Mechanisms for addressing the impact of COVID-19 on infrastructure projects

S S King¹, R A Rahman¹, M A Fauzi² and A T Haron¹

¹Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia
²Faculty of Industrial Management, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia

Abstract. The COVID-19 pandemic has affected the overall economy and the construction industry badly. The Movement Control Order (MCO) caused the suspension of the construction sector, including infrastructure projects. Contractors are suffering losses and facing many problems caused by the pandemic, even with the on-going government financial aids. By identifying the right approaches to improve existing government policies and strategies, contractors could better manage the problems. Thus, this research aims to explore mechanisms for reducing COVID-19’s negative impact on the infrastructure construction industry. To achieve that objective, this study involves collecting and analyzing interview data with industry practitioners. The significant findings from the analysis are: (1) COVID-19 affects the infrastructure construction industry by causing financial and productivity problems; and (2) mechanisms to address those problems include legal, financial, productivity, and environmental support. This paper's finding is valuable for the government in determining the right actions in assisting contractors in this critical period.

Keywords. Sustainable development, COVID-19, Construction industry, Decision making.

1. Introduction
Malaysia’s construction industry suffered MYR18.5 billion in losses during the first three phases of the lockdown to curb the outbreak of COVID-19, said Senior Work Minister Datuk Seri Fadilah Yusof, during an engagement session with construction industry players [1]. The impacts such as the suspension of project operations, disruption of supply chains, and workforce shortage cause the industry to suffer since the COVID-19 virus hit the country early this year. The impact of Covid-19 will be felt through all segments in the Construction industry, both operationally and financially [2]. Many sites had not resumed operations in September due to financial issues. With the fallout of the economy, the construction industry is expected to suffer further and longer [3]. Inevitably, some construction projects will have to be terminated due to a lack of funding. The government’s financial aids since Aprils seems to have a limited effect in assisting the industry’s recovery. Many contractors are still facing difficulties in cash flow. More effective actions are needed by the government to generate faster healing in the construction sector. Effective strategies can be developed through effective communication with industry players. If the government intends to help the contractors, a comprehensive understanding of the contractors' problems is crucial. An effective responding plan can be developed to reduce the damages caused by the pandemic to the minimum. This study aims to identify the contractors' problems in infrastructure projects and potential solutions from contractors' perspective. The study focuses exclusively on contractors in infrastructure projects to obtain insight information for public projects. The study's findings enable the government to initiate more effective strategies to help the contractors and promote the industry's faster recovery.
2. Literature Review
Numerous studies were conducted on the impacts of COVID-19, but most studies are not targeted at the construction sector. A few studies aim to address the impacts the construction industry had faced arising from the COVID-19 pandemic. Gamil and Alhagar [4] have tried to identify the pandemic's impacts on the overall construction industry. The study collected the data through interviews and online questionnaires. The finding identified the top five most affected parts: the suspension of projects, workforce shortage, time overrun, cost overrun, and financial impact.

Al Amri and Marey-PÅ [5] exposed the implications of the COVID-19 pandemic on global and regional economies and Oman's construction industry. The study obtained the results through secondary research based on news, statistics, and literature. The finding on the main problems can be summarised into five main categories: Decline of the economy reduce the demand for real estate, thus reducing the need for new projects, lockdown situation results in reduced commercial activity and new contracts, contractual problems with delayed projects, issues in materials supply and labor burden.

Alenezi [6] has evaluated the impact of COVID-19 on the construction industry in Kuwait. The study used a questionnaire survey to collect data from various professionals in the construction industry. The main finding revealed that the delay of the projects was due to the COVID-19 pandemic. The employees unable to work at any time due to the pandemic were the main reason.

The existing works related to the impact of COVID-19 on the construction industry have not taken an in-depth look at the contractors' problems. Most works are examining the effects on the industry overall. The finding of the existing studies also lacking details. The detailed analysis of the impacts is vital to be useful for developing strategies or solutions. Therefore, research needs to base on the Malaysian context to understand the impacts of COVID-19 on the local construction industry. Different countries are having different situations and are dealing with varying degrees of seriousness of the COVID-19 outbreak. It is also essential to separate public and private projects when the research intends to investigate the construction industry's problems. This is because the client of public projects is mostly the government. Also, public projects often use the Jabatan Kerja Raya (JKR) standard form of contract. In contrast, private projects usually use the Pertubuhan Arkitek Malaysia (PAM) standard form of contract. This study intends to provide valuable finding that is based on the local industry. The contractors' perspective allows for practical problems caused by the pandemic to be revealed. Effective solutions can only be developed when the practical issues are addressed and examined.

