

Engineering Projects and Crisis Management:

A Descriptive Study on the Impact of COVID-19 on Engineering Projects in Bahrain

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Abstract— Worldwide, COVID-19 has brought many countries/economies to a sudden halt, with impacts affecting various sectors, such as education, construction, businesses, tourism, health, and many more. The rapid spread of the virus called for immediate actions and protocols. Even though in some countries, including the Kingdom of Bahrain, construction restrictions were not applicable, project delays and finances are expected to be some of the long-term impacts of COVID-19. The disruption of supply chains, the economic status of enterprises, and the health conditions of the workers are just a few of the impacts of COVID-19 on the engineering and construction market. This research aims to shed light on the impacts of COVID-19 on the construction and engineering sector in Bahrain, investigating both the public and private sectors. To measure the impact of the pandemic and assess the progression of engineering projects in the country, exploratory research was conducted. The target population was licensed engineering offices in the Kingdom of Bahrain, and governmental bodies involved in the construction and engineering industry. The results indicated that the subsidies and support received from the government have indirectly ensured the stability of this sector. However, risks associated with the pandemic persist, as projects are bound to face challenges such as slowdown and delays and financial difficulties, along with the uncertainty of the market, which remains a concern for the future.

Keywords—Engineering Projects, Disaster management, COVID-19

I. INTRODUCTION

The turn of the year 2020 brought the world to a completely unpredicted and unprecedented new year. The end of 2019 marked the first appearance of COVID-19; shortly afterwards, it was followed by an outbreak which spread to almost all parts of the world. According to the World Health Organization, the virus's quick pace of spread has infected 29,155,581 confirmed cases and has caused around 926,544 deaths worldwide [1]. In the Kingdom of Bahrain, the first case was officially recorded by the end of February 2020 [2]. Immediate measures were taken to control the spread of the disease in the country, which included the closure of educational and public buildings, cancellation of national events, and closure of borders. This was soon followed by the enforcement of precautionary measures which included certain protocols, such as social distancing and adaptation of hygienic practices. Additionally, a campaign of random testing was implemented for early detection of the virus, in addition to isolation and quarantine measures [3]. Worldwide, these measures have led to the disruption of 'business as usual' in various sectors, such as education, business, tourism, transportation, and construction.[4],[5],[6]. Although in many

countries, including Bahrain, no direct legislation was enacted for the construction sector to stop the progression of work there, this sector was similarly affected, specifically in that an online platform would not prove effective in executing construction work, unlike other businesses which have successfully shifted to a digital platform.

This study aims to describe the actual impact of COVID-19 on engineering and construction projects in Bahrain. The paper begins with a general overview of the impact of crises on projects. This is followed by a description of the protocols and procedures that have been employed in Bahrain specifically within the engineering and construction sector. To clearly understand the impact of COVID-19 on projects in Bahrain, an online survey was sent to licensed engineering offices in the country. Additionally, telephone discussions were conducted with staff in public organizations to obtain their insight concerning the impact of the pandemic on their projects. The results and discussion section of the paper highlight the main finding of this research and the views of engineering firms in the long and short term. Finally, the conclusion section summarizes the paper and presents suggestions that could be implemented in the future to combat similar crises.

II. LITERATURE REVIEW

A. Management of projects during a crisis

In business generally and in construction specifically, there is always a margin of risk that is associated with any project. This could be attributed to the nature of the field itself, as it requires collaboration with multiple parties, such as clients, designers, contractors, subcontractors and suppliers. Uncertainty also adds future risks to any project. In projects, this may be due to an unforeseen reason, which could impact the project at various magnitudes [7]. As a result of the importance of managing risks in projects and due to the uncertainties associated with the construction field, risk management was established as an individual field in construction in the 1980s. Thevendran and Mawdesley in their research refer to risk management as "a managerial process aimed at controlling the level of risks and mitigating their effects" [8]. Perry and Hayes, on the other hand, defined risk as "exposure to loss/gain or the probability of occurrence of loss/gain multiplied by its respective magnitude" [7]. Ostrowska and Mazur defined a crisis as an event that occurs without prior notice and that shifts practices to an unprecedented methods [9]. In engineering and construction projects, a crisis could lead to financial disruption, submission delays, or even the loss of lives. The main aspect of a crisis is

