Factors affecting the management of Riyadh's construction sector in the light of COVID-19

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ABSTRACT

Riyadh, the capital of Saudi Arabia, is significantly influenced by the COVID-19 pandemic. While countries have begun to ease restrictions and lockdowns, factors influencing the construction sector should be examined in light of COVID-19. Therefore, the purpose of this study is to identify and evaluate the factors that impact Riyadh's construction sector in the context of the COVID-19 outbreak. A systematic review of previous publications was conducted to develop a questionnaire to achieve the research goal, 67 valid copies of the questionnaire were received. The data were analyzed using reliability analysis and RII. Results factors were classified into four main groups (Managerial factors - Economic factors - Social and Cultural factors - Environmental Factors). The top factors affecting Riyadh's construction sector were Abandonment of talent and expertise by business owners during the pandemic period (Managerial group); Conflict in bidding prices by contractors due to the lack of projects offered due to the pandemic (Economic group); Customs, traditions and social relations in the areas in which the projects are implemented (Social and Cultural group); and The process of requesting raw materials, whether local or imported from abroad and its effects (Environmental group).

1. Introduction

The construction sector acts as a backbone of the economic growth of any country, it has an impact on every sector's role at all levels of the economy [1, 2]. It's significant since it represents the country's residents' prosperity, health, and quality of life [3, 4]. The construction sector not only aids countries develop socially and economically, but it is also a major global industry that employs millions of people and contributes to national and global economies [5]. Activity in the construction sector can significantly affect poverty reduction and income generation [6]. Due to its labor-intensive nature and connections with numerous other economic sectors, it has a significant potential to generate employment [7]. In the last fifty years, Riyadh, Saudi Arabia's capital, has developed from a modest city of half a million people to a city of more than seven million people. Riyadh currently contributes around 29% of the kingdom's GDP [8]. Saudi Arabia, as the world's largest oil exporter, is constantly on the rise, and the construction sector in particular has seen substantial growth [9]. Among the Gulf Cooperation Council (GCC) nations, Saudi Arabia has the largest and fastest-growing construction sector [10]. Saudi Arabia is pursuing a renaissance in infrastructure development, driven by the oil boom, its construction market is one of the most active in the world [11].

The globe has seen an unprecedented crisis as a result of the COVID-19 epidemic, which has impacted Saudi Arabia's economy and considerably increased uncertainties around its economic outlook (Figure 1, a, b, c) [12]. The COVID-19 outbreak has had a significant influence on the construction industry, which has been faced with enhancing worker safety and well-being [13]. Schools and institutions, for example, have successfully transitioned from traditional to digital environments. However, in other areas, such as construction, virtual jobs cannot be substituted for actual jobs [14, 15]. It is critical to have a good safety policy, especially because of the rapid expansion of the (COVID-19) epidemic, to limit infections in construction projects, not just for the construction team, but also for project workers and linked businesses [16]. To minimize the spread of infection and overloading of the healthcare system, more people are taking care of the illness. Countries have taken drastic steps, such as imposing full or partial quarantine [17] and suspending transportation [18]. Saudi Arabia, like the rest of the world, is grappling with the challenges posed by the post-COVID-19 situation, which has defined a new status quo for our economy and culture. There is no doubt, that the success of construction industry projects is greatly dependent on how well and efficiently they are managed in order to get the best results for the country's progress [19].
The COVID-19 dilemma has resulted in lower site productivity, higher compliance costs, project delays, and raised the risk of infection for construction workers [20].

During the COVID-19 epidemic, the new rules and procedures were generally strict for everyone [21]. Based on the categorization of exposure risk, specific suggestions were made to construction industry professionals and workers [22]. The workplace, supply chain, buying, legal, and contractual aspects all have entirely new processes in place. To put it another way, strict statutory law has been established by governments around the world to reflect this new norm for workplace conduct [23].

Therefore, when the governments decided to ease their restrictions and lockdowns, it is important to consider the factors that influence the construction industry in light of COVID-19 (Figure 1(d)). This is critical since construction companies must reopen and operate in the face of a virus that has presented a serious threat to the sector and the economy. For that, the purpose of this study is to identify and evaluate the significant factors that affect Riyadh’s construction sector in light of the COVID pandemic.

