Impact of Pandemic Measures on Construction Project Performance in Indonesia

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Abstract—
Covid-19 has resulted in recession and economic downturn. In Indonesia, the pandemic and its measures pose challenges for construction companies. This study aims to identify the impact of the Covid-19 pandemic measures on the performance of construction projects in Indonesia. This study identifies five potential factors which affect project performance, namely: (1) challenge in implementing social distancing, (2) movement restrictions, (3) challenge of working from home, (4) planning for limiting the number of workers, (5) continuous use of PPE. A cross-sectional survey is performed with targeted respondents of top-level management of Indonesian construction firms. The primary analysis was conducted by using Partial Least Square (PLS). Results indicate that overall construction has two variables affect project performance and industrial construction has three variables affect project performance. This result is essential for the top-level management to ensure their awareness of factors that affect performance on construction and facilitate the construction players to overcome the five factors mentioned in this paper.

Index Terms—*construction, pandemic, performance, project.*

I. INTRODUCTION

In December 2019, there was a new outbreak caused by Corona Virus Disease 19 (Covid-19). Since spreading throughout the country, the Covid-19 pandemic has had very severe consequences [1]. The emergence of Covid-19 caused many industries to be closed, and a lockdown policy was implemented. Most of the employees lost their jobs, and most small companies could not pay the salary during the lockdown policy [1].

In 2021, the case of Covid-19 in Indonesia had increased significantly. The Ministry of Health of the Republic of Indonesia, on December 26, 2021, reported that 4,261,759 people were confirmed positive for Covid-19. The number of patients who recovered was 4,113,049 people, the number of patients who died was 144,055, and the case fatality rate was 3.4%.

Based on data from the Central Statistics Agency (BPS), the growth of Gross Domestic Product (GDP) in the second quarter was at minus 5.39% (year on year), and in the second quarter is at minus 4.52% (year on year) [2].

The decline in the construction sector makes this sector important for research. Business activity in the construction sector in Indonesia in the first quarter showed signs of contracting growth with WNB (Weighted Net Balance) of 0.08%, lower than 0.66% in the previous period [3].

As a result of the uncertainty of the current situation, the impact of the Covid-19 pandemic being faced by the construction industry is not enough to be identified only from the economic aspect. In addition to the financial part, there are many impacts faced by the construction industry due to the Covid-19 pandemic. In construction, problems that come will affect the performance of project completion [4]. Project performance in construction is considered an indicator of project management's success or failure.

Therefore, a study is needed to examine the impact of pandemic measures on project performance.

II. LITERATURE REVIEW

II.1 Variables Identified in Previous Research

Past studies identified several variables which affect construction performance, as seen in Table 1.

TABLE 1. Variables Identified in Previous Research

		References										
No	Impact Pandemic on Construction Industry	(Alsharef, 2021)	(Ogunnusi, 2020)	(Yadeta, 2020)	(Osuizugbo, 2020)	(Shibani, 2020)	(Ghandour, 2020)	(Stiles, 2020)	(Abdullah et al., 2021)	(Hepburn et al., 2020)	(Simpeh, F., et al, 2021)	(Zhimin et al., 2020)

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No	Variable											
1	Challenge due to implementing social distancing	v	v	v	v	v	v	v				
2	Level of movement restriction during the pandemic (lockdown)	v		v	v	v	v					
3	Challenge due to working from home	v	v	v			v					
4	Level of planning limiting the number of workers		v					v	v	v		v
5	Level of Continuous Use of Safety Personal Protective Equipment (PPE)	v		v	v	v	v	v			v	

II.1.1 Challenge due to implementing social distancing

The challenge of implementing social distancing is the most common variable in previous research. Social distancing is one of the central policies widely implemented after the Indonesian state was affected. The implementation of social distancing in Indonesia, according to [5], is complicated due to cultural issues.

II.1.2 Level of Movement Restrictions During Pandemic (Lockdown)

Restrictions on movement during the pandemic are the second most common variable after social distancing. The restriction reduces mobility, which resulted in the closure of many industries.

For construction projects, lockdown means delays for equipment supply and delivery, as well as material shortages [6]. There is a scarcity of materials to support ongoing projects and fluctuations in material prices [1]. Thus, in effect, it resulted in significant scheduling problems.

