

Exploring the Mitigation Measurement for Impact of the Pandemic on Construction Projects in Oman

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HOW TO CITE:

Azan AL-Shukaili, Shuhairy
Norhisham, Muhammad Zakwan,
Hussin A. M Yahia, Rashid Salim,
Masoud Al-Qassabi (2026).
Exploring the Mitigation Measurement
for Impact of the Pandemic on
Construction Projects in Oman.
International Journal of Special
Education, 41(24s), 686-697

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ABSTRACT:

The pandemic has had a significant impact on the global economy and institutions, presenting substantial challenges to the public construction industry in Oman. This research aims to develop a framework for measuring mitigation and addressing the primary challenges in managing projects and successful transformation programs. The study encompasses both global and local impacts, examining the onset of the pandemic, its effects on construction projects, factors that influence delays, and strategies to mitigate negative consequences. This study highlights the impact of a pandemic on the construction industry. The research analyses the pandemic's impact on construction projects in Oman and identifies problems that were appropriately avoided. Define a mitigation plan to address the risk components that could hinder project completion. This study aims to develop a framework to mitigate the negative impacts of the pandemic on the public construction industry in Oman. This study summarizes the findings of recent studies, highlighting the identification and classification of critical risks, including financial (project completion), supply chain, regulatory, legal, and health and safety risks, as well as mitigation strategies. The study also presents several recommendations to provide the basic knowledge and information needed for future research. Based on these insights, a conceptual framework is proposed to guide pandemic mitigation practices in the construction sector in Oman.

Keywords: COVID-19 Pandemic, Construction Projects, Risk Mitigation, Construction Industry, Oman.

1. Introduction

Many projects were affected when the World Health Organization declared the coronavirus outbreak a pandemic on March 11, 2020 (ILO, 2022). The projects faced several obstacles, including delays in submitting and postponing, providing materials for projects, and preventive measures in terms of health and safety. As well as the change in the period of projects. Since Covid19 is considered a force majeure in contracting projects, it prevents the completion of projects on time. Disputes between the two parties (contractors and owners) in cases of delays related to the completion of projects. GCC countries awarded contracts worth \$4.1 billion, 40% less in the same month than the \$6.2 billion in contracts in 2019. A sharp decline was recorded in the Middle East and North Africa region, averaging 42%. Of the projects that could have been worked on, 550 projects worth \$60 billion were suspended or delayed on March 1. Water projects accounted for 15%, which is \$9 billion, and transportation for 11%, with a value of \$23 billion (Deloitte, 2021). Companies are responsible for employees and contracts awarded on projects. The business world will never be what it is now. The entire construction industry will be changing in many respects, including labor shortages and difficulty in sourcing materials.

The Sultanate of Oman, like the rest of the world, is facing pandemic. The challenge that pandemic poses to the Sultanate is unprecedented. The increase in the number of cases infected with the virus has had a significant impact on all sectors, including the construction industry. The government is making continuous efforts to reduce the effects of COVID-19. His Majesty Sultan Haitham issued in 2020 the formation of a committee to handle the mechanism of dealing with developments resulting from the spread of the virus. This committee takes measures and makes decisions to reduce the effects of the virus. His Majesty's directives to form this committee had the effect of limiting the spread of the epidemic and addressing its effects (Spa, 2021). According to Umar, T. (2021), Based on the criteria for the impact of pandemic on the construction industry, the results and discussion

section is divided into four sub-sections. The first section is about delays in construction projects; the second section is about manpower management; the third section is about health, safety, and the environment; and the fourth and final section is about legal issues (Umar, 2021). Explain Al Amri & Marey-Pérez, 2020 The COVID-19 pandemic has affected all industries in the Sultanate of Oman. The study covers global and regional economic impacts. The construction industry and its economic prospects in the global pandemic were also discussed. The companies faced difficulties in terms of contracts, labour shortages, and the supply chain. This led to construction contracts being delayed and the workforce declining, leading to unemployment. Difficulty requesting currency from other countries due to the global travel ban (Al Amri & Marey-Pérez, 2020). Through this study, he extracted the impact of reducing the impact of the virus in the construction industry. Suggest solutions that will avoid delays in projects.

