The mitigation of Covid-19 in the perspective of contractor for sustainable construction in Indonesia

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Abstract. Construction has been significantly influenced by COVID-19. In some countries, construction projects are discontinued, and even in some countries where construction work is still permitted, high safety standards are required. Construction site safety is essential during the COVID-19 pandemic. The contractor is responsible for creating a safe workplace at the project site. Therefore, this paper presents project risk identification and mitigation during the covid-19 pandemic based on contractor’s perspective. This research identified the risk factors related to the COVID-19 pandemic that consist of 5 categories: man, materials, machines, methods, and environment. Between these risk factors, worker shortage, site accessibility, and lack of construction materials, caused by the strict large-scale social restrictions (PSBB) policy are the biggest challenges faced by the contractor. The findings of this research develop the project risk categories and mitigation strategies from the contractor's perspective. It suggests that future construction in addition to planning the design, operate, maintenance, supply chain, and project management must also consider the occurrence of a pandemic.

1. Introduction
The Covid-19 pandemic has paralyzed on various sectors in Indonesia, almost all commercial, economic and social activities are affecting from the COVID-19 pandemic. The construction sectors are no exception, they are also affecting from this crisis. Tangerang city officially implemented strict large-scale social restrictions (PSBB) as active cases increased in the city. This is implemented to prevent the spread of the coronavirus. Nevertheless, the construction sector can run with strict health protocols. As one of the most important machines to encourage economy development, infrastructure construction projects are in urgent need of continuation. Therefore, the road access project at Soekarno-Hatta International Airport cannot be shut down during the pandemic. Although, the implementation of strict large-scale social restrictions (PSBB) causes the project delay as an example PSBB obstructed the transportation system which has obstructed the supply of materials in project site.

This study has been concerned to this special aim of what are the risks of COVID-19 and the impact to road access project at Soekarno-Hatta International Airport. This study goals to investigate the specific risks and impacts deliver by the COVID-19 pandemic in road construction work as well as the risk response strategies adopted by the project management teams to minimize the risk and impact. The findings develop the studies of risk identification and assessment of road construction projects and establish possible involvements to construction management during the COVID-19 pandemic.
2. Literature Review
Since the COVID-19 pandemic happened, the construction projects risks had been methodically investigated and different potential risk had been explained by researchers. For example, project risk was placed in engineering design, construction management, construction safety, natural hazards, politic, social, and economic [1]. Other opinion, risks could be classified into two categories, namely, external risk and internal risk [2]. Based on the classified risk, researchers have investigated special risks from other perspectives in construction projects. For example, some researchers centred on the safety issues of construction. They discussed that project safety was concerned to technical risk, geological risk, and environmental risk [3].

Workers’ safety behaviours and attitudes were main factors that impacted accidents in project [4]. Contractor responsibilities to preserve workers’ health and safety. Project risks might also be combined into the supply chain. specification changes, shortage of materials and equipment, late delivery of material and equipment, subcontractors’ bad performance, and bad climate would impact to the project risks of schedule and cost overrun [5].

The risks classified above would impact to the cost, schedule, and quality of a project [6]. Further risk loss classified into financial loss, time loss, quality loss and social impact [7]. Zhou et al. [8] construction project risks could cause tremendous impact on project cost, schedule, and quality [9][10]. Despite some studies mentioned the influence of natural disasters such as earthquakes, bad climate, or floods on construction projects, only few of them were managed under the framework of a global pandemic.

2.1. Risk Management. Risk management is a systematic way to minimize the impact of uncertain condition and/or to reduce the probability of the negative events [11]. According to [12] describes 3 (three) process of risk management activity: (i) risk identification; the risk identification explains the risks (what, how, when, where and why the risks can occur to the project), (ii) risk analysis; calculate the value of probability and severity of the risks, (iii) risk response planning: risk response is the process to apply the best efforts or strategies to minimize the impact of the risks. When applied on every project, risk management is directly paralleled with project success indicators i.e cost, quality and time [11].

