

The Impact of COVID-19 Pandemic on The Construction Projects in Indonesia: Identifying the Risks from the Stakeholders' Perspective

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ARTICLE INFO

Article history:

Received 30-06-2023

Revised 25-07-2023

Accepted 16-07-2023

Available online 31-08-2023

E-ISSN: 2622-1640

P-ISSN: 2622-0008

How to cite:

Hasibuan G. C. R., Jaya I., Al Fath M.T.. The Impact of COVID-19 Pandemic on The Construction Projects in Indonesia: Identifying the Risks from the Stakeholders' Perspective. International Journal of Architecture and Urbanism. 2023. 7(2):279-287.

ABSTRACT

Covid-19, which is declared as a pandemic by the World Health Organisation (WHO) on March 11 2020 has significant impacts in many sectors around the world. Nevertheless, there is a lack of research which analyses the impact of Covid-19 in the construction projects risks in developing countries. Given the lack of research related to the construction projects risks due to Covid-19, the overall aim of the study is to identify and classify the risk in a construction project as a result of Covid-19 Pandemic in Indonesia. The methodology which is used in this study is by implementing the questionnaire approach with the targets from the related construction industry stakeholders. The findings identified five risks which have the highest possibility to occur in a construction project as a result of Covid-19, in which the highest risk is delayed funding on construction project design (Score: 0,2523) while the lowest risk is unknown threat or vandalism from the neighborhood gangster (score: 0,0136). Further study will focus on the way in which we could develop a new framework model for risk management and preventive measures of these risks adjusted to Covid-19 impact.

Keywords: Covid-19, impact, construction projects, risks, stakeholders.



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<http://doi.org/10.32734/ijau.v7i2.13510>

1. Introduction

Covid-19 has been declared as Pandemic by the World Health Organization (WHO) on March 11 2020 [1,2] and has significant impacts around the world. Covid-19 was assumed to have origins in a market in Wuhan, China, in December 2019 [3,4]. Globally, the number of confirmed cases of Covid-19 as on August 23, 2020, are 23,402,118 and 808,998 deaths and 15,935,688 recovered [5]. According to Haleem et al. [6], the global economic sector, including the lives of people, have been affected by the Covid-19. One of the sectors which are affected is the construction sector, particularly the construction projects [10-17],[36-43]. It is well known that construction industry and project involve complexity [7], uniqueness [8,9], where each project could not be generalized; unpredictability [7], and uncertainty and risks [8,9]. Although only emerged in a relatively short period, some reports such as [10],[11] show concern from the construction industry stakeholders over the impact of Covid-19, which arguably could make a long term effect in the on-going or future construction projects.

As an example, in India, KPMG [12] estimates that approximately there will be a reduction of 13% - 30% in the construction project in terms of investment affecting GVA (Gross value added), and there will be a reduction in terms of employment of 11% to 25%. KPMG [12] further argues that Covid-19 will have a significant impact on the country since 60% of investment also emerges from the construction industry. Similarly, in Australia, based on the perceptions of the contractor, the production rate has been decreased to be only 60% as a result of Covid-19 new regulation [10]. The contractors that were interviewed and surveyed in the report by Emmett [10] also inform that they are in a dilemma in operating the social distancing regulation but then at the same time are in fear of having a breach of contract. As a result, there is an intense effort on how to find a solution, particularly regarding the contractual solution for the contractors and developers due to the disruption of construction supply chain [13]. Bailey et al. [14] claim that although in a construction project are impacted due to the result of Covid-19, it has different implication to each country in both legal and contractual aspect. As other examples, the apparent impact is the delay of infrastructure projects [15,16] and property projects which occur in Indonesia [16]. The postponement of infrastructure projects were implemented due to some of the fund being allocated for Covid-19 handling [15,17]. Nevertheless, in contrast to China or other countries, the report from AGC [45] also indicates that there still lies speculation about the impact of Covid-19 in the US construction project. However, there is another survey implemented by Dodge and Analytics [11] which found that 67% (out of 172 contractors) of the surveyed contractors indicate their concern on the impact of Covid-19 in the US, as there are delays on the project ranging from site closing down and disrupted material logistic to the concern on health and safety which impacted on project suspension and cancellation by the owner; thus the delay is not only due to government regulation for closing the site [11].