2. Literature review

Infections with COVID-19 have spread swiftly throughout the world. Governments took enormous measures over the first several months to stop the virus' spread and stop the collapse of the health system [7]. Since 2020, COVID-19 has changed the world and forced social, cultural, and economic systems to modify their organizational frameworks and operational procedures [24]. Additionally, outbreaks of the coronavirus (COVID-19) have seriously disrupted the economy, had a catastrophic impact on international trade, and concurrently harmed households, enterprises, financial institutions, industrial facilities, and infrastructure firms [25]. Because the coronavirus is an infectious disease, construction work has temporarily been halted to prevent its spread while also taking into account the worries of the workers in the sector [25]. Given that the construction sector is a major source of revenue for any country's economy, countries needed to pay attention to it, especially in the face of crises, one of which is the (COVID-19) pandemic, which has changed the way the world looks at the economy, particularly in the Middle East [16]. The major industry, construction, has a significant direct and indirect economic impact [26]. This industry's independence makes it essential to the expansion of several jobs, which otherwise wouldn't be supported if the construction process stopped working. In Australia and the UK, construction accounts for around 7% of the GDP [27]. However, developing-country construction markets are thought to be more susceptible to the pandemic's issues.

The construction industry, like many others, is unable to avoid the negative consequences of widespread COVID-19. The COVID-19 pandemic has had a spread of effects thereon. Therefore, It was stressed that connected organizations' readiness for handling newly generated issues at various levels of the building professions should be increased [24]. The challenges that the global construction sector will face include a lack of site labor, factory closures, low worker morale, low productivity, material shortages, failure to hand over projects on time, plant and material shortages, border closures, delays or difficulties obtaining necessary permits, and changes in the work culture on job sites [20]. The pandemic had a negative impact on the construction industry since it reduced the number of employees in the country, which hampered construction projects that required them and resulted in a financial slump. Since a lot of construction workers have tested positive for the coronavirus since the epidemic, the labor shortage in the sector has gotten worse [28]. Due to a disturbing supply chain and staff shortages caused by quarantines, many projects have already been suspended or postponed [29].

Academics have been attempting to evaluate the impact of the COVID-19 outbreak on the construction sector. Pamidimukkala and
Kermanshachi [13] identified seventeen challenges that were divided into five categories: organizational, economic, psychological, individual, and moderating. There were also eleven strategies discovered that effectively dealt with the challenges, which were divided into three categories: personnel protection, project performance protection, and project continuity protection. Pamidimukkala and Kermanshachi [13] revealed that the most important strategies for overcoming previous challenges are redefining workplace safety through signboards, making sure a safe distance between the workforce, providing sanitizers and washing facilities in the field, and employing effective technologies for increasing project productivity while maintaining workers safe.

Assaad and El-adaway [23] analyze expert views published at numerous highly regarded resources to investigate the consequences of the pandemic on the US construction sector (e.g., Engineering News-Record). Workforce-related (e.g., layoffs), project/workplace-related (e.g., site closures), procurement/supply chain-related (e.g., delayed delivery), and contractual/insurance-related (e.g., delayed supply) were the four categories they divided the consequences into (e.g., suspension or termination of projects).

Olanrewaju, AbdulAziz, Preece and Shobowale [20] examined the strategies used by construction companies to keep COVID-19 from spreading on job sites during and after the lockdown, they highlighted isolating sick workers, conducting daily checks for COVID-19 symptoms, prohibiting hugging/handshakes on the job site, posting health advisory signs and infographics, and supplying face masks to workers as critical steps to make workplaces "COVID-safe".

Alsharefa, Banerjee, Udinn, Albert and Jaselski [30] interviewed 34 subject matter experts (SMEs) from 17 states across the US. The SMEs represented a wide diversity of construction types, company sizes, and employment responsibilities. the research finding confirmed that the pandemic resulted in significant delays in construction, material procurement, and other sectors.

According to Rani, Farouk, Anandh, Almutairi and Rahman [21], Labor shortages, supply-chain disruptions, decreased construction productivity, an increase in project financing rejection rates, and a decline in foreign investment in the sector are just a few of the overall critical pandemic effects. Gildersleeve, Cantrell, Daken, Durham, Mullens, Batorowicz and Johnson [31] views the COVID-19 pandemic experience as traumatic since so many people's sense of normalcy was disturbed by its quick and unexpected arrival. According to Hou and Chen [32], the pandemic had a substantial impact on the US steel sector, causing a slew of supply chain issues in the construction industry. El NGO Gar and El hegazy [33] studied the financial impact of the continuing COVID-19 epidemic on construction projects, taking into consideration crucial components such manpower, equipment and machinery, and material, as well as their negative effect on overall construction costs. Labor rates for skilled workers are predicted to grow by 20%–25%, while labor rates for semi-skilled and unskilled workers are expected to climb by 10%–15%, according to the study. According to Al-Mdawi, Brito, Abdul Nabi, El-Adaway and Omnggo [34], the epidemic had a significant impact on safety management procedures, contract language interpretation, building materials costs, risk management practices, construction materials, construction workers, and construction subcontractors. Umar [3] used semi-structured interviews with construction industry specialists to assess the impact of COVID-19 on the GCC construction industry and give recommendations for how to keep construction going. He discovered that the COVID-19 impact mostly caused delays in construction projects, effective worker management, health and safety concerns, and legal challenges. The main factors that could cause delays in construction projects across the GCC region include border tightening, a reduction in the number of workers on construction sites, and disruptions in supply chain management [5]. Table 1 shows 43 critical factors affecting Riyadh's construction sector based on a comprehensive analysis of relevant published literature and expert interviews.

