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# The Impact of COVID-19 on Construction Project Performance: A Case Study in Pakistan

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**Abstract:** COVID-19 has had unprecedented effects on construction markets globally due to supply chain disruptions and workforce restrictions, etc. However, construction industries in developing countries are more vulnerable to the obstacles associated with the pandemic. As such, the goal of this paper is to capture the impact of COVID-19 on construction projects' performance in developing countries by taking the Pakistani construction sector into perspective. A multistep project-based research methodology was adopted, including a literature analysis and questionnaire survey with 20 construction professionals to assess factors affected by COVID-19; formulation of open-ended questions against each factor; collecting data using semi structured interviews; and presenting challenges and adopted mitigation strategies to examine the perceived impact. Results showed that the pandemic has caused a total of 13 factors to impact the project performance, which are grouped under four construction groups, including material and equipment, human resource, occupational health and safety, and financial and contracts. The factors impacted the most by the pandemic are cash flow management, supply chain disruptions, increased overheads, construction safety measures, material shortage, contractual issues, and construction workforce. This research contributes to the body of knowledge by providing a foundation for researchers to enhance investigating the impact of the COVID-19 in developing countries.



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**Keywords:** COVID-19; COVID impact; construction performance; Pakistan; construction and COVID-19

## 1. Introduction

The outbreak of COVID-19 has severely affected the globe [1], and the disease was declared a global pandemic in May 2020 by the World Health Organization [2]. COVID-19 has caused an immense and unprecedented economic shock to world economies [3], including their construction sectors and their various operations [4]. The construction sector has the potential for the development of infrastructure by boosting local employment and enhancing economic effectiveness [5], and the pandemic has strongly affected these objectives [6]. The pandemic has imposed several challenges that resulted in delays and cost overruns in construction projects [7]. Many of the challenges were due to health and safety implementation issues [8], disruptions in the supply chains [6], financing issues [9], lack of workforce [3], challenges in worksite accessibility [10], and unavailability of equipment and materials [11]. Consequently, numerous construction companies struggled to manage the effects of the pandemic on the projects' performance caused by market disruptions [12]. For example, the implementation of social distancing and sanitation protocols significantly altered on-site operations, further contributing to project delays and increased costs [13]. During the peak of the pandemic, job loss was a crucial problem in the construction industry due to suspension of projects [3]. According to Al-Mhdawi et al. [4], construction markets in developing countries are more prone to risk because of the situation of the pandemic.

This aligns with the study of Diop [14], who found that the reallocation of government budget funds to contain the spread of COVID-19 cases is one of the causes of disruptions to infrastructure projects in developing countries. Moreover, travel restrictions and supply chain disruptions have significantly affected projects in developing countries because of lack of expertise and unavailability of imported materials [7].

Pakistan is considered among the countries regarded to be significantly affected by COVID-19 [15]. During the initial stages of the pandemic, many countries, including Pakistan, implemented strict lockdown measures to curb the spread of the virus. These lockdowns led to the temporary suspension of construction activities, exacerbating delays and increasing project costs [16]. In major cities, such as Karachi and Lahore, construction sites were shut down, and workers were forced to stay home, leading to significant disruptions in project timelines [16]. The financial impact on contractors and stakeholders was immense, with many facing liquidity issues and delayed payments due to the halt in construction activities [17]. The Pakistani government also imposed travel restrictions, which further impacted the movement of labor and materials, essential for construction projects [18]. The national labor force survey also anticipated a rise in unemployment of 8.1% during the 2020–21 (a period when the pandemic hit the most) as compared to that of 5.8% witnessed in 2017–18 [19]. The above discourse justifies that Pakistan's economy has suffered in various sectors, and the construction sector is no exclusion.

The literature about the impacts of COVID-19 on the construction sector is still developing. However, no significant research has been published to investigate the pandemic's impact on the construction performance in Pakistan. Therefore, this research aims to study the impact of the pandemic on the performance of Pakistan's construction sector through a project-based approach with three objectives: (1) to identify critical factors influencing project performance during COVID-19; (2) to investigate the impact of COVID-19 on project performance using semi-structured interviews; and (3) to present adopted strategies that addressed challenges during the pandemic. The associated objectives are put in place to help identify and compile an extensive list of factors affected by COVID-19, to find out the extent of the impact on the on-going projects, and to present the mitigation strategies adopted by stakeholders against the challenges faced. The findings of this study will help the stakeholders to mitigate the impacts of similar crises in case identical or comparable events occur again.

### *1.1. Impact of COVID-19 on the Construction Industry*

The outbreak of COVID-19 has negatively impacted the construction sectors in various parts of the globe [20]. The emergence of COVID-19 has also deteriorated many aspects of construction projects' performance such as technological, political, social, communication, economic, planning and execution [21]. There are numerous uncertainties due to the measures that aimed to slow the spread of COVID-19 or to flatten the curve, and many challenges were experienced on construction projects and jobsites [22]. During the pandemic, the initial problem observed in the construction sector was the shortage of material from suppliers mainly due to restriction on the movements [3]. Unforeseen shortages of materials inevitably lead to overpricing that caused drastic changes in the form of unjustifiable construction costs [23]. Another major issue witnessed was dealing with scheduling errors due to temporary closure of projects that caused discrepancies in schedules and payments [24]. Reduced movement of people due to travel restrictions was another concern in the construction sector, which also hampered the progress of various construction projects during the pandemic [25]. These problems ultimately attributed to liability for extension of time and cost overruns [20]. Due to such restrictions, countries with high population numbers like Indonesia and China remained in lockdown for a longer period that further limited the access to many recourses needed for construction [26]. Construction heavily depends on movement of personnel, and any compromise to this process will have negative effects on construction quality, time and costs as well [27]. For example, a study assessing construction projects in Singapore highlighted that the pandemic shifted

the prioritized risks from financial issues to labor shortages, underscoring the critical need for adaptive risk management strategies [28]. Similarly, an integrated framework for post-COVID-19 recovery in China emphasized the significance of management and technological innovation in improving construction project performance [29].

