
THE IMPACT OF THE COVID-19 PANDEMIC ON THE IMPLEMENTATION OF CONSTRUCTION PROJECTS

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ABSTRACT

The COVID-19 pandemic has severely impacted construction projects, leading to delays caused by disruptions in material availability, labor mobilization, supply chains, and project productivity. In Indonesia, these challenges significantly affected the completion time and costs of building projects. This study aims to identify and analyze the dominant factors influencing project delays due to the COVID-19 pandemic and propose effective mitigation strategies. Using a quantitative descriptive method, data were collected through questionnaires and interviews with key project personnel from 30 active building projects of PT. PP (Persero) Tbk during 2020. The Relative Importance Index (RII) was applied to measure the influence of each factor. The results indicate that project productivity was the most influential factor causing delays, followed by material and labor availability, mobilization issues, and poor planning. Risk classification revealed 7 high-risk factors, 5 medium-risk factors, and 1 low-risk factor. The study provides practical mitigation recommendations, emphasizing proactive planning, flexible resource management, and adaptive project scheduling. These findings will support construction companies and policymakers in developing robust risk management strategies to enhance project resilience against future crises.

KEYWORDS

COVID-19, Construction Project Delay, Relative Importance Index, Risk Management, Project Productivity



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INTRODUCTION

In 2020, the world, including Indonesia, was experiencing the COVID-19 pandemic, which impacted all aspects of people's lives (Sebastianus, 2022). In the covid 19 pandemic in India, it was identified that 116.18 million (25 percent) workers were affected by Lockdown 1 and 78.93 million (17 percent) workers were affected by Lockdown 2 so that they were at risk of losing their jobs, in addition to the availability of labor in big cities continued to decline (Estupinan, 2020). In Indonesia, a total of 82.29% of Large and 84.20% of Small and Medium Enterprises

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experienced a decrease in income (BPS, 2020). Many factors cause work disruptions that impact implementation delays caused by the COVID-19 pandemic (Fernando & Zriaitul, 2017). This pandemic has affected the disruption of business operations, supply chains, and funding in the construction industry and ultimately caused unemployment (Anwar et al, 2020). The COVID-19 pandemic has become an additional problem that affects management decisions at all levels. The construction industry cannot ignore the impact it causes, not only now but possibly in the future (Alenezi, 2020a).

COVID-19 is an infectious respiratory tract infection caused by the coronavirus. The novel SARS-CoV-2 virus was first discovered in Wuhan, China 2019. Furthermore, WHO stated that the phenomenon of the COVID-19 outbreak has become a worldwide pandemic (Kompas, 2020).

A drastic decline in trade activities between countries occurred during the COVID-19 outbreak, and there was also a change in the structure of trade networks between countries. A drastic decrease in trade in most of these countries will occur until December 2020 (Vidyaa and K. P. Prabheesh, 2020). The effects of the pandemic on industrial sectors are very diverse, depending on the extent to which different jobs can be done remotely, as well as differences in what types of businesses are allowed and not allowed to continue operating during the pandemic (Cortez, 2020).

The state issued a policy of restricting activities to prevent the spread of the pandemic (Rudi, 2022). So, the level of economic, social, and religious activities during COVID-19 was greatly affected by the disruption of transportation services due to this pandemic (Mogaji, 2020). In addition, the lockdown by the government in dealing with COVID-19 has had an impact on the project stoppage in the infrastructure sector, because workers cannot physically go to the work site and do their work (Jallow et al., 2020).

For reference, in Infrastructure Intelligence (2020), COVID-19 caused a decline in construction productivity in the United Kingdom, resulting in delays in work and cost overruns. The 7% decrease in productivity was due to a lack of labor and physical distancing procedures between workers while working. A 1% decrease in productivity was due to the transfer of design information due to remote work (Minnullina et al., 2020). Material availability and delayed delivery of materials led to a 7% decrease in productivity (Mishra, 2020). In the city of Leicester, a third to half of the work can continue during lockdown conditions (Febe, 2024) One-third of these jobs are in highly vulnerable sectors so that the next possible impact will be increased unemployment (Cartwright et al., 2020).