2. COVID-19, A Pandemic

The pandemic has affected every lifestyle. Disrupted all significant businesses and shut down small and medium enterprises worldwide. This study focuses on the observed impact of the Coronavirus on the construction industry in the Sultanate of Oman before and after. The Sultanate of Oman is a country rich in its oil and non-oil resources, and the bulk of the economy is highly dependent on oil and various industries for projects. However, the construction industry is the second-largest supporter of the economy. In any case, recent articles have looked at the impact of the Coronavirus on all areas of different projects, whether it is the oil industry or the Omani construction industry. Additionally, the absence of writing in light of the pandemic's impact on development work encourages further exploration in this area. Disrupted all significant construction projects and shut down small and medium enterprises worldwide. It also impacted the construction industry in the Sultanate of Oman (Said Ambu Saidi et al., 2021). Therefore, there is a need to determine the impact and risk of pandemic on the construction industry in Oman. Public construction projects are

experiencing particular difficulties, including delays owing to the pandemic, lockdowns, financial problems, project timelines, project suspensions, supply chain problems, staff illness, and other factors (Abdullah et al., 2021). It is essential to identify mitigation measure of risks the construction industry in Oman. Impact of the pandemic on all areas of different projects, whether the oil and gas or Omani construction industries (Al Amri, 2021). The pandemic has significantly impacted the public construction industry in Oman, underscoring the urgent need for a comprehensive, written framework to measure and mitigate these impacts.

The study aims to establish a framework for minimizing adverse effects on projects and provides valuable insights. Researchers must be aware of these limitations to provide valuable insights and identify potential areas for further research. The limitations will be in data availability and generalizability. The study focuses on the impacts and assessments of the pandemic on the construction industry. Discover and establish a framework for minimizing adverse effects on projects. It is crucial for researchers to be aware of these scope and limitations when conducting a study on the impact of the pandemic on construction projects in Oman. By recognizing these factors, the study can provide valuable insights while also acknowledging its boundaries and potential areas for further research.

3. Methodology

The COVID-19 pandemic has profoundly altered various aspects of our global landscape, resulting in substantial disruptions across all business sectors. This study presents a comprehensive analysis of the pandemic's repercussions on construction projects globally, with a specific focus on the situation in Oman. It delves into critical modifications within the construction industry induced by the pandemic, examining factors such as labour shortages, project cost overruns, disruptions in supply chains, and the inflationary pressures on both labour and material costs. The study assesses the resultant impacts and associated risks facing the

construction sector during this period. Furthermore, it identifies specific mitigation strategies tailored to the challenges confronting the Omani construction sector. A structured framework for these mitigation measures is developed, alongside recommendations for strategic interventions aimed at alleviating the pandemic's adverse effects on the public construction sector in Oman.

4. Impact of the COVID-19

In December 2019, pandemic first surfaced in Wuhan, China, and spread quickly over the globe, infecting 48,539,872 people and causing 1,232,791 fatalities in 215 nations (Khan et al., 2020). The pandemic has intensified further since the ILO's initial detection and expanded its geographical reach. Almost 2.7 billion workers, or about 81 percent of the global workforce, are currently under full or partial lockdown measures (ILO, 2022).

The pandemic, declared by the World Health Organization on March 11, 2020, has significantly impacted numerous projects (ILO, 2022), including those in Oman. Challenges include submission and postponement delays, difficulty sourcing materials, health and safety measures, and adapting to project timelines. Pandemic has been classified as a force majeure in project contracts, leading to delays and disputes between contractors and owners. Companies have been forced to take responsibility for their employees and project contracts. Labour shortages and difficulty sourcing materials have impacted the construction industry. The pandemic has been recognized as a global pandemic, impacting the construction industry globally. This literature discusses the onset of pandemic, its effects on construction projects, the factors influencing delays, and strategies to mitigate the negative impacts of the construction industry in Oman.

4.1 Impact of pandemic in construction project GCC.

The cumulative number of COVID-19 cases around the world has reached 765,903,278, according to the World Health Organization (WHO 2023). The United States of America and

China were among the countries most affected by the Corona virus. America 103,343,569 people and China 99,252,425 people. According to the statistics of the Gulf Cooperation Council countries, the number of injuries reached 4,152,432 cases. In the Sultanate of Oman, the number of cases of pandemic has reached about 399,449 (GCC-STAT 2023). These numbers are massive in themselves and hurt every aspect of life. Aside from the loss of life, businesses and individuals will be affected by the long-term financial effects of the expected global recession. For that, we must improve, update, and adapt to the constantly changing environment; we must increase our capability in ways we have never seen before.

