Analysis of the Covid-19 Pandemic Impact on the Performance of Construction Projects in Denpasar City

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Abstract— *Construction projects in Denpasar City have directly experienced the impact of the Covid-19 pandemic, which has brought about major changes in the construction sector which have been deeply felt by project stakeholders. The impacts include aspects of human resources, materials and equipment, work methods, and finances. The problems described have the potential to affect the performance of construction projects. The purpose of this research is to analyze the impact of the Covid-19 pandemic on the performance of construction projects in Denpasar City and formulate strategies to improve the performance of construction projects that are dominantly affected by the Covid-19 pandemic. Technical analysis of the data was determined using multivariate analysis with data obtained through surveys with online questionnaires and analyzed using SmartPLS software; Focus Group Discussions (FGD) and fishbone diagrams were conducted. The results of this study concluded that the Covid-19 pandemic had an impact on the performance of construction projects in Denpasar City, especially on the human resource aspect in terms of 2.5% time, 0.9% in terms of costs; material and equipment aspects in terms of time 3.0%, in terms of cost 1.2%, in terms of quality 0.1%; aspects of work methods in terms of time 3.4%, in terms of cost 0.7%, in terms of quality 0.7%; and the financial aspect in terms of costs 4.9%, in terms of time 1.5%. The Covid-19 pandemic variable that has the most impact on the performance of construction projects is the material and equipment aspect of 3.321 from the P-value calculation. Strategies to improve the performance of construction projects include providing equivalent alternative materials, studying contracts with suppliers in more detail, re-scheduling, monitoring related to material expeditions, pre-ordering first to suppliers, changing work methods, and seeking to find other heavy equipment service providers.*

Keywords— ***Impact of the Covid-19 Pandemic, Fishbone Diagram, Focus Group Discussion (FGD), Construction Project Performance, SmartPLS***

I. INTRODUCTION

The construction sector, which is directly or indirectly affected, is currently struggling with all its might to survive and recover. The construction sector is one of the worst sectors affected by the Covid-19 pandemic due to the implementation of construction projects, one of the most important activities for national economic development. Major changes due to the impact of the pandemic brought about major changes in the economic, social and environmental sectors were greatly felt by project stakeholders such as implementing contractors, supervisory consultants and owners. According to data from the Electronic Procurement Service (LPSE) of Denpasar City, it was recorded that the tender list for the type of procurement for construction work in the Denpasar City Government from 2019 was 130 tender data, the list of tender data decreased in 2020, with only 25 tender data

with three tender data submitted successfully and 22 tender data failed.

The data show that the growth in the value of the construction index has decreased from 4.9% to 2.1% in 2020 [7]. The decline in the construction index was due to many problems in project implementation, ranging from budget diversion for handling Covid-19, limited resources, and other circumstances. Obstacles in the implementation of construction projects will arise when the project objectives are not realized. During the Covid-19 pandemic, the problems generally faced by project stakeholders were in the construction implementation phase. The impacts include aspects of human resources, materials and equipment, work methods, and finances. The problems described have the potential to affect the performance of construction projects. So, it is important to measure such so that the cost, quality and time are right. From this, it is necessary to carry out this research so that the performance of construction projects in Denpasar City remains in a stable condition during the Covid-19 pandemic.

The purpose of this study is to analyze the impact of the Covid-19 pandemic on the performance of construction projects in Denpasar City, to analyze the impact variables of the Covid-19 pandemic that most dominantly affect the performance of construction projects in Denpasar City, and to formulate strategies to improve the performance of the most dominant construction projects. affected by the Covid-19 pandemic in Denpasar City.

II.   LITERATURE REVIEW

2.1. Impact of the Covid-19 Pandemic

The Covid-19 pandemic continues to have a significant impact on the construction world. Therefore, it is warned that raising awareness of the occupational safety and health of construction workers is very important. Therefore, good countermeasures are needed in dealing with the Covid-19 pandemic, so that the implementation is not hampered and the safety and health of construction workers are important.