II.1.3 Challenges due to working from home

The Ministry of PUPR issues Ministerial Instruction No. 02/IN/M/2020 regarding the protocol for preventing the spread of Covid-19 which contains the mechanism for organizing construction. The instruction was then implemented by construction companies, both at the head office and project operations, one of which was the implementation of Work from Home. The WFH policy creates several challenges to completing projects in teams and communication skills that affect the quality of a project [7].

II.1.4 Level of planning limiting the number of workers

Limiting the number of workers is the main factor that requires employees to work from home. Research conducted by [8] states an increased frequency of requests for employee leave due to concerns when traveling to the office by public transportation. The rules imposed by the government on several construction sectors are employees who are allowed to work from the office or Work from Office (WFO) a maximum of 50 percent so that restrictions on the number of workers to come to project sites are getting tighter. The main factor in the challenge in implementing planning for limiting the number of workers in this study is that many countries globally, especially in Indonesia, have adopted a planning policy for restricting the number of workers.

II.1.5 Level of Continuous Use of Safety Personal Protective Equipment (PPE)

An essential policy in the workplace, especially projects that require teams to work together. Research [9] stated that 24.6% believed that Personal Protective Equipment (PPE) for COVID-19 infection control would be fully available in the workplace. Research by [10] states that in Indonesia, the ability of the public to understand how to handle the Covid-19 pandemic is considered very low. Construction companies often ignore the concept of occupational safety and health (K3), which is one aspect of labor protection and is a fundamental right of every worker. It can be seen that the importance of Personal Protective Equipment (PPE) in the country globally, but awareness of construction in Indonesia does not yet exist.

III. THEORETICAL WORKS

III.1 Theoretical framework

The framework of this research is shown in Figure 1. The independent variable (X) was taken from several previous research. Meanwhile, the project performance (Y) in the construction industry domain was adopted from previous research.
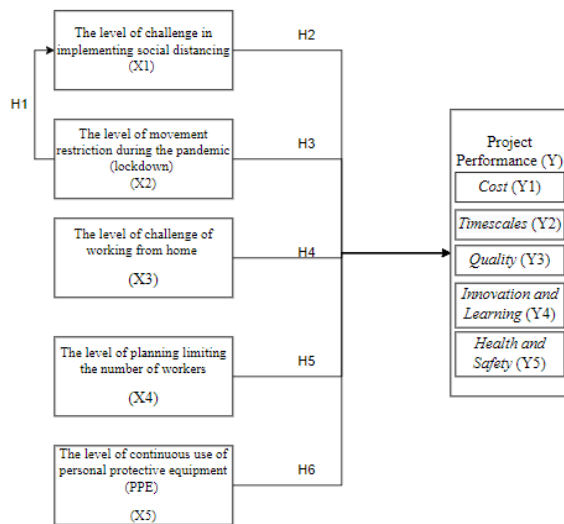
FIGURE 1. Research Framework

III.2 Hypothesis

The initial hypothesis of the research is as follows:

III.2.1 H1: The level of movement restrictions during the pandemic (lockdown) has a positive effect on the level of challenge in implementing social distancing.

Lockdown measures are very effective means of social distancing and ultimately alleviating pandemic severity [11]. According to [11], different lockdown measures implemented in affected countries influence pandemic severity and social distancing (i.e., mobility). The result is adopting strict lockdown measures (e.g., restriction on public gathering, workplace closing, and stay-at-home order) significantly reduces mobility at transit stations, retail and recreation facilities, and workplaces increases time spent near one's home, all of which entailing people to stay home and avoid unnecessary travel. For construction companies, the covid-19 pandemic has resulted in grounding of many projects due to lack of construction materials because of lockdown that made the supply of materials impossible [12].

III.2.2 H2: The level of challenge in implementing social distancing has a negative effect on project performance.

Social distancing policies in a workplace will carry out work from home policies. The impact of social distancing policies allows project completion to be delayed [13]. Social distancing policies require all workers to avoid social gatherings [14]. Some companies cannot hire workers to participate in some jobs. The reduced number of the project management team also has impact on construction work. The more fewer number of workers, the longer it will take to realize each stage of construction [14].

III.2.3 H3: The level of movement restriction during the pandemic (lockdown) negative effects on project performance.

The issue of lockdown alone within establishment has impacted a lot of things negatively; in terms of movement of workers to work, movement of materials, movement of everything that has to do with job. Enactment of regulations to restrict human movement is against construction industry resources. All the workers and technical engineers need to nearly work on-site either to perform activities or to monitor the work is done correctly. MCO as lockdown alternatives has given a lot of negative impacts towards the project success whereby the contributing factors to project success such as time, cost, and resource availability are affected [15].