The construction industry is one of the main reasons for providing employment opportunities to millions of people in all parts of the world. It also contributes to social and economic development. Prior to the outbreak of the pandemic, about 7.7% of the workforce worldwide was employed. Forecasts indicate that it contributes about 13.4% of the global GDP (gross domestic product) value. The construction industry would have contributed 6.10% in the UK, 5.50% in Japan, and 9.0% in Oman (Umar, 2021).

According to MEED Projects, GCC countries awarded contracts worth \$4.1 billion, 40% less in the same month than the \$6.2 billion in contracts in 2019. A sharp decline was recorded in the Middle East and North Africa region, averaging 42%. Of the projects that could have been worked on, 550 projects worth \$60 billion were suspended or delayed on March 1. Water projects accounted for 15%, which is \$9 billion, and transportation for 11%, with a value of \$23 billion. Figure 1 shows projects in the GCC that have been cancelled or postponed due to pandemic (Deloitte GCC Powers of Construction 2020).

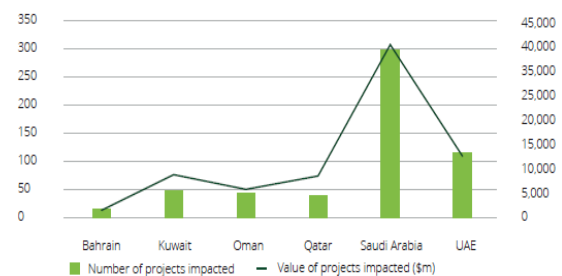


Figure 1: Projects in the GCC that are cancelled or postponed due to COVID-19 (Deloitte GCC Powers of Construction 2020).

The Omani government reported a 10% cut in spending. According to Reuters, it also halted the implementation of new projects it was planning to implement. 300 projects have been suspended in Saudi Arabia, 115 projects in the UAE, 8.2 billion in capital projects will be postponed in Qatar, and Bahrain will reduce costs by 30% (Deloitte GCC Powers of Construction 2020). According to MEED Projects, figure 2 below depicts project spending predictions for 2020, broken down by GCC nations (\$ million).

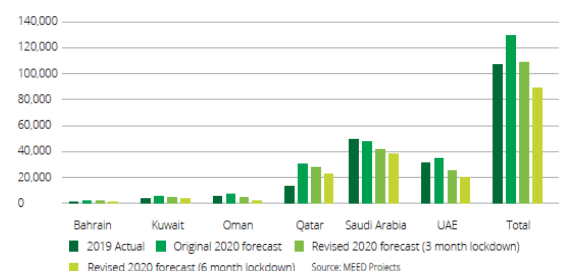


Figure 2: Forecast projects spending 2020, GCC (\$m) (Deloitte GCC Powers of Construction 2020).

The impact of Covid-19 on the construction industry in Oman. The pandemic has completely changed the global economic outlook. The main reason for delays in projects is the ongoing pandemic. With the impact on the worldwide economy, the Omani economy is affected. The research discussed global and regional economic implications with the construction industry on the spread of pandemic and economic prospects. The study found that the construction industry has been significantly affected by pandemic in Oman. In addition, the virus has caused a global shutdown, affecting global oil prices a slowdown in the construction sector due to its impact on the

scarcity of materials and resources. Pandemic has led governments to focus exclusively on the relief sector. It also led to contract delays on projects, staff cuts, most of the workforce on vacation, and another over the travel ban being closed (Al Amri and Marey-Pérez, 2020). Moreover, the pandemic forced most of them to shut down activities and reduce social mobility. But on the other hand, Omani society has benefited from the provision of aid and national initiatives. Some government policies and procedures related to the economy have changed.

(Bsisu, 2020) in a study on the impact of the pandemic on Jordanian civil engineers and the construction industry. The study aims to find what Jordanian engineers imagine about avoiding the closure crisis. And how is the future of civil engineering in the future? Civil engineering is the construction industry in Jordan that contributes significantly to the GDP. Where there are many consulting offices and construction projects. An online field study was conducted in the form of a questionnaire. Jobs for 150 different civil engineers at work, on-site, and in the office. It concluded that most civil engineers were significantly affected by the pandemic by imposing a complete shutdown and accumulating economic costs. It highlights the importance of developing an integrated plan that helps sectors ease restrictions during the closure period. Preventive health and safety must be in place on the construction site, and the implementation of an infection control policy is essential on all construction sites. The pandemic has resulted in an economic and social crisis for all population segments and other sectors. Effect of pandemic

on building construction projects: Impact and response mechanisms. The study focused on the role of the construction industry and its role in advancing the economy. The impact of pandemic on the construction industry has delayed projects. The study aims to identify and address problems affecting the construction industry, minimizing the harmful effects of pandemic on the construction industry. The results showed the effects of pandemic on the construction industry in terms of operational and financial terms. Implementing a timetable for the project is necessary due to the authorities' delay in some relevant approvals. Moreover, shortage of skilled labor, scarcity of resources and materials, and logistical problems. The government must assist companies in reducing the effects, finding future financial solutions, and facilitating governments and banks in the future (Zamani, Rahman, Fauzi and Yusof, 2021).