Table 1: Variables and Indicators of the Impact of the Covid-19 Pandemic

Variables	Indicators
Human Resources (X1)	Reduction of labor/labor lost their job
	Difficult to communicate directly between stakeholders
	Labor income is reduced
	Labor activity is limited
	Labor productivity decreases

Variables	Indicators
Materials and Equipment (X2)	Material accommodation limitations
	Material delivery delay
	Limited material availability
	Limited availability of heavy equipment
Working Method (X3)	Implementing difficult work methods due to implementing physical distancing
	Time extension request
	Project suspension
	Barriers to project implementation permits
Financial (X4)	Project cost swelling
	Real price difference
	Limited funding
	Material price increase
	Increase in equipment rental prices
	Allocation of salary payment costs
	Troubled company cash flow
	Increased project cost expenditure

Source:[7], [3], [9], [15], [4], [13], [11], [2], [10]

2.2. Construction Project Performance

Measurement of the performance of a construction project must be carried out to find out whether in the process of work activities there are errors from the predetermined plan, or whether performance can be achieved according to the planned schedule, or whether the performance results are as expected [14]. Construction project performance can be measured based on the cost, quality and time spent.

Table 2: Construction Project Performance Variables and Indicators

Variables	Indicators
Cost (Y1)	Budget cancellation
	Construction project cost control
	The exact number of units of material purchased
	Budget accuracy used in construction projects
	Recording the Cost of Job Variants
	Monitoring of work processes and stages so as to avoid fines
	Control of the auction process by finding suppliers for certain materials and comparing supplier prices

Variables	Indicators
Quality (Y2)	Materials and number of units used are appropriate.
	Report work quality deviations
	Placement of materials according to working drawings
	Worker productivity
Time (Y3)	Carrying out the work does not exceed the planned time
	Arrange the work order logically
	Gives the obligation of employees to be absent every day
	Day-to-day monitoring
	Accelerate project time
	Considerations for choosing a supplier

Source: [5], [8], [12], [6], [1]

III.   METHOD

This research was conducted on government projects in Denpasar City. The methods used in data analysis techniques are quantitative and qualitative. The data sources specified include primary data obtained directly from the results of distributing questionnaires regarding the impact of the Covid-19 pandemic that affects the performance of construction projects in Denpasar City. As well as data from the results of the Focus Group Discussion (FGD) to formulate strategies in improving the performance of construction projects that are most dominantly affected by the Covid-19 pandemic. While secondary data were obtained from the Electronic Procurement Service (LPSE) web page for the Denpasar City area to get the total number of projects that won tenders in 2020-2021. The data analysis technique applied is multivariate analysis with surveys using online questionnaires using Google Form, then the questionnaires will be disseminated via social media or email to respondents, then analyzed using SmartPLS software. Qualitative analysis is done by conducting direct Focus Group Discussion and fishbone diagrams. A minimum sample of 26 populations at a 5% margin of error of 24 construction projects with respondents to fill out the questionnaire from this study, including one project manager/executor from the contractor and one team leader/supervisor from the supervisory consultant, and one person from the owner, so that the total minimum sample of respondents is 72 respondents. Meanwhile, the selection of sources for the FGD was determined by using a non-probability sampling technique with purposive sampling. Purposive sampling is used for the sample of informants that is adjusted to the research objectives. The focus group discussion resource persons were attended by five people consisting of three project managers (contractors), and two team leaders (supervising consultants).

IV.   RESULTS AND DISCUSSION

In this study, the total number of respondents who participated was 78. Based on the results of the questionnaires that have been distributed, the characteristics of the respondents who contributed to this study were the right respondents.