The construction industry in Taiwan, according to FTI Consulting Asia Pacific (2020), experienced delays in various projects. The delays were due to the unavailability of materials and labor. (Marioga et al., 2021) The reduced mobility of local construction workers generally causes this shortage of labor and materials. According to Belt and Road News (2020), construction companies in Africa experience a shortage of local skilled workers from the region, as they are unable to travel to project sites due to travel bans, quarantines, and isolation. (Khairani & Supriyadi, 2021) The current slowdown in the world economy has also had serious impacts on Indonesia's economic growth (Nasution, DA, et al., 2020).

Infrastructure and property projects that have been postponed due to the COVID-19 pandemic have made the construction materials industry cautious in developing strategies. An uncertain market makes operations not run normally (Kontan, 2020).

One example was construction activities at the Banten Provincial PUPR Office, which were temporarily suspended (postponed work) until there was an order and further information from the government (Public Relations of PUPR, 2020). The impact of COVID-19 also touches the workforce in various sectors affected by COVID-19, whose characteristics are quite diverse (Rahman et al., 2020).

On December 30, 2020, the cumulative confirmed COVID-19 cases in Indonesia amounted to 735,124, with 109,439 active cases, or 14.9%. The number of patients recovered from confirmed positive was 603,741 (82.1%), and the number of deaths was 21,944, or 3.0% of the confirmed positive (<https://covid19.go.id>).

Decree of the Governor of East Java Number: 188/202/KPTS/013/2020 of 2020 concerning Guidelines for Large-Scale Social Restrictions in Handling Coronavirus Disease 2019 in the City of Surabaya, Sidoarjo Regency, and Gresik Regency. The laws and regulations issued by the President of the Republic of Indonesia, Ministers, and Governors are then used as a basis by the Regional Head and the work units under him as a basis for issuing regulations as a follow-up to efforts to prevent the spread of Covid 19 at the regional level and ministerial work units.

Delays in construction projects increase the time to complete the planned project. Untimely completion of work results from unachieved productivity levels and will ultimately result in cost overruns. The impact of such project delays is costly and often leads to disputes and claims Sayed et al. (2017)

Variables in the implementation of projects that contribute significantly to the delay in implementation are materials, labor, equipment, and finances (Parviz A. & Koushki Nabil Kartam, 2004). Still, according to Parviz (2004) in his research, projects that experience significant delays and large cost overruns are caused by delays in the delivery of construction materials. The implementation time of a construction project is greatly influenced by the availability of materials in the field; the need for materials to be used must be calculated periodically to provide stock in the field (Ismael, 2013).

Insufficient stock of basic materials will result in delays in ongoing projects. The occurrence of construction delays is also influenced by the magnitude of supply chain disruptions (Panova & Hilletoft, 2018). The supply chain in the construction sector is very dynamic and changes over time, so it must be able to adapt to changes in demand parameters (Pan et al., 2011).

One of the significant impacts that occurred due to the COVID-19 pandemic was the delay of the project (Gamil, Y., & Abdulsalam Alhagar, 2020). During the COVID 19 pandemic, the construction sector, especially projects, experienced many delays and delays, due to restrictions on the movement of goods and reduced material supply, then the impact of labor also emerged due to the fear of gathering to avoid the spread of the virus among the workforce (Gamil, Y & Abdulsalam

Alhagar, 2020). According to (Dimyati & Nurjaman, 2014), project management is a process of planning, organizing, and leadership in controlling existing members and resources to achieve the specified goals (Islamiati & Suwandari, 2021). Meanwhile, project management aims to find the best method so that existing resource management can get maximum results (Hansen, 2020).

According to Husen (2010) The resources used in the project must be carefully considered: labor, equipment, materials, and working capital. Aspects that need to be considered in determining the quantity of these resources include:

1. The availability of the number of resources according to the needs.
2. Finance is used to pay for the resources to be used.
3. Productivity level
4. The capabilities of the resources used.
5. The effectiveness of the resources to be used.