III.2.4 H4: The level of challenge of working from home has a negative effect on project performance.

Work from Home (WFH) requires workers not to come to office by face to face with other workers. The WFH situation during the Covid-19 pandemic will certainly provide a change in the working atmosphere for workers. Obstacles that can affect the implementation of WFH are the absence of work and communication tools, lack of coordination, "domestic" environmental disturbances in the household, and so on. Process to communication management on a project in accordance with PMBOK requires an intense exchange of information and project reports [16]. Communication will be difficult to achieve if there are restrictions on direct communication and interaction within a project team.

III.2.5 H5: The level of planning limiting the number of workers has a negative effect on project performance

Restrictions on the number of employees working on the project because occupational health and safety (K3) policy due to the Covid-19 pandemic has been implemented in nine countries including Indonesia, Malaysia, Singapore, India, Taiwan, New Zealand, Australia, Japan, England, and America. A number of workers are considered to have a high impact on project performance [17]. Lack of availability local workers a has resulted in a high demand for labor outside region and high labor wages. Overburdening may have adverse implications on their productivity because wellness compromises which negative implications on project [14].

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III.2.6 H6: The level of continuous use of Personal Protective Equipment (PPE) has a positive effect on project performance.

According [13], Covid-19 pandemic requires project managers to focus on the safety and health of employees. The occupational safety and health (K3) program carried out by contractors is the basis for building a program system for workers and employers to prevent accidents and diseases due to work relations in the work environment. Availability of all PPE, construction safety equipment, and the implementation of infection control policies are important things to attention [9]. According [12], general 76.7% of respondents agreed that contractors in the construction industry had equipped their PPE while working to prevent Covid-19.

IV. METHOD

This study used a project analysis unit. Selected project is a construction project in Indonesia. A purposive sampling technique was used in this research in which consideration of certain characteristics, in accordance with the criteria that the researcher wants [18]. This research used a questionnaire survey with the population in this study were project leaders and managers who came from top-level management from service providers or contractors who carried out construction projects and were being affected by the covid-19 pandemic.

Questionnaires were distributed to 265 respondents by online (linkedin and social media) and offline distribution. Responses were obtained 144 respondents with total response rate of 56%. Classifications respondent resulted in Table 2. Number of respondents who filled out the questionnaire was 62 respondents from the construction industry, 12 infrastructure construction, 16 commercial construction, and 10 residential construction.

Sample selection indicates the sample size should be equal to the larger of 10 times the largest number of formative indicators used to measure a single construct [19]. This research have 60 minimum sample that must be fulfilled. Based on the minimum number of samples, this research can process 62 data from the construction industry and 100 data from overall construction.

TABLE 2. Classification of Respondents

	Respondent Profile	Frequently
Construction Type	Industrial Construction	62
	Infrastructure Construction	12
	Commercial Construction	16
	Residential Construction	10
Total Project Value	0-2,5M	71
	2,5 M- 50M	17
	> 50 M	12
Project Working Time	1 – 6 month	77
	7– 12 month	5
	>12 month	18

V. RESULT AND DISCUSSIONS

This research consists of four independent variables, one dependent variable, and one mediating variable. The scale used is the Likert scale, which is a scale with four or five levels of statements that express an agreement or disagreement of a series of questions [20].

V.1 Result for overall construction (100 respondents)

To evaluate the convergent validity of the formative construct, the researcher considers the value outer loadings must be equal to or greater than 0,7 [19]. Based on the minimum limit for the value of the outer loading Table 3. lists the variables that were omitted because they had an outer loadings value < 0,7.

TABLE 3. Outer Loadings Overall Construction

Variable	Indicator	Loading Factor	Interpretation
X1	X1.1	0,854	Valid
	X1.2	0,859	Valid
	X1.3	0,85	Valid
X2	X2.1	0,848	Valid
	X2.2	0,711	Valid
	X2.3	0,756	Valid
	X2.4	0,703	Valid
	X2.5	0,707	Valid
X3	X3.2	0,719	Valid
	X3.3	0,852	Valid
	X3.4	0,925	Valid
X4	X4.2	0,856	Valid
	X4.3	0,785	Valid
	X4.4	0,789	Valid

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X5	X5.1	0,809	Valid
	X5.2	0,9	Valid

The approach to assessing discriminant validity is indicated by the value of cross-loadings. The current cross-loadings value must be greater than the cross-loadings value with other constructs that can be shown in Table 4.