2.3. Analysis of the Covid-19 Pandemic Impact on Construction Project Performance
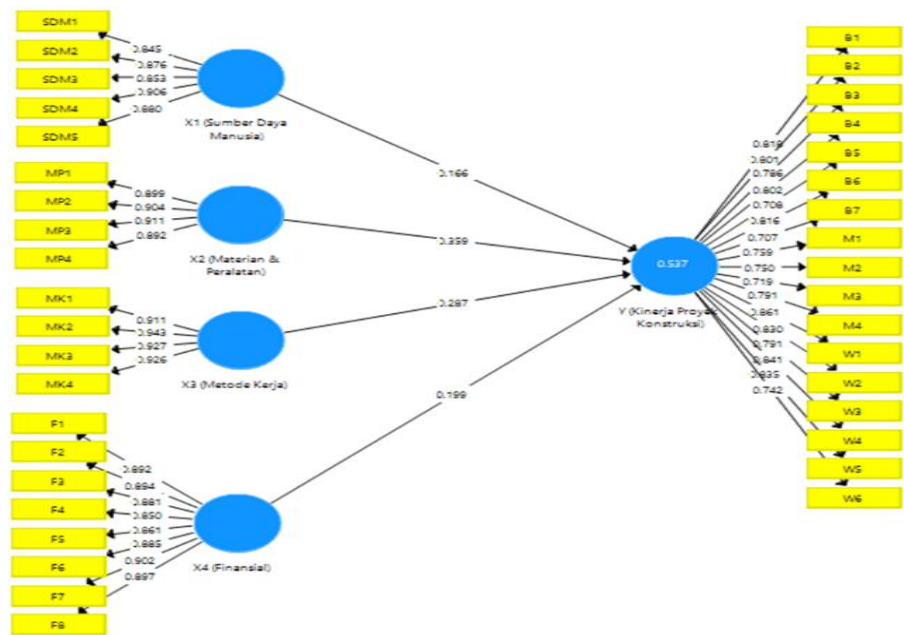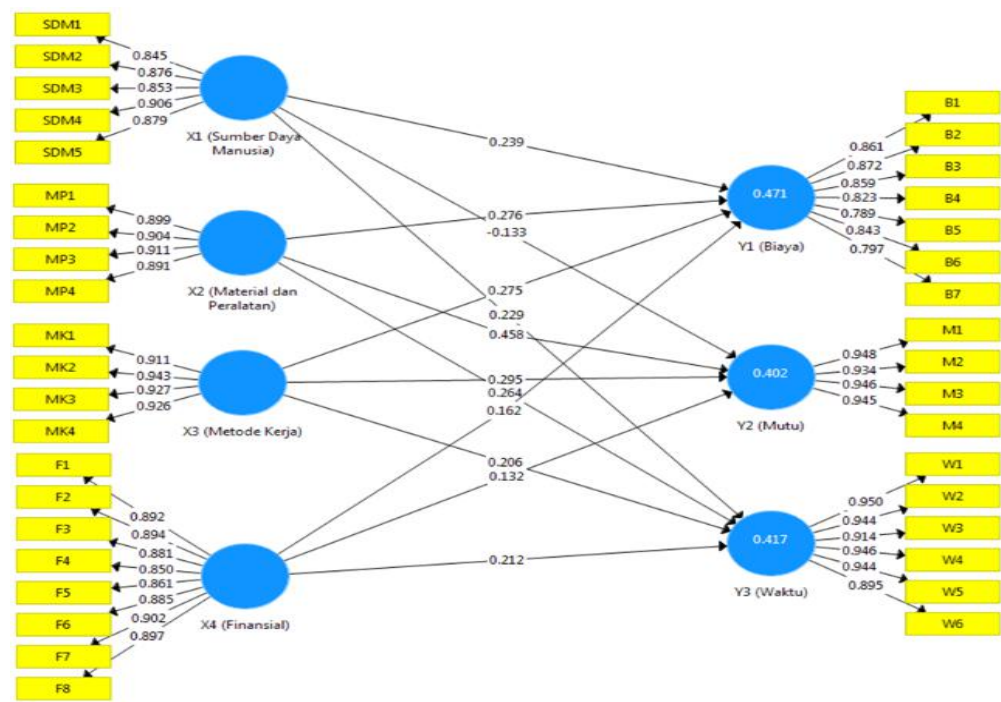