Moving the case to Indonesia, as on August 23 2020, the number of confirmed cases in Indonesia is 153,535 cases, 6,680 deaths and 107,500 recovered, based on data from Task Force of accelerating the handling of Covid-19 [18]. Correspondingly, there is a dearth of research which has analyzed the impact of Covid-19 on construction project risks, particularly in developing countries. Risk management application like its tools and technique is still not utilized optimally to maintain project's objectives and achieve success according to Raz et al. findings, as they indicated that only some projects (from total >100 projects) had implemented the risk management tools [19]. In a similar argument, despite its cruciality for project's success, there is a lack of research which could indicate the response for the analysis of risk and its management from the construction industry stakeholders, as studied by Akintoye and Macleod [20]. Previous research by Khodeir and Mohamed [21] indicated the way in which political variable such as unrest situation in Egypt (January revolution in 2011) combined with the construction industry development brought the opportunity for a substantial transformation in Egyptian construction project risk management. Taking forward from these previous researches, the overall aim of the study is to identify and classify the risk in a construction project as a result of Covid-19 in Indonesia. The study also aims to make a replicated study with new data and modified approach based on the previous research by Khodeir and Mohamed [21].

1.1. Risk in construction project

One of the variables in a construction project that needs to be handled is project risk. Project Management Institute (PMI) [22, p.373] delineates risk in a project as *“an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives”*. Another similar definition is described by Raz et al. [19], who maintain specifically about project risk, as *“undesired events that may cause delays, excessive spending, unsatisfactory project results, safety or environmental hazards, and even total failure”*. Hillson and Murray-Webster [23] also concur that *“risk is uncertainty that matters”*, and thus supports the PMI's definition. Likewise, in PMBOK by PMI, it is perceived that project risk could be traced to an association with uncertainty, and it is classified to be ‘known’ and ‘unknown’ risk [22]. The ‘known risk’ could be managed in advance by implementing contingency reserve while ‘unknown risk’ cannot and should be given an allocated budget of general contingency or reserve in risk management [24]. Nevertheless, it should be taken into account in the above definition that uncertainty could not be equalized as the same definition as risk, where the former represents lack of detail about its assessment for occurring and the latter is being predicted and assessed via statistical measurement [25]. Relating to the pertinence of risk, the most challenging standard to be carried out within the project management could be in managing the risk, both on the challenge for the manager in recognizing its root and the action plan as a result of risk consequences [7]. Due to the significant impact of the term and the uniqueness of every project, the related stakeholder such as contractor and sub-contractors must identify the risk in a construction project, manage them accordingly and implement taking

feedback/recommendations from their attorney in order to take corrective action for avoiding negative impact [26].

1.2 Type of risk in construction project

There are many types of risk in a construction project. Risk in project management is classified into two categories according to project-management.com, namely 'most common project risk' (namely cost risks, schedule and performance risks) and 'other type of risk' (namely strategic risks, governance risks, market risks, operational risks, legal risks and risk associated with external hazards [27]). In this literature review, the risk is classified according to PMI in PMBOK [28] and by CIOB in designing building [29] as both classifications share similar traits of risk. Accordingly, there are four types of project risk, namely, technical risk, management risk, commercial risk and external risk [28], which are shown in Figure 1. Meanwhile, moving on to the next classification by CIOB in designing building [29], the classification of risk consists of, 1. project risk which is classified within the project deliverables, 2. business risk which are within the boundary of operating the business project, 3. environmental risk which refers to the neighborhood and environmental aspect that could influence the achievement of project's aim, and finally 4. external risk which refers to the risk which is outside the control of the project boundary such as force majeure occurring in a country.