TABLE 4. Cross Loadings Overall Construction

Var	X1	X2	X3	X4	X5
X1.1	0,854	0,374	-0,057	-0,007	-0,086
X1.2	0,859	0,304	-0,159	-0,117	-0,146
X1.3	0,850	0,436	-0,160	-0,146	-0,130
X2.1	0,527	0,848	0,089	0,049	0,106
X2.2	0,156	0,711	0,089	0,140	0,086
X2.3	0,228	0,756	-0,082	0,044	0,028
X2.4	0,286	0,703	-0,069	0,007	0,001
X2.5	0,238	0,707	0,096	0,119	0,050
X3.2	-0,235	-0,014	0,719	0,508	0,489
X3.3	-0,050	0,111	0,852	0,463	0,362
X3.4	-0,122	0,014	0,925	0,497	0,408
X4.2	-0,154	0,043	0,505	0,856	0,434
X4.3	-0,050	0,073	0,445	0,785	0,400
X4.4	-0,044	0,102	0,448	0,789	0,368
X5.1	-0,148	0,114	0,387	0,413	0,809
X5.2	-0,103	0,040	0,444	0,438	0,900

Table 5 swown value of Composite Reliability and Cronbach's Alpha for X1; X2; X3; X3; X4; Y from the variable was reliable because it produced a value > 0.6 [21]. Colinearity is under number 5 so there is no problem with collinearity [19].

TABLE 5. Reliability Test Overall Construction

Variable	Cronbach's Alpha	Composite Reliability	VIF	
X1	0,817	0,89	1,31	
X2	0,815	0,863	1,286	1
X3	0,783	0,874	1,64	
X4	0,740	0,852	1,654	
X5	0,643	0,846	1,463	
Y	0,932	0,942		

Variable X1; X2; X3; X4; X5 provides on project performance (Y) amounted to 0.397 or 39.7%. While the rest is influenced by variables outside the research model. Tabel 6 shows the influence of a weak variable.

TABLE 6. R Square Overall Construction

Variable	R Square
Y	0,397
X1	0,195

Figure 2 shows PLS-SEM model for overall construction. Table 7 shows the results of the hypothesis test from t table parameter. The hypothesis test results can be concluded that the effect of variables on the performance of construction projects in Indonesia due to Covid-19 pandemics is:

1. The level of movement restrictions during the pandemic (lockdown) has a positive effect on the level of challenge in implementing social distancing
2. The level of challenge in implementing social distancing has a negative effect on project performance.
3. The level of movement restriction during the pandemic (lockdown) has a positive effect on project performance.
4. The level of challenge of working from home has a positive effect on project performance
5. The level of planning limiting the number of workers has a positive effect on project performance
6. The level of continuous use of personal protective equipment (PPE) has a negative effect on project performance.
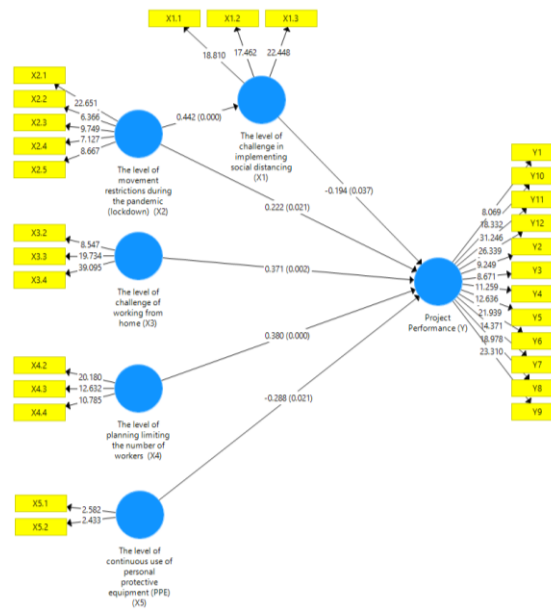
FIGURE 2. PLS-SEM Model Overall Construction

TABLE 7. Results of Hypotheses Overall Construction

Code	Variable	Original Sample (O)	t value	P value	Conclusion
H1	The level of movement restrictions during the pandemic (lockdown) -> level of challenge in implementing social distancing	0,442	4,64	0,000	Reject H0
H2	The level of challenge in implementing social distancing -> project performance	-0,194	2,029	0,043	Reject H0
H3	The level of movement restriction during the pandemic (lockdown) -> project performance.	0,222	2,258	0,024	Reject H0
H4	The level of challenge of working from home ->on project performance	0,371	3,442	0,001	Reject H0
H5	The level of planning limiting the number of workers ->project performance	0,38	4,078	0,000	Reject H0
H6	The level of continuous use of personal protective equipment (PPE) ->project performance	-0,288	2,378	0,018	Reject H0