Fig. 1: Output Calculate Algorithm Model 1

Fig. 2: Output Calculate Algorithm Model 2

Table 3: Cronbach's Alpha and Composite Reliability Model 1

	Cronbach's Alpha	Composite Reliability
X1 (Human Resources)	0.922	0.941
X2 (Materials and Equipment)	0.923	0.945
X3 (Working Method)	0.945	0.961
X4 (Financial)	0.960	0.966
Y (Construction Project Performance)	0.961	0.965

Table 4: Cronbach's Alpha and Composite Reliability Model 2

	Cronbach's Alpha	Composite Reliability
X1 (Human Resources)	0.922	0.941
X2 (Materials and Equipment)	0.923	0.945
X3 (Working Method)	0.945	0.961
X4 (Financial)	0.960	0.966
Y1 (Cost)	0.928	0.942
Y2 (Quality)	0.959	0.970
Y3 (Time)	0.970	0.975

Based on Fig. 1, Fig. 2, Table 3, and Table 4, it can be concluded that the construct is declared if the composite reliability value is above 0.6. It can be concluded that the research variables of human resources, materials and equipment, work methods, finances, and construction project performance are declared to meet reliability.

Table 5: Fornell-Larcker Criterion Model 1

	X1	X2	X3	X4	Y
X1	0.872				
X2	0.548	0.901			
X3	0.310	0.424	0.927		
X4	0.144	0.275	0.233	0.882	
Y	0.482	0.626	0.538	0.389	0.787

Seen in Table 5. Fornell-Larcker Criterion Model 1, the values between X1 and X1 are 0.872, X2 and X2 are 0.901, X3 and X3 are 0.927, X4 and X4 are 0.882, Y and Y are 0.787, then the results of these values indicate that strong discriminant validity.

Table 6: Fornell-Larcker Criterion Model 2

	X1	X2	X3	X4	Y1	Y2	Y3
X1	0.872						
X2	0.548	0.901					
X3	0.310	0.424	0.927				
X4	0.150	0.276	0.237	0.883			
Y1	0.500	0.569	0.505	0.340	0.835		
Y2	0.229	0.546	0.479	0.309	0.715	0.943	
Y3	0.469	0.535	0.439	0.368	0.711	0.507	0.932

Seen in Table 6. Fornell-Larcker Criterion Model 2 diagonally the values between X1 and X1 are 0.872, X2 and X2 are 0.901, X3 and X3 are 0.927, X4 and X4 are 0.883, Y1 and Y1 are 0.835, Y2 and Y2 are 0.943, and Y3 with Y3 of 0.932, then the results of these values indicate that the discriminant validity is strong. This implies that each latent variable has strong discriminating validity.
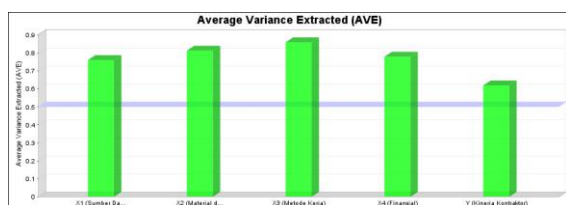

Fig. 3: Histogram AVE (Average Variance Extracted) Model 1
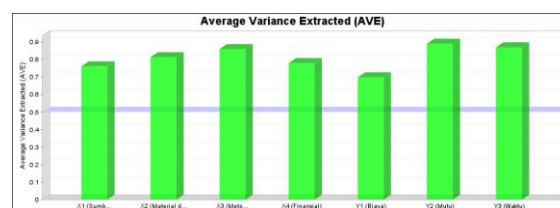