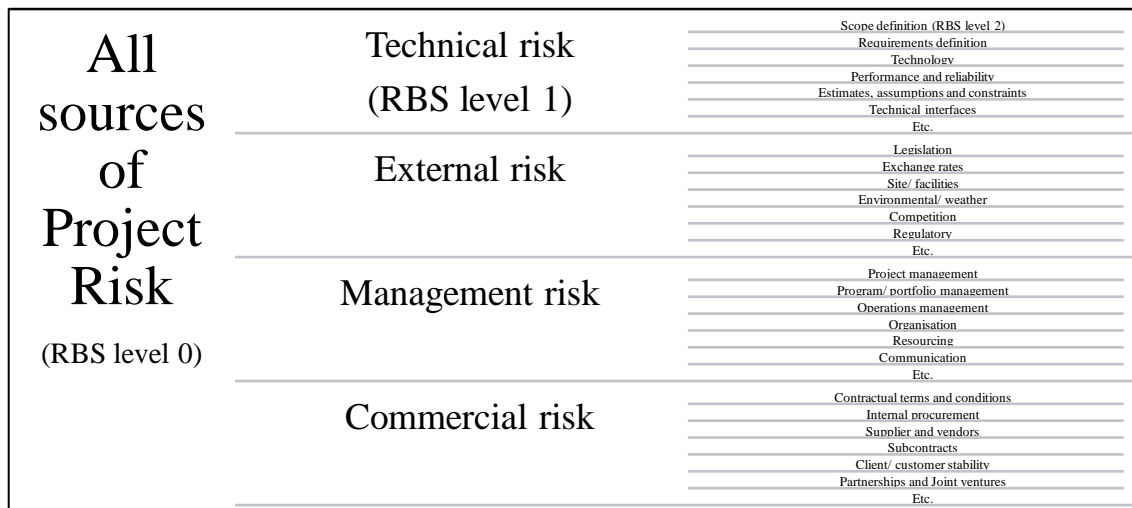


Figure 1 Project risk classification from risk breakdown structure (RBS), adapted from PMBOK by PMI [28,p.406]

1.3 Risk management

When managing a project, there lie several standards to be followed to maintain the construction project objectives in a timely manner. PMBOK by PMI delineates standards in project management into ten scopes, which includes project Risk management [28]. PMBOK [28] delineates risk management in a project as “the processes of conducting risk management planning, identification, analysis, response planning, response implementation and monitoring risk on a project”. The advantage of risk management is to execute proactive actions so that high probability of huge loss could be minimized and it also tries to avoid the additional cost in an optimal way, which is to be expended for risks [8]. In essence, risk management is pertinent for minimizing the impact of negative consequences due to the risk emergence while also playing a role in assisting the related stakeholders either the owner (the project client), the contractors and the consultants or the clients' official representatives to be in the right track of project's objectives particularly the triple constraints [7]. The risk likely impacts the triple constraint of the project, and therefore risk management should be considered as a continuous cycle which needs to be continuously updated and refined during the construction project life-cycle [20].

2. Method

The method which is used in this study is by implementing a questionnaire approach from the related construction industry stakeholders in order to recognize the impact of Covid-19 on construction projects in Indonesia. The questionnaire method utilized as a part of social science now has been implemented outside its realm [30]. This study, therefore, began by identifying the risk which occurs in the project specifically in a construction project, then analyzed their judgement regarding the risks due to the impact of Covid-19 in the Indonesian construction project. The study also has specific objectives which are to classify the risk of Covid-19 and to identify the risk which would have the highest probability to occur as a result of Covid-19. Primary sources are obtained from the respondents via the questionnaires. The risk formula is delineated below.

$$R = P \times I \tag{1}$$

		Threats					Opportunities						
Probability	Very High 0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05	Probability	Very High 0.90
	High 0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04		High 0.70
	Medium 0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03		Medium 0.50
	Low 0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02		Low 0.30
	Very Low 0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01		Very Low 0.10
		Very Low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very High 0.80	Very High 0.80	High 0.40	Moderate 0.20	Low 0.10	Very Low 0.05		
		Negative Impact					Positive Impact						

Figure 2 Probability and Impact Matrix, adapted from PMBOK by PMI [28,p.408]

The methodology is adapted from [21,22,28]. The risk (R) is delineated as the equation of risk probability (P) and the risk impact (I) from PMBOK [21,22,28]. Using the adoption of Likert scales invented by Rensis Likert [31], during the questionnaire, each respondent is given the Likert scale which assesses the impact and probability of each risk, categorized by “very low” to “very high” [22,28]. According to PMBOK created by PMI [28], for quantitative measurements, these Likert scales are then converted into quantified values from very low “0,1” to very high “0,9”; meanwhile for impact value, the scales are very low “0,05” to “very high “0,80” (Figure 2).