The functions of the project management system (Dimyati & Nurjaman, 2014) are as follows:

1. Planning aims to make decisions on the management of data and information that will be carried out in the future,
2. Organizing aims to unite the activities of members, who have their own and interconnected activities, and interact with their environment to achieve organizational goals,
3. Actuating, aiming to coordinate all members of the organization in carrying out activities,
4. Controlling, aiming to measure the quality of analysis and evaluation of activities.

Problems that generally occur at the project site regarding the implementation of the work are due to improper material management (Madhavi, 2013; Minnullina et al., 2020; Mishra, 2020; Mogaji, 2020; Muhwezi et al., 2014). Material management factors include inventory, material purchase, and procurement, which are generally in the procurement cycle (Madhavi, 2013). Furthermore, poor construction labor productivity is also one of the causes of problems in the implementation of construction projects; this is very important for the performance of construction projects (Alaghbari et al., 2019).

Risk management has a different meaning for everyone, but in general, the term refers to the management of anything that can jeopardize the achievement of organizational goals (Lazuardi & Gigih, 2015). This includes legal liability risks, financial risks, workplace safety, fraud, and data security (Shellie, 2020). In addition, risk management also includes the identification, evaluation, and prioritization of risks (defined in ISO 31000 as the impact of uncertainty on objectives), followed by the coordinated and economical deployment of resources to minimize, monitor, and control the likelihood or impact of adverse events (Hubbard, 2009). Managing risk is a strategic tool to benefit from important initiatives implemented in an organization (Srinivas, 2016).

Risk mitigation is carried out against risks that have high value. Mitigation steps are taken to reduce the possibility of risk occurrence and also the impact of risks that can occur Each level of risk has a different handling, at level I risk, namely risks that can threaten the achievement of the company's goals risk management is

carried out by avoiding (avoid) which means avoiding risks by not carrying out activities or stopping activities that increase risk (Kum et al., 2019). In level II risk, a dangerous and rare risk, risk management is carried out by sharing and dividing the risk faced with other parties. Level III risk is a risk that occurs routinely by handling risks by reducing (reduce), which means reducing the possibility and impact of risks, for example, by improving procedures, making new policies, replacing or buying tools, and others. In level IV risk, which is a risk that is not dangerous, risk management is carried out by accepting (accepting), which means accepting the level of risk that occurs and is still within the limit of risk tolerance, and maintaining or managing so that it does not develop to a high level.

The COVID-19 pandemic has significantly disrupted the construction sector, causing widespread delays in project implementation, supply chain disruptions, and productivity declines (Sumo, 2019). In Indonesia, the pandemic exacerbated existing challenges in material availability, labor mobilization, and project scheduling, resulting in time and cost overruns. Despite ongoing efforts, many construction projects struggled to adapt to new health protocols, limited working hours, and logistical constraints, seriously impacting project completion and economic growth.

The urgency of this study lies in the critical need for effective risk management strategies to mitigate the impacts of future pandemics or similar crises on construction projects. Understanding the dominant factors influencing project delays is essential for developing proactive mitigation plans, improving project resilience, and maintaining productivity under adverse conditions. Additionally, the construction sector's pivotal role in national economic recovery necessitates a strategic approach to managing disruptions caused by unforeseen global events. Moreover, as digital transformation and remote work become increasingly prevalent, construction companies must adopt adaptive management practices that ensure project continuity while complying with health regulations. The development of comprehensive frameworks to manage pandemic-induced risks will not only enhance project success rates but also safeguard the sector's contribution to economic development.

Previous studies, such as Gamil & Alhagar (2020), emphasized the impact of the COVID-19 pandemic on construction project delays due to labor shortages and material supply disruptions. Similarly, Alenezi (2020b) found that productivity loss, limited mobility, and regulatory restrictions significantly hampered construction activities in Kuwait. In Indonesia, research by Awab et al. (2021) identified key delay factors, including project funding issues, logistical challenges, and lack of preparedness for health crises, further highlighting the need for robust risk management frameworks.