3. Methodology
The data collection involved the interview with the contractor’s companies who had been involved in building construction projects. A qualitative approach has been used to analyze the collected data. The following subsection discusses how the data collection has been collected and been analyzed.

3.1. Data Collection
Phone interviews were carried out with open-end questions to collect data on contractors' problems due to COVID-19 and their proposed solutions to the issues. Face-to-face personal interview was not viable and not permitted due to the onset of COVID-19 in the country. Interviews are used because it is deemed to be appropriate for understanding the respondents' perspectives and experiences. This approach has also been used to identify success factors in other construction management topics, including design-build in public sector projects [7], and construction readiness of highway projects [8]. Another advantage of the interview is that samples can be controlled more effectively as there arises no difficulty of the missing returns; non-response generally remains very low [9]. Open-ended interview questions are used because they allow the interviewer to gain more detailed and in-depth information. The author asked the questions by phone and took notes while the respondents were attending the questions. The respondents are randomly selected nationwide of the contractors involved in infrastructure projects, and their firm size ranges from G1 to G7. This is with the purpose the data collected represent contractors nationwide, and the feedback is from small to large size contractors firms. Total numbers of 20 interviews were carried out.
3.2. Data Analysis

The data collected from the interview were analyzed using the thematic analysis approach. Thematic analysis is used because it allows researchers to see and make sense of collective or shared meaning and experiences. This approach also provides systematic themes and sub-themes of the processed data. Examples of other construction management topics that use this method to analyze qualitative data include identifying problems in construction projects [10], attributes of change agents in construction companies [11], and parameters for highway construction projects [12]. In this study, the raw data obtained through interviews are checked and read for understanding and familiarity. The points in the data are then identified, followed by defining the codes, and identifying the interpretive codes, and searching for appropriate sub-themes. Lastly, with the sub-themes developed, the themes are defined and named. A chart that depicts the themes and sub-themes were created after the analysis.

4. Results and discussion

4.1. Consequences of COVID-19

The problems of contractors caused by COVID-19 from the analysis of data obtained from the interviews are grouped into two main categories, namely Financial and Productivity. Figure 1 shows the two categories and the associated subthemes. Table 1 matches the responses of the respondents with the sub-themes.

![Figure 1. Overview of the consequences of COVID-19.](image-url)
Table 1. Consequences of COVID-19.

| Respondent 1 | Respondent 2 | Respondent 3 | Respondent 4 | Respondent 5 | Respondent 6 | Respondent 7 | Respondent 8 | Respondent 9 | Respondent 10 | Respondent 11 | Respondent 12 | Respondent 13 | Respondent 14 | Respondent 15 | Respondent 16 | Respondent 17 | Respondent 18 | Respondent 19 | Respondent 20 | Total |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|-------|
| Financial    |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |       |
| Cost         | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            |             |
| Income       | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            |             |
| Productivity |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |              |       |
| Process      | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            |             |
| Management   | /            |              | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            | /            |             |

Financial domain includes determinants that affect the economic performance of a company. The economic problems may impact company finance and the economic environment of the company. There are two major sub-themes under financial problems.

Cost. Cost covers all the outflow of finance. The cost is often a great concern of contractors since a project's profits usually receive only after completing the project. The cost affects the company's cash flow and business sustainability. Besides the increment of construction cost due to a more extended project period, all the respondents who mentioned cost refer to SOP compliance. Additional costs to comply with the newly introduced standard operating procedures (SOP) are entirely a direct result of the pandemic. The cost is difficult to estimate as the situation is changing and uncertain. Since the construction industry is labor-intensive, workers’ costs to comply with SOP can be very high. The responses that illustrate the problems in cost include:

“Contractors have to upfront a sum to comply with the standard operation procedure (SOP), which is not stated in the contract. The legal cost still retains, and the contractor has to bear the unexpected additional cost.”