A study conducted on 45 independent construction projects in the UK revealed productivity losses of about 7% due to various factors, including labor shortages and social distancing protocols especially during the pandemic times [30]. Similarly, a study conducted by Sami et al. [31] explored the impact of the pandemic on the UAE construction industry and found that the pandemic caused financial losses, unavailability of resources, and delays in projects. Nguyen [32] also explored the impact on the Vietnamese construction sector and found that construction companies faced declines in revenue that ultimately pushed them to lay-off the workers and reduce their wages. In the UK construction industry, the critical identified challenges include low productivity rates, cash-flow disruption, and price escalation, etc. [6]. Moreover, Al-Mhdawi et al. [7] quantified the impact of COVID-19 on the private and public sectors of the Iraq construction industry by identifying factors and various construction themes. The result indicated that the most impacted construction theme was safety and risk management, and the most affected factors were safety management measures, interpretation of contract language, and building material prices. According to a study, the construction projects in the UK did not only face delays due to the pandemic but have also failed to be started again at later anticipated timelines [33].

### 1.2. COVID-19 and the Pakistan Construction Industry

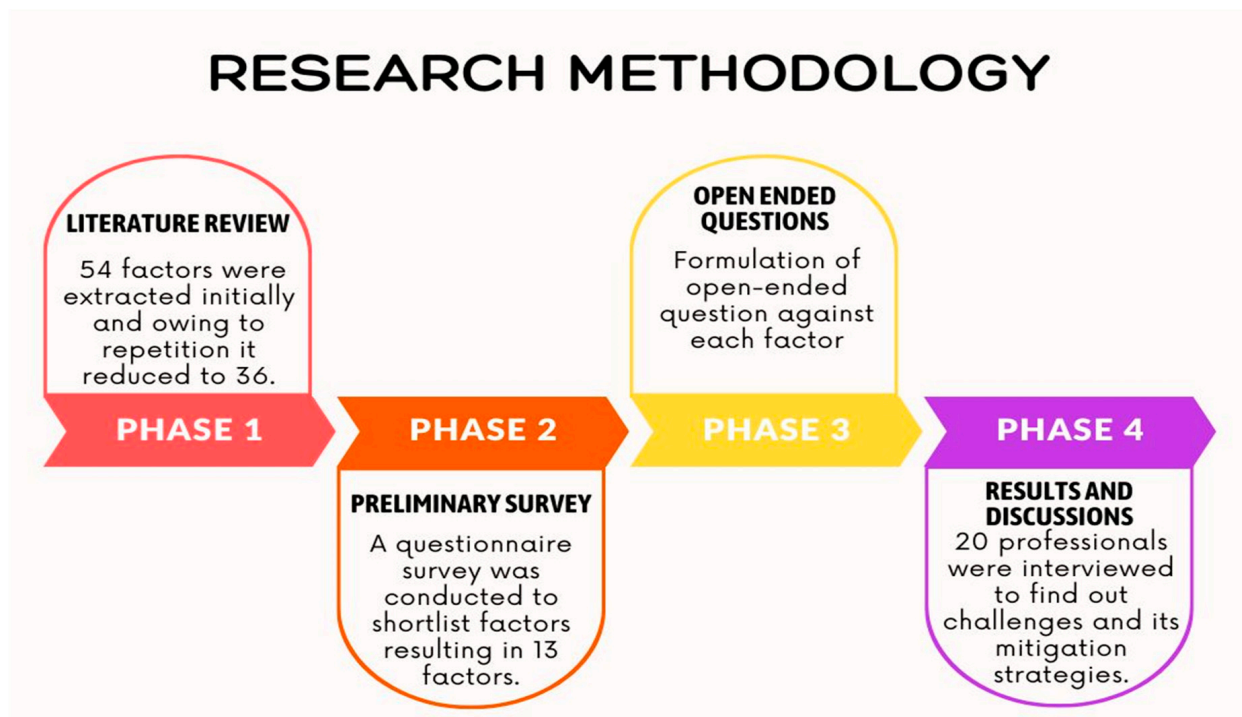
Pakistan possesses a Human Development Index (HDI) of 0.56 that rates the country in a medium development category with a rank of 154 out of 189 countries [34]. This makes the country prone to risks posed by the pandemic [4]. Construction is considered as one of the main components of the industrial sector in Pakistan's economy that contributes 2.61% to the national GDP and absorbs 7.61% of the labor force [35]. According to an economic survey from 2020–21, the total workforce in the country was reduced from 55.74 to 35.04 million due to COVID-19 [19]. This indicates that people were either unable to work or lost their jobs in the construction sector as well due to it being highly labor intensive [4]. To mitigate the severe impact of the pandemic on the economy and the construction workforce, the government of Pakistan announced a construction package of Pak Rupees 1240 billion (USD 11.209 billion) with a supportive policy for the construction sector. Through the policy, the government of Pakistan resumed the construction activities and provided amnesty schemes, tax exemptions, diaspora investment incentives, and subsidies for construction investors. This initiative resulted in the resumption of construction jobs and an increased construction growth rate of 8.34% for 2020–2021 as compared to the previous year figure of 5.46% [19]. These events highlight that the construction industry in Pakistan has also experienced hurdles due to the pandemic that need to be investigated from the ground realities. However, no research study has been on record to highlight such challenges and the strategies exercised by the stakeholders for their mitigation. Therefore, this research targets to fill this gap by doing a project-based study encompassing various types of construction projects from different geographical locations to ascertain a realistic picture.