Sambasivan and Soon (2007) explored delay causes in the Malaysian construction industry, identifying factors such as poor material management and labor inefficiency as critical contributors to project setbacks. Ismael (2013) further examined how insufficient material stock and supply chain issues directly influence project timelines and cost overruns, emphasizing the importance of efficient resource planning and coordination. Studies by Panova and Hilletoft (2018) also

underlined the significance of dynamic supply chain management in mitigating construction project delays.

However, existing research often focuses on general factors causing project delays, with limited emphasis on the unique challenges of pandemic conditions. There is a lack of comprehensive empirical studies that systematically analyze the specific impacts of COVID-19 on construction project implementation in Indonesia, particularly regarding the relative importance of various risk factors and the effectiveness of mitigation strategies employed during the crisis.

This study offers novelty by applying the Relative Importance Index (RII) method to quantify and rank the dominant factors influencing construction project delays during the COVID-19 pandemic. By focusing on empirical data from multiple projects of PT. PP (Persero) Tbk, this research provides a structured analysis of risk levels and offers actionable mitigation strategies tailored to pandemic-related disruptions in the Indonesian construction sector.

RESEARCH METHOD

This study uses quantitative methods and approaches, where the data used is data from the results of questionnaires to respondents to explain the existing problems. From the data obtained, analysis and discussion were then carried out to get results and conclusions (Sugiyono, 2018). The case study that is the object of this research is the impact of the COVID-19 pandemic on building construction projects in Indonesia. The research methods used are descriptive and explanatory. The descriptive method describes the problem in detail, resulting in a pattern of the issues affecting the impact of the COVID-19 pandemic on construction projects. Meanwhile, the explanatory method is to explain why these problems can occur.

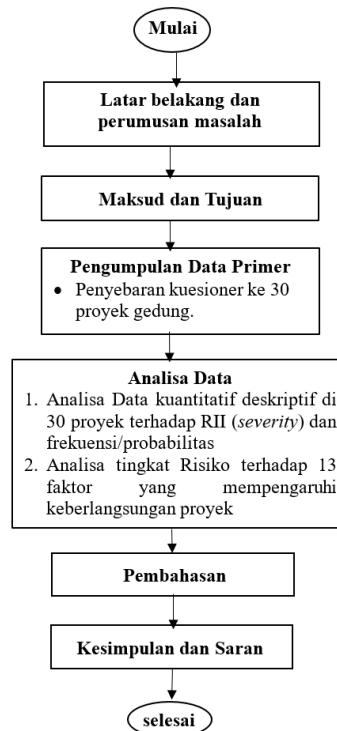


Figure 1. Author's Research Steps

This research uses primary data, which is obtained directly from the original source. This data can take the form of opinions or the results of observations on a certain object, activity, or event. This study obtained primary data through interviews and questionnaire distribution with parties directly involved in the project to be researched.

The resource persons who will be given questionnaires and interviews are key building project personnel from PT. PP (Persero) Tbk, with the positions of Project Manager (PM), Site Engineering Manager (SEM), Site Operational Manager (SOM), or Site Administration Manager (SAM). The projects that will be the object of this study amount to 30 (thirty) building projects of PT. PP (Persero) Tbk is still active and running from March 2020 to December 2020.

The questions that will be asked of the resource persons include matters related to the impact of the COVID-19 pandemic on the implementation of the project in question. The scope and matters that will be asked of the resource persons to be appointed are as follows:

Project administration data,

The impact of the COVID-19 pandemic on the delay in implementation by owners, PSBB policy from the local government,

Restrictions on working hours during the pandemic,

Implementation of health protocols in the project,

Origin of materials for the project needs,

Availability of materials in the project during the pandemic,

Disruption of material delivery to projects during the pandemic

The cause of the interruption of material delivery to the project,

Origin of the workforce,
Availability of labor in the project,
Disruption of labor mobilization during the pandemic,
Causes of disruption of labor mobilization to the project site,
Delay in the implementation of the work as a whole,
Project time addendum

The building project of PT. PP (Persero) Tbk, active from March 2020 to December 2020 and will be the object of the research, has different locations with a minimum contract value of 40 billion Rupiah. From March 2020 to December 2020, this project was still being implemented. The list of research projects is displayed according to the project list.