4.2 Identifying Risk Factors in Construction During Pandemic

The construction industry is a significant service sector that offers the fundamental services needed to develop the country's housing, transportation, health, and education systems. Its GDP contribution increased from 5.0% in 2010–2011 to 8.3% in 2017–18. With about 44 million job opportunities, it is the largest employer in India after agriculture, making up 12% of all employment. Urban areas with project cost states exceeding 100 million have the highest construction rates. It frequently experiences earthquakes, floods, cyclones, landslides, and rapidly urbanizing areas (Mohamed Elnaggar & Elhegazy, 2022).

Table 1: Some research impact of pandemic in construction projects

Main Factor	Project Completion								Supply Chain				Regulatory compliance								
Sub-Factor	LD	ROM	RL	LP	PT	IPC	SOP	SWO	SM	OC	MD	SL	HK	DET	PPEs	LW	CTM	PMTF	TCE	PTW	HS
(Choi & Staley, 2021)						✓		✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓

(Alsharef et al., 2021)				√		√	√		√			√						√			
(Rani et al., 2022)	√		√					√	√			√									
(Raj al., 2022)									√			√									
(Zamani et al., 2021)		√	√	√	√	√															
(Abdullah et al., 2021)	√	√	√					√	√	√	√	√	√	√	√	√	√	√	√	√	√
(Jallow et al., 2021)									√												
(Nguyen et al., 2021)					√	√				√											
(Umar, 2021)						√			√				√	√	√	√	√	√	√	√	√
(Aljuneidi et al., 2023)									√	√		√									
(Al Amri, 2021)										√											
(Said Ambu Saidi et al., 2021)	√	√							√	√	√										
(Ling et al., 2022)						√	√	√	√		√	√									
(Prasad et al., 2023)									√	√		√									
(Sutterby et al., 2023)									√	√	√	√									
(Waheeb et al., 2023)					√	√			√												
(Lagat et al., 2023)				√		√			√	√	√	√									

(Badawy et al., 2023)				√			√			√	√								
(Hasibuan et al., 2023)				√	√	√			√			√						√	
LD= Lock Down, ROM=Restriction of Movement ,RL= Reduced labor, LP= Late payment, PT= Project timeline, IPC= Increased project cost, SOP= Suspension of project, SOW= Stop work order, SM= Shortage of material and machineries, OC= Overhead cost, MD= Materials Deterioration, SL= Shortage of labour, HK= Hygiene kits (Face mask, hand sanitizer, soap), DET= Detection Equipment/Testing , PPEs= , LW= Limited works, CTM= Cleaning tools and materials, PMTFWA= Proper maintenance of toilet facilities with adequate supply of liquid soap and disposable towels., TCE= Training and communication with the employees on the new hazards and controls, PTW= Providing transportation for workers, HS= Health Supervisor.																			

The global outbreak of pandemic has had a significant impact on construction projects worldwide, impacting them in various ways, including projects, labour, supply chain, and safety. The following critical impacts of the pandemic on construction:

a. **Project Completion:** Project delays were one of the most immediate and widespread effects of the pandemic. Lockdowns, social distancing measures, and disruptions in the supply chain made it difficult for construction projects to proceed as planned (Alsharef et al., 2021). Several construction sites had to be temporarily closed, and even after reopening, they often faced reduced productivity due to safety measures (Rani et al., 2022). The project's impact is due to restriction of movement, reduced labour, late payment, project timeline, and increased project cost (Zamani et al., 2021). Lockdown, restrict project indent, reduced labour, suspension of the project, and stop work order to contain the virus resulted in significant project delays. Construction sites were temporarily closed, causing disruptions in project schedules (Abdullah et al., 2021).

b. **Supply chain:** Global supply chain disruptions have impacted on the availability of construction materials, causing price increases and delayed project completion (Aljuneidi et al., 2023). Material and machinery shortages increased overhead costs/cost overruns, material

deterioration, and labour shortages (Abdullah et al., 2021). As shown in the above table, most studies discuss the supply chain impact on construction.