3. Research methods

The authors used a multistep research methodology that included (1) a detailed literature review of previous studies to extract an initial list of factors that may affect the construction sector in light of the COVID epidemic from previous studies; (2) face validity with ten experts on the draft questionnaire was conducted, validity process includes modifying, removing and adding factors for the final questionnaire; (3) distributing and gathering questionnaire data from industry professionals to assess the significance and impact of each identified factor; (4) Cronbach's alpha check to verify the survey's reliability; (5) RII to evaluate and prioritize the identified factors. There are two major sections of the survey questions. The first section for respondent's demographic information, while the second section contains forty-three critical factors arranged into four categories (Managerial factors - Economic factors - Social and Cultural factors - Environmental Factors). In this study, the respondents' opinions are gathered through a web-based questionnaire.

3.1. Population of the study

All respondents who will match the specific requirement provided for study analysis are referred to as the population. The participants in the study included project managers, office engineers, site engineers, and contractors that worked in the construction industry. According to statistics from the General Contractors Federation in Riyadh, the number of contractors classified by degree (from first to fourth degree) in the city of Riyadh reached 229 in 2021.

3.2. Sampling technique and sample size determination

A random sample technique was employed to ensure the population's representativeness, which served to ensure the analysis' reliability. The sample size of the responders was calculated using equation no. (1) with a 95% confidence level [35, 36].

$$n = \frac{n'}{1 + (n'/N)}$$

Where: $n$ = total number of population; $N$ = sample size from a finite population $n'$ = sample size from an infinite population, $n' = S2/V2$

$S2 = \text{variance of the elements in the population, and V = standard error of the sampling population.}$ (Usually, $S = 0.5$, and $V = 0.05$) Hence, $n' = S2/V2 = (0.5)/0.05^2 = 100$ From Eq. (1), for $N = 229$; hence, $n = 100/[1 + (100/229)] = 69.6$ say 70 respondents.

It was calculated that sending the questionnaires to 70 responders would reach a 95% confidence level.

3.3. Face validity

Checking the questionnaire's face validity basically means ensuring that it is suitable for measuring what it claimed to be useful for measuring [37]. Ten experts were asked to revise the draft questionnaire and recommend any required revisions to check the face validity of the questionnaire utilized in this study.

3.4. Reliability test measure

According to Mathewos [38], any study that relies on measurement must be concerned with reliability. The term "reliability" relates to the idea that data collection and processing procedures produce consistent findings. Others can make similar findings and reach similar conclusions using the same basic data. To put it another way, it's a quality that makes
### Table 1. Critical factors affecting Riyadh's construction sector.

