that variations always lead to poor time performance when introduced midstream during construction, whether client-initiated or consultant initiated. The most effective method for minimizing variations is a thorough, complete, and presented project brief from the clients. The clients should offer sufficient time for design consultants to produce the complete and detailed design and its documentation. A full understanding of the roles and responsibilities between clients and consultants at an early stage can ensure minimal changes from the original design because of non-compliance with the client’s objectives and/or a design arising from a poorly derived brief.

Only six interviewees agreed that obtaining permits from the municipality is an important owner-related factor affecting CTP. Only seven interviewees agreed that rework and insufficient staff strength are important contractor-related factors. **I1, I5, I6, I7, I8** and

**I15** were of the view that the escalation of material prices does not directly affect CTP. Poor contract management and poor communications are key consultant-related factors affecting the CTP of high-rise building projects. Only nine interviewees agreed that underestimation of project cost affects CTP, while only eight interviewees agreed that poor quality assurance/control affects CTP. Approximately 10 interviewees agreed that the contract and contractual relationships have an impact on CTP. Most of the interviewees endorsed the two external factors *problems with neighbours and unforeseen ground conditions*, while only a few endorsed the external factors of *weather conditions, regulatory changes and building codes and inflation*. **I4** introduced the new factor *mismatches between the design and budget*, which was endorsed by six other interviewees.

Most of the respondents stated, that unrealistic contract duration arises from the acceleration in the project schedule due to the delays in the construction activities and it may increase the expectations on labour performance and may cause frequent disruptions in site management due to the delays in tools, equipment, and material supply. High expectations on labour performance, which can be referred to as working overtime, can cause the following problems: labour's physical fatigue, which ultimately will demotivate due to poor mental attitude of the workforce. Eventually, all of this will not only be affecting labour performance level, but also the quality level of output due to the poor workmanship, which is therefore rework, project time, and cost overruns. Further, the subcontractors play a significant part in the success of any construction project and typically clients view them as an extension of the main contractor. Therefore, any delay originating from any of the appointed subcontractors can adversely affect the contractor's on-time project completion. Also, some respondents pointed out, that since high-rise building projects involve higher risk compared to horizontal buildings, before the show up of subcontractors at the construction site, they must be briefed about the scope of their work, which shows the significance of communication between the parties. Even if it will cost more, it is recommended to choose a subcontractor with better qualifications and experience, as the cheapest subcontractor may end up delaying the project. Accidents due to poor site safety can reduce the work rate and efficiency, which will lead to work disruption and ultimately to project schedule delay. This is because construction site accident causes loss of labour productivity. Due to the population growth and urbanization, high-rise buildings have higher demand than horizontal buildings. Respondents said new construction technologies are very important in high-rise building projects. The selection of proper construction methods is very important for high-rise building projects since those are involved higher risks.

### **4.3 DISCUSSION**

Delays are the most common and widespread issue affecting both commercial and public building projects (Fashina, et al., 2020). The study findings reveal that the delayed delivery of a project will have a cost implication for the employer and that the contractor will have to take responsibility for the additional costs incurred due to the delay in project delivery. A project delay will have an impact on project costs. Thus, a project delay will have a major impact on the works and will lead to liquidated damages, prolongation costs and project disruptions. Time performance of a construction project is important for a QS because it directly influences project success. If a delay occurs on one floor or in a particular area of a building, it would cause the overall project to delay. High-rise buildings are mainly used for commercial purposes and condominiums. Thus, the buildings have to be sold early and money earned.

Fifty-four factors that affect CTP were identified from the literature under six categories. The interviewees introduced several new factors that had not been mentioned in the literature. Most of the interviewees agreed with the factors stated in the literature. The majority of owners seek a quick project completion; nonetheless, they must carefully undertake appropriate research to determine the contract duration (Zidane and Andersen, 2018). The manner a contractor responds to various events is largely determined by the contract type and scope of work (Gebrehiwet and Luo, 2017). All of the interviewees believed that poor communication is one of the most significant owner-related factors affecting CTP. Variations (design changes/extra work), unrealistic contract duration, owner interference, and pending payments were the other factors accepted by all the interviewees. Regarding contractor-related factors, all the interviewees agreed that inadequate experience of the contractor, improper planning, poor site management, poor construction methods, underestimation of project complexity, financial problems (difficulty in obtaining credit), poor communications and misunderstandings, and poor material procurement programs were the crucial factors affecting the CTP of high-rise building projects. Poor contract management and poor communications are key consultant-related factors affecting the CTP of high-rise building projects. Approximately 10 interviewees agreed that the contract and contractual relationships have an impact on CTP. Most of the interviewees endorsed the two external factors problems with neighbours and unforeseen ground conditions, while only a few endorsed the external factors of weather conditions, regulatory changes and building codes and inflation. I4 introduced the new factor mismatches between the design and budget, which was endorsed by six other interviewees. The interviewees endorsed 49 factors that were considered as factors that significantly affect CTP excluding poor feasibility and project analysis, obtaining permits from the municipality, rework, insufficient number of staff and mismatches between design and the budget.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