Data collection in this study used a questionnaire and interview methods. The interview was conducted with direct questions and answers to resource persons from 30 building projects of PT. PP (Persero) to obtain the main data and the complementary data. The respondent as a resource person is one of the key personnel (Project Manager, Site Engineering Manager, Site Operational Manager, or Site Administration Manager) in the project to be researched. The Likert scale measures the attitude, opinion, and perception of a person or a group of people towards a situation or phenomenon. The Likert scale used in this study uses a scale of 5 assessment weights.

To analyze the factors and components of projects affected by the COVID-19 Pandemic, the *Relative Importance Index* (RII) or IKR (Relative Importance Index) method was used. The RII method is used to determine the level of influence of factors from variables that have been conceptualized based on the level of importance of each respondent; the scale used is 1 to 5. This study used RII to measure the dominant factors due to the COVID-19 pandemic, which resulted in disruptions in the implementation of building projects. *The Relative Importance Index* (RII) has the following equations:

$$RII = \frac{\sum W}{A \times N}$$

Where :

RII = *Relative Importance Index* (IKR)
W = Total ratings from respondents / participants
A = Highest scale (In this study: 5)
N = Total number of respondents/participants

The variable with the highest value is given a rank of 1 (one), and so on with the lowest IKR or RII value in order. If there are two or more of the same IKR or RII values, then the ranking is determined by summing the rankings that represent it and dividing by the number of variables that have the same value. This analysis method will be very useful to identify the ranking of respondents and priority members for the *study variables*.

RESULT AND DISCUSSION

Impact & Probability Analysis

The data processing carried out in this study uses RII (Relative Importance Index) analysis based on data from 32 projects in the building division of PT. PP (Persero) Tbk. The RII (Relative Importance Index) method is used to determine the level of influence of factors from the variables that have been conceptualized based on the level of importance of each respondent; the scale used is 1 to 5. The results of the RII analysis can be seen in the following table:

No	Pengaruh Covid 19 terhadap Faktor yang menentukan berlangsungnya pelaksanaan proyek	Skala Penilaian					RII	Rangking
		1	2	3	4	5		
1	Keberlangsungan pelaksanaan proyek	2	13	9	7	1	0,550	3
2	Waktu pelaksanaan proyek	9	6	10	5	2	0,506	6
3	Ketersediaan tenaga kerja	5	11	12	2	2	0,506	6
4	Ketersediaan material	7	13	7	3	2	0,475	8
5	Mobilisasi dan transportasi	5	11	8	7	1	0,525	4
6	Ketersediaan alat dan <i>sparepart</i>	9	11	8	2	2	0,456	10
7	Produktivitas proyek	2	10	14	1	5	0,581	1
8	Jam kerja proyek	7	7	10	8		0,519	5
9	Biaya Proyek	12	7	5	5	3	0,475	8
10	Cash flow proyek	10	9	8	3	2	0,463	9
11	Perencanaan dan penjadwalan	7	10	3	4	8	0,575	2
12	Legal issues	13	12	5	2		0,375	11
13	Kecepatan keputusan dari owner / konsultan MK	7	12	8	2	3	0,488	7

Figure 2. Results of the RII analysis assessment score on the Project

Based on the results of the RII analysis, it was obtained that the score of rank 1 is the productivity factor. This shows that project productivity is the factor that has the most influence on the delay in work progress during the COVID-19 pandemic. The research on the 13 variables of the influence of COVID-19 on the factors that determine the implementation of the project that has been carried out will then be compiled into a tabulation of the relationship of the variables with 30 projects, as well as some evidence from several influential factors. The tabulation results show the influence of COVID-19 on the implementation of several building projects at PT. PP (Persero) Tbk is known that 32 projects significantly influence project productivity factors, planning and scheduling, mobilization and transportation, project implementation time, labor availability, material availability, and legal issues. These factors can be seen from *the evidence* attached to the S curve, lockdown regional regulations, and claim letters from vendors/subcontractors.

Risk Level Analysis

Then, after obtaining the RII value as the impact value of 30 different projects and tabulating the frequency/probability of the influence of COVID-19 on 32 projects, the author can formulate the risk value by comparing the two indicators (Mulyarko, 2015).