## 2. Materials and Methods

To achieve the objectives of the study, a comprehensive research methodology was adopted comprising of three phases. In the first phase, a thorough literature review was performed of 48 research papers related to the COVID-19 pandemic to identify the factors that can affect construction projects' performance. In the second phase, a preliminary survey was conducted to shortlist the most significant factors of the construction industry by using the Relative Importance Index (RII) calculated through Equation (1). The following method has been used in many research studies [32,36,37]:

$$RII = \Sigma W / (A_x \times N) \quad (1)$$

The exercise resulted in 13 shortlisted factors. The next step was then to divide the shortlisted factors into appropriate construction themes using past literature. In the third phase, an open-ended question was formed against each shortlisted factor. Twenty on-going construction projects, with 4 from each province of the country, were targeted for the study purposes. Following a qualitative approach, the study adopted the conduction of semi-structured interviews as used [7] from construction professionals to obtain the insights about the project performance during the pandemic times. This approach was selected as other pandemic-related studies had also recommended its appropriateness due to its allowance of getting exhaustive views and experiences [21,38]. The recorded interviews were conducted through face-to-face discussions with strict compliance of social distancing protocols. The participants were asked to respond only in the perspective to their projects. In the final phase, the collected data were analyzed to find out the challenges posed by COVID-19 on the targeted projects' performance, followed by an appropriate discussion on mitigation strategies and conclusions. The research methodology process of this paper is illustrated in Figure 1.



**Figure 1.** Research Methodology.

### 2.1. Identification of Factors

This research has carried out a thorough database search to find out the essential COVID-19-associated factors that can influence the construction sector. Searching of relevant papers was performed using Scopus, Google Scholar, and Clarivate repositories as used previously [7]. Keywords used for searching included “novel coronavirus”, “COVID-19”, “pandemic and construction”, “COVID-19 impact”, “pandemic impact on construction”, “COVID and cost”, and “COVID and time”. Only those research papers were selected that were relevant to construction and COVID-19. After exhausting the said literature, 54 factors were obtained from a total of 48 shortlisted papers. Owing to similar meaning, the authors reduced the factors to 36 to avoid repetition. Since these shortlisted factors might not truly correspond to the situation of the local construction industry, therefore, there was a need to verify such factors from the industry experts. For this purpose, a total of twenty construction practitioners having an experience of minimum 10 years were contacted to verify the relevancy of these factors. The survey, conducted between October 2020 and August 2021,

assessed the significance of the factors on the construction projects of Pakistan project performance with a 5-point Likert scale where 1 = no significance, 2 = slight significance, 3 = moderate significance, 4 = high significance, 5 = very high significance.

Hassan Naveed et al. [39] in their study shortlisted factors on the basis of their above mean RII scores. The same methodology was used that resulted in a shortlist of 13 factors. Furthermore, based on the analyzed literature, the authors categorized these factors into four construction themes, namely Human Resource, Financial, Occupational Health and Safety (OHS), Contracts, and Material & Equipment. All the 13 factors along with their RII scores are presented under their respective themes in Table 1.

2.2. Development of Instrument Survey

After the conduction of the preliminary survey and thereby shortlisting 13 factors, an open-ended question was formulated against each factor to conduct semi-structured interviews. The open-ended questions were pilot tested by construction professionals and researchers to ensure fulfillment of the purpose of study, and some of the questions were rephrased accordingly. This approach was also adopted by Salami et al. [40]. The semi-structured interview method was preferred because it is constructive in determining complications [41] and enables the interviewees to speak in detail on each subject factor, as utilized by Sami et al. [31]. The open-ended questions were developed in a sequential manner attached in Appendix A, allowing respondents to correlate to the preceding question(s) and express their justification coherently, so as to form the dataset of answers that have been analyzed and discussed in the following Section 3. All the open-ended questions developed against each shortlisted factor are presented in the survey instrument section of Table 1.

Table 1. Factors, RII and Questions.

Identification of Factors			Survey Instrument	
Sr.	Factors	RII	References	Question
Material and Equipment				
1	Challenges in importing material and equipment	4.28	[31,41]	What challenges did you face in importing material and how did you manage challenges while importing material or equipment during COVID-19?
2	Challenges in locally procuring materials	3.80	[4,42]	What challenges did you face while procuring material locally during COVID-19 and how did you manage it?
3	Escalation of material prices	3.64	[4,42]	Prices are escalated during pandemic. How your project performance affected by escalation? And how did you manage it?
Human Resource				
4	Job uncertainty of employees	4.44	[11,43]	Did COVID-19 create job uncertainty? If yes, how did that job uncertainty impacted your project performance?
5	Foreign workers returned to their country due to COVID-19	3.72	[44]	Are there foreign employees working on your project? If yes, did they return to their respective countries? Also, how did you manage difficulties created after their departure?
6	Shortage of labor	3.32	[4,45]	Do you face labor shortage on your project? Also, how do you cope with the shortage of labor to achieve the desired project performance?
Occupational Health and Safety				
7	Effect on Construction Safety	4.12	[4,44]	How did COVID-19 affect the construction safety on your project?
8	Need of educating worker about COVID-19	3.84	[44]	Up to what extent there is a need of education our labor community regarding COVID-19? Will it create any impact on productivity/performance of project?



Table 1. Cont.

Identification of Factors			Survey Instrument	
Sr.	Factors	RII	References	Question
9	Legal issues/Disputes arising from contracts	3.64	[4,46]	Financial and Contracts What kind of contractual disputes did you face during pandemic and how did you manage it?
10	Financial Market instability	4.00	[12,47]	What were the challenges related to financial market instability during COVID-19, How did you cope with hurdles for your project during COVID-19?
11	Delays in Payment of Salary	3.96	[19,31,48]	How delays in salaries of staff affected the performance of project?
12	Difficulty in maintaining required operational cash flow	3.92	[15,34]	What difficulties did you face in maintaining operational cash flows? How did you cope cash flow for your project during COVID-19?
13	Increasing cost overheads in project	3.60	[4,39]	What were the reasons for additional cost overheads during the pandemic?