For ethical consideration, the data which have been gathered would be kept confidential, and the identity related to the respondents will never be disclosed to the public; the data would only be known and kept securely by the authors. Respondents were informed in advanced before doing the questionnaire and are informed that their participation was on a voluntary basis. The questionnaire distributed at the beginning of July 2020 and collected a total number of 49 completed responses with three double responses from the same respondents. For the sampling of respondents, the background of respondents varied from the lower level to top-level in both public, private construction sector and also a related expert from the academia. In order to ensure the replicability and trustworthiness of the study, we also tested the reliability and validity value. Reliability indicates that there is consistency in the results when data collection is being implemented, of which there is no measurement change [32]. To test the reliability of the questionnaire, we also use Cronbach’s alpha, developed by Cronbach [33]. The Cronbach’s alpha formula [33] is delineated below.

$$\alpha = \frac{n}{n-1} \left(1 - \frac{\sum_i V_i}{V_t} \right) \tag{2}$$

Where:

n = Number of items

V_i=Variance of item scores after weighting

V_t=Variance of test scores

Table 1 [34, n.p] represents the nexus between the value of Cronbach's alpha and its’ internal consistency. According to the table below, the value indicated by smaller than 0.5 is unacceptable while the minimum standard for acceptable Cronbach’s alpha is ≥ 0.7; meanwhile, if the Cronbach’s alpha is ≥ 0.9, the internal consistency is considered to be the best and most reliable.

Table 1 From Glen [34,n.p]

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

The validity test represents the validity of data instruments for measuring the data, and as maintained by Bolarinwa, it consists of face validity, constructs validity, criterion and content validity [35]. In this case, we use face validity where there was a pilot questionnaire examined and assessed by the related expert to identify how valid the questionnaire is to measure the purposes intended to the potential respondents. All the risks variables for questionnaire are adapted and combined from many sources [7,20-22,25,27,44,28].

3. Result and Discussion

Based on the analysis of the questionnaire, there are five highest risks which are identified as a result of the Covid-19 Pandemic on the construction project in Indonesia. From the reliability score by using the Cronbach's alpha in excel spreadsheet, it is indicated that the internal consistency is 0,9553, which indicates excellent score representing the high percentage of reliability and replicability from the data collection.

1. Delayed funding on construction project design (score: 0,2523). The finding is concurrent with the actual implementation in infrastructure projects, as there is a statement from the Minister of Public Works and People's Housing who states that DED (Detailed engineering design) and survey work which are part of non-physical activities are delayed, as reported in Jakarta post by Mufti [15]. It is also due to the fact that there is a budget refocusing and reallocating policy, in which 44,58 trillion Rupiah is being reallocated for Covid-19 handling, from a total budget of 120,2 trillion Rupiah [17]. Finding is also in line with the challenges faced by the infrastructure project, as maintained by the Directorate General of Infrastructure Financing, Ministry of Public Works and People's housing Eko Heripoerwanto, in *Bisnis.com* by Yasa [36] some of which are as follows: 1. There is a challenge for financial close to be fulfilled which is still on the preparatory stage concerning the construction project of a new toll road, 2. There is a slow-down of highway construction during Covid-19 Pandemic, 3. Some crucial decision making is limited due to the implementation of teleconference regarding work activities [36].
2. Delayed on contract progress payment (score: 0,2336). The vice secretary-general of Gapensi (Association of Indonesian National Construction Contractors), Errika Ferdinata stated (in *Bisnis.com* by Gunawan) [37] that there was concern from some of the contractors to take construction project during Pandemic, as Ferdinata further maintained that if the construction project is being funded by bank-loan, then the liquidity will be impacted due to Covid-19 Pandemic; however, for the government-funded project, it is unlikely to occur [37]. For instance, the on-going strategic project such as trans-Sumatera toll road is still being executed by strictly following the Covid-19 health protocol, and it is expected that in the fourth quartal of 2020 the toll road of Pekanbaru - Dumai section project will be completed [38]. However, it is also to be underlined that due to state budget reallocation mentioned earlier [17], next year budget is rearranged for some of the current project [37]. As an example for this, is what occurs in Temef Dam Project in East Nusa Tenggara, where there is a refocusing of the budget from 280 billion Rupiah to 176,7 billion Rupiah; thus it has become a challenge for the project manager to maintain timely progress with less funding [39].
3. Restriction on the import of the construction materials and Construction Project being suspended until further notice (score: 0,2149).The project was also temporarily suspended (in the red zone) due to constraints in the mobilization process and lack of labour and material availability, as stated by the Directorate General of Construction Ministry of Public Works and People's housing Trisasongko Widiyanto (in *detikfinance* by Novika) [40]. However, in the case of Temef Dam project, it has not created a significant impact since it is a Dam project and thus only require a few prefabricated materials [39]. In global comparison, the Pandemic also influences the disruption of supply chain management [10,41,13], in specific the imported construction material and the high possibility of sub-contractors business being closed