From the table above, it is found that the risk value in the low category is legal problems due to COVID-19 related to the implementation of construction projects. This also reflects the severity index (SI) value and the frequency (frequency) of the

hazard, which is low. In addition, 5 factors were obtained that were included in the medium category, and 7 factors that were included in the high category.

4.3 Risk Response Discussion & Recommendations

In line with what happened in the project area, when the COVID pandemic occurred, some areas' working hours were limited, and COVID protocols were added, causing the project to slow down its progress to follow the applicable legal procedures and regulations. Therefore, when the author looks at the quantitative results of low risk of legal issues, the project team has followed the relevant legal procedures. In addition, if you look at it from the owner/MK side, the restriction hampers decisions (Araya, 2020).

In terms of materials and tools, it can be seen that in the news media in 2019, Krakatau Steel lost money due to a decrease in revenue due to the pandemic, which, of course, the steel company had to reduce the number of workers to improve cash flow (Anggi & Viktor, 2021). In addition, the shortage of materials, tools, spare parts, and labor availability is caused by 3rd parties such as subcontractors and suppliers who also experience restrictions on working hours and the number of workers, thus affecting production (suppliers & subcontractors) and the number of workers (subcontractors). The same is the case for transportation and project teams, who experience problems with exports due to the reduction in the number of human resources (Bowles et al., 2015).

Project planning/scheduling when a force majeure occurs, such as a pandemic, causes a sequence of work that changes according to these conditions. Decreased project productivity is caused by the specialization of work that cannot be applied optimally due to the limited number of people in one project. According to the journal, work specialization is the division of work activities into sorted tasks (Stephen, 2013).

Everyone's work is specialized in one part of the work activity, so the work results increase. In addition, job specialization will develop employees to become experts in their fields, which leads to increased work effectiveness (Cahyani, 2019).

Of course, when there is a decrease in project productivity, it will cause a series of problems, such as project delays that cause poor project cash flow and increased costs, and finally, failure to implement the project (Bsisu, 2020). Therefore, researchers have formulated risk response recommendations to avoid/reduce risks if a similar pandemic occurs.