that it is a sudden event with a significant impact on projects. Additionally, a crisis is normally an event that occurs beyond the control of the contracting parties and could be due to an economic, natural, social or military reason. The authors describe three stages to a crisis, the pre-crisis stage, the acceleration stage, and the post-crisis stage. Each stage has different confidence and security levels; however, data collection and actions during each stage are deemed necessary to cope through the different phases. Furthermore, the post-crisis stage is the stage where coping with the crisis has been achieved or a level of stability has been achieved [9].

Although the reasons and circumstances for each crisis could be considered to be unique, their impact is most likely similar. In the engineering and construction sector, a crisis will most likely result in financial burdens and project delays. According to the literature, firms commonly react similarly to lessen financial burdens through cutting expenses, employee reduction, and restructuring the firm's structure [10]. Research conducted in Malaysia and Vietnam indicated that the latter-mentioned strategies have been implemented during economic recession in the two countries. Additionally, another strategy employed during the re-structuring of an organization and its operations was to invest in human resources to enable staff to be effective team players during a recession [10].

Given the nature of the construction industry, which has become known for delays, this has become a subject that has been extensively researched by several researchers [11],[12]. The reasons behind delays could be attributed to multiple factors occurring at different times during a construction project and with different magnitudes. Delay reasons universally include planning issues, financial difficulties, contractor capabilities and project management. According to researchers, there are more than 30 reasons that could result in delays in the construction industry [11],[12].

COVID-19 adds yet another reason for the delay of projects due to the disruption occurring at multiple levels. This includes financial difficulties, the need for planning and rescheduling of working hours, delivery of materials, the contractors' capability, availability of resources, and, finally, the need for project management to navigate through the crisis.

B. COVID-19 and Bahrain's action plan

The first confirmed case of COVID-19 was announced in Bahrain on the 24th of February 2020 after a Bahraini citizen arrived from an infected overseas country [2].

After this, the Kingdom of Bahrain through the governmental executive committee declared that precautionary measures would be enforced to combat the spread of the virus in the country. This included closure of educational facilities and the transformation to an online platform, cancellation of public events and limitations on gathering, travel limitations, social distancing, and good hygiene practices. Additionally, a medical national task force was assigned to ensure adherence to health guidelines and to prepare health and quarantine facilities as needed. Disease treatment was also provided to all citizens and residents at no cost, in addition to granting employees up to two weeks' medical leave upon returning from an infected country. Employees were also encouraged to work from home whenever applicable [13].

Furthermore, to ensure the stability of the business sector and the economy in the country, an incentive was introduced to support citizens and the private sector. The incentive included facilitating salary payments for private sector employees through the Unemployment Fund for up to three months starting from April 2020. Private companies and individuals would be exempted from municipal fees for three months, businesses, depending on their field of specialty, were to be exempted from industrial land rentals and tourism taxes for the same period. Furthermore, individuals and businesses were to receive support with utility bills. Monthly work fees, and issuing and renewing of work permits during the same period would also be waived for individuals and businesses [13].

The incentive also called for doubling the liquidity support fund to \$9.8bn (BHD3.7bn), with the central bank deferring loan installments and extending the credit payments, in addition to facilitating other support to distressed businesses through other agencies [13],[14].

III. METHODOLOGY

Initially, a literature review was conducted by reviewing the current literature, reports and legislations issued concerning managing the outbreak amongst engineering projects worldwide and in Bahrain in particular. To thoroughly reach out to engineering firms, the use of a survey was thought to be the simplest, most cost-efficient, and yet effective way to gather information. Given the current social distancing protocols in the country, this has also proven to be a safe way for the collection of data. Before the survey was disseminated, it was verified by an academic who is specialized in surveys and a professional in the field of engineering. Comments given by the two reviewers were taken on board and the survey was edited before being sent to engineering firms. This ensured that the content of the survey was viable both scientifically and professionally.

