



Research paper

Project cost and time key factors distressing building construction projects of Sindh Pakistan: a post-pandemic approach

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Abstract: The construction industry plays a major role in the boost of the country's economy, providing basic facilities for residential and creating thousands of job opportunities. During COVID-19, the construction sectors in Sindh Pakistan was highly suffered and leading to delays in the completion of projects. As the construction sector was globally affected, building construction projects were also affected by completing the projects on estimated time and cost. Thus, this research investigates the significant factors of time and cost that affected the Hyderabad building construction projects during COVID-19 situation. Questionnaire surveys were designed to collect data from the employees working on building projects in Sindh Pakistan. The collected data was analyzed through the Average Index method. Unsafe working environment; shortage of workers; and increasing project cost was observed as significant factors that were highly affected during COVID-19. The results and findings shall be supportive for stakeholders to take into consideration of factors in the early stage of the expected pandemic situation. This research suggested that the stakeholders shall modify or amend the contract clause regarding for pandemic situation and incorporate the identified factors in the contract that should be considered by stakeholders to save the time and cost of the projects.

Keywords: COVID-19, pandemic, project time, project cost, Sindh building projects

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1. Introduction

Time and cost are important in successful completion of projects. Unfortunately, during COVID-19 construction sectors were affected globally including Pakistan's construction projects which also suffered to complete the project's estimated time and cost [1]. Delay in the completion of building projects was the main issue in the construction industry in Pakistan which affected the project cost and time, schedule, and reputation actions in front of customers. The construction stakeholders must initiative for the successful and timely completion of projects and handover to the client [2].

Building construction projects in Pakistan have much more complex and observed delays in completion. The major factors for delay in completion were (1) availability of labour; (2) error in design; (3) late delivery of materials; and (4) EOT claims. It has been suggested that to reduce the impact of time overrun factors, stakeholders need to take steps in an early stage of project and monitor progress frequently by visiting project sites [3]. Measuring the performance of building projects, cost and time are the basic parameters. Currently, the building projects of Pakistan face problems to complete the projects on cost and time. Delay in the completion of building projects has been occurring due to several factors related to time and cost. The factors were (1) the price of machinery and its maintenance; (2) an increase in material prices; (3) late delivery of the site; and (4) a delay in approving the drawings [4]. The study concluded that stakeholders must have a strong communication system to resolve the issues timely.

A study mentioned that cost and time overrun were one of the major problems faced by stakeholders in building construction of Sindh – Pakistan. The major factors for cost and time overrun were; (1) client financial issues; (2) rising of material prices; (3) delay in design submission; (4) financial issues by contractor; and (5) decision-making process. Findings could help stakeholders to control time and cost overrun factors in early stage to avoid delays in completion period [5].

Time overruns on projects is facing the main cause in the construction industry of Pakistan. It determined that very few projects in Pakistan were completed under contract time. During review identified factors that affect time overrun in construction projects in Sindh were; (1) design changes while construction; (2) lack of drawings; (3) incomplete project documents; (4) modification of the contract; (5) government involvement; (6) coordination issue between the contractor and client; (7) delay in the transportation of materials; and (8) lack of information in the specification [6]. The researcher suggested that time overrun factors could be controlled by taking early actions and remedial measures such as avoiding changes in design during construction, the project shall be awarded the best price contractor, complete drawings and project information must be provided by authorities, the proper communication channel between the stakeholders, avoid taking revise decision that could delay the project, and supply of material on time.

The COVID-19 pandemic has had a significant impact on construction projects worldwide. The pandemic has caused government-mandated shutdowns, new safety requirements and protocols, supply chain disruptions, and limitations on work hours and site access. The COVID-19 pandemic has had a significant impact on the construction industry, particularly

in terms of project time and cost. It is important for contractors to evaluate existing costs and the possibility of cost increases when bidding for a project.