2.3. Demographics of Projects

For selecting the projects for the case studies, the research targeted at least 10 large scale on-going projects from each provincial territory, resulting in a total of 40 projects. However, owing to non-provision of willingness by their stakeholders to participate in the study, the number was reduced to a total of 20 projects, with 4 projects from each region; i.e., Sindh, Punjab, Balochistan, Khyber-Pakhtunkhwa, and Federal Territory. These projects belonged to both the public and private sectors, which can be broadly classified in building and infrastructure categories representing the construction of buildings, roads, wind power, border crossing facilities, and dams. The relevant details of the projects are presented in Table 2.

Table 2. Project’s Profile.

S. No.	Project ID	Type	Working Sector	Location	Covid-Attributable Delays
1	A	Building	Private	Islamabad	210
2	B	Building	Private		197
3	C	Building	Government		90
4	D	Building	Private		365
5	E	Infrastructure	Government	KPK	90
6	F	Infrastructure	Private		150
7	G	Infrastructure	Government		27
8	H	Building	Private	Punjab	90
9	I	Building	Private		30
10	J	Building	Private		90
11	K	Infrastructure	Government		45
12	L	Infrastructure	Government	Sindh	210
13	M	Infrastructure	Government		50
14	N	Infrastructure	Private		90
15	O	Building	Private		120
16	P	Infrastructure	Private	Balochistan	30
17	Q	Infrastructure	Government		28
18	R	Infrastructure	Private		210
19	S	Infrastructure	Government		17
20	T	Building	Private		60

2.4. Demographics of Respondents

The impact of COVID-19 on the construction sector being a complicated issue, it was necessary to obtain insights from experienced professionals. For selecting participants, purposive sampling was adopted because it is commonly used by many similar studies.

A purposive sample is a type of non-probability sample selected based on the specific characteristics of a population and the study's objectives, relying on the researcher's judgment and expertise [49]. Another selection criterion is that all interviewees should have a minimum of 10 years of working experience in the construction industry. It was considered imperative to sample individuals in senior positions because they are the ones who face immediate accountability during crises. A total of 20 construction professionals having more than 10 years of experience and key positions on projects selected in the previous section were interviewed to obtain the project insights from the pandemic period. The relevant details of interviewees are presented in Table 3.

**Table 3.** Respondent's Profile.

S. No	Position of Respondents	Project ID	Experience (Years)	Qualification
1	Senior contract manager	A	20	MSc
2	Manager Projects	B	17	MSc
3	Assistant Project Engineer	C	17	MSc
4	Project Coordinator	D	16	BSc
5	Project Manager	E	19	BSc
6	Deputy Project Manager	F	16	BSc
7	Project Manager	G	22	BSc
8	Project Engineer	H	17	MSc
9	Project Manager	I	16	BSc
10	Project Manager	J	14	BSc
11	Planning Engineer	K	13	MSc
12	Project Coordinator	L	13	MSc
13	Site Engineer	M	12	BSc
14	Project Engineer	N	15	BSc
15	Construction Manager	O	17	BSc
16	Civil Engineer	P	15	MSc
17	Senior Quantity Surveyor	Q	14	BSc
18	Manager Projects	R	16	MSc
19	Project Engineer	S	18	BSc
20	Project Manager	T	14	BSc

### 3. Results

This section provides details of projects and their corresponding respondents, which is followed by findings on shortlisted factors existing under the devised themes.

#### 3.1. Material and Equipment

Q: What challenges did the project face in importing materials and how were those challenges managed?

All the participants indicated that they faced many challenges in importing materials. Supply shortages at source, increased shipment cost, and port congestion were some common challenges that led to delays and cost overruns. One of the participants mentioned that they had tried to import generators from the United Kingdom for more than six months, but the shipment was delayed due to supply shortages and staff rotations at the source. Another participant stated that procuring Dampa ceiling from a local supplier that deals with OEM also resulted in project delay due to scarcity of the product at the source. One more participant described the procurement of wind turbines and their allied components from multiple destinations like Germany, China, and Taiwan. The organization ended up paying double the amount of shipment cost for timely arrival because of a high-priority project. Four participants revealed that importing various MEP items faced challenges of ordering in limited quantity due to port congestion issues.

Most of the projects tried to cope with the challenges by switching to local suppliers. Instances of material replacement were also practiced on some projects; however, some of the suggested replacements were rejected by the client due to their possible adverse

impact on quality. One project stakeholder agreed to reduce the material approval time from 14 days to 1 day under the conditions of the contract to manage the delays caused by COVID-19. Only one recently started project was able to overcome the imported material procurement issues by engaging multiple vendors in its initial phase of execution.

Q: What challenges did you face while procuring material locally during COVID-19 and how did you manage those challenges?

In material procurement from the local market, inter-provincial travel ban, local industry closure, and supply shortages were common challenges faced by the targeted construction projects. Most of the participants addressed that the consultant's inability to travel caused hinderances in material approval, which ultimately caused delays. Three participants stated that procurement of bricks, stones, and marble was delayed due to provincial border closure. Participants mentioned that the closure of the steel industry resulted in severe steel shortage, which badly affected the projects in terms of their timelines.

To mitigate the effects, most of the companies adopted diversifying their material sources for the projects. Seven participants commented that whenever possible, their companies ordered material in bulk from other provinces because of the unpredictability around the inter-provincial transport restrictions. However, this exercise led to upfront cash flow problems for contractors. Another participant stated that their project managed to obtain the transport permit for their material delivery due to it being a high priority. One of the companies adopted a strategy to replace its wooden shuttering with that of steel because of its reusability and no vulnerability on shortage. Some participants stated that their organizations managed to contract with a ready-mix concrete supplier to counteract shortages of cement and aggregates.

Q: How much has the escalation of material prices affected your project performance? How did you manage the issue?