c. **Regulatory compliance:** The pandemic has profoundly impacted health and safety practices in the construction industry. Construction sites typically require workers to be close to one another and share tools and equipment, which is why the pandemic has significantly changed how health and safety are managed on these sites. Here are some of the critical impacts:

- Personal protective equipment like masks and gloves has become more common on construction sites. Employers must supply the proper PPE and ensure employees are instructed in its proper use (Choi & Staley, 2021).
- Construction companies have had to invest in training and educational programs to ensure that their workers are aware of the risks associated with the virus and the necessary measures to mitigate those risks. These programs include training on proper hygiene practices and using personal protective equipment (PPE) (Abdullah et al., 2021).
- There has been an increasing focus on health and hygiene on construction sites. It includes regularly cleaning tools and equipment, providing handwashing stations, and ensuring

that shared spaces such as break areas are regularly sanitized (Umar, 2021).

- Papers published by (Staley, 2021) and (Abdullah et al., 2021) some of the effects on construction projects like Shifts in Project Timelines and Planning, Remote Inspections, Changes in Work Practices, and Remote Work for Administrative Roles.

4.3 The impact of pandemic on the construction in Oman

The pandemic has significantly disrupted construction projects in Oman, leading to delays and financial difficulties. Factors such as labour shortages, supply chain disruptions, and rising costs have made it challenging to complete projects on time and profitably (Umar, 2021). The GCC region has imposed curfews and travel restrictions to prevent the spread of the pandemic. A government directive to reduce the workforce by 50% may further delay projects. Border closures and movement restrictions are also significant factors. Material delivery delays are a primary cause of project delays, reported by nearly 90% of construction experts (Abushammala & Farrag, 2024).

The Oman construction industry faced financial challenges due to declining oil prices and reduced funding, worsened by the pandemic. Supply chain disruptions led to increased building material costs and container prices, causing project delays and financial strain on construction companies (Al Amri, 2021). Mishrif and Khan's 2023 paper examines Oman's logistics and supply chain networks, highlighting the economic impact of

COVID-19 on transportation services and job losses. They highlight the 22% decline in turnover for logistics and transport companies, affecting timely delivery of construction materials (Mishrif & Khan, 2023). The pandemic has heightened risks in the construction supply chain, particularly in Oman, due to material shortages and delays in customs clearance, causing project delays and increased costs (Karamoozian & Wu, 2024).

The pandemic has significantly impacted Oman's construction industry, necessitating adaptations and mandatory compliance with health protocols (Abushammala & Farrag, 2024). The government implemented work-from-home initiatives and stricter health protocols, reevaluating regulations to ensure safety. However, many contracts did not include provisions for pandemic-related disruptions, leading to disputes and claims for relief entitlements (Fayaz et al., 2022).

5. Mitigation Measure of Risks the Construction

The COVID-19 pandemic severely impacted the global construction sector, leading to project delays, supply chain disruptions, and workforce challenges. In Oman, structural vulnerabilities exacerbated these issues, emphasizing the need for effective risk mitigation strategies. This study explores global and Omani approaches to addressing pandemic-related risks in the construction sector, focusing on risk management, labor shortages, supply chain disruptions, and health-related concerns.

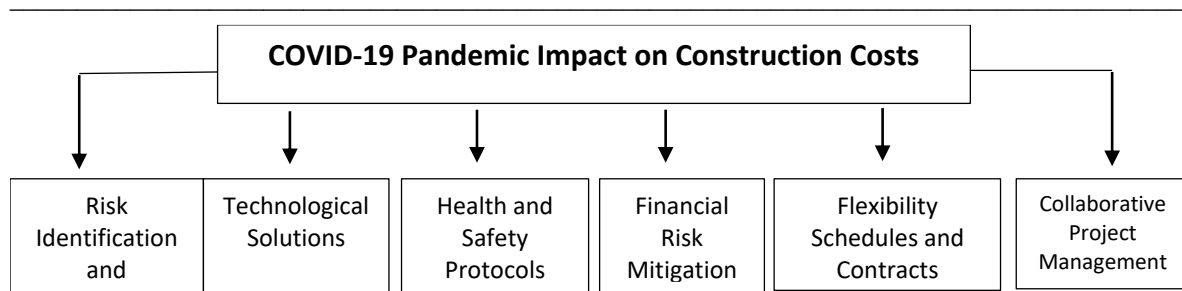
Risk Type	Mitigation Measures (Global)	Mitigation Measures (Oman)
Financial Risks	Construction companies prioritize three strategies: improved on-site raw material cost management, improved financial oversight, and efficient multi-tasking during construction operations (Norhaidin & Keng, 2023).	A committee was established to assess the pandemic's effects. The government implemented measures for liquidity improvement, the Central Bank deferred repayment of private sector loans for six months, and diversified revenue streams (Al Amri, 2021).