Fig. 4: Histogram AVE (Average Variance Extracted) Model 2

Discriminant validity indicators are known from the display of cross-loading between the indicators and their constructs. The model is declared good if the AVE (Average Variance Extracted) of each construct is greater than 0.50. Figures 3 and 4 show histograms of AVE Model 1 and Model 2, each construct's value is > 0.5 indicating that the discriminant validity is strong.
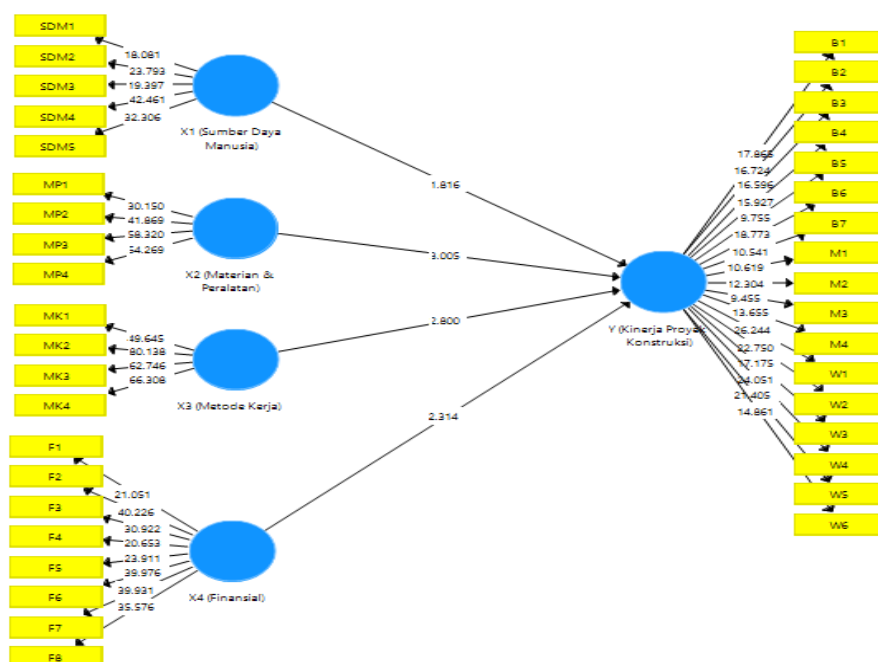

Fig. 5: Output Bootstrapping Model 1

Table 7: Direct Effect Hypothesis Model 1

Direct Effect					
Find PATH COEFFICIENT using BOOTSTRAPPING					
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X1 → Y	0.168	0.176	0.096	1.739	0.041
X2 → Y	0.358	0.349	0.116	3.084	0.001
X3 →Y	0.288	0.287	0.098	2.939	0.002
X4 → Y	0.200	0.214	0.099	2.024	0.022

The results of statistical testing on the impact of the Covid-19 pandemic with variables of human resources, materials and equipment, work methods, and finances affect the performance of construction projects (P <0.05).
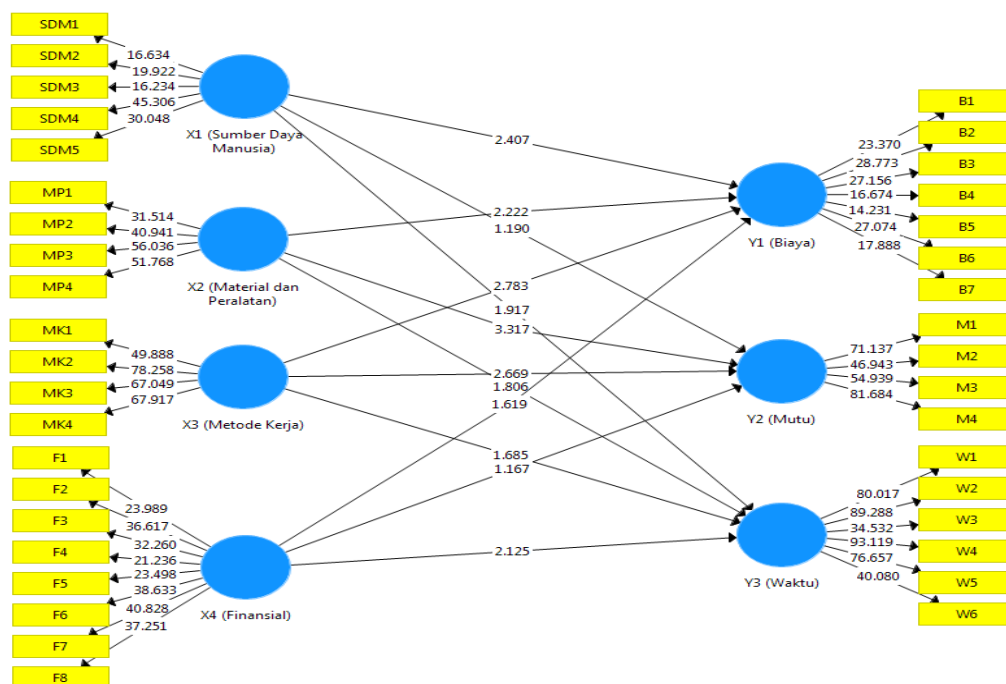