2. Literature review

The economy of the nation benefits significantly from the contributions made by the building sector. COVID-19 had a significant impact on Pakistan, where it was estimated that more than 11,000 people lost their lives and that over 500,000 people were injured. In light of this circumstance, the government of Pakistan made the decision to implement a comprehensive and well-thought-out lockdown over the whole nation in an effort to get control of the COVID-19 crisis. The implementation of the lockdown resulted in negative consequences for Pakistan's construction sector [7]. According to the findings of a research that looked at the effects that COVID-19 had on building projects, the most significant challenge that contractors encountered following COVID-19 was "Rework". In order to successfully finish the remaining aspects of the project, the contractors faced the difficulty of resuming or remobilizing the work. The contractor discovered that there were insufficient finances to finish the remaining portion of the job. Therefore, it has been proposed that the strategies should be aligned with the coordination of the customer in order to finish the remaining portion of the project [8].

A study impact of COVID-19 on the construction industry of Nepal. The research found major factors impacting the construction industry were; (1) reduce in budget from the government; (2) contractor financial situation; (3) delay in payment; (4) cost overrun; (5) supply chain problems; (6) unavailability of the labour force; and (7) health and safety issues. It has been observed that there was no financial support from the government to manage construction projects with SOPs. The government and regulatory authority should support the construction industry to build efficient, competent, and resourceful sectors [9]. By monitoring and forecasting the construction projects, cost and time factors could be managed efficiently [10]. It suggested that stakeholders take early action to decrease the effects of factors during running projects. The government reduced budget for the construction sector during the COVID-19 period [11]. The action had a detrimental effect on the construction industry, particularly on primary contractors, resulting in financial difficulties that made it difficult to finish the project within the projected time and cost parameters. During the COVID-19 crisis, it was seen that eighty percent of projects continued to go forward as planned. Despite this, the performance of the project was severely impacted, which resulted in a delay in the completion of projects within the contracted budgeted cost.

When building projects continue to be carried out, even in the midst of a pandemic, the parties involved are obligated to carry out the health protocols, as well as to provide extra funding, skilled labour, and sophisticated equipment, so that the health protocols may be carried out without any hitches. During the COVID-19, the stakeholders saw that conducting construction projects using an online coordination system had not been significantly altering the performance of construction projects. This was a significant

concern for the stakeholders [11]. COVID-19 has risen and affected the global construction industry, including the construction of building projects. The study aims to the identification of problems in building construction projects caused by COVID-19. Twenty interviews were conducted with main contractors and found that financial issues faced by the contractor were major issues and delays in the completion of building projects during COVID-19. It was suggested that during the pandemic of COVID-19, financial aid support and providing complete information are needed to control and manage building projects smoothly [12]. Further, the problems caused by COVID-19 were highlighted in Fig. 1.

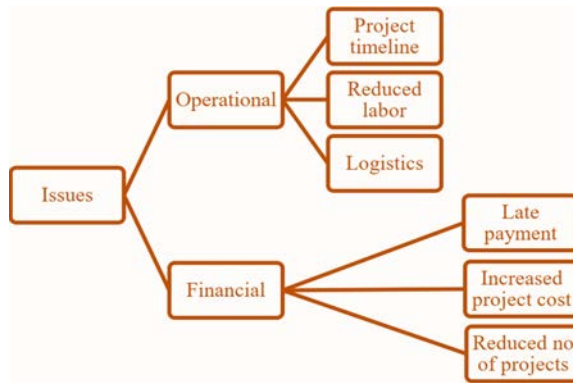


Fig. 1. Problems in the construction industry were faced by COVID-19 moderated from [12]

An investigation of the elements that had an effect on the construction sector in Malaysia during the COVID-19 conference. It has been observed that termination of projects, shortage of labour, cost and time overrun the projects, financial instability, unsafe working environment, delay in payments, and lack of SOPs were highlighted as the major findings, which could not be considered by stakeholders to manage the construction projects effectively. This is because the findings were not able to be considered by stakeholders. During the planning stage of building projects, the results assist project stakeholders in realizing the sequences of abrupt epidemics and preparing for the worst-case scenario [13]. Further summarise cost and time factors identified by different authors and their mitigation measures as shown in Table 1.