Most of the participants agreed that their projects were affected by price escalation of materials. According to some participants, cost overruns in projects were mostly attributed to uncertain fluctuations of material prices that caused project performance to deter in terms of project cost. The delays in delivery to destinations and shortages from the source are the main reasons for such steep prices. One participant explained that steel prices witnessed a sudden increased price in the market that caused unforeseen cost overruns on the project. On the other hand, there were instances where this rise in material prices did not affect projects because of sufficient material availability on the project sites due to them being in far flung areas. The contractors were bound to order in bulk in the first place, and afterwards, the resumption of the market after lockdown helped in the fall of material prices, which ultimately resulted in no major effect on those projects.

Related to mitigation of price escalation, many of the participants believed that the major effect was mostly covered through the price adjustment formula applicable on the contracts, whereas some participants mentioned that their clients helped in procuring materials at pre-covid market rates due to their influence on the suppliers.

### 3.2. Human Resource

Q: Did COVID-19 create job uncertainty? If yes, how did that job uncertainty impact your project performance?

According to the data of 20 case studies, many of the participants agreed with the notion of job uncertainty among construction workers due to COVID-19, which influenced the project positively or negatively. Six participants stated that the employees were doing their best to secure their jobs, which positively affected the project performance, whereas five participants stated that their workers suffered from distress due to the uncertain situation in the market, which negatively affected their productivity and worsened the project performance. Additionally, two participants commented that half of the project employees were sent on leave and that created a burden on the remaining ones to achieve the desired project objectives.



On the other hand, a couple of the participants revealed that their project was not much affected by this uncertainty because the construction industry was allowed to start physical work after a period of around one month. Moreover, two participants stated that their projects were not affected due to the job uncertainty because of being high-priority projects that ensured a significant amount of labor and staff on-site. The workers of projects in remote areas also did not face any job uncertainty because their sites were in remote areas, which bounded the contractors to have an ample number of workers present to proceed in accordance with project timelines.

Q: What challenges did your project face regarding the foreign workers employed on the project?

Out of 20 projects, 15 projects did not have foreign workers employed on the projects, whereas the remaining 5 projects had employees from China, Germany, and Turkey. Out of the 5 projects, foreign employees of only 1 project managed to depart to their respective countries after foreseeing the crisis early, whereas employees from the remaining 4 projects did not return to their countries because of quarantine policies, international border closure, and fear of job loss. According to respondents, the projects did not suffer much but the well-being of those employees suffered more due to being away from their families during the pandemic times.

Q: How did you cope with the shortage of construction workers to achieve the desired project performance?

Only four projects faced labor shortages due to COVID-19. The major reasons for this shortage were travel restrictions and the mindset of the construction workforce. Intercity travel restrictions via public transport were placed by various provincial governments from time to time even after the withdrawal of the major lockdown. For the latter reason, most of the construction workers believed that the coronavirus was only active in cities and not in villages. This belief stopped workers who lived in villages from returning to project sites located in urban areas. Moreover, the quarantine in isolation and vaccination rules imposed by the employers were also other concerns among workers that stopped them from travelling back to project sites. This labor shortage resulted in increased overheads for the employers. The available workers were pampered with increased amenities on project sites, COVID-19 safety awareness talks, and were also provided enhanced financial incentives for job continuity to meet the project objectives.

The other 16 projects did not face labor shortages due to the availability of an ample workforce around the project vicinity and the poverty concerns among the workforces.

### 3.3. Occupational Health and Safety

Q: How did COVID-19 affect the construction safety on your project?

According to the findings, it is observed that most of the projects had a significant impact on OHS due to COVID-19. All the participants mentioned that the compliance of COVID-19 protocols resulted in increased OHS overheads on their projects. Additional safety engineers were hired on two projects to cater for the conduction of daily safety drills pertaining to COVID-19 and monitoring of social distance compliance by the workers. Similarly, COVID-19 protocols pushed the constructors for creation of more labor camps facilitated with wall-mounted sanitizers. Moreover, the project sites were complemented with posters printed in local languages promoting wearing facemasks and using sanitizers. Similarly, some projects witnessed installation of walk-through sanitization gates at access points for enforced compliance of COVID-19 protocols. The provision of facemasks, sanitizers, and gloves also resulted in the increased cost of PPE procurement. In one project, a medical team was also called on-site to ensure safety and well-being by daily screening of the workers during the start.

Q: What were the challenges faced due to compliance of COVID-19 based OHS protocols? Is there a need for educating workers regarding COVID-19?

Some respondents mentioned that the stress created among the workers due to COVID-19 protocols decreased their productivity, which affected the project pace. All the partici-

pants mentioned that compliance of COVID-19 SOPs initially slowed down workers' overall performance. This is aligned with previous findings [33]. According to one participant, the stress was causing absenteeism among workers as well. Considering challenges in implementing SOPs, most of the participants stated that workers were mostly reluctant to follow COVID-19 protocols, which made the task even more challenging. The participants also stated that there were sanitizers and masks available on-site; however, no one committed to use them due to lack of seriousness. For the justification, participants mentioned that the workers in remote areas were unaware of the virus and its effects. Similarly, the workers were not ready to mentally accept COVID-19 and its consequences that ultimately pushed them to unfollow the SOPs on-site. One participant stated that they faced extreme resistance by the workers when asked to be vaccinated.

On some projects, these challenges were coped by implementing fines on violation of COVID-19 protocols. Contrarily, the workers were also awarded with financial incentives on positive compliance.

Due to these challenges, all the projects' respondents unanimously agreed that the construction workers of Pakistan have lack of awareness and require education and training regarding COVID-19. Regarding the impact of training on project performance and productivity, the participants believed that the education might affect the productivity of the workers by creating awareness. The workers will have a safe feeling, which will help in completing the task on time.

### 3.4. Financial and Contracts

Q: What were the challenges related to financial market instability during COVID-19? What actions were taken to mitigate the effect of those challenges?