V.2 Result for industrial construction (62 respondents)

To evaluate the convergent validity of the formative construct, the researcher considers the value outer loadings must be equal to or greater than 0.7 [19]. Based on the minimum limit for the value of the outer loading Table 8 lists the variables that were omitted because they had an outer loadings value < 0.7.

The approach to assessing discriminant validity is indicated by the value of cross-loadings. The current cross-loadings value must be greater than the cross-loadings value with other constructs that can be shown in Table 9.

Table 10 shows value of Composite Reliability and Cronbach's Alpha for Each item from the variable was reliable because it produced a value > 0.6 [21]. Colinearity is under number 5 so there is no problem with collinearity [19].

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TABLE 8. Outer Loadings Industrial Construction

Variable	Indicator	Loading Factor	Interpretation
X1	X1.1	0,744	Valid
	X1.3	0,745	Valid
	X1.4	0,805	Valid
X2	X2.2	0,832	Valid
	X2.3	0,901	Valid
	X2.4	0,914	Valid
	X2.5	0,919	Valid
	X2.6	0,931	Valid
X3	X3.3	0,855	Valid
	X3.4	0,887	Valid
	X3.5	0,755	Valid
X4	X4.1	0,748	Valid
	X4.2	0,910	Valid
	X4.5	0,744	Valid
X5	X5.1	0,973	Valid
	X5.2	0,884	Valid

TABLE 9. Cross Loadings Industrial Construction

Var	X1	X2	X3	X4	X5
X1.1	0,744	0,496	0,153	0,400	0,095
X1.3	0,745	0,467	0,071	0,323	0,034
X1.4	0,805	0,563	0,064	0,227	-0,194
X2.2	0,600	0,832	0,126	0,328	-0,063
X2.3	0,550	0,901	0,257	0,294	0,040
X2.4	0,614	0,914	0,151	0,289	-0,161
X2.5	0,596	0,919	0,168	0,311	-0,060
X2.6	0,638	0,931	0,165	0,254	-0,129
X3.3	0,067	0,141	0,887	0,154	0,170
X3.4	0,033	0,205	0,755	0,153	0,133
X3.5	0,311	0,268	0,113	0,748	-0,014
X4.1	0,376	0,257	0,245	0,910	0,072
X4.2	0,287	0,301	0,243	0,744	0,106
X4.5	-0,049	-0,085	0,117	0,040	0,973
X5.1	-0,016	-0,079	0,151	0,126	0,884
X5.2	-0,125	-0,044	0,128	-0,194	0,197

TABLE 10. Reliability Test Industrial Construction

Variable	Cronbach's Alpha	Composite Reliability	VIF	
X1	0,647	0,809	1,951	
X2	0,941	0,955	1,868	1
X3	0,795	0,873	1,111	
X4	0,745	0,845	1,275	
X5	0,860	0,927	1,039	
Y	0,634	0,714		

Variable X1; X2; X3; X4; X5 provides on project performance (Y) amounted to 0.417 or 41.7%. While the rest is influenced by variables outside the research model. Table 11 shows the influence of a strong enough variable.