Table 1. Summary of key factors affecting construction projects and mitigations

Authors	Factors	Mitigations
[6]	<ul style="list-style-type: none"> - Changes in design - Contract modification - Working relationship between parties - Incomplete project information 	Client minimizes possibility of making changes in design during construction. Effective communication between parties makes good relationships that improve quality of work and timely completion of projects.

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Table 1 – *Continued from previous page*

Authors	Factors	Mitigations
[6]	<ul style="list-style-type: none"> – Design change – Communication – Incomplete drawings – Lack of information 	Frequently communication between parties reduces factors' impact on project cost and time. Communication helps in timely resolving of issues to complete a project on time.
[14]	<ul style="list-style-type: none"> – Inadequate planning – Delay in payments – Financial difficulties of stakeholders – Frequent changes in design 	Stakeholders have focused on the planning stage and reserved an adequate amount of funds for timely payment to contractors. Payments on time from clients support the contractor's successful completion of projects.
[5]	<ul style="list-style-type: none"> – Inflation – Decision-making process – Shortage of funds – Design issues 	These factors have been discussed at the initial stage of projects to control, manage and handle factors easily if occur during construction.
[3]	<ul style="list-style-type: none"> – Shortage of labour – Delay in supply of material – Mistake in design – Extension of time claims 	Possible mitigation measure has been applied to reduce the impact of factors. Client provides enough time to smoothly completion of projects.
[13]	<ul style="list-style-type: none"> – Unsafe working environment – Late in payments – Cost and time overrun – Financial stability 	During COVID-19 situation, stakeholders take early precautions to provide a safe environment and timely payments to a contractor that could help and support in managing the situation easily.
[9]	<ul style="list-style-type: none"> – Decreasing of budget – Cost overruns – Health and Safety – Delay in payments – Shortage of labour 	The government institute should come forward to manage, control, and support stakeholders for the completion of projects on time and at cost.
[11]	<ul style="list-style-type: none"> – Health and safety protocol – Inadequate planning – Additional cost – Working environment – Late delivery of material 	There should be a COVID-19 task force team that ensure health and safety precaution has been taken properly so that projects could not be affected by cost and time.
[12]	<ul style="list-style-type: none"> – Project Timeline – Shortage of labour – Delay in payments – Increasing project cost 	The government and client should add financial compensation to contractor project costs to cover the COVID-19 significances that could support project completion.
[4]	<ul style="list-style-type: none"> – Cost of machinery – Increasing material price – Delay in delivery of site – Delay in approving drawings 	Strong communication has been developed and arranged weekly meetings between parties, sort out these issues and found solutions to smooth completion of projects under project cost and time.

3. Research aim

The purpose of this research is to determine the aspects that were significantly impacted by COVID-19 and contributed to delays in the completion of building construction projects. The increased amount of time and money needed to finish a project as a result of a delay in its completion. This study might aid and support the stakeholders in managing the variables during future projected COVID-19 circumstances by identifying the elements and providing them. This would ensure that the projects function successfully.

4. Research methodology

Research methodology chart mentioned the process to be followed and adopt to achieved required data and results. The process of methodology chart has been mentioned in Fig. 2.

According to methodology chart, detail literature has been conducted from past research papers / publications from different sources such as google scholar and science direct. This paper present 21 factors identified during literature review that frequently affected on