The respondents of 14 projects, representing the majority, agreed to the notion of financial market instability during the COVID-19 period after resumption of the market. Major challenges faced by the projects due to financial flux were supply chain disruptions, cash flow interruptions, and material price fluctuations that caused delays in most of the projects. A major challenge faced by the projects was the continuously increasing delivery costs of the material resources demanded by the suppliers after the lockdown due to market uncertainty. This led to a disrupted supply chain for most of the critical material resources used on projects. Participants also shared that various suppliers stopped providing material on credit, causing cash flow interruptions. This factor led to delayed payments to other stakeholders like subcontractors, staff, and workers of the project. Similarly, some participants highlighted that there was market unpredictability in terms of availability of raw materials, which resultantly pushed the suppliers to demand higher rates of their material products than normal. There were a couple of projects that were not affected by these challenges, but their respondents agreed to the unstable financial market perception. The major reason for the low impact on those projects was the availability of ample material resources until the financial situation became normal.

Contrary to this, participants from six projects disagreed with the perception of financial market instability. For rationale, they stated that the economic activity decreased globally because of total lockdown; however, in Pakistan, the government took special measures and gave relief to the construction industry to maintain the economic activity. According to them, the special package announced by the government for the construction sector as discussed previously resulted in increased construction activity as compared to other sectors. In their views, this assists much in resumption of the industry after withdrawal of the first lockdown.

For mitigation, participants stated that financial management was performed through strategic planning and prioritization. The less critical activities were put on hold and finances were diverted to the most critical ones. To mitigate the effect of supply chain disruptions and material price fluctuations, the stakeholders started to place orders 6 months in advance to acquire material.

Q: Did your project workers face delay in salary receipt? If yes, how did this delay affect the performance of the project?

A total of 12 projects, representing the simple majority, did not face this challenge of delayed salary disbursement. These projects mainly belonged to the public sector, which had their financial budget already approved by the government up to the fiscal year; i.e., June 2020. The construction sector got the special package from the government afterwards, which resulted in smooth payment to contractors and ultimately to their employees. However, the representatives also mentioned that their projects faced the issue of delayed salary payments to employees. According to these participants, the major reasons for these delays were imbalance of cashflow, market instability, and non-payment by the clients. Due to the cash flow imbalance, some projects also faced a 20% reduction in addition to the delay of 2 months in salary disbursement to workers. Moreover, the financial market instability caused the investors to halt the investment, which ultimately resulted in delayed payment of salaries to project staff.

This issue did cause decreased motivation among the project employees; however, the performance of those projects was not reported to be affected due to this challenge because of a common understanding about the uncertain market situation created due to COVID-19.

Q: What difficulties did you face in maintaining operational cash flows? How did you cope with cash flow for your project during COVID-19?

According to most respondents, despite the availability of an allocated budget, the projects faced operational cash flow problems because of the disruptions caused by the pandemic to normal operations that resulted in delayed preparation and approval of invoices within the stipulated time. This also delayed payments from main contractors to subcontractors, vendors, and suppliers because most of such payments were linked to pre-set milestones and deliveries of various items that were either not executed or not approved due to the restrictions imposed by the pandemic.

Another participant stated that the delivery of material on credit was stopped and the overall flow of cash with the vendors was disrupted in the chain due to fewer business activities. Likewise, a participant highlighted that the major effects of cash flow problems were delayed payments to petty contractors that gave rise to slow progress, which further escalated late payments.

To maintain operational cash flow, one participant mentioned that the minimum limit of an interim payment certificate was abolished on his project along with a reduced payment period of 15 days. Similarly, another participant commented that their organization managed cash flow by borrowing capital from its other business portfolios.

Q: What were the reasons for additional cost overheads during the pandemic?

According to the study findings, participants identified the reasons for cost overheads as additional costs due to time delays, additional labor payments, shortage of materials, repeated closure of sites due to rise in COVID-19 cases in the area, high price fluctuation of materials, and the increased cost for OHS implementation.

Different strategies were mentioned and implemented by stakeholders to address the increased cost overheads and reduce their impact on the overall cost of the project. One participant mentioned that the client helped to execute SOPs and provided the additional required funds for the purpose. Additionally, given the uncertainty, many organizations reduced their profit margins to secure jobs and strengthen their positions during the pandemic.

Q: What kind of contractual disputes did you face during a pandemic and how did you manage it?

The construction projects in Pakistan are usually driven by the FIDIC condition of contracts. In these conditions, some clauses outline methods and guidelines to deal with such a situation, such as Clause 8 (delays and suspension), Sub-clauses 8.4 (delay caused by authorities) and 8.7 (delay damages), and Clause 19 (force majeure). However, according to some respondents, these clauses failed to completely address the loss of parties

under the pandemic situation because such events had not previously occurred and were totally unanticipated.

Out of 20 projects, all the projects were granted extension of time (EOT) due to the pandemic. However, 7 projects faced disputes between the parties regarding the grant of cost associated with the EOT due to the pandemic. The main reason for disputes about such projects was the fixed-job overheads faced by the contractors with limited staff allowed by the client during the execution.

Moreover, many amendments were made to existing contracts to accommodate the revised completion dates, payments methods, material and equipment specifications, authority approvals, and inspection methods. For example, a participant mentioned that the material approval time by the consultant was reduced from 16 to 2 days. Similarly, the minimum limit of an interim payment certificate was removed with a reduced payment period of 15 days.