Fig. 6: Output Bootstrapping Model 2

Table 8: Direct Effect Hypothesis Model 2

Direct Effect					
Find PATH COEFFICIENT using BOOTSTRAPPING					
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X1 → Y1	0.239	0.241	0.101	2.358	0.009
X1 → Y2	-0.133	-0.119	0.110	1.216	0.112
X1 → Y3	0.229	0.233	0.116	1.972	0.025
X2 → Y1	0.276	0.279	0.122	2.265	0.012
X2 → Y2	0.458	0.456	0.138	3.321	0.001

	Direct Effect				
	Find PATH COEFFICIENT using BOOTSTRAPPING				
	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
X2 → Y3	0.264	0.262	0.140	1.880	0.030
X3 → Y1	0.275	0.270	0.111	2.479	0.007
X3 → Y2	0.295	0.291	0.120	2.455	0.007
X3 → Y3	0.206	0.195	0.112	1.835	0.034
X4 → Y1	0.162	0.176	0.098	1.656	0.049
X4 →Y2	0.132	0.140	0.110	1.202	0.115
X4 → Y3	0.212	0.218	0.097	2.180	0.015

The results of statistical testing on the impact of the Covid-19 pandemic with the variables of human resources, materials and equipment, work methods, and finances affect the performance of construction projects in terms of cost, quality, and time (P <0.05). It's just that there are two hypothetical aspects that have no effect (P> 0.05), namely the aspect of human resources on quality because, if there is a reduction in labor, it will not directly affect the quality but is more influential in terms of time. The second is the financial aspect of quality because the quality aspect does not significantly affect the financial aspect.

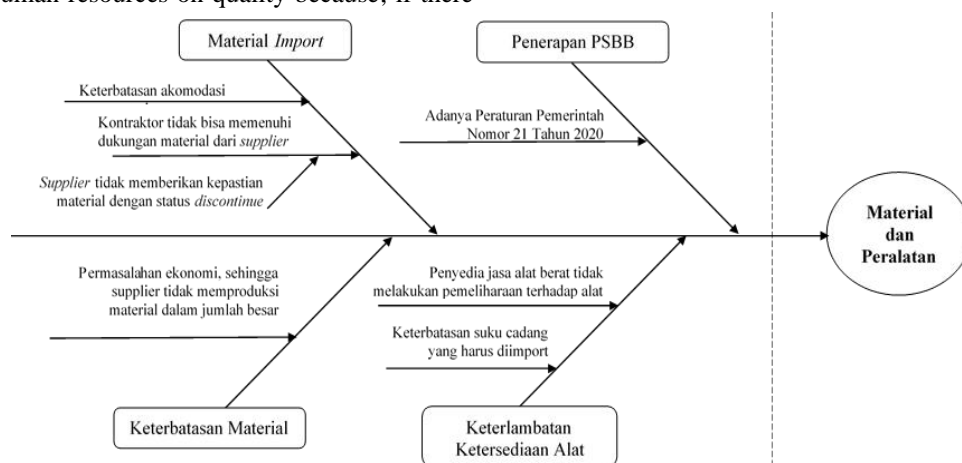2.4. Strategies in Improving the Performance of Ca Are Mostly Affected by the Covid-19 Pandemic