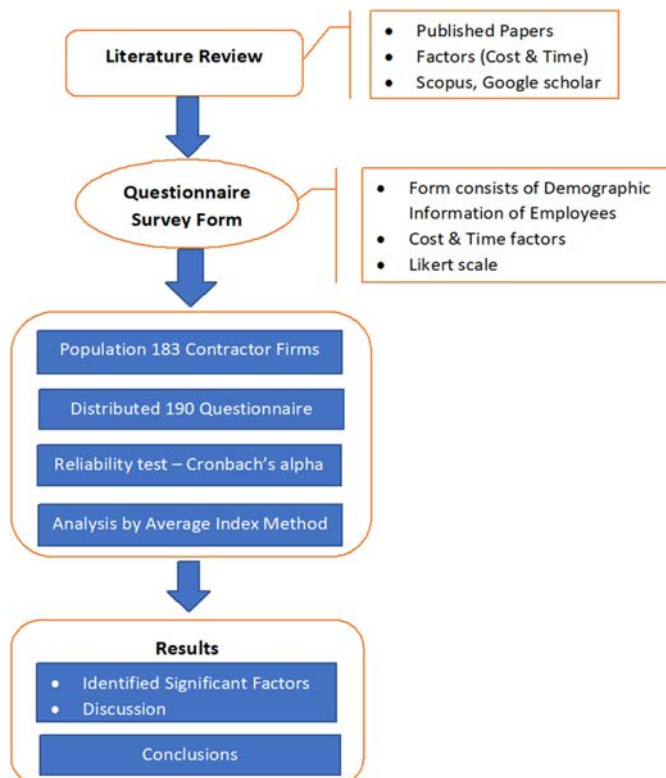


Fig. 2. Methodology chart

cost and time. Based on factors, questionnaire survey form has been built to conducted data from respondents working with contractor firms on building projects in Hyderabad. Received survey forms were analysed through reliability test to check the consistency of respondents. Further, survey form was analyses through average index method to identified significant factors that affected cost and time on building projects in Hyderabad during COVID-19. Conclusion has been made based on results that could support contractors for timely completion of building projects.

4.1. Data sampling

The targeted population was engineers who were working with contractor firms and have wide range of experience in managing medium to large building construction projects. To achieved accurate number of sampling, this paper chose contractor firms working around in Hyderabad city. Around, 183 contractors firm were involved on building projects in Hyderabad city of Sindh. Respondents were chosen from these contractor companies for data collection. Sample size has been calculated based on identified 183 contractor firm. Sample size calculator helps in identifying number of respondents required to achieve the objective of research [15]. This paper used sample size calculator to know number of respondents required for this research, so therefore 183 number has been inserted in calculator to know the sample numbers, as mentioned below in Fig. 3.

Result

Sample size: 125

This means 125 or more measurements/surveys are needed to have a confidence level of 95% that the real value is within $\pm 5\%$ of the measured/surveyed value.

Confidence Level: 95%
 Margin of Error: 5%
 Population Proportion: 50% Use 50% if not sure
 Population Size: 183 Leave blank if unlimited population size.

Calculate Clear

Fig. 3. Sample size calculator [15]

Figure 3 shows sample required for this paper was 125 to get the results with confidently with confidence level of 95%.

4.2. Data collection

Questionnaire survey form has been sent to employees working with contractors on building construction projects. Total 190 questionnaire survey form were distributed by emails, what's up application and physically visiting project sites. The employees have been

asked to choose the significant factors that were highly affected by COVID-19 on building projects. Only 121 numbers of responds were received completely and this present 64% of 190 form distributed among engineers.

4.3. Data analysis

The 121-questionnaire survey form has been received from the employees to analyse the data to achieve the result. In first phase, Reliability techniques were applied on received 121 survey form by using Cronbach's alpha through SPSS tool to check the consistency of received respondents. As [16] mentioned that if Cronbach's alpha value is 0.7 or more shows consistency and reliability of works. This paper applied Cronbach's technique on received survey form and observed that 0.87 value was achieved that shows high consistency of results.

In second phase, received questionnaire survey form was analysed through the Average Index Method (AI). The level of significance of these factors was measured on the ordinal scale. A five Likert scale was adopted as 1 = Not Significant (NS); 2 = Slightly Significant (SS); 3 = Moderately Significant (MS); 4 = Very Significant (VS); 5 = Extremely Significant (ES). AI is calculated by using the following formula:

$$(4.1) \quad AI = \frac{\sum(1X1 + 2X2 + 3X3 + 4X4 + 5X5)}{\sum(X1 + X2 + X3 + X4 + X5)}$$

Where:

X1 = Number of respondents on a scale of 1
 X2 = Number of respondents on a scale of 2
 X3 = Number of respondents on a scale of 3
 X4 = Number of respondents on a scale of 4
 X5 = Number of respondents on a scale of 5

Evaluation ranges to assess significant level

1.00 < AI < 1.50: Not Significant (NS);
 1.50 < AI < 2.50: Slightly Significant (SS);
 2.50 < AI < 3.50: Moderately significant (MS)
 3.50 < AI < 4.50: Very Significant (VS);
 4.50 < AI < 5.00: Extremely Significant (ES)

5. Results and discussion

The findings of the research are based on the employee's responses, and the result achieved from the Average Index method is mentioned below in Fig. 4.