#### 4. Discussion

Figure 2 describes the challenges, impacts, and mitigation strategies of all four projects. In the material and equipment group, supply chain disruption was commented as the most common challenge that caused material shortage, possibly because construction supply chains can be complicated owing to the variety of materials used and involvement of many parties (suppliers and subcontractors) required in the construction phase [50]. In the context of Pakistan, China is one of the major suppliers of construction items such as iron and steel, as well as construction equipment and machineries [51]. The interviewees stated that construction projects in Pakistan are experiencing disruptions due to shortage of equipment and raw materials, which is, in turn, attributed to the severe impact of the pandemic on the Chinese manufacturing industry. Many participants expressed the same concern reflected in the following statement: “The pandemic most immediate impacts on the Pakistani construction industry are felt by the contractors and subcontractors in terms of material delivery and shortage, particularly in the private sector”. This aligns with a previous study [7]. On the other hand, most of the interviewees pinpointed the disruption or delays in construction processes resulting from the lockdown, provincial and international border closure, shutdown of local industry, and price escalation. The above discourse is also aligned with the high RII score of 4.28 for challenges in importing material and equipment, indicating that firms must focus on diversifying their suppliers and local sourcing strategies to mitigate future risks.

In the human resource group, job uncertainty was commented as the most common challenge faced during the pandemic. However, this uncertainty faced by private projects only increased the workload for the remaining employees. The interviewees further stated that construction projects in Pakistan did not experience labor shortage because of a stimulus package provided by the government of Pakistan to the construction sector [19]. In fact, most interviewees highlighted that the labor shortage was because of their mentality and lack of education rather than any other challenge imposed by COVID-19. The findings regarding labor shortage in Pakistan are contrary to other studies (Al-Mhdawi et al. [4]) and to the highest score of RII 4.44 for job uncertainty of employees because of the intensive availability of local labor [13].

In occupational health and safety, 65% of the projects encountered maintaining construction safety as a real challenge for the progress of their project, which is also aligned with the highest score of RII 4.12 for effect on construction safety.

On the other hand, 40% of the projects faced difficulties in educating their workers regarding COVID-19. Effective safety management in construction projects is of utmost significance in all organizations because it promotes a sustainable and healthy working environment [52] and minimizes associated delays and disruptions [8]. In Pakistan, the interviewees mentioned that the commitment of construction companies in Pakistan to safety laws and regulations are very weak, even before the start of the pandemic, as is the case for the Iraq construction industry [7]. The safety measures imposed by the Pakistani

government in line with the recommendations of the World Health Organization have contributed to activating the role of safety management, particularly in the construction sector. Now there is a need to establish on-site safety management units specialized for COVID-19 testing and to impose social distancing, besides their construction duties in ensuring the proper application for construction safety measures. However, it is not easy to implement SOPs because of the existing behavior of the workforce. Although there is no evidence on whether such improvement would last in the future, many of the interviewees have emphasized the need to educate and train labor and incorporate effective safety management plans into the Pakistani construction industry like those adopted by developed countries in the region and around the globe.



Figure 2. Impact, Challenges, and Strategies.

In financial and contracts, cash flow management, increased cost overheads, timely salary issuance, lack of funds, and stopping crediting were some challenges encountered by the projects. In the context of Pakistan, despite the government-announced stimulus package, the construction sector faced financial issues because of the disruption caused to normal operations when everyone stopped going to work and finance teams faced difficulties in obtaining the approved invoices from consultants and contractors, preparing payments, and obtaining the required signatures within the stipulated time. This aligns with the study of Sami et al. [31]. It is also noted that, earlier in April 2020, the government opened the construction sector and gave a special package, which included amnesty scheme for investors, tax exemptions, diaspora investment incentives, and a Rs 36 billion subsidies (for 10 years) under their niche Naya Pakistan Programme [19], which is why a low number of projects faced funding issues. The RII score of 4.00 for financial market instability is not consistent with information provided by the participants because of the aforementioned reasons.



Generally, common contractual-related challenges in construction projects include contradictions and vagueness in contract documents, unclear scope, inefficient negotiation process, and poor contract communication [18]. Such contractual-related challenges may lead to legal consequences, including penalties and lawsuits for not meeting contract terms, invalidation of contracts that do not follow current regulations, and even deterioration of relationships among the various project stakeholders. However, the pandemic has shed light on such aspects due to the imposed governmental measures and regulatory changes. For instance, the pandemic has given rise to many disruptions, cost increases, and project delays in Pakistan due to either the full lockdown on one hand and strict safety measures and regulations imposed by the government on the other. The following describes the impressions from many of the interviewees: Practices to accommodate social distancing in construction sites may be implemented, including staggering shifts, daily temperature checks, wearing masks, providing additional hand washing and sanitizing gates, and the restricted use of shared tools or equipment among construction workforces increase the cost of the projects. The major dispute discovered that there was no cost associated with EOT that resulted in increasing cost overheads of contractors.

Furthermore, the data in Table 1 reveal interesting insights into the COVID-19-attributable delays experienced by various projects. Analyzing the delays, it becomes evident that private sector projects generally faced more significant delays compared to public sector projects. Specifically, building projects in the private sector, such as Project D with a delay of 365 days, experienced the highest delays. In contrast, infrastructure projects in the public sector, like Project S, had relatively lower delays, with some as low as 17 days.

Post-COVID-19, new construction technologies may gain further traction in emerging economies. These trends offer hope and resilience for the industry's recovery. The adoption of advanced construction technologies such as additive construction (3D printing) and extended reality (XR) training can significantly enhance the efficiency and effectiveness of construction projects. According to Wang et al. [53], promoting additive construction in fast-developing areas requires a thorough analysis of policies and stakeholder perspectives to facilitate its implementation. Similarly, Li et al. [46] highlight the importance of XR training in improving construction safety, skill acquisition, and overall project management. Incorporating these innovative technologies can help mitigate some of the challenges faced by the construction industry during the pandemic and beyond, paving the way for a more resilient and advanced construction sector in Pakistan.