The targeted population was certified engineering firms in Bahrain; the list was obtained from the official governmental system responsible for issuing building permits for all types of building projects [15]. The list includes experienced offices which are licensed by the Council for Regulating the Practice of Engineering Professions. In Bahrain, this is the legal authority responsible for granting legal status to practice engineering-related activities. The survey was sent to 155 active offices via email. As a follow-up procedure, phone calls were made to the firms to ensure the receipt of the survey and increase the response rate. Furthermore, telephonic discussions were held with officials in the public sector. The two main bodies responsible for projects in Bahrain are the Ministry of Housing and the Ministry of Works. Officials from both entities shared their views concerning the impact of COVID-19 on the progression of housing and public projects. The survey consisted of 22 questions and was divided into two parts. The first part comprises five questions related to general demographic data about the office such as the specialty, category, and the number of employees working in the firm. The second part of the survey tackled the impact of COVID-19 on engineering projects with a variety of questions such as identifying the main current challenges, the evaluation of the precautionary measures adopted and their impact on the progression of the work, future changes that could be predicted and the main changes that could be applied to navigate through such a crisis in the future.

A. Sample description

Around 40% of the licensed engineering offices in Bahrain participated in this survey. Licensed offices are categorized into three categories depending on the number of engineers, their specialty, and years of experience in the firm. The categories are denoted as A, B, and C, with around 50% of the licensed engineering offices belonging to the A category, 31% to the B category, and 19% to the C. The responses followed this division to a certain extent with just above 45% of the responses received from A category offices. This was followed by 28% from the B category and 23% from the C category. In terms of specialization, 82% of the offices provided design services, and 77% provided supervision services. A few offices, around 6%, provided construction services. Other specializations were also practiced by participating offices, which included land surveying, land development, consultation and reporting with each not exceeding 2%. Regarding the number of employees in the engineering office, the majority of the participating firms had less than 25 employees, with a percentage of 67%; 17% of the firms had between 25 and 50 employees; while 16% of the firms had a larger number of employees, out of which 8% were above 50 and less than 100, and the other 8% had employee numbers above 100.

IV. RESULTS AND DISCUSSION

A. Impact of the pandemic on the progress of projects

Based on the results obtained, the construction industry has been impacted at a high to severe rate: 37% of the engineering offices have been impacted highly by COVID-19, while 15% experienced a severe impact. In comparison, 33% respondents indicated that their projects were moderately impacted, while around 13% indicated that they had experienced a minor impact, and less than 2% indicated an insignificant impact.

The main challenges that firms are currently facing can be summarized as follows (percentages indicate the occurrence of these challenges based on the responses received):

- Project delays as a result of the pandemic (70%).
- Financial difficulties affecting all involved parties (67%).
- Lack of projects and less willingness of investors to launch new projects (63%).
- Maintaining employees' salary payments (55%).
- Reduced efficiency of work delivered (43%).
- Absence of employees either due to sickness or travel restrictions (40%).
- Implementing new modes of conducting work (38%).
- Shifting to an online platform (33%).
- Shortage of supplies and materials (35%).
- Restricted site access (32%).

Other challenges reported included communication with the government and a general slowdown of work.

Around 45% of the responses obtained agreed that the current period is posing a threat to the firms. On the other hand, 37% thought that they have passed the critical period

and are heading towards better stability. In addition, around 11% of the firms had struggled only during the first two months of the outbreak, whilst 9% of the responses indicated that they had not experienced any major difficulties during the pandemic (Fig. 1).

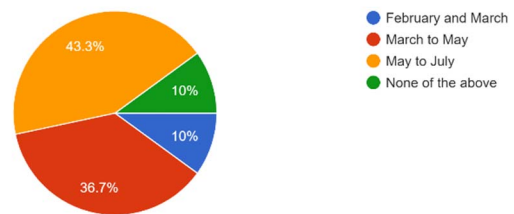


Fig. 1. Percentage of firms indicating the worst period for the firm since the start of the pandemic

Results showed varied responses in terms of the number of times projects had been halted as a result of health and safety concerns. Around a third of the responses, 35%, indicated that projects had been halted two to three times as a consequence of the safety measures. Equally, 28% of the responses indicated that a halt had been experienced more than three times, and the other third (28%) indicated that the project had never been stopped. Only 9% of the responses indicated that they had experienced work coming to a stop only once.