TABLE 11. R Square Industrial Construction

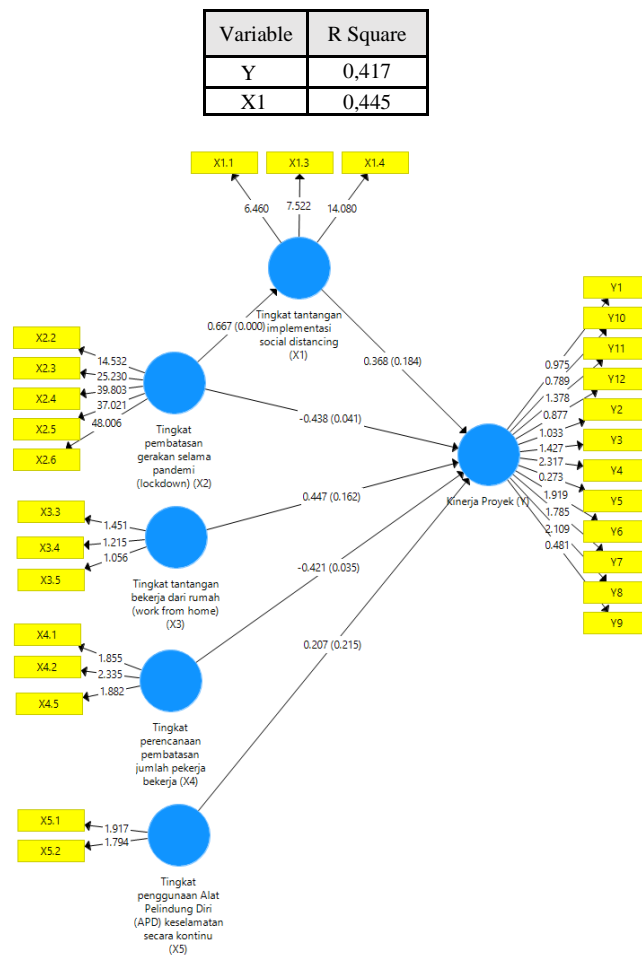| Variable	R Square
Y	0,417
X1	0,445

FIGURE 3. PLS-SEM Model Industrial Construction

Figure 3 shows PLS-SEM model for industrial construction. Table 12 shows the results of the hypothesis test from t table parameter. The hypothesis test results can be concluded that the effect of variables on the performance of construction projects in Indonesia due to Covid-19 pandemics is:
1. The level of movement restrictions during the pandemic (lockdown) has a positive effect to the level of challenge in implementing social distancing
2. The level of challenge in implementing social distancing is not significant on project performance.
3. The level of movement restriction during the pandemic (lockdown) has a negative effect on project performance.
4. The level of challenge of working from home is not significant on project performance
5. The level of planning limiting the number of workers has a negative effect on project performance
6. The level of continuous use of personal protective equipment (PPE) is not significant on project performance.

TABLE 12. PLS-SEM Model Industrial Construction

Code	Variable	Original Sample (O)	t value	P value	Conclu-sion
H1	The level of movement restrictions during the pandemic (lockdown) -> level of challenge in implementing social distancing	0,667	7,463	0,000	Reject H0
H2	The level of challenge in implementing social distancing -> project performance	0,368	1,293	0,197	Failed Reject H0
H3	The level of movement restriction during the pandemic (lockdown) -> project performance.	-0,438	2,005	0,046	Reject H0
H4	The level of challenge of working from home ->on project performance	0,447	1,437	0,151	Failed Reject H0

H5	The level of planning limiting the number of workers ->project performance	-0,421	2,224	0,025	Reject H0
H6	The level of continuous use of personal protective equipment (PPE) ->project performance	0,207	1,277	0,202	Failed Reject H0

This research conducted a different calculation between overall construction (100 respondents) and industrial construction due to the results of the hypothesis with 100 respondents produced several counterintuitive results. These results are contrary to the original hypothesis. For example, the result of hypothesis 1 the level of movement restrictions during the pandemic (lockdown) has a positive effect on project performance, which explains that the results are contrary to so-called counterintuitive. The results of hypotheses 2, 4, and 6 are also not in accordance with the alleged early hypothesis.

The data obtained by the researcher consists of four classifications of project types. One project that meets the minimum sample criteria for processing data again. Selected samples for processing are industrial construction samples with 62 respondents. The results obtained on processing data in industrial construction are hypotheses 1, 3 and 5 proved to be in accordance with the initial hypothesis.

Processing data respondent industrial construction is a construction that requires specific specifications and requirements such as for oil refineries, heavy industry / basic industries, mining, nuclear, and so on. Its planning and implementation require specific accuracy and expertise/technology. The need for more workers than other types of construction. Value this research is in accordance with the characteristics or characteristics of the type of project that is used for data processing.

CONCLUSION

The results of data processing show that the results of data processing with different types of projects produce different conclusions. Overall construction shows all variables that have an effect on project performance, but only the level of challenge in implementing social distancing as mediation variables, the level of challenge in implementing social distancing have negative effect on project performance and the level of continuous use of personal protective equipment (PPE) have negative effect on project performance. Whereas in industrial construction only three variables according to the initial hypothesis shows that level of movement restrictions during pandemic has a positive effect to level of challenge in implementing social distancing, the level of movement restriction during the pandemic (lockdown) have negative effect on project performance and the level of planning limiting the number of workers have negative effect to project performance.

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