2.2. Risk Identification. Risk identification techniques such as brainstorming, interviewing with project stakeholders, delphi technique, checklist. In risk identification there is also the term risk breakdown structure which is useful for describing more specific risks. The picture below is drawing schematic of risk identification and risk loss for covid-19 in road access project at Soekarno-Hatta International Airport

![Figure 1](image)

**Figure 1:** Schematic of Risk Identification and Risk Loss for COVID-19 in Road Access Project at Soekarno-Hatta International Airport

2.3. Risk Assessment. Risk assessment is the main process of risk analysis [12]. Risk measurement goals to assess the risk. Qualitative analysis is carried out with the process of determining the possibility of the occurrence of risks as shown in table 1 and the impact as shown in table 2 of the risks
that have been identified. Calculating the risk value depends on the likelihood (L) and severity (S). Risk value is determined by multiplying the likelihood with the severity with the formula (1). Risk assessment matrix is the combination of likelihood (L) and consequence or severity (S). Risk level also shown in the form of a risk matrix.

\[
\text{Risk (R)} = \text{Likelihood (L)} \times \text{Severity (S)} \quad (1)
\]

| Table 1. Likelihood Level |
|---------------------------|
| Level | Likelihood | Description |
| A | almost certain | Will occur frequently |
| B | Likely | May occur several times |
| C | occasional | Likely to occur during lifetime |
| D | Unlikely | Unlikely to occur during lifetime |
| E | Rare | So unlikely event, it may not be experienced |

| Table 2. Consequences Level |
|-----------------------------|
| Level | Consequences | Impact on project objectives |
| Time | Cost | Quality |
| 1 | Very Low | 1 week | < $100 | Minor impact on secondary functions |
| 2 | Low | 1-4 weeks | $100-$500 | Minor impact on overall functionality |
| 3 | Medium | 1-3 months | $501-$1K | Some impact in key functional areas |
| 4 | High | 3-6 months | $1K – $5K | Significant impact on overall functionality |
| 5 | Very High | > 6 months | <$5K | Very significant impact on overall functionality |

| Table 3. Risk assessment matrix |
|--------------------------------|
| Level | 1 | 2 | 3 | 4 | 5 |
| A | Medium | High | High | Very High | Very High |
| B | Medium | Medium | High | High | Very High |
| C | Low | Medium | High | High | High |
| D | Low | Low | Medium | Medium | High |
| E | Low | Low | Medium | Medium | High |

2.4. **Risk Response.** After the risk identification and risk assessment being adopted, the risk response can be applied to mitigate, minimize, or eliminate the impact of the risk. Risk response planning is a process that aims to minimize the level of risk faced to an acceptable level. Efforts to minimize this risk are carried out by determining action options for reduce project losses. Techniques for dealing with risks are classified into 4 namely: controls through avoid, mitigate, transfer or accept the risk.

3. **Research Methodology**

The risk structure is applied in this study to investigate the specific risks caused by the COVID-19 epidemic. The risk factors include men, machines, materials, methods, and environment [8]. These factors are immediately affected by the pandemic and develop specific risks that are much different from normal circumstance. In addition, issues associated with risk factors such as site situation, labor skills and availability, materials and equipment delivery would impact to cost, time and quality of the project [13]. Hence, this study underlines three aspects of risk loss caused by COVID-19 epidemic,
namely, cost, time, quality. Based on the analysis, the framework of risk identification and risk loss of this study is shown in Figure 1.

COVID-19 has affected various sectors in Indonesia, including construction industry. This study focuses on the construction stage of road projects owing to the reality that it involves the most resources of on-site workers, materials, and equipment. These factors are immediately affected by the COVID-19 epidemic and the large-scale social restrictions (PSBB) policy. A case study is applied in this research to analyse the risk of COVID-19 and its potential influences on road access project at Soekarno-Hatta international airport. This study is based on the criteria limitation: the project should be in the construction stages during the COVID-19 epidemic and the project should report the specific impacts of the COVID-19 pandemic.