down [10]. The disruption of the global supply chain entails a limited number of construction workers, the quarantine protocol from government, and the suspension of manufacturing construction company, which has a possibility of project delay [13]. This argument is supported as the countries which produced the imported material are reported to close or suspend their business such as China [10,42] and Italy [42].

4. Change of working regulation (score: 0,2044). Risk no. 4 was aligned with the Directorate General of Construction Ministry of Public Works and People's housing Trisasongko Widiyanto (in detikfinance by Novika) [40], who stated that large-scale restrictions were a substantial factor in increasing the length of the project, although he further maintained that dispute in construction is still yet to happen as a consequence of Covid-19 [40]. Change of work regulation is also implemented in the way in which there is an additional procedure such as visitor screening and medical check-up for the employees and construction workers in the Temef Dam project [39]. Comparably, according to Mace group [41], it is delineated that visualization of the impact of Covid-19 in construction industry should be implemented by dividing them into two-phase, namely 'the shock' and 'the time bomb'. The report [41] further claims that 'the shock' entails the closing of site construction, lack of worker availability and material and the way in which they could execute the new normal while maintaining the safety procedures. On the other hand, 'the time bomb' reflects the long term action needs to be implemented as the effect is not apparent, and it impacts on the delay of delivery and increased amount of project time and project cost [41].
5. Change of Interest rate and currency fluctuation is on the fifth rank for the significant risk that is likely to occur due to Covid-19 (score: 0,1885). The risk is in line with the report from Deloitte where currency fluctuation will influence the construction project where the international currency is utilized, and the related assets will experience severe impact mainly if there is no prior hedging procedure being executed [43].

4. Conclusion

The study has identified five risks which have the highest possibility to occur in a construction project as a result of Covid-19 in Indonesia, based on the analysis from the questionnaire method. The five highest risks which are likely to occur are as follows: 1. Delayed funding on construction project design, 2. Delayed on contract progress payment, 3. Restriction on the import of the construction materials and Construction Project being suspended until further notice, 4. Change of working regulation, and 5. Change of interest rate and currency fluctuation. The further study will focus in the way in which we could develop a framework model for risk management and preventive measures of these risks adjusted to Covid-19 impact.

5. Acknowledgments

The authors would like to thank all of the respondents who have participated in this research.

6. Conflict of Interest

The authors have no conflicts of interest to declare.

References

- [1] J. (TIME) Ducharme, 'The WHO Just Declared Coronavirus COVID-19 a Pandemic | Time', 11-Mar-2020. [Online]. Available: <https://time.com/5791661/who-coronavirus-pandemic-declaration/>. [Accessed: 18-Jun-2020].
- [2] WHO, 'Coronavirus (COVID-19) events as they happen', *WHO characterizes COVID-19 as a pandemic*, 11-Mar-2020. [Online]. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>. [Accessed: 18-Jun-2020].
- [3] WHO, 'Coronavirus disease 2019 (COVID-19) Situation Report-94 HIGHLIGHTS', Apr. 2020.[Online]. Available: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200423-sitrep-94-covid-19.pdf?sfvrsn=b8304bf0_4. [Accessed: 25-Jun-2020]
- [4] VOA news, 'WHO Expert Believes Wuhan Wet Market Played Role in COVID Outbreak | Voice of America - English', 08-May-2020. [Online]. Available: <https://www.voanews.com/covid-19-pandemic/who-expert-believes-wuhan-wet-market-played-role-covid-outbreak>. [Accessed: 26-Jun-2020].