“Additional cost burden for complying with the SOP at the site. The workers need to relocate to bigger accommodation and extra cost of cleaning.”

Income. Income encompasses the inflow of finance. The primary income of contractors is the profit gain through projects. The payment claims are considered the income of the contractors. As projects are suspended during MCO, there would be no payment from clients. Contractors suffered a loss of income as running costs in the form of overhead did not stop with projects. Overhead is the expenses or background costs of running a business or company. COVID-19 severely affects the economy. The decline of the national economy with fewer developments directly impacts the contractors’ income since the job opportunity has reduced. The cease of income has posed tremendous pressure on contractors’ cash flow. The income problem is the main reason contractors firms were in a state of insolvency. The responses that illustrate the problems in income include:

“Loss of finance due to running cost and wages maintained while the project jobs have to stop. Income stopped.”
“Contractors suffer a huge sum of money. Salary to pay resources (workers, machinery) despite no work production. When no production, no incoming funds for the company as no claim from the client.”

4.2. Productivity
Productivity comprises of all the factors that may affect the progress of the operations. It includes all the elements affecting the development and output. There are two sub-themes under productivity problems.

Process
The process is the program to execute. It covers the activities that transform inputs into outputs. For contractors, a project’s process is a series of construction operations. Many factors affect the progress of construction operations. Multiple respondents mentioned the delay in materials supply, and the site labor shortage is causing delay to the project works. In China, the most reported impact of COVID-19 is the acute shortage of labor [13]. Similar to China’s construction industry, our local industry is heavily dependent on non-local workers. The movement control and lockdown have interrupted the materials supply and caused many foreign workers’ returning home country. Although construction work is allowed, the supply chain disruption may not resume fully in the short term. The responses that illustrate the problems in the process include:

“The pandemic affected the entire supply chain in the construction industry. For example, lack of material or delay in material supply during COVID-19 affects the work progress.”

“Restriction on labors to affect the productivity level to drop, work progress delayed, and contractors are exposed to liquidated and ascertained damages, which is not a contractor fault.”

Management
Management is an organizational element which covers coordination and administration tasks to achieve projects’ goal. The problems of contractors mostly concern the compliance of SOP. The problems come from workforce control at the site and the unclear SOP guidelines from the authority. The problem of workforce management becomes more complicated with mega projects. Managing a tremendous amount of site labors at a large project site is challenging and not to mention the laborers working at the site are under many different sub-contractors. Besides managing the workforce during the operations, the project with site accommodation needs to deal with accommodation arrangement issues and ensure the workers comply with the SOP while staying at the site accommodation. The responses that illustrate the problems in management include:

“Need to follow SOP, which is problematic in terms of management and control of the labors.”

“Uncertainty to the operation due to government instruction changes from time to time. The contractors are unclear about the SOP at the projects site cause it keeps changing.”

4.3. Solutions for problems cause by COVID-19
From the analysis of the interviews’ responses, the proposed solutions can be grouped into four main categories, namely, Legal, Finance, Productivity, and Environmental. Figure 2 shows the four categories and the associated subthemes. Table 2 links each respondent with their respective solutions.

4.4. Legal
Legal takes into consideration all the aspects relating to the law. Various laws and regulations are governing construction projects. The responses that mentioned legal issues are all referring to the contractual arrangement.

Contract
The standard form of contracts such as JKR and PAM contracts are usually used to bind the contractor and client's contractual relationship. There is no clause in either JKR or PAM form of the contract specified contractors' entitlements due to the virus outbreak. The force majeure clause under
Extension of Time (EOT) entitlement in the contract does not clearly express the inclusion of a virus outbreak. As the COVID-19 pandemic is the first occurrence, Malaysia has no precedence to decide whether the outbreak can be considered under the scope of force majeure. The respondents suggest the government allow contractors to claim Extension of Time (EOT) for the delay due to projects stopping during MCO and not imposing Liquidated and Ascertained Damages (LAD) to the contractors’ delay works caused by the COVID-19. The responses that illustrate the legal solution include:

“Government as the client to revise the contract to aid the contractor to claim losses.”

“For projects that delay due to lockdown, the government should grant Extension of Time to cover the period of projects stopping.”