| Groups                  | Factor                                                                                                    | References                  |
|-------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------|
| **Managerial Factors**  | Ranking of projects in terms of priority in implementation based on importance, large project size, and the need for implementation. | [58, 59]                    |
|                         | Developing plans to simulate the consequences of project implementation in light of the pandemic through risk simulation programs and measure the risks involved in the implementation. | [66, 61]                    |
|                         | Abandonment of talent and expertise by business owners during the pandemic period.                          | [62]                        |
|                         | At the project level, changing the cost, risk and implementation management mechanism for daily management and forming an emergency team to avoid sudden emergency risks. | [61, 63, 64]                |
|                         | Forming small teams and groups in project management to avoid pressure on the general manager of the company or institution. | [66, 65]                    |
|                         | Study alternatives for implementation in municipalities, institutions and companies to reduce harm, such as reducing material import operations and reliance on available local materials. | [65, 66]                    |
|                         | The participation of all parties in the institution in making the decision to gain knowledge and experience from everyone and benefit from experiences to reduce risk and facilitate implementation. | [65]                        |
|                         | Using a webserver (server) to collect information with a unified entry system for all workers within the company or institution to avoid mixing as much as possible. | [67, 68, 69]                |
|                         | Activating the Crisis Management Department permanently and continuously within the institution or company to develop immediate solutions to manage the emergency crisis and make a reference for it. | [61]                        |
|                         | Selecting the administrative and technical staff from the same area to avoid movement and encouraging them to continue the construction work and the importance of its continuation. | [65]                        |
|                         | Reviewing the financial flow and budget periodically and continuously for the organization or company in general and the project in particular during the pandemic period. | [65]                        |
|                         | Submitting the schedule with identifying the critical path (events affected by the pandemic)                 | [63]                        |
|                         | Adherence to health prevention measures such as lack of rapprochement, wearing a mask, avoiding touching, maintaining work, and training workers on the site to avoid infection. | [63, 65]                    |
|                         | Accreditation in the communication processes and meetings between the parties concerned with remote communication technologies, such as the Zoom program or the video conference. | [62]                        |
|                         | Distribution of work in the implementation of the project in a way that reduces mixing and the adoption of the process of delivering reports to the higher authorities through Internet correspondence. | [65]                        |
|                         | Putting in place a medical specialist and a safety and security engineer to enhance prevention methods and follow up any work injuries or contacts and take samples continuously for individuals. | [76, 71, 72]                |
| **Economic Factors**    | Low wages of workers in the construction sector, including engineers, workers, technicians and project managers, due to the lack of projects implemented during the pandemic period. | [73]                        |
|                         | Conflict in bidding prices by contractors due to the lack of projects offered due to the pandemic.          | [74, 75]                    |
|                         | Activating the item raising the risk ratio in the bidding pricing clause.                                   | Expert interviews           |
|                         | Stopping production lines in countries from which construction materials are imported, and stopping sea and land transport lines. | [78]                        |
|                         | Instability in raw material costs during the pandemic period.                                             | [76, 77, 78, 79, 80]       |
|                         | Increasing unemployment and exploitation in the wages of workers in the construction sector by some company owners during the pandemic period. | [77]                        |
|                         | Take advantage of the down payment in the project's workflow during the pandemic period.                   | [78]                        |
|                         | The possibility of re-directing the project budget to other projects related to the (covid-19) pandemic.    | Expert interviews           |
|                         | The complete closure of the red zones declared by the government and where there are existing projects.     | Expert interviews           |
|                         | Reducing working hours on projects during the pandemic period.                                            | [79, 81]                    |
|                         | Weak purchasing power and economic stagnation of the sector due to the partial and total closure of the classified areas. | [65]                        |
|                         | Optimizing the equipment and mechanisms used in implementing projects during the pandemic period.          | Expert interviews           |
|                         | Slow productivity due to social distancing and limited mobility among workers.                             | [82, 83]                    |
|                         | Postponement of payments, salaries and tax exemptions during the pandemic period.                           | [74]                        |
|                         | Costs of prevention measures and tools conditional on project workflow.                                     | [76, 78, 79]                |
|                         | Severe labor shortage.                                                                                    | Expert interviews           |
|                         | The difficulty of recruiting workers to close borders between countries.                                    | Expert interviews           |
| **Social and Cultural Factors** | The social and cultural relations of the manager in maintaining the progress of projects in light of the crisis and supporting and motivating the project executing team. | [82, 83]                    |
|                         | Customs, traditions and social relations in the areas in which the projects are implemented.                | Expert interviews           |
|                         | Educational background and people's commitment to prevention methods, income level and it well-being in the areas where the projects are being undertaken. | [82]                        |
|                         | The congestion of the place of implementation of projects with population, movement and economic activity.  | [84]                        |

(continued on next page)
it possible to duplicate data collection approaches and have similar findings.

Cronbach's Alpha (α) is a scale that was created to measure internal consistency. It should always be in the range between 0 and 1. This method of measurement was created utilizing a framework in which participants were asked a series of questions in order to evaluate a certain definition. Internal consistency refers to the extent to which all inquiries contribute favorably to assessing the same notion or structure and, as a result, are linked to the objects’ interconnection. As a result, Cronbach's Alpha (α) is defined as the fraction of test variation owing to a set of factors used to compute the alpha reliability coefficient [39, 40], as shown in equation no. (2)

$$\alpha = \frac{I - 1}{I - 1 - \frac{\sum_{i=1}^{n} \sigma_i^2}{\sigma_X^2}} \quad (2)$$

Where: I = Number of Items; σ2 = variant items; Σσ2 = total score variant.

Cronbach's Alpha with a high value indicates the build's internal accuracy σX2. The higher the coefficient, the more linear the relationship between the factors is, and the better the internal consistency [38].

The following are some general guidelines from [39]: >0.9 (Excellent), >0.8 (Good), >0.7 (Acceptable), >0.6 (Questionable), >0.5 (Poor), and ≤0.5 (Unacceptable). Although the number of elements on the scale has a role in increasing Alpha's value, it should be noted that this has diminishing returns [40].

Cronbach’s alpha-coefficient is the most commonly used objective metric of reliability. The internal accuracy of the data reliability scale received from the questionnaire was tested with this coefficient before any further analysis in this study. Reliability analysis shows that the findings are consistent.

### 3.5. Relative importance index - RII

The Relative Importance of factors influencing the management of construction sector projects was used to rank the various factors. The approach was applied to the groups of respondents in this study. The relative importance index is calculated and the relative rank for each factor is determined using a five-point scale of 1, 2, 3, 4, and 5. Table 2 shows the scale, as well as the ordinal, adjectival, and descriptive ratings.