- [5] Worldometer, ‘Coronavirus Cases’, *Worldometer*, 2020. [Online]. Available: <https://www.worldometers.info/coronavirus/> [Accessed: 23-Aug-2020].
- [6] A. Haleem, M. Javaid, R. Vaishya, and S. G. Deshmukh, ‘Areas of academic research with the impact of COVID-19’, *American Journal of Emergency Medicine*. W.B. Saunders, 2020.
- [7] N. Banaitiene and A. Banaitis, ‘Risk Management in Construction Projects’, 2012. DOI: 10.5772/51460.
- [8] I. N. Norken, I. B. N. Purbawijaya, and I. G. N. O. Saputra, *Pengantar Analisis dan Manajemen Risiko pada Proyek Konstruksi*, 1st ed. Denpasar: Udayana University Press, 2015.
- [9] Ikigai Consulting, ‘What Makes Construction Projects Different? | Ikigai Consulting’, 21-Nov-2014. [Online]. Available: <https://www.ikigaiconsulting.com/insights/what-makes-construction-projects-different>. [Accessed: 24-Jun-2020].
- [10] T. Emmett, ‘COVID-19: the impact on Australian construction projects | Turner & Townsend | Turner & Townsend’, *Turner and Townsend*, 22-Apr-2020. [Online]. Available: <https://www.turnerandt Townsend.com/en/perspectives/covid-19-and-the-impact-on-australian-construction-projects/>. [Accessed: 18-Jun-2020].
- [11] N. . Hamilton, ‘Many Contractors Concerned About Longer-Term Impacts of COVID-19 Crisis, According to Dodge Data & Analytics | Business Wire’, 23-Apr-2020. [Online]. Available: <https://www.businesswire.com/news/home/20200423005151/en/Contractors-Concerned-Longer-Term-Impacts-COVID-19-Crisis-Dodge>. [Accessed: 03-Jul-2020].
- [12] KPMG, ‘Covid-19 Assessment of economic impact on construction sector in India’, May 2020.[Online]. Available: <https://home.kpmg/content/dam/kpmg/in/pdf/2020/05/covid-19-assessment-economic-impact-construction-sector.pdf?r>. [Accessed: 10-Jun-2020].
- [13] J.Huie, S.Farabow (Authors partner), ‘Managing Project Risk Associated with the Coronavirus Outbreak Through Force Majeure Provisions | Seyfarth Shaw LLP’, 04-Mar-2020. [Online]. Available: <https://www.seyfarth.com/news-insights/managing-project-risk-associated-with-the-coronavirus-outbreak-through-force-majeure-provisions.html>. [Accessed: 24-Jun-2020].
- [14] J. Bailey, N. Bouchardie, and I. Madalena, ‘COVID-19: The Current Impact on Construction and Engineering Projects | White & Case LLP’, 14-Apr-2020. [Online]. Available: <https://www.whitecase.com/publications/alert/covid-19-current-impact-construction-engineering-projects>. [Accessed: 24-Jun-2020].
- [15] R. R. Mufti, ‘COVID-19 crisis delays several infrastructure projects - Business - The Jakarta Post’, *The Jakarta Post*, 23-Apr-2020.[Online]. Available: <https://www.thejakartapost.com/news/2020/04/23/covid-19-crisis-delays-several-infrastructure-projects.html>. [Accessed: 16-Jun-2020].
- [16] M. Sukaesih, ‘Analysis: COVID-19 impact on construction sector - Wed, May 6 2020 - The Jakarta Post’, *The Jakarta Post*, Jakarta, 06-May-2020.[Online]. Available: <https://www.thejakartapost.com/news/2020/05/06/analysis-covid-19-impact-construction-sector.html>. [Accessed:16-Jul-2020]
- [17] Biro Komunikasi Publik Kementerian PUPR, ‘Menteri Basuki : Pekerjaan Konstruksi Yang Ditunda Akibat Realokasi Anggaran Pembangunan Infrastruktur Sebesar Rp 44,58 Triliun Akan Jadi Prioritas di Tahun 2021’, 22-Apr-2020. [Online]. Available: <https://www.pu.go.id/berita/view/18184/menteri-basuki-pekerjaan-konstruksi-yang-ditunda-akibat-realokasi-anggaran-pembangunan-infrastruktur-sebesar-rp-44-58-triliun-akan-jadi-prioritas-di-tahun-2021>. [Accessed: 20-Aug-2020].
- [18] Gugus Tugas Percepatan Penanganan Covid-19, ‘Peta Sebaran | Gugus Tugas Percepatan Penanganan COVID-19’, 23-Aug-2020. [Online]. Available: <https://covid19.go.id/peta-sebaran>. [Accessed: 23-Aug-2020].
- [19] T. Raz, A. Shenhar, and D. Dvir, ‘Risk Management, Project Success, and Technological Uncertainty’, *R&D Manag.*, vol. 32, pp. 101–109, Mar. 2002.
- [20] A. S. Akintoye and M. J. MacLeod, ‘Risk analysis and management in construction’, *Int. J. Proj. Manag.*, vol. 15, no. 1, pp. 31–38, Feb. 1997.