The results show that factors which were more than 3.5 considers important factors highly affected by COVID-19 on building Construction projects were; (1) unsafe working environment; (2) shortage of workers; (3) Increasing project cost; (4) inflation; (5) late payment; and (6) Communication between the client and contractor.

The first important factor highlighted during COVID-19 was the unsafe working environment. During COVID-19 peak period, the Sindh government implement restriction and isolated people at home to control COVID-19. By implementing the SOPs, the employees were avoiding working in the office environment and being afraid of increasing COVID-19 cases. There was no plan from the Sindh government to implement at working place to save from COVID-19. As [17] mentioned that unsafe working environments in offices increase

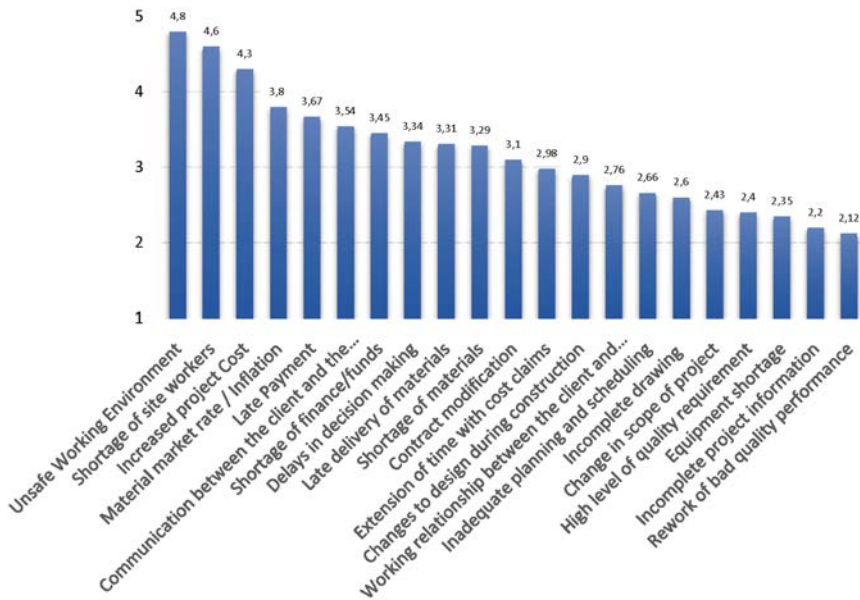


Fig. 4. Cost and time factors affecting the building construction projects

fear among employees. During working from home, employees face a lack of tools to complete tasks on time [18]. The researcher suggested that providing the tools and promoting the usage of technology through virtual meetings, and access to emails from homes can manage the work smoothly.

The second important factor found during COVID-19 was the shortage of workers. COVID-19 highly impacted the Sindh building projects and it's affected the shortage of labour from the market. Decreasing the number of laborers has directly affected the productivity of workers [19]. During COVID-19 and restrictions from the Sindh government, the supply of laborers has decreased and projects were delayed due to a shortage of labour. Due to the travel ban and SOPs implemented by the government, skilled laborers were not available in the construction industry of Pakistan [20]. It has been suggested that to take precautionary measures and provide a safe environment for labour workers.

The third important factor found during COVID-19 was the increase in project cost. During COVID-19, all construction activities have been stopped due to restrictions. It affects the project and delays the completion of projects. This delay led the stakeholder to face financial crises to complete the building project on the estimated time. For completing the remaining part of the project, the contractor requested to increase the cost of the project. As [21] suggested that during the COVID-19 situation, early identification, and consideration of cost factors, can support and manage the cost of the projects smoothly.