The RII is used to evaluate the survey results. It’s calculated by examining the rating and practicality of each factor measurement using equation no. (3) that considers a number of variables [41, 42].

$$RII = \frac{5(n_5 + 4n_4 + 3n_3 + 2n_2 + n_1)}{5^5(n_5 + n_4 + n_3 + n_2 + n_1)} \quad (3)$$

Where: RII = Relative Importance Index.

- $n_1, n_2, n_3, n_4, n_5$ = Number of indicators of answer.

The RII value ranges from 0 to 1.0 when calculated using the RII equation. The 0.2 numbers represent the weakest, while the 1.0 values represent the strongest. Data from surveys and desk research is processed, appraised, and interpreted qualitatively.

### 4. Results and discussion

#### 4.1. Analysis results

**4.1.1. Statistical data of questionnaires distributed and collected**

The final number of questionnaires that will be analyzed is 67, and all of them are valid for statistical analysis. A questionnaire was created and submitted electronically via a specific link, and it was sent to two target groups via email, messenger, WhatsApp, and other forms of communication. 67 respondents responded to the questionnaire and resent it, and it was downloaded, organized, and encoded to be subject to statistical analysis.

**4.1.2. General information about the respondents**

Information on the respondents in this research is shown in Table 3 as general information about them.

**4.1.3. Factors affecting the management of construction sector projects in the light of COVID-19**

Respondents were asked to rank the factors influencing the management of construction sector projects in light of COVID-19 on a Likert scale of 1–5. This section presents the results of 43 factors that affect project management in the construction sector in light of COVID-19.

Figure 2 summarize the top factor affecting Riyadh's construction sector were Abandonment of talent and expertise by business owners during the pandemic period (Managerial group); Conflict in bidding prices by contractors due to the lack of projects offered due to the pandemic (Economic group); Customs, traditions and social relations in the areas in which the projects are implemented (Social and Cultural group); and The process of requesting raw materials, whether local or imported from abroad and its effects (Environmental group).

**4.2. Group one: managerial factors**

Table 4 and Figure 3 describe the relative importance index (RII) and ranking of managerial factors. The respondents ranked the abandonment of talent and expertise by business owners during the pandemic period first position with RII = 0.902.

Study alternatives for implementation in municipalities, institutions, and companies to reduce harm, such as reducing material import operations and reliance on available local materials was ranked the second position with RII = 0.794 by respondents.

**4.3. Group two: economic factors**

Table 4 and Figure 3 summarize the relative importance index (RII) and ranking of economic factors. The respondents ranked conflict in

### Table 2. A rating scale for factors affecting the management of construction sector projects in the light of COVID-19.

| Ordinal number | 1 | 2 | 3 | 4 | 5 |
|----------------|---|---|---|---|---|
| Degree of effect | Very low | Low | Moderate | High | Very high |

### Table 1 (continued)

| Groups | Factor | References |
|--------|--------|------------|
| Environmental Factors | The knowledge and experience of the leader and the team about environmental methods that mitigate the expected risks of the (covid-19) pandemic | [66] |
| Compliance with environmental laws by citizens and staff to reduce infection | [76, 86, 85] |
| The process of requesting raw materials, whether local or imported from abroad, and its effects | [65, 83, 86, 87] |
| Examine the resources imported from abroad before accreditation | [65, 82] |
| The degree of tolerance of the pandemic risk by the institution or company | [61, 76, 80] |
| Availability of databases on the environment within the institution or company to facilitate the prevention mechanism and the project implementation process | |

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bidding prices by contractors due to the lack of projects offered due to the pandemic in the first position with RII = 0.910.

The difficulty of recruiting workers to close country boundaries was ranked the second position with RII = 0.872 by respondents.

### 4.4. Group three: social and cultural factors

Table 4 and Figure 3,4 summarize the relative importance index (RII) and ranking of social and cultural factors. The respondents ranked customs, traditions, and social relations in the areas in which the projects are implemented in the first position with RII = 0.594.

The social and cultural relations of the manager in maintaining the progress of projects in light of the crisis and supporting and motivating the project executing team was ranked the second position with RII = 0.564 by respondents.

#### 4.5. Group four: environmental factors

Table 4 and Figure 3,4 summarize the relative importance index (RII) and ranking of environmental factors. The respondents ranked the process of requesting raw materials, whether local or imported from abroad, and its effects in the first position with RII = 0.588.

Examine the resources imported from abroad before accreditation was ranked the second position with RII = 0.570 by respondents.