Sri Lanka's construction industry has grown significantly in recent years, notably in the property development sector. The number of high-rise building projects being built in Sri Lanka has increased. Economic progress, increasing suburbanization, and greater consumer expenditure in Sri Lanka have fuelled the demand for high-rise buildings. Among the three elements of construction project management, namely cost, quality and time, time is the most critical element. This study analysed the factors affecting CTP in high-rise building projects through an extensive literature review and semi-structured interviews. The study findings pave the way for a new era in the construction industry. Completion of a construction project on time is important because otherwise the project cost and quality would be affected. Time performance is a key measure of the success of a high-rise building project because high-rise buildings can serve as operating platforms for various businesses. The delay factors were validated in the semi-structured interviews. Fifty-four delay factors affecting CTP were identified under six main categories as those related to the owner, contractor, consultant, contract, contractual relationships and external factors. The interviewees also introduced several new delay factors. Forty-four of the factors were identified and highlighted. The study findings would help construction industry practitioners to increase CTP in high-rise building projects. They can also help review the delay factors that mostly affect CTP. However, the study was limited to high-rise buildings in Sri Lanka. If the factors were identified at early stages they could be minimised or even mitigated and the chance of future occurrences can be minimised. The

study used a qualitative approach. Factors affecting CTP were identified through the literature review. The required data were collected from a series of semi-structured interviews identified from purposive sampling. The data were analysed using manual content analysis and validated for high-rise building projects using semi-structured interviews. Fifty-four factors were identified under six categories, including owner, contractor, consultant, contract, contractual relationships and external factors. New additional factor mismatches between the design and budgets are identified. Further, interviewees endorsed 49 factors that were considered as factors that significantly affect CTP. The improved CTP increase the contractor's revenues, allowing them to expand their business and contribute to the country's economic growth. The study would help raise awareness to improve CTP in high-rise building projects.

## 6. REFERENCES

- Ajibade, A.O., 2006. The impact of contractors' management capability on construction project performance in Nigeria. Unpublished B. Tech. dissertation, Federal University of Technology, Akure.
- Assaf, S.A. and Al-Hejji, S., 2006. Causes of delay in large construction projects. *International journal of project management*, 24(4), pp.349-357.
- Austin, Z. and Sutton, J., 2014. Qualitative research: Getting started. *The Canadian Journal of Hospital Pharmacy*, 67(6), pp. 436-440.
- Bacon-Shone, J., 2015. *Introduction to quantitative research methods*. Hong Kong: A publication of Graduate School.
- Basari, I., 2017. Estimation risk of high risk building project on contractor. *Journal of Engineering*, 3(2), pp. 29-34.
- Braimah, N. and Ndekugri, I., 2009. Consultants' perceptions on construction delay analysis methodologies. *Journal of Construction Engineering and Management*, 135(12), pp. 1279-1288.
- Do, S.T., Nguyen, V.T. and Dang, C.N., 2021. Exploring the relationship between failure factors and stakeholder coordination performance in high-rise building projects: empirical study in the finishing phase. *Engineering, Construction and Architectural Management*, 29(2), pp. 870-895.
- Dolage, D.A.R. and Pathmarajah, T., 2015. Mitigation of delays attributable to the contractors in the construction industry of Sri Lanka-consultants' perspective. *Engineer: Journal of the Institution of Engineers, Sri Lanka*, 48(1).
- Durdyev, S., Omarov, M. and Ismail, S., 2017. Causes of delay in residential construction projects in Cambodia. *Cogent Engineering*, 4(1), p. 1291117.
- Dwijendra, N.K.A., Akhmadeev, R., Tumanov, D., Kosov, M., Shoar, S. and Banaitis, A., 2021. Modeling social impacts of high-rise residential buildings during the post-occupancy phase using DEMATEL method: A case study. *Buildings*, 11(11), p. 504.
- Fakunle, F.F., Opiti, C., Sheikh, A.A., and Fashina, A.A., 2020. Major barriers to the enforcement and violation of building codes and regulations: a global perspective. *SPC Journal of Environmental Sciences*, 2(1), pp. 12-18.
- Famiyeh, S., Amoatey, C., Adaku, E. and Agbenohevi, C., 2017. Major causes of construction time and cost overruns. *Journal of Engineering, Design and Technology*, 15(2), pp. 181-198.
- Fashina, A.A., Fakunle, F.F. and Opiti, C. (2020, May). Exploring the common delay factors related to major parties involved in construction projects: A systematic review. *PM World Journal*, 9(5).
- Fedorov, M., Matys, E. and Kopytova, A., 2018. Strategic and tactical aspect of the relations between the participants of ICP in high-rise construction. *E3S Web of Conferences*, 33, p. 03054.
- Gonzalez, P., González, V., Molenaar, K. and Orozco, F., 2014. Analysis of causes of delay and time performance in construction projects. *Journal of Construction Engineering and Management*, 140(1).
- Gebrehiwet, T. and Luo, H., 2017. Analysis of delay impact on construction project based on RII and correlation coefficient: Empirical study. *Procedia Engineering*, 196, pp. 366-374.