Fig. 7: Fishbone Diagram Analysis Results

Table 9: Results of Focus Group Discussion (FGD) Analysis

Causative Factor	Sub-Factors Cause	Root of the Problem	Countermeasures Strategy	FGD Agreement
Materials and Equipment	There is a replacement for imported materials.	- Limited transportation accommodation during the Covid-19 pandemic. - The contractor cannot fulfill material support from the supplier. - The supplier does not provide certainty regarding materials that have discontinued status.	- Provide alternative materials that have equivalent alternatives. - Before Entering into a work agreement with the supplier, the contractor should study the contract in more detail first.	Agree
Materials	Delivery of	There is Government Regulation (PP)	- Conducting re-scheduling related	Agree

Causative Factor	Sub-Factors Cause	Root of the Problem	Countermeasures Strategy	FGD Agreement
and Equipment	materials originating from outside the city experienced delays due to large cities implementing PSBB during the Covid-19 pandemic.	Number 21 of 2020. Large-Scale Social Restrictions in the Context of Accelerating Handling of Corona Virus Disease 2019 (Covid-19).	to delays in construction project work, causing an extension of the contract period. - Monitoring related to material expeditions	
Materials and Equipment	Limited availability of materials by suppliers during the Covid-19 pandemic.	Due to economic problems, suppliers do not produce materials in large quantities.	The contractor can pre-order first with the supplier.	Agree
Materials and Equipment	There is a delay in the availability of heavy equipment.	- Limited spare parts must be imported from abroad during the Covid-19 pandemic. - The heavy equipment service provider does not perform maintenance on the heavy equipment.	- Contractors can change work methods and try to find other heavy equipment service providers.	Agree

V. CONCLUSION AND SUGGESTIONS

5.1 Conclusions

The conclusions from the results and discussions, among others, are: the Covid-19 pandemic has an impact on the performance of construction projects in Denpasar City, in particular on the aspects: Human resources have an impact on the performance of construction projects in terms of a significant time of 2.5%, which in this case was work experienced delays, and in terms of significant costs of 0.9% causing construction project expenditures to exceed the planned costs. Materials and equipment have an impact on the performance of construction projects in terms of significant time of 3.0% to be late due to inappropriate considering of supplier selection, in terms of significant costs of 1.2% so that cost control for materials and equipment becomes inappropriate and in terms of significant quality 0.1% resulted in the type of material and the number of material units and heavy equipment used were not in accordance with the requirements. The work method has an impact on the performance of construction projects in terms of significant time of 3.4% to be ineffective in compiling the method of carrying out work, 0.7% in terms of significant costs causing the

project budget to be inappropriate due to having to change the method of work that has been planned, and from a significant quality aspect of 0.7% due to not according to the required technical specifications. Financial impact on the performance of construction projects in terms of significant costs of 4.9% causes the project cash flow to exceed the required and significant time in terms of 1.5% so that the work exceeds the planned time.

The Covid-19 pandemic variable that has the most impact on the performance of construction projects in Denpasar City is the material and equipment aspect, including limited material accommodation, delays in material delivery, limited material availability, and limited availability of heavy equipment, 3,321. Strategies to improve the performance of construction projects in Denpasar City which are most dominantly affected by the Covid-19 pandemic, namely the Material and Equipment Aspects, are pursued through Focus Group Discussions, as follows: Provide alternative materials that have equivalent alternatives. Before entering into a work agreement with the supplier, the contractor should study more detail the contract with the supplier first;   perform re-scheduling related to delays in construction project work resulting in an extension of the contract period; monitoring related to

material expeditions; contractors can pre-order in advance to the supplier; and contractors can change work methods and seek to find other heavy equipment service providers.

5.2 Suggestions

The suggestion from the results and discussion of this research is that construction project companies can use this research to pay attention to the factors that can affect the performance of construction projects in the implementation of construction projects during the Covid-19 pandemic. For other researchers, it is expected to examine other sources and references regarding the impact factors of the Covid-19 pandemic because this research only examines aspects of human resources, materials and equipment, work methods and finances. Therefore, this research can be considered for further development. In relation to strategies to improve the performance of construction projects, construction project actors are expected to understand and monitor to overcome urgent problems that occur in the implementation of construction projects.