- [21] L. M. Khodeir and A. H. M. Mohamed, 'Identifying the latest risk probabilities affecting construction projects in Egypt according to political and economic variables. From January 2011 to January 2013', *HBRC J.*, vol. 11, no. 1, pp. 129–135, Apr. 2015. DOI: 10.1016/j.hbrej.2014.03.007
- [22] Project Management Institute, *A Guide to the Project Management Body of Knowledge*, Third. Newton Square, Pennsylvania: Project Management Institute, 2004.
- [23] D. Hillson and R. Murray-Webster, *Understanding and Managing Risk Attitude - David Hillson, Ruth Murray-Webster - Google Books*, 2nd ed. Aldershot: Gower, 2007.
- [24] Career Academy Com, 'Project Management Professional (PMP)® Exam Prep Course 11-Project Risk Management', *Project Management Professional (PMP)® Exam Prep Course 11 - Project Risk Management Workbook*. [Online]. Available: https://cdn.ymaws.com/www.careeracademy.com/resource/resmgr/Docs/workbook7/PMP_WB11.pdf. [Accessed: 24-Jun-2020].
- [25] Designing buildings, 'Risk in building design and construction - Designing Buildings Wiki', 09-Apr-2020. [Online]. Available: https://www.designingbuildings.co.uk/wiki/Risk_in_building_design_and_construction. [Accessed: 22-Jun-2020]. Note from the webpage: The text is based on 'Risk Management in Construction' by José Cardoso Teixeira, Janusz Kulejewski, Micha Krzemiski and Jacek Zawistowski. The original manual was published in 2011, developed within the scope of the LdV program, project number: 2009-1-PL1-LEO05-05016 entitled "Common Learning Outcomes for European Managers in Construction". and reproduced here in a slightly modified form with the kind permission of the Chartered Institute of Building.
- [26] Suretylearn, 'A Quick Introduction to Construction Risks and Contracting Practices', Jan. 2014. [Online]. Available: http://suretylearn.org/wp-content/uploads/2014/01/M8_SuretyLearn-Construction-Risks-2013.pdf
- [27] Project-management.com, 'Types of Risk in Project Management', 10-Aug-2019. [Online]. Available: <https://project-management.com/types-of-risk-in-project-management/>. [Accessed: 19-Aug-2020].
- [28] PMI, *A guide to the project management body of knowledge PMBOK guide*, Sixth edit. Newton Square, Pennsylvania: Project Management Institute, 2017.
- [29] Chartered Institute of Building (CIOB), 'Risk management - Designing Buildings Wiki', 28-Jun-2020. [Online]. Available: https://www.designingbuildings.co.uk/wiki/Risk_management. [Accessed: 26-Aug-2020]. Note from the webpage: The text is based on 'Business Management in Construction Enterprise' by David Eaton and Roman Kotapski. The original manual was published in 2008. It was developed within the scope of the LdV program, project number: 2009-1-PL1-LEO05-05016 entitled "Common Learning Outcomes for European Managers in Construction", and reproduced in a slightly modified form with the kind permission of the Chartered Institute of Building (CIOB).
- [30] Y. Sun, D. Fang, S. Wang, M. Dai, and X. Lv, 'Safety Risk Identification and Assessment for Beijing Olympic Venues Construction', *J. Manag. Eng.*, vol. 24, no. 1, pp. 40–47, Jan. 2008.
- [31] R. Likert, 'A technique for the measurement of attitudes.', *Arch. Psychol.*, vol. 22 140, p. 55, 1932.
- [32] A. O. Adeniran, 'Application of Likert Scale Type and Cronbach's Alpha Analysis in an Airport Perception Study', pp. 4–5, Jan. 2019.
- [33] L. J. Cronbach, 'Coefficient alpha and the internal structure of tests', *Psychometrika*, vol. 16, no. 3, pp. 297–334, Sep. 1951.
- [34] S. Glen, 'Cronbach's Alpha: Simple Definition, Use and Interpretation - Statistics How To.com Elementary Statistics for the rest of us!' 08-Dec-2014. [Online]. Available: <https://www.statisticshowto.com/cronbachs-alpha-spss/>. [Accessed: 20-Jul-2020].
- [35] O. Bolarinwa, 'Principles and methods of validity and reliability testing of questionnaires used in social and health science researches', *Niger. Postgrad. Med. J.*, vol. 22, no. 4, p. 195, 2015.
- [36] A. Yasa, 'Kementerian PUPR Ungkap Dampak Covid-19 Ke Proyek Pemerintah - Ekonomi Bisnis.com', 28-Jun-2020. [Online]. Available: <https://ekonomi.bisnis.com/read/20200628/45/1258669/kementerian-pupr-ungkap-dampak-covid-19-ke-proyek-pemerintah>. [Accessed: 26-Jul-2020].