### 4.6. Analysis discussion

#### 4.6.1. Group one: managerial factors

COVID-19 outbreak has resulted in significant talent management challenges, including hiring freezes and layoffs; wage freezes canceled bonuses, and pay reductions; and increased employee stress and burnout [43]. Aside from that, many employees who have been fortunate enough to keep their jobs are suffering wage freezes, canceled bonuses, and compensation cutbacks. Employers have enforced salary reductions of 29%, salary freezes of 42%, and bonus reductions of 37% [44]. Pay decreases were reported by 67% of CEOs, 56% of middle managers, and 49% of professionals and supervisors around the world and in all industries [44]. Abandonment of talent and expertise during the pandemic period is a critical challenge and has a significant impact on the performance of the construction sector in general and during the crises especially, their absence will magnify the loss of management experiences and problem-solving skills. Therefore, the managerial level should take into account preserving these experts and developing their talents as future planning for effectively managing any coming crisis.

The COVID-19 pandemic’s restrictions increased the possibilities of supply chain disruption, posing additional problems for businesses [45]. Therefore, material importation has become more difficult during a pandemic; as a result, it is important to examine potential alternatives in order to keep construction projects moving forward. In general, material shortages and delays are considered one of the primary reasons for construction project delays all around the world [46]. According to Lopes, Gomes and Mane [45], there is a pressing need to formalize the supply chain, diversify the supply of services and products for companies that rely on the outside, implement metrics that allow for early detection of supply chain disruptions, effectively manage stocks, and promote proactive crisis resolution strategies.

#### 4.6.2. Group two: economic factors

During the COVID-19 epidemic, the construction bidding market was severely hit; Projects in the design and bidding phases were significantly impacted as projects started being delayed, placed on hold, or canceled. This happened even while construction projects that were already under way continued to move forward with improved safety standards on job sites; which drastically reduced the number of offers available in the market. This has generated conflict in bidding prices by contractors due to the lack of projects offered during the pandemic. Hanák, Drozdová and Marović [47] declare that it is essential for a contractor's market survival to be able to make a competitive proposal for a construction tender. It can be difficult for contractors to ensure their competitiveness in a tender because the construction sector is primarily known as a competitive business climate driven by the low-cost approach [48]. A highly competitive environment may force contractors to lower their bid price significantly [47]. Contractors mostly use cost-oriented pricing; however,
risk pricing should be adjusted, especially if a tender is evaluated by using multiple criteria, especially in such a pandemic era.

The construction industry has traditionally struggled with a labor shortage, but the pandemic has made the problem even worse. According to reports, a significant proportion of construction workers have tested positive for the coronavirus [28]. Furthermore, governates in their fighting the COVID outbreak have closed borders to prevent the disease from spreading. Umar [5] revealed that the tightening of the borders will have an impact on the number of workers on construction sites as well as supply chain management throughout the GCC region.

Because the spread of COVID-19 is mostly linked to individual interaction, the fact that construction workers have been coming into contact with one another is one of the primary contributors to the delays in restarting projects. The amount of personnel who are permitted to work in an area, the manner in which staff members carry out their duties, and the manner in which project managers envision the working environment have all been impacted by laws designed to reduce the transmission of the virus by physical distance [14].

4.6.3. Group three: social and cultural factors
Past viral public health outbreaks, like the 2014 Ebola epidemic, have highlighted the importance of people's customs and traditions in preparing for and responding to community transmission, particularly when health systems are overburdened [49, 50]. Beyond the direct effects of COVID-19 on health, jobs, and wages, the epidemic is making people more anxious and worried, which is impacting their social relationships, their trust in other people and in institutions, their sense of personal safety and belonging, and their sense of community [51]. The global existence of COVID-19 and its social transmission pathways necessitates social and community solutions; At the community level, community engagement helps to maximize the success of COVID-19 readiness, response, and recovery programs, preventing and controlling transmission [52]. Gilmore, Ndejjo, Tchetchia, de Claro, Mago, Diallo, Lopes and Bhattacharyya [53] claimed that identifying how community engagement approaches have been used in past epidemics may support more robust implementation within the COVID-19 response. This provides evidence that the customs, traditions, and social relations in the epidemic areas can play important and active roles in the prevention and control during the implementation of projects.

Companies were forced to act for guaranteeing the protection and well-being of their employees due to the pandemic's ambiguity and side effects. COVID-19 has resulted in more workers suffering from job burnout, a recurrent stress condition characterized by persistent feelings of exhaustion and a lack of ambition to succeed in their profession, as a result of these stresses [54]. Furthermore, continual exposure to COVID-19 breaking news instills worry and makes it easy to focus on the virus's traumatic symptoms and potential consequences [13]. As a result, construction managers and authorities should be aware of the pandemic's issues and develop effective measures to encourage and motivate their workers.