B. Expected work delays

As a consequence of the pandemic, engineering firms are expecting delays in submission of projects, with the majority of the responses indicating a moderate to high anticipation of delays, 33%, and 30% respectively. In comparison, 13% of the responses showed very high anticipation of delays, whilst 15% and 8% thought they would be least likely to experience delays (Fig. 2).

The reasons for the delay varied amongst the study sample. More than half of the respondents, 55%, claimed that the main reason for the delay in projects and work in general was due to the application of the precautionary measures. The second main cause of delay was the sudden transformation to online platforms, with a percentage of 41.4%. The third cause of delay was attributed to the spread of the disease among the workers, 37.9%. The fourth cause of delay was the miscommunication between parties, 36.2%. The fifth factor was related to the lack of supplies and materials and the disruption of overseas supply chains, 29% and 21% respectively. Other reasons for delay included the financial status of the client causing a complete stop or a delay to work, length of time required to gain approval from the authorities, and finally the reduction of employees causing additional pressure and delays.

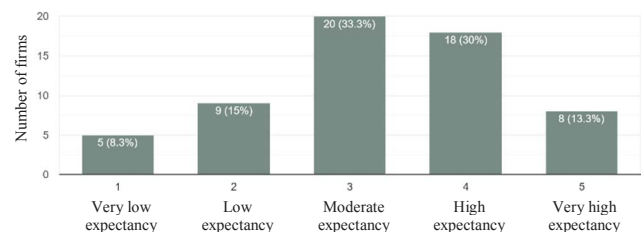


Fig. 2. Rate of expected delays in projects

Although the precautionary measure was the main cause of project delays, when asked whether they thought application of the precautionary measures at construction sites was easy or difficult, around 45% of respondents indicated that they were neither too difficult nor too easy to apply at construction sites (Fig. 3). Additionally, maintaining good hygiene practices was one of the main measures practiced at sites (71%) to ensure the health and safety of the workers.

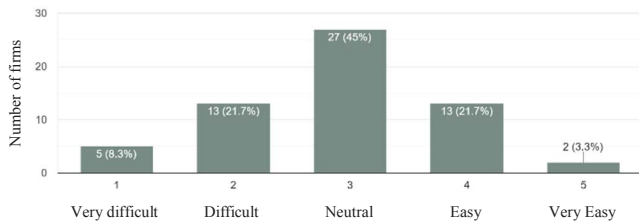


Fig. 3. Applicability of precautionary measures at construction sites

C. Future challenges

The current impacts of the pandemic are posing future threats to the engineering and construction industry. According to the responses obtained from the survey, 80% of the engineering firms expect that cash flow liquidity will be one of the main threats. The second impact (75%) is related to the termination of employment agreements, which could result in reduced efficiency, delayed projects, and overloading issues. Other future challenges included the termination of contracts (67%), reduced demand for projects (63%), force majeure claims (47%), increased use of technology (40%), and, finally, restriction in supply chains (30%) (Fig. 4).

Furthermore, when inquiring about investors' and clients' willingness to launch a new project, the majority of the responses (38%) reported that clients are expected to be least willing in the future to start a new project, as opposed to only 3.4% who thought that clients would be most willing to take that venture. Additionally, 27% and 26% of the responses respectively showed that clients could be either neutral or less willing to start new projects in the future.

D. Government stimuli economic package

The economic package that was initiated by the government had benefited many engineering firms. Based on the responses received, around 88% of the firms required the economic support provided by the government. Most of the benefits offered in the package were utilized by the firms; this includes salary payments, utility bills, and exemption of other fees, as described in section 2.2. A few of the respondents indicated that they were not able to register for the economic benefits within the time frame given. Others indicated that, although they had received the support from the government,

they found that this was not enough to cover their financial obligations, thus significantly affecting the firms to the extent of complete closure of the office.