The fourth factor found during COVID-19 was inflation. Restrictions on public transport from country-country and city-city create a shortage of material from the markets. Due to a shortage of materials, the construction item raised the price which directly affected

the contract budget. The contractor suffered during the COVID-19 period by raising the inflation in markets. The project cost was going to overrun the project cost. The stakeholders were unpredictable and were not ready to face the COVID-19 restriction. According to the situation, the client should revise the cost of the project and re-estimate the activities that cause to increase the inflation, to compensate the contractor to complete the project [22].

The fifth factor found during COVID-19 was late payment. During the COVID-19 period, the government sector faces a financial crisis to control and manage COVID-19, and not release payments to the construction sector. The late payment from the client faces the contractor delay in the completion of payments to the sub-contractor, staff salaries, procurement of material, and running cost of the project. Disturbance in the government sector during COVID-19, the contractor could not receive the payments on time. The late payment from the government sector to contractors has affected most of the delay and cost of the project overrun.

The sixth factor found during COVID-19 was communication between the client and contractor. During the peak period of COVID-19, there was a big communication gap observed between the client and contractors. This communication gap leads to delays in the process of implementation to completion of building projects on time. Slow communication between the parties affects the construction projects, result led to cost overruns.

6. Key factors affecting project cost and time

During a COVID-19 period, construction projects has been suffered around the country including building projects of Sindh Pakistan. During literature review and data analyse, it has been observed that major factors were affecting during COVID-19 and increase project cost and time. This research deeply analysing the factors that impacting cost and time, as mentioned in Fig. 5.

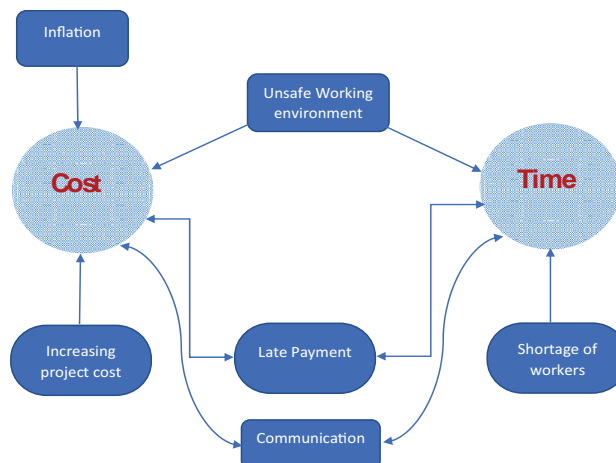


Fig. 5. Key Factors affecting cost & time

According to Fig. 4 inflation and frequently increasing of cost is directly affected cost of the project, shortage of labour affects project time, and unsafe working environment, late payment, and communication issue affecting the project cost and time. So therefore, contractors and concerned stakeholders should consider these factors during working in COVID-19 period and take early precautions to reduce the impact of cost and time for completion of project estimated time and cost successfully.

7. Conclusions

COVID-19 affected the construction industry of Pakistan including building projects in Sindh. During COVID-19, the building projects of Sindh were highly suffered, delay and resulted to lead an increase in the cost and time of the projects. The results identified six significant factors; (1) unsafe working environment; (2) shortage of workers; (3) increasing project cost; (4) inflation; (5) late payment; and (6) communication between the client and contractor. Identified six factors, directly and indirectly, affecting cost and time as mentioned in Figure 5, that have to be managed and controlled with the support of all stakeholders. Based on the results, the research suggested that the contract should be revised to consider the significant factors and make proper mechanisms to implement and face any expected COVID-19 situations smoothly. The government must take actions to control the market price/inflation to avoid any cost overrun of the projects. The client must pay the contractor on time, to successfully completion of projects. Late payment affects the schedule and delays in completion. During COVID-19, the client, and contractor must arrange frequent communication by email, teams meeting, and telephone to update about the site activities and make solutions and arrangements for the timely completion of projects.

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