Data collection in this study can be classified into two types i.e., primary and secondary data. Primary data obtained from on-site observation. In-depth interviews using risk identification checklists with the project manager and safety officer of the main contractor of road access project at Soekarno-Hatta International Airport. In addition to interviews and observations both used risk assessment sheet. The risk assessment sheet includes risk identification, risk assessment and risk response. In-depth interviews with expert are also used to support the results of recent literature studies. Primary data is used to risk identification, then the risk assessment is analysed, the final step being assigning how to mitigate the risk. The data collected will be analysed descriptively, then the results will be given in tables and narration descriptions.

4. Result and Discussion
This study has identified 5 risk categories, i.e., man, material, machine, method and environmental. The result of respondent's answer to probability (P) and impact (I) is analysed to find the risk level. The results of the risk assessment can be seen in table 4 below.

**Table 4. COVID-19 Risks Identification and Risk Assessment in Road Access Project at Soekarno-Hatta International Airport**

| No | Risk Category | Risk Identification                                                                 | Risk Assessment | Risk Level |
|----|---------------|-------------------------------------------------------------------------------------|----------------|------------|
| 1  | Man           | Worker shortage due to physical distancing on-site                                   | E              | 5          | High       |
|    |               | Interruption of workers accessibility to the project site due to Large-Scale Social Restrictions | E              | 5          | High       |
| 2  | Materials     | Material supply chain delays                                                        | C              | 5          | High       |
|    |               | Difficulty in material delivery due to Large-Scale Social Restrictions               | E              | 5          | High       |
|    |               | Lack of epidemic prevention materials such as disinfectants, hand sanitizer, masks   | E              | 3          |            |
| 3  | Machine       | Extend the duration of heavy equipment lease                                        | E              | 5          | High       |
|    |               | Difficulty in machine delivery due to Large-Scale Social Restrictions                | E              | 5          | High       |
| 4  | Method        | Adjustment of construction method on site due to a physical distancing of workers   | E              | 5          | High       |
| 5  | Environmental | Local residents panic due to COVID-19 pandemic control policies                      | E              | 3          | Medium     |
After calculating the level of risk that occurs, the next step is to respond and control systematically. Response and control of project risk in this study are as shown in Table 5 below.

Table 5. COVID-19 Risks Control in Road Access Project at Soekarno-Hatta International Airport

| No | Risk Category         | Risk Response | Response Strategies                                                                 |
|----|-----------------------|---------------|-------------------------------------------------------------------------------------|
| 1. | Man                   | Reduction of workers due to physical distancing on-site | Mitigate | Schedule adjustment, Software support: AutoCAD, Staad Pro, Etabs, Revit |
|    |                       | Interruption of workers accessibility to the project site due to Large-Scale Social Restrictions | Mitigate | Chartered buses or private cars for workers |
| 2. | Material              | Material supply chain delays | Mitigate | Coordination with material suppliers |
|    |                       | Difficulty in material delivery due to Large-Scale Social Restrictions | Mitigate | Asking help from local governments to allow material truck |
|    |                       | Lack of epidemic prevention materials such as disinfectants, hand sanitizer, masks | Mitigate | Coordination with medical suppliers |
| 3. | Machine               | Extend the duration of heavy equipment lease | Transfer | COVID-19 pandemic includes Force Majeure |
|    |                       | Difficulty in machine delivery due to Large-Scale Social Restrictions | Mitigate | Asking help from local governments to open road access to site |
| 4. | Method                | Adjustment of construction method on site due to a physical distancing of workers | Mitigate | personal protective equipment (PPE) and mask |
| 5. | Environmental         | Local residents panic due to COVID-19 pandemic control policies | Mitigate | Communication with local residents |

**Man risks.** Many workers are working from home for the strict large-scale social restrictions (PSBB) policy. Workers are unable to arrive to office because of the access roads to the project is completely closed. It is quite difficult to implement work from home for all workers in the construction industry. Coronavirus disease is transmitted from person to person, so it is not possible to bring together many workers in office. In order to reduce the number of workers on the project site, the contractor arrange the work schedule by dividing into several shifts. Allowing workers in the office to work from home, so some workers should work from home such as creating Google forms to receive some information, signing documents digitally, sending mails, making conversation and organizing meetings
via teams, zoom or google meet. Designing, planning, scheduling and costing can also be finished with software support at home such as AutoCAD, Staad Pro, Etabs, Revit etc. Contractor also organize the gap between the two seats in the office, according to the regulations of the government. This effort is done with the intention of physical distancing.