Because of the new circumstances, it is necessary to reevaluate previous ways of working and acquire new skills in order to improve one's ability to handle the situation, to ensure the health and safety of employees, and to keep the performance metrics that have been agreed upon [55]. Some of the most important concerns that senior managers need to address include providing employees with the support necessary to disconnect from their work environment and ensuring that they have reasonable working time arrangements. Keeping workers motivated, assisting them in navigating different working modalities, ensuring that teams continue to work well together, and maintaining good collaboration are also important concerns.

4.6.4. Group four: environmental factors
The coronavirus pandemic (COVID-19) has impacted negatively the worldwide manufacturing and supply chain system [56]. A comprehensive lockdown was imposed in most of the world's major economies.

The COVID-19 epidemic has disrupted most transportation and distribution links between suppliers, production facilities, and customers [56]. Importers and exporters also have found it difficult to ship or transport resources and materials throughout many international borders, as restrictions and the slowdown of major trading partners' industrial operations have hampered seaports, which are the primary route for international trade.

Infections that are contracted on the job have the potential to spread to other workers, as well as to the workers' families and other social contacts. Occupational infections can be controlled in the same ways that other illnesses can be controlled: by regulating the source of the infection and its channel of transmission, and by safeguarding individuals who are susceptible to the infection. If sufficient precautions are taken, it is possible to avoid contracting the vast majority of Occupational infections [57]. A long incubation time and a high transmission rate characterize the COVID pandemic. As a result, imported materials should be thoroughly checked to reduce the danger of infection to construction workers. Moreover, Olanrewaju, Olanrewaju, AbdulAziz, Preece and Shobowale [20] stressed the importance of providing face masks and safety equipment to workers in order to keep the workplace "Covid-safe."
### Table 4. Summary of relative importance index and ranking for factors affecting the management of construction sector projects.

| Groups                        | Factor                                                                 | RII     | Rank |
|-------------------------------|------------------------------------------------------------------------|---------|------|
| **Managerial Factors**        | Ranking of projects in terms of priority in implementation based on importance, large project size, and the need for implementation | 0.654   | 10   |
|                               | Developing plans to simulate the consequences of project implementation in light of the pandemic through risk simulation programs and measure the risks involved in the implementation | 0.786   | 5    |
|                               | Abandonment of talent and expertise by business owners during the pandemic period | 0.902   | 1    |
|                               | At the project level, changing the cost, risk and implementation management mechanism for daily management and forming an emergency team to avoid sudden emergency risks | 0.720   | 5    |
|                               | Forming small teams and groups in project management to avoid pressure on the general manager of the company or institution | 0.686   | 8    |
|                               | Study alternatives for implementation in municipalities, institutions and companies to reduce harm, such as reducing material import operations and reliance on available local materials | 0.794   | 2    |
|                               | The participation of all parties in the institution in making the decision to gain knowledge and experience from everyone and benefit from experiences to reduce risk and facilitate implementation | 0.690   | 7    |
|                               | Using a webserver (server) to collect information with a unified entry system for all workers within the company or institution to avoid mixing as much as possible | 0.520   | 15   |
|                               | Activating the Crisis Management Department permanently and continuously within the institution or company to develop immediate solutions to manage the emergency crisis and make a reference for it | 0.519   | 16   |
|                               | Selecting the administrative and technical staff from the same area to avoid movement and encouraging them to continue the construction work and the importance of its continuation | 0.626   | 11   |
|                               | Reviewing the financial flow and budget periodically and continuously for the organization or company in general and the project in particular during the pandemic period | 0.586   | 13   |
|                               | Submitting the schedule with identifying the critical path (events affected by the pandemic) | 0.614   | 12   |
|                               | Adherence to health prevention measures such as lack of rapprochement, it wearing a mask, avoiding touching, maintaining work, and training workers on the site to avoid infection | 0.704   | 6    |
|                               | Accreditation in the communication processes and meetings between the parties concerned with remote communication technologies, such as the Zoom program or the video conference | 0.552   | 14   |
|                               | Distribution of work in the implementation of the project in a way that reduces mixing and the adoption of the process of delivering reports to the higher authorities through Internet correspondence | 0.684   | 9    |
|                               | Putting in place a medical specialist and a safety and security engineer to enhance prevention methods and follow up any work injuries or contacts and take samples continuously for individuals | 0.738   | 4    |
| **Economic Factors**         | Low wages of workers in the construction sector, including engineers, workers, technicians and project managers, due to the lack of projects implemented during the pandemic period. | 0.808   | 3    |
|                               | Conflict in bidding prices by contractors due to the lack of projects offered due to the pandemic | 0.910   | 1    |
|                               | Activating the item raising the risk ratio in the bidding pricing clause | 0.594   | 14   |
|                               | Stopping production lines in countries from which construction materials are imported, and stopping sea and land transport lines | 0.774   | 5    |
|                               | Instability in raw material costs during the pandemic period | 0.728   | 8    |
|                               | Increasing unemployment and exploitation in the wages of workers in the construction sector by some company owners during the pandemic period | 0.574   | 15   |
|                               | Taking advantage of the down payment in the project's workflow during the pandemic period | 0.626   | 13   |
|                               | The possibility of re-directing the project budget to other projects related to the (covid-19) pandemic | 0.538   | 17   |
|                               | The complete closure of the red zones declared by the government and where there are existing projects | 0.720   | 9    |
|                               | Reducing working hours on projects during the pandemic period | 0.770   | 6    |
|                               | Weak purchasing power and economic stagnation of the sector due to the partial and total closure of the classified areas | 0.750   | 7    |
|                               | Optimizing the equipment and mechanisms used in implementing projects during the pandemic period | 0.686   | 11   |
|                               | Slow productivity due to social distancing and limited mobility among workers | 0.666   | 12   |
|                               | Postponement of payments, salaries and tax exemptions during the pandemic period | 0.802   | 4    |
|                               | Costs of prevention measures and tools conditional on project workflow | 0.562   | 16   |
|                               | Severe labor shortage | 0.702   | 10   |
|                               | The difficulty of recruiting workers to close borders between countries | 0.872   | 2    |
| **Social and Cultural Factors** | The social and cultural relations of the manager in maintaining the progress of projects in light of the crisis and supporting and motivating the project executing team | 0.564   | 2    |
|                               | Customs, traditions and social relations in the areas in which the projects are implemented | 0.594   | 1    |
|                               | Educational background and people's commitment to prevention methods, income level and well-being in the areas where the projects are being undertaken | 0.526   | 3    |
|                               | The congestion of the place of implementation of projects with population, movement and economic activity | 0.468   | 4    |
| **Environmental Factors**    | The knowledge and experience of the leader and the team about environmental methods that mitigate the expected risks of the (covid-19) pandemic | 0.546   | 3    |
|                               | Compliance with environmental laws by citizens and staff to reduce infection | 0.532   | 4    |
|                               | The process of requesting raw materials, whether local or imported from abroad, and its effects | 0.588   | 1    |
|                               | Examine the resources imported from abroad before accreditation | 0.570   | 2    |
|                               | The degree of tolerance of the pandemic risk by the institution or company | 0.498   | 4    |
|                               | Availability of databases on the environment within the institution or company to facilitate the prevention mechanism and the project implementation process | 0.444   | 5    |
Figure 3. Relative importance index for factors affecting the management of construction sector projects.
5. Conclusion and recommendation