No	Uraian Faktor	Tingkat Risiko	Tingkat Risiko	Jenis Risk Response	Rekomendasi Respons Risiko
1	Terlambatnya proyek	Tinggi (15)	15	Reduce	Mitigasi atas terlambatnya proyek adalah dengan cara melakukan sequencing dari awal hingga akhir untuk melakukan overlap pekerjaan yang dapat dilakukan dan mengurangi durasi proyek secara menyeluruh
2	Ketidaksediaan tenaga kerja	Tinggi (15)	15	Reduce	Manajemen sumber daya manusia (MSDM) diperlukan oleh perusahaan dalam memitigasi kurangnya tenaga kerja akibat Covid-19. Perusahaan dapat melakukan alokasi SDM sesuai kebutuhan proyek masing-masing.
3	Kekurangan material	Tinggi (15)	15	Avoid	Hal ini dapat dimitigasi dengan cara melakukan perencanaan pengadaan yang tepat dan menggunakan prinsip keagihan yaitu <i>just in time</i> dan juga <i>first in first out</i> untuk menghindari terjadinya kekurangan material.
4	Gangguan mobilisasi & transport	Tinggi (15)	15	Avoid	Dengan adanya gangguan mobilisasi dan transportasi tentunya pergerakan proyek juga semakin terbatas, oleh karena itu manajemen waktu proyek harus dilaksanakan dengan baik, dengan cara <i>schedule</i> pekerjaan yang dibuat menyesuaikan terhadap <i>constraints</i> atau <i>threats</i> yang ada.
5	Produktivitas proyek menurun	Tinggi (15)	15	Reduce	Penurunan produktivitas harus segera dimitigasi oleh tim proyek tentunya dengan cara melakukan <i>Root Cause Analysis</i> yang memiliki banyak metode seperti <i>ishikawa diagram</i> , <i>5 whys</i> , dsb terhadap penurunan produktivitas proyek.
6	Perencanaan/penjadwalan buruk	Tinggi (15)	15	Avoid	Perencanaan yang buruk dapat dicegah dengan cara melakukan manajemen waktu yang dibantu dengan analisa CPM atau disebut juga dengan <i>Critical Path Method</i> untuk melakukan perencanaan yang baik dengan menjaga jalur kritis proyek.
7	Jam kerja proyek berkurang	Tinggi (12)	12	Reduce	Untuk melakukan mitigasi terhadap faktor berkurangnya jam kerja dapat diatasi dengan cara peningkatan <i>resources</i> / <i>crashing</i> maupun <i>overlapping</i> / <i>fast tracking</i> .
8	Kegagalan pelaksanaan proyek	Sedang (9)	9	Avoid	Kegagalan pelaksanaan proyek dapat dimitigasi dengan cara selalu melakukan update <i>risk register</i> sebagai pedoman tim proyek mencegah terjadinya risiko kegagalan proyek.
9	Ketidaksediaan alat dan sparepart	Sedang (9)	9	Avoid	Ketidaksediaan alat dan <i>sparepart</i> merupakan salah satu risiko tim proyek yang dapat dimitigasi dengan cara <i>scheduling long lead item</i> untuk mencegah runtutan <i>delayed schedule</i> .
10	Biaya Proyek meningkat	Sedang (9)	9	Avoid	Peningkatan biaya proyek harus segera diatasi mengingat bahwa salah satu objektif proyek adalah aspek biaya. Hal ini dapat dimitigasi dengan cara selalu melakukan <i>cost control</i> dan melakukan update <i>cost baseline</i> selama berjalannya proyek.
11	Memburuknya Cash Flow	Sedang (9)	9	Avoid	Mitigasi dari faktor ini dapat dilakukan dengan cara melakukan komunikasi yang intens dengan owner proyek selaku pihak yang akan membayar penyedia jasa (kontraktor). Komunikasi ini bertujuan untuk mencegah ketidakpastian dalam pembayaran oleh owner yang dapat mengancam <i>cashflow</i> proyek.
12	Keputusan Owner/MK lambat	Sedang (9)	9	Transfer	Keputusan pihak owner yang lambat harus segera dimonitor ketika melakukan rapat monitoring & evaluasi mingguan. Isu-isu mengenai keputusan penting harus segera dibawa sebagai pembahasan agar owner dapat mempertanggungjawabkan dikemudian hari apabila ada beberapa keputusan yang lambat.
13	Permasalahan legal	Rendah (2)	2	Avoid	Melakukan analisa prosedur-prosedur dan peraturan hukum yang berlaku terkait pekerjaan ketika masa pandemi berjalan mengingat banyak peraturan baru yang dikeluarkan oleh pemerintah maupun pihak-pihak yang memiliki <i>power</i> atau <i>key stakeholder</i> pada proyek yang dilaksanakan.

Table 3. Risk Response Recommendations to Risk

CONCLUSION

The research and interviews conducted on building projects by PT. PP (Persero) Tbk during the COVID-19 pandemic concluded that several key factors were significantly affected, including project sustainability, implementation time, labor and material availability, mobilization and transportation, availability of tools and spare parts, productivity, working hours, project costs, cash flow, planning and scheduling, legal issues, and decision-making speed by owners or consultants. The Relative Importance Index (RII) analysis revealed that project productivity was the most influential factor causing delays during the pandemic. Risk level classification showed one low-risk factor (legal issues), five medium-risk factors (including tool and spare part unavailability, increased costs, and slow decision-making), and seven high-risk factors (such as poor planning, project delays, labor and material shortages, and decreased productivity). The study offers mitigation strategies for

future crises, emphasizing proactive risk management. For future research, conducting a more detailed analysis of the cost implications of reduced productivity and exploring multiple case studies on the effectiveness of risk mitigation strategies in similar projects is recommended. Additionally, longitudinal studies examining the long-term impacts of pandemic-induced disruptions on project performance and supply chain resilience in the construction sector would provide valuable insights for more robust crisis preparedness frameworks.

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