- [37] A. Gunawan, 'Sebagian Anggota Gapensi Khawatir Ambil Proyek pada Masa Pandemi - Ekonomi Bisnis.com', 24-Jul-2020.[Online]. Available: <https://ekonomi.bisnis.com/read/20200724/45/1270825/sebagian-anggota-gapensi-khawatir-ambil-proyek-pada-masa-pandemi>. [Accessed: 20-Aug-2020].
- [38] H. P. Lubis, 'Reassessing the New Norm of Infra Development in Sumatera (1H 2020 Performance) . Presented during Webinar "Perencanaan dan Manajemen Proyek Infrastruktur di Kala Pandemi, Departemen Teknik Sipil, Universitas Sumatera Utara - 14 Aug 2020.', 2020.
- [39] A. Zuliansyah, 'Project Management during Covid-19 (Case study Temef Dam Packet II) Presented during Webinar "Perencanaan dan Manajemen Proyek Infrastruktur di Kala Pandemi, Departemen Teknik Sipil, Universitas Sumatera Utara - 14 Aug 2020.', 2020.
- [40] S. Novika, 'Begini Ganasnya Dampak Corona terhadap Proyek Infrastruktur', 12-Jun-2020. [Online]. Available: <https://finance.detik.com/infrastruktur/d-5051410/begini-ganasnya-dampak-corona-terhadap-proyek-infrastruktur>. [Accessed: 26-Jul-2020].
- [41] Mace group, 'COVID-19: Managing the impact and risks on construction | Mace', 07-May-2020. [Online]. Available: <https://www.macegroup.com/perspectives/200507-managing-the-impact-and-risk-on-construction>. [Accessed: 10-Jun-2020].
- [42] EIC, 'COVID-19 and the Global Construction Business | EIC Federation', 2020. [Online]. Available: <https://www.eic-federation.eu/covid-19-and-global-construction>. [Accessed: 19-Jun-2020].
- [43] Deloitte, 'Impact of COVID-19 on infrastructure projects & assets', 27-May-2020. [Online]. Available: <https://www2.deloitte.com/ng/en/pages/finance/articles/the-impact-of-COVID-19-on-infrastructure-projects-and-assets.html>. [Accessed: 17-Aug-2020].
- [44] S. Iqbal, R. Choudhry, K. Holschemacher, A. Ali, and J. Tamosaitiene, 'Risk management in construction projects', *Technol. Econ. Dev. Econ.*, vol. 21, pp. 65–78, Jan. 2015.
- [45] K. Simonson, 'Coronavirus impacts loom but have yet to affect construction inputs or projects', AGC Data Digest, Feb-2020. [Online]. Available: <https://www.idahoagc.org/blog/coronavirus-impacts-loom-have-yet-affect-construction-inputs-or-projects>. [Accessed: 30-Jul-2020].