REFERENCES

[1] Agsarini, I., Wiguna, I.P.A. 2015. The Influence of Project Condition Factors on Construction Project Performance. *Prosiding Seminar Nasional Manajemen Teknologi XXII*, (1991): 1–8.

[2] Araya, F., Sierra, L. 2021. Influence between COVID-19 Impacts and Project Stakeholders in Chilean Construction Projects. *Sustainability* (Switzerland), 13(18).

[3] Boy, W., Erlindo, R., dan Aidil Fitrah, R. 2021. Factors Causing Delays in Lecture Building Construction Projects During the Covid-19 Pandemic. *Rivet (Riset Dan Invensi Teknologi)*, 01(01): 57–64.

[4] Darmawan, M.B., Yuwono, B.E. 2021. Factors Delays in High-rise Building Construction Projects During the Pandemic. *Prosiding Seminar Intelektual Muda*, 168–173.

[5] Djukardi, A.K., Semiawan, A.E. 2019. Project Performance Indicator Model in Regional High-rise Residential Building Sector D.K.I. Jakarta. *Forum Mekanika*, 7(2).

[6] Fitriyani, N., Kadri, T. 2020. Project Performance Measurement Using the Performance Prism Method (Case Study of Pondok Indah Mall 3 And Office Project). *Artikel Penelitian Universitas Trisakti*.

[7] Hidayat, F., Wijaya, N., Jayadi, M.S.P. 2021. Comparative Analysis of the Impact of the Covid-19 Pandemic on Large and Small Scale Contractors in the City of Jabodetabek. *Konferensi Nasional Teknik Sipil 15*, 20–21.

[8] Latief, Y., Abidin, I.S. 2013. Pattern of Relationship Between Project Cost Performance and Impact of Project Cost Deviations With Cost Overrun Indicator Approach in Sub-Contractor Management. *Jurnal Konstruksia*, Volume 4(2): 61–75.

[9] Maelissa, N., Gaspersz, W., Metekohy, S. 2021. The Impact of the Covid-19 Pandemic for the Implementation of Construction Projects in Ambon City. *Jurnal Simetrik*, 11(1): 411.

[10] Olatunde, N.A., Awodele, I.A., Adebayo, B.O. 2022. Impact of COVID-19 Pandemic on Indigenous Contractors in a Developing Economy. *Journal of Engineering, DeOlatunde, N.A., Awodele, I.A., Adebayo, B.O. 2022. Impact of COVID-19 Pandemic on Indigenous Contractors in a Developing Economy. Journal of Engineering, Design and Technology, 20(1): 267–280.Sign and Technology*, 20(1): 267–280.

[11] Pamidimukkala, A., Kermanshachi, S. 2021. Impact of Covid-19 on Field and Office Workforce in Construction Industry. *Project Leadership and Society*, 2: 100018.

[12] Putra, H.E., Sulistio, H. 2020. Effect of Change Order on Cost, Quality, and Time in High-rise Building Construction Projects. *JMTS: Jurnal Mitra Teknik Sipil*, 3(4): 1349.

[13] Rehman, M.S.U., Shafiq, M.T., Afzal, M. 2021. Impact of COVID-19 on Project Performance in the UAE Construction Industry. *Journal of Engineering, Design and Technology*, (June).

[14] Syaferi, D.O., Hidayat, B., Ophiyandi, T., Ferial, R. 2021. Analysis of the Contractor's Performance during the Covid-19 Pandemic in West Sumatra Province. *IOP Conference Series: Earth and Environmental Science*, 708(1): 0–12.

[15] Triyawan, A., Fendayanti, Z.E.U. 2021. The Impact of the Covid-19 Pandemic on the Sustainability of Construction Service Companies. *Forum Ekonomi*, 23(2): 223–230.