Risk Type	Mitigation Measures (Global)	Mitigation Measures (Oman)
Safety Risks	• Adherence to effective health and safety standards. • OSHA regulations require the use of personal protective equipment. • 3. Reporting work-related injuries during the pandemic, with employers required to comply with additional measures. (Choi & Staley, 2021)	Companies implemented remote work policies and health protocols to ensure worker safety during the pandemic, reducing on-site work and promoting adherence to safety and health protocols (Mishrif & Khan, 2023).
Operational Risks	• Utilizing project management software for scheduling, including Standard Operating Procedures (SOPs). • Development and application of technology. • 3. E-monitoring for site logistics and control. (Fatimah et al., 2023)	Shift work and worker retention have been key strategies for maintaining progress and preventing layoffs, even with reduced wages or workdays, after the pandemic (Umar, 2022).
Supply Chain	In order to mitigate material delays, businesses established contingency buying strategies and diversified their suppliers across many areas (Seneviratne et al., 2024).	Implement digital supply chain operations to reduce delays and increase efficiency, manage raw material inventory to prevent supply chain disruptions, and diversify supplier networks to avoid a single point of failure (Mishrif & Khan, 2023).

6. Mitigation measures to reduce the negative impacts

The COVID-19 pandemic has significantly impacted the public construction sector in Oman, resulting in delays, increased costs, and operational disruptions due to labour shortages, supply chain issues, and changing regulatory requirements (Mishrif & Khan, 2023). This article proposes a comprehensive framework to mitigate these adverse effects, incorporating advanced project management practices, supply chain resilience initiatives, and strict compliance mechanisms (Raoufi & Fayek, 2021). The framework should also emphasize public health

measures, economic support, and organisational resilience. This multifaceted approach underscores the urgent need for effective strategies to manage disruptions and safeguard ongoing and upcoming projects. By developing a structured framework, construction professionals can better navigate future crises with increased effectiveness (Umar, 2022). The proposed conceptual framework addresses the impact of COVID-19 on construction costs, focusing on project completion, supply chain disruptions, and regulatory compliance (Abdullah et al., 2021). It proposes a comprehensive framework with six key elements to mitigate these impacts effectively.



7. Conclusion

This study critically analyses the pandemic's effect on construction projects in Oman, focusing on interruptions that included cost overruns, supply problems, labour instability, and project suspensions. The study employed a mixed-methods approach to research, identifying the primary risk areas and developing a framework to effectively mitigate these risks, supported by both quantitative and expert information. Societies and economies around the world are affected for a long time when a pandemic occurs on Earth. While the current pandemic is ongoing, many previous studies have examined the effects of past pandemics and speculated about what would happen if another pandemic were to occur. The global lockdown caused by the pandemic has affected everyone, either directly or indirectly. It is crucial to take action to reduce the impact of crises on businesses and individuals while the crisis continues. If the industry is allowed to continue operating, delays in construction projects can be reduced. Some GCC countries currently allow construction companies to operate with fewer employees. The best way for construction managers to manage their workers and their

progress is to work in shifts, although limiting headcount will slow progress. A construction company must carefully manage such situations, keeping social factors in mind, especially if it is already working in shifts and the government has ordered staff cuts.

The suggested framework for mitigation comprises three main pillars: identifying key risks, implementing adaptive approaches (e.g., digital solutions, flexible contracts, and worker support solutions), and proposing long-term policy solutions. These lessons offer a valuable perspective on advice for construction companies and policymakers on how to enhance resilience against future disruptions. Although the study is confined to Muscat and represents a specific moment in the pandemic, the integrative approach adopted in it, along with context-specific findings, provides a strong basis for future research and policy processes. Extending the framework to a broader range of regions and crises would also enhance its validity. In short, the pandemic revealed structural weaknesses in the Omani construction industry yet presented an opportunity for change. The study provides an evidence-based practical roadmap toward the development of a stronger adaptive industry.

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