**Material risks.** The material supply chain has been disturbed due to strict large-scale social restrictions (PSBB). Many construction materials are needed to continue the construction process but PSBB policy cause the materials are not arriving the construction site which is delaying the construction work. The construction materials that ordered from different factories in the country or abroad by different delivery truck for construction work, those things cannot arrive on time. All material trucks are not able to arrive on time due to PSBB so the construction work is disturbed. It causes schedule delay in construction project. To response this risk, contractor-maintained communication and coordination with suppliers to ensure the supply of concrete, steel, and other major construction materials. Considering the fact that the suppliers were also having trouble delivering construction material due to PSBB policy. The contractor recourse from the governments, who had strongest power to permit material transport trucks still operate.

**Machine risks.** The limitations of workers and materials have an impact on extending the duration of equipment lease. Yet, for the projects in the construction stages, the delay in equipment usage schedule would greatly obstruct the construction process. As a result of strict large-scale social restrictions (PSBB), all project equipment has been lying in project site for a long time. In the contract documents between contractors and equipment subcontractors had mentioned ‘Force majeure’, one of them is ‘Large Scale Epidemic’. COVID-19 pandemic includes this criterion. So, in case of ‘Force Majeure’ in the project then no compensation will be paid by the contractor due to extending the duration of equipment lease. Besides, all tools and machines should be cleaned regularly. All shared equipment including machines and heavy equipment must be disinfected before and after use. Users of tools or vehicles should wash or sanitize their hands before and after use. This is applied by contractor to meet the requirements of health protocol.

**Method risks.** According to the epidemic health protocol in Tangerang government, all working places should conform the basic requirements of health protocol standard, while working in the project site, workers must use safety equipment such as helmets and safety shoes, etc. But now in pandemic situation, additional personal protective equipment (PPE) that is needed to prevent against the transmission of the coronavirus. Workers must wear mask to protect themselves and also wear gloves on their hands, personal protective equipment (PPE) on their bodies and worker must keep sanitizer. Sanitizer must be sprayed as often as possible to keep hands clean. If contractor failed to meet the health protocol standard, the construction project would be shut down. Therefore, protocol health in construction projects was stricter.

**Environmental risks.** When the road access project at Soekarno-Hatta International Airport construction work was planned to resume in March, the local residents around the construction site were scared about the workers transmit the coronavirus. At the time, the local residents were scared of coronavirus spread, especially in the road access project location. The local resident immediately closed their roads, and non-local residents were not permitted in. The road access to the construction site were closed and workers were unable to come in to the construction site while construction materials could not be arrived in. To mitigate the scared among residents and break the problems of closed site accessibility, the contractor coordinates with the local government. Together with local government officers, project manager visited local residents to explain epidemic awareness and health protocol that applied to project site to them.

**5. Conclusion and Suggestion**

The COVID-19 pandemic has done significant impacts on various sectors, including the construction project. With so many workers involved project construction was under greater risk of epidemic spread and infection. So, the government has been implemented strict large-scale social restrictions (PSBB). As a result, supply chains have been disturbed and workers are not able to get to the construction site.
Contractor have also encountered extreme uncertainty. By investigating road construction projects, this paper found the specific risks related to the COVID-19 pandemic from the perspective of contractor. Risk factors of man, materials, machines, methods, and environmental prevention pressure were main factors of the COVID-19 risk structure. Between these risk factors, worker shortage, site accessibility, and lack of construction materials were the most major challenges faced by the projects.

Increasing the number of projects used as case studies could be organized in the future to validate our conclusion. Furthermore, the risk analysis of this study is focused on the construction phase, because we consider that this stage is under direct influence by the pandemic. Future road construction process including design, operate, maintenance, supply chain, and project management should examine the possible effect of a global pandemic, and the effects of the global pandemic on other stages of tunnel construction should be further analysed.

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