---

**Figure 2.** Overview of the mechanisms to address COVID-19’s impact.

**Table 2.** Mechanisms to address COVID-19’s impact.

| Respondent | Legal | Contract | Financial | Opportunities | Financial aids | Productivity | Process | Management | Environmental | Economic stability |
|------------|------|---------|----------|--------------|---------------|-------------|---------|------------|---------------|-------------------|
| 1          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 2          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 3          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 4          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 5          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 6          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 7          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 8          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 9          | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 10         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 11         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 12         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 13         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 14         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 15         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 16         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 17         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 18         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 19         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| 20         | /    | /       | /        | /            | /             | /           | /       | /          | /             | /                 |
| Total      | 6    | 2       | 13       | /            | /             | /           | /       | /          | /             | /                 |
4.5. Financial

Financial covers all the matters that affect the fund and credit performance of a company. After analysis of the interview data, there are two sub-themes related to finance.

Opportunities. Income opportunities cover the chances to gain an inflow of finance. The income opportunity of contractors depends firstly on the possibility of winning the tender of projects. Two responses mentioned the impacts of the economy on the number of development projects. The government is requested to increase spending on development projects and to create and roll-out projects. The answers that illustrate the income opportunities solution include:

"The government needs to boost the country's economy, overcome unemployment, and to increase the nation's spending power. When the economy is good, there is a demand for the built environment that creates opportunities for contractors."

"The government needs to make sure the developments are not slow down or stopped. This affects the contractor's job opportunities."

Financial aids. With the moratorium for loans ended at the end of September, Many contractors face problems in repaying loans. One potential long-term impact on construction companies is that companies with a high level of debt and low cash reserves may face liquidity crisis. Even with two stimulus packages to combat the financial impacts of the COVID-19 pandemic, most industry players are still lacking funding for projects and even business continuing. Respondents seem to regard government intervention to be the only financial solution. Further and increasing financial aids from the government are the only answer to help the industry regain financial stability. The responses that illustrate the financial aids include:

"Governments to give financial aids. More incentives."

"Financial support from the government to reduce the contractors’ burden in complying with the SOP. Some SOP costs can be borne by the government, such as additional cost to provide extra accommodation for labors due to social distancing, cost to disinfect and sanitize the site."

4.6. Productivity

Process. Process covers the activities that transform inputs into outputs. Few responses from the interviews pointed out that the government should make sure contractors are not facing a labor shortage on site. The government also should ensure the material supply chain resume quickly to avoid delays caused by the lack of materials. Responses that illustrate the solutions related to the process include:

"Contractors to add resources and allow to work 24 hours to catch up the delay or try to complete the project as early as possible to reduce the cost."

"Government to make sure enough site labor in the market."

Management. Management is an organizational element which covers coordination and administration tasks to achieve projects’ goal. The management related solutions proposed by the respondents are mainly on SOP compliance. Companies need to plan and coordinate well in executing the SOP on site. A response suggested the government give clear SOP and provide an officer to assist at the project site. Access control systems are an essential method of managing employees in an office and site. Responses that illustrate the solutions related to management include:

"A well-planned of SOP to control workforce at the project sites."

"Government can provide officers to the projects site to help in the explanation and supervision of labor SOP."

7
4.7. Environmental

Environmental involves the surroundings or conditions in which a company operates. Environmental factors include all those that influence or are determined by the surrounding environment. It also includes factors that influence the business environment. Two sub-themes of environmental solutions are crises and economic stability.

Crisis. A crisis is referring to the situation of the country in dealing with the COVID-19 pandemic. It is mainly dealing with the seriousness of the outbreak. The situation is evaluated by the total number of cases and the areas exposed to positive cases. As the situation directly decides the duration needed for movement control or necessity of lockdown, two responses urge the government to control the situation and stop the virus's outbreak as soon as possible. The answers that illustrate the solution related to the crisis include:

“Government needs to control the situation so that virus does not spread seriously.”

“The government needs to make sure there are proper policies to stop the spreading of COVID-19 viruses.”

Economic stability. Economic stability refers to the economy's constant growth without high and frequent fluctuations in the overall economy. Economic stability creates the right environment for job creation and the balance of payments. The necessary condition for contractors to be able to have stable and sustainable growth is a stable economy. Six respondents mentioned the focus on the economy by the government as one of the solutions. It is crucial after the economy has been badly affected by the pandemic. Therefore, the government should take serious action to promote the recovery and stability of the economy. The responses that illustrate the solution related to economic stability include:

“The government has subsidized to help small and medium enterprises (SME) to maintain their operation.”