## 5. Conclusions

This research captured the impact of COVID-19 on construction projects' performance in Pakistan. First, the authors analyzed the literature, followed by a questionnaire survey with 20 construction professionals to create a comprehensive and validated list of construction factors affected by COVID-19. Second, 20 semi-structured interviews were conducted with professionals experienced in the Pakistani construction industry to collect the data for finding out the impact of each factor on construction project performance. Third, analysis was performed on the collected data, which resulted in presenting challenges and mitigation strategies encountered by the projects across the country. The study presented data that explain differences in the captured impact in various provinces. Based on the adopted research methodology, the authors identified a total of 13 construction factors that impacted project performance grouped under four construction groups, including material and equipment, human resource, occupational health and safety, and financial and contracts. The highly impacted factors during the pandemic include cash flow management, supply chain disruptions, increasing overheads, and job uncertainty. The less affected factors include timely approval of material, exporter country's policies, and returning of foreign employees. The pandemic had a relatively higher impact on the private sector compared with the public sector because of government policies.

This study contributes to the construction industry in rapidly developing economies, such as Pakistan, by offering specific recommendations based on the findings illustrated

in Figure 1. The identified strategies, including the claiming of Extensions of Time (EOT), diversification of material sources, and transitioning to local suppliers, are crucial in mitigating the impacts of supply chain disruptions. Additionally, the establishment of safety management units dedicated to COVID-19 testing and the enforcement of social distancing measures can significantly enhance occupational health and safety standards. The adoption of advanced technologies, such as 3D printing and Extended Reality (XR) training, is proposed to enhance long-term resilience and operational efficiency in construction projects. It is imperative for policymakers and industry leaders to advocate for these strategies and technological advancements to cultivate a more resilient construction sector capable of withstanding future disruptions. Ultimately, the authors contribute to the body of knowledge by providing the foundation for discovering the impact of the pandemic on project performance in developing countries.

While this study provides valuable insights into the impact of COVID-19 on construction projects in Pakistan, it has several limitations. First, the sample size of 20 construction professionals may not fully capture the diversity of experiences across the entire industry. Future research should consider larger sample sizes to validate these findings. Additionally, this study is based on qualitative data, which, while rich in detail, may benefit from quantitative analysis to generalize the results. Another limitation is the focus on Pakistan; comparative studies involving other rapidly developing economies could provide a broader understanding of the pandemic's impact on the construction sector globally. Future research should also explore the long-term effects of the pandemic on construction projects and investigate the effectiveness of the recommended strategies over time.

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## Appendix A. Open-Ended Questions and Consent Form

### Consent Form

This research is being undertaken by Syed Rafay Ali Bukhari for a Master thesis project at the Department of Construction Engineering and Management at National University of Science and Technology, Pakistan. This research aims to explore the impact of COVID-19 on construction project performance.

All responses will be treated in the strictest confidence and will not be shared willingly or otherwise with any third party. Data and information analysed will be anonymized to preserve your identity, and all information collected will be securely destroyed upon successful completion of the award.

### Section One

Title of study: The Impact of COVID-19 on Construction Project Performance: A Case Study in Pakistan.

### Section Two—Information

Please can you answer the following questions by placing a tick (✓) in the appropriate boxes below. Thank you for completing this consent form.

*Consent Form*

Question	Res
Have you read and fully understood the letter/information sheet that accompanies this invitation to participate in this research?	
Do you agree to participate in this proposed dissertation research conducted by the School of Civil and Environmental Engineering (SCEE)?	
Do you understand that you are free to withdraw from this study, at any time and without giving reasons?	
Do you give permission for the research team members to have access to your anonymized responses and/or data/information?	
Do you understand that all information and data collated will be anonymized, securely stored during the research period, and published wherever necessary?	

**RESPONDENT PROFILE**

**Personal Information**

• Name: \_\_\_\_\_

• Please indicate your Organization's role: \* Mark only one oval.

- Senior Project Manager
- Manager Projects
- Assistant Project Engineer
- Project Coordinator
- Project Manager
- Deputy Project Manager

Other: \_\_\_\_\_

• Educational Qualifications: \* Mark only one oval.

- Bachelors
- Masters
- Doctorate

Other: \_\_\_\_\_

• Please indicate your experience (in years) \* Mark only one oval.

- No experience 1-5
- 6-10
- 11-15
- 16-20
- 20 and above

Other: \_\_\_\_\_

Project Name: \_\_\_\_\_

Project Working Sector: \_\_\_\_\_ (Government/Private)

Project Location: \_\_\_\_\_

Project Type: \_\_\_\_\_ (Building/Infrastructure)

## OPEN-ENDED QUESTIONS

Please answer the following question to find out the impact of COVID-19 on Construction Industry of Pakistan.

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### MATERIAL AND EQUIPMENT

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Q1: What challenges did you face in importing material and how did you manage challenges while importing material or equipment during COVID-19?

Q2: What challenges did you face while procuring material locally during COVID-19 and how did you manage it?

Q3: Prices are escalated during pandemic. How your project performance affected by escalation? And how did you manage it?

### Human Resource

Q4: Did COVID-19 create job uncertainty? If yes, how did that job uncertainty impacted your project performance?

Q5: Are there foreign employees working on your project? If yes, did they return to their respective countries? Also, how did you manage difficulties created after their departure?

Q6: Do you face labor shortage on your project? Also, how do you cope with the shortage of labor to achieve the desired project performance?

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### Occupational Health and Safety

Q7 How did COVID-19 affect the construction safety on your project?

Q8 Up to what extent there is a need for education in our labor community regarding COVID-19? Will it create any impact on productivity/performance of project?

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### Financial & Contracts

Q9 What kind of contractual disputes did you face during pandemic and how did you manage it?

Q10 What were the challenges related to financial market instability during COVID-19, How did you cope with hurdles for your project during COVID-19?

Q 11 How have delays in salaries of staff affected the performance of project?

Q12 What difficulties did you face in maintaining operational cash flows? How did you cope cash flow for your project during COVID-19?

Q13 What were the reasons for additional cost overheads during the pandemic?

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