E. Impact of COVID-19 on the public sector

In the public sector, two main governmental bodies are responsible for major construction projects in the country. The Ministry of Housing is responsible for housing projects and the Ministry of Works deals with infrastructure and public building projects such as schools, governmental office buildings, roads, and bridges. The impact of COVID-19 on projects in the public sector was similar to that in the private sector in terms of expected project delays as a result of supply chain disruptions and workers' absence due to illness or change of working schedules. Furthermore, projects involving foreign companies' contracts have been impacted the most, in comparison with contracts with local contracting companies. However, in terms of financial obligations, on-going contracts and projects were privileged with secured payments until the end of this financial year, whereas new projects were halted or postponed, as a reduction in the last quarter budgeting was unavoidable due to the government's financial obligations. Additionally, it is expected that the coming year or two will pose a reduction in governmental-allocated budgets for public projects, which may be reduced by up to 30%.

On another level, the Minister of Works and Municipalities Affairs and Urban Planning has announced that infrastructure and construction projects in the country will continue, without any plans for them to close, but workers and site managers must adhere to the precautionary measures declared by the governmental executive committee. This includes temperature taking before entering construction sites, commitment to wearing facial masks, and social distancing. This is in addition to the good hygiene practices and awareness campaigns that were carried out for laborers. Furthermore, there is controlled access in and out of workplaces in addition to revisions to working hours schedules to ensure the safety of workers [16].

V. CONCLUSION

The current implications of the health crisis we are experiencing have imposed threats to the construction and engineering industry. Worldwide, many industries have been affected by the COVID-19 outbreak. Lockdowns, social distancing and other precautionary restrictions have contributed to the complete closure and/or slowdown of businesses, and suspension or delays to services and projects. The construction industry is subjected to delays due to the nature and number of the contractual parties involved. The precedence of the current situation has also added to the uncertainty and increased the threats and challenges facing engineering firms.

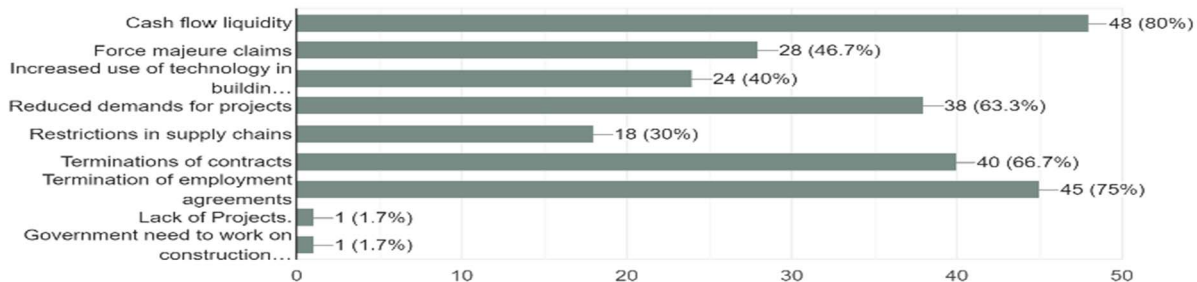


Fig. 4. Long-term impacts of COVID-19 on engineering projects

Several offices have resorted to a digital platform to resume work, whilst others had difficulties in managing the shift to an online platform, thus imposing further threats to them. Long-term threats were mainly linked to financial difficulties, shortage of projects and re-consideration of employment contracts in the future.

Based on the analytical review of the responses received, the following conclusions can be drawn:

- Health and safety are the main priorities during this period.
- The incentive introduced by the government was crucial for many firms.
- Firms need to reconsider their operational plans to include a digital platform.
- Digital on-site project management tools could be adopted for handing contractual documents.
- Local employment should be considered to avoid issues related to travel restrictions.
- The use of local market suppliers should be explored to overcome disruption to overseas supply chains.
- Introduce new on-site working schedules to ensure social distancing is applied.
- Lessons learned from the pandemic should be considered for firms' future development.

The limitations in this study include the sample size. However, despite the fact that only around 40% of responses were collected, it has given an insight into the actual impact of the pandemic on engineering firms and projects. Future studies could include studies related to on-site management and post- pandemic crisis management.

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