“The government should focus on the economy so that our national economy is not declining too seriously. The construction industry is greatly affected by the overall economy. Fewer developments when the economy is terrible.”

5. Conclusions

The spread of COVID-19 globally impacts significantly on the construction industry. Most contractors are suffering from the impact. Identifying the contractors’ problems and examining the potential solutions is necessary to seek an effective responding plan. The main problems of the contractors are economic and productivity. Suspension and reducing projects directly affecting contractors’ income, and the SOP complying at the site create additional costs. Problems with disruptions of the supply chain and labor shortage are also posing significant problems to the contractors in dealing with productivity. Many of the solutions proposed are related to financial aids. This seems understandable when the main problems are economic. Contract issues were raised to assist contractors in claiming loss and expenses and extension of time (EOT). This study's finding creates insight into the stakeholder that is liable for the delays and disruption of the supply chain to take appropriate steps to protect their interests. The proposed solutions presented in this study provide alternative options that may solve the contractors’ problems. Contractors affected by the COVID-19 pandemic may consider express entitlements of relief under their contract. Future works can develop a comprehensive plan for the authority to assist the involved contractors in overcoming the crisis. This paper also provides a foundation for future works to conduct an insight survey on other local construction industry payers such as developers and consultants.

6. References

[1] The Straits Times 2020 Malaysia’s construction industry records $6b losses in first three lockdown phases

[2] Deloitte 2020 COVID-19’s impact on the engineering & construction sector. Deloitte
[3] Kabiru J M and Yahaya B H 2020 Can Covid-19 Considered as Force Majeure Event in the Nigeria Construction Industry? *International Journal of Scientific Engineering and Science*, Volume 4, Issue 6, pp. 34-39, ISSN (Online):2456-7361

[4] Gamil Y, and Alhagair A 2020 The Impact of Pandemic Crisis on the Survival of Construction Industry: A Case of COVID-19. *Mediterranean Journal of Social Sciences*, 11(4), 122-122

[5] Al Amri T, and Marey-PÂ M 2020 Impact of Covid-19 on Oman's Construction Industry. *Technium Social Sciences Journal*, 9(1), 661-670

[6] Alenezi T A N 2020 The Impact Of Covid-19 On Construction Projects In Kuwait

[7] Lee Z P, Rahman R A and Doh S I 2020 Success Factors of Design-Build Public Sector Projects in Malaysia. *IOP Conference Series: Materials Science and Engineering*, Vol. 712, No. 1, p. 012045

[8] Rahman R A, Radzi A R, Saad M S H and Doh S I 2020 Factors affecting the success of highway construction projects: the case of Malaysia. *IOP Conference Series: Materials Science and Engineering*, Vol. 712, No. 1, p. 012030

[9] Kothari C R 2004 *Research Methodology: Methods and Techniques* New Age International (P) Limited. Second Edition

[10] Rahman R A and Ayer S K 2017 Prevalent issues in BIM-based construction projects. *Proceedings of Joint Conference on Computing in Construction*, Vol. 1, 645-652

[11] Radzi A R, Bokhari H R, Rahman R A and Ayer S K 2019 Key Attributes of Change Agents for Successful Technology Adoptions in Construction Companies: A Thematic Analysis. *In Computing in Civil Engineering 2019: Data, Sensing, and Analytics*, 430-437

[12] Radzi A R, Rahman R A, Doh S I and Esa M 2020 Construction readiness parameters for highway projects. *IOP Conference Series: Materials Science and Engineering* Vol. 712, No. 1, p. 012029

[13] FTI Consulting 2020 The Impact of COVID-19 on the Construction Industry in China. FTI Article, Issue August 19

[14] Deloitte 2020 How the Construction Industry can take proactive steps to mitigate the impact of Covid-19 restrictions

[15] Suresh S, Renukappa S, and Stride M 2020 The impact of Covid-19 on the UK construction industry

**Acknowledgment**

This work is supported by the Ministry of Higher Education, Malaysia [RDU200705]. The authors are also thankful to the industry practitioners that participated in this work.