The world has witnessed an unparalleled calamity as a result of the COVID-19 epidemic, which has hurt Saudi Arabia’s global economy and created serious worries about its future prospects. The construction industry, like so many others, is unable to avoid the negative consequences of widespread COVID-19. It has been affected by the COVID-19 epidemic in a number of ways. The COVID-19 outbreak has had a significant influence on the construction industry, which has been tasked with improving worker safety and well-being. Because construction firms must reopen and operate in the face of a virus that has remained a big threat to the industry and economies, it is necessary to look into the factors that influence construction sector management in light of COVID-19. According to the outcomes of the study, the factors affecting the management of Riyadh’s construction sector in light of COVID-19 could be divided into four groups (Managerial factors - Economic factors - Social and Cultural factors - Environmental factors). Research findings indicate that the abandonment of talent and expertise by business owners during the pandemic period was the top managerial factor affecting the management of Riyadh’s construction sector in the light of COVID-19, conflict in bidding prices by contractors due to the lack of projects offered due to the pandemic was the top economic affecting the management of Riyadh’s construction sector in the light of COVID-19, customs, traditions and social relations in the areas in which the projects are implemented was the top social and cultural factor affecting the management of Riyadh’s construction sector in the light of COVID-19, and the process of requesting raw materials, whether local or imported from abroad, and its effects was the top environmental affecting the management of Riyadh’s construction sector in the light of COVID-19.

It is recommended that all parties involved in the workflow of construction sector projects, from the supreme authority to the project’s implementing workforce, be made aware of the influence of the COVID-19 pandemic.

6. Limitation and future research

The target population in this study was limited to Riyadh contractors; therefore, the results cannot be extrapolated to a larger population. It is advised that this study be replicated in different communities. Factors that affect the construction sector in the light of crises such as COVID-19 are not limited to the factors that have been addressed; further factors may need to be investigated. Furthermore, it is suggested that a robust framework be developed for efficiently handling any future pandemic crises, taking into account elements that affect the construction sector’s performance.

Declaration

Author contribution statement

Shabbab Alhammadi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data included in article/ supp. material/referenced in article.

Declaration of interest’s statement

The authors declare no conflict of interest.

Additional information

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