- Hamzeh, A.M., Mousavi, S.M. and Gitinavard, H., 2020. Imprecise earned duration model for time evaluation of construction projects with risk considerations. *Automation in Construction*, 111, p. 102993.
- Haslinda, A., Xian, T., Norfarahayu, K., Hanafi, R. and Fikri, H., 2018. Investigation on the factors influencing construction time and cost overrun for high-rise building projects in Penang. *Journal of Physics: Conference Series*, 995, p. 012043.
- Hsieh, H.F. and Shannon, S.E., 2005. Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), pp. 1277-1288.
- Hwang, B.G. and Low, L.K., 2012. Construction project change management in Singapore: Status, importance and impact. *International Journal of Project Management*, 30(7), pp. 817-826.
- Ibironke, O. T., Oladinrin, T. O., Adeniyi, O. and Eboime, I. V., 2013. Analysis of non-excusable delay factors influencing contractors' performance in Lagos State, Nigeria. *Journal of Construction in Developing Countries*, 18(1), pp. 53-72.
- Juan, T.S., 2018. *Preparation of pre contract master programme by construction planner in high rise building project*. University Teknologi Malaysia, Faculty of Built Environment, Malaysia.
- Le-Hoai, L., Lee, Y.D. and Nguyen, A.T., 2013. Estimating time performance for building construction projects in Vietnam. *KSCE Journal of Civil Engineering*, 17(1), pp.1-8.
- Leung, A.W. and Tam, C.M., 2003. Scheduling for high-rise building construction using simulation techniques. *CIB REPORT*, 284, p. 186.
- Maxwell, J. A., 2005. *Qualitative research design: An interactive approach*. London: Sage Publications.
- Meeampol, S. and Ogunlan, S., 2006. Factors affecting cost and time performance on highway construction projects: Evidence from Thailand. *Journal of Financial Management of Property and Construction*, 11(1), pp. 3-20.
- Nguyen, V.T., Do, S.T., Vo, N.M., Nguyen, T.A. and Pham, S.V., 2020. An analysis of construction failure factors to stakeholder coordinating performance in the finishing phase of high-rise building projects. *Advances in Civil Engineering*, 2020.
- Olawumi, T. O. and Chan, D., 2019. An empirical survey of the perceived benefits of executing BIM and sustainability. *Construction Innovation*, 19(3), pp. 321-342.
- Omar, M.A., Fashina, A.A. and Fakunle, F.F., 2020. The status quo of Somaliland construction industry: A development trend. *PM World Journal*, 9(5), pp. 1-18.
- Fashina, A., Fakunle, F. and Omar, M., 2020. A study on the effects of construction project delays in Somaliland construction industry. *Journal of Management, Economics and Industrial Organization*, 9(3), pp. 89-102.
- Perera, B., Samarakkody, A. and Nandasena, S., 2020. Managing financial and economic risks associated with high-rise apartment building construction in Sri Lanka. *Journal of Financial Management of Property and Construction*, 25(1), pp. 143-162.
- Rauzana, A., 2016. Causes of conflicts and disputes in construction projects. *IOSR Journal of Mechanical and Civil Engineering*, 13(05), pp. 44-48.
- San Santoso, D., Ogunlana, S.O. and Minato, T., 2003. Assessment of risks in high rise building construction in Jakarta. *Engineering, Construction and Architectural Management*, 10(1), pp. 43-55.
- Saparamadu, K.D.C.I.S. and Kumanayake, R.P., 2021. Causes and effects of delays in high rise building projects of Sri Lanka. In: *114<sup>th</sup> Annual Sessions of the Institution of Engineers*, Sri Lanka.
- Sheikh, A.A., Fakunle, F.F. and Fashina, A.A., 2020. The status quo of building codes and construction practices in Somaliland: practitioners' perceptions. *SPC Journal of Environmental Sciences*, 2(1), pp. 4-11.
- Shoar, S., Chileshe, N. and Edwards, J.D., 2022. Machine learning-aided engineering services' cost overruns prediction in high-rise residential building projects: Application of random forest regression. *Journal of Building Engineering*, 50, p. 104102.
- Walker, D. and Shen, Y., 2002. Project understanding, planning, flexibility of management action and construction time performance: two Australian case studies. *Construction Management and Economics*, 20(1), pp. 31-44.

- Widowati, E.D. and Rachmawati, F., 2020. Identifying factors affecting schedule and cost performance on building project. In: *IOP Conference Series: Materials Science and Engineering*, 930(1), IOP Publishing.
- Yin, R.K., 2011. *Case study research: Design and methods*. 4<sup>th</sup> ed. California: Sage publications.
- Zhang, Y. and Zuo, F., 2016. Selection of risk response actions considering risk dependency. *Kybernetes*. 45(10), pp. 1652-1667.
- Zidane, Y. and Andersen, B., 2018. The top 10 universal delay factors in construction projects. *International Journal of Managing Projects in Business*, 11(3), pp. 650-672.