Eduvest - Journal of Universal Studies
Volume 4 Number 12, December, 2024
p- ISSN 2775-3735- e-ISSN 2775-3727

ANALYSIS OF FACTORS AFFECTING THE MAINTENANCE PERFORMANCE OF HEAVY EQUIPMENT IN CONSTRUCTION PROJECTS (CASE STUDY IN MOROWALI PROJECT, SULAWESI)

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ABSTRACT

This study aims to analyze various factors that affect the maintenance performance of heavy equipment in construction projects, with a focus on projects in Morowali, Sulawesi. Heavy equipment maintenance is a critical aspect that can affect the smooth and successful operation of a construction project. Through data collection using questionnaires distributed to workers and employees at the project site, this study evaluates the influence of work environment, employee competence, and spare parts availability on maintenance effectiveness. The results show that these factors have a significant impact on maintenance performance, which in turn affects the overall operation of the project. These findings are expected to provide insight for project managers in designing more effective maintenance strategies.

KEYWORDS *Machine maintenance, maintenance performance, construction projects, work environment factors, employee competence, spare parts availability.*

INTRODUCTION

In the construction industry, heavy equipment maintenance is not only a routine activity, but also a vital foundation to maintain the smooth and sustainable running of the project. The maintenance performance of heavy equipment has significant direct implications for various operational aspects of construction projects. An effective maintenance system not only ensures machine reliability, but also minimizes the risk of operational disruptions that can result in time delays, increased costs, and even deterioration in the quality of the project's final deliverables. However, it should be acknowledged that a variety of complex factors can affect the maintenance performance of a machine in the field. Thus, having a

How to cite:	Wahyu Widiarto, et al (2024). Analysis of Factors Affecting The Maintenance Performance of Heavy Equipment in Construction Projects (Case Study In Morowali Project, Sulawesi). *Journal Eduvest. 4*(12), 11919-11934
E-ISSN:	2775-3727

deep understanding of these factors is essential for the success and smooth running of a construction project. By comprehensively understanding the various factors that affect machine maintenance performance, project managers can identify potential challenges and devise appropriate strategies to address them, thereby improving the efficiency and effectiveness of machine maintenance and optimizing overall project performance.

Heavy equipment maintenance is not only an important aspect of the construction industry, but it is also an activity that relies heavily on the skills and knowledge of the workforce that performs the work. In other words, the quality of the maintenance performance of the machine is greatly influenced by the ability and experience of the workers involved. For example, factors such as the work environment can affect worker morale and overall performance, which in turn can affect the effectiveness of machine maintenance in construction projects. A study by Riyanto et al (2017) confirms that a conducive work environment can significantly improve employee performance. In addition, research conducted by Hatmanto (2022) highlights that employee competencies play an important role in managing various task complexities and work environments in the construction industry. Furthermore, a study from Manzini (2009) shows that parts management also has a significant impact on equipment performance, system reliability, as well as overall cost efficiency and maintenance measures. By paying attention to all these factors, a deep understanding of human resource management, a good working environment, and parts management will be crucial for the success of heavy equipment maintenance in construction projects.

Therefore, a deep understanding of the factors that affect the maintenance performance of heavy equipment is essential to achieve success in construction projects. Conducting a comprehensive analysis of how the work environment, employee competencies, and parts availability affect machine maintenance performance can provide valuable insights for stakeholders. With a deeper understanding of these dynamics, project managers can develop strategies and best practices that aim to improve the effectiveness of machine maintenance. In addition, a good understanding of these factors can also help in reducing downtime and overall improving the overall performance of the construction project. Thus, integrating knowledge of a conducive work environment, strong employee competence, and efficient parts management can be an important step in improving the final output of a construction project.

RESEARCH METHOD

Data Collection

In this study, data collection was carried out using a questionnaire. The questionnaire acts as a primary data provider that has a direct relationship with the research objectives. Primary data is collected according to the project being handled so that primary data is more consistent with the research question. The target respondents, sample size, how the questionnaire was created and distributed and analyzed to present accurate data are as follows.

Target Responden

This study is a study on construction projects, the target respondents are workers and employees in Morowali in Sulawesi.

Sample Size

Sample size is the number of subjects required in a study. In this study, the sample size was determined by the slovin method. The following is the formula for calculating the sample size using the slovin method (Anugraheni, 2023).

$$n = \frac{N}{1 + Ne}$$

n = Minimum sample quantity
N = Populasi
e = Error rate

In this study, the workers in the PT PP construction project in Sulawesi are a population of 100 people. The error rate used is 0.05. Thus, a minimum sample of 80 people was obtained.

So, the minimum sample size based on the slovin method is 80 respondents.

Questionnaire Design

Sveinsdottir et al. (2006) conducted a study that revealed that the evaluation of work environment conditions can be measured by considering various stress factors in the workplace. These factors include workload levels, career development opportunities, company policies, rewards for performance, feedback on work, relationships with employers, levels of boredom at work, interactions with coworkers, clarity of responsibilities, quality of training programs, and the impact of mistakes in performing tasks. Thus, a comprehensive assessment of the work environment involves considering various factors that can affect the welfare and productivity of workers.

Kolinska et al. (2017) explained that in evaluating the availability of spare parts, there are a number of criteria that can be considered. These criteria include responsiveness in parts delivery, transportation efficiency, optimal goods storage performance, proper inventory management, service coverage ratio, and the number of maintenance jobs successfully completed. By considering these various aspects, organizations can ensure the availability of adequate spare parts to support the operational continuity and maintenance of equipment effectively.

Williams (2005) identified seven criteria used to evaluate the capabilities of personnel in a team. These criteria include the utilization of knowledge and skills, opportunities for personal growth and development, level of involvement in important decision-making, quality of relationships with colleagues, opportunities to set individual goals, income levels, and contributions to existing tasks. Through a comprehensive assessment of these aspects, management can identify the strengths and development potential of team members and ensure the continuity of optimal productivity and performance in the work environment.

According to Kumar et al. (2013), there are several criteria that can be used to evaluate maintenance performance. These criteria include the success rate in completing tasks, the percentage of work that requires revision or repair, the frequency of corrective maintenance needs, operational downtime resulting from maintenance activities, and the number of accident incidents that occur during the maintenance process. By monitoring and evaluating these indicators, organizations can gain better insights into the effectiveness of their maintenance programs and identify areas that need improvement to improve performance and safety in the work environment.

To compile an effective questionnaire in evaluating the various factors that have been discussed earlier, we designed the table below. This table includes a questionnaire design tailored to relevant factors that can be used to measure work environment conditions, spare parts availability, personnel capabilities, and maintenance performance. By filling out this questionnaire, respondents will provide responses that will help in comprehensively evaluating various aspects related to maintenance effectiveness in construction projects.

Question	Type	Option
General Question		
Name	Short Fill	-
Gender	Y/N	-
Position	Choice	Operator, Manager, Supervisor, etc.
Ever been involved in a construction project?	Y/N	-
How knowledgeable is the maintenance process?	Likert	1 - 5 scale
How knowledgeable is project management?		
Working Environment		
I often feel like I don't have enough tasks to keep me busy.	Likert	1 - 5 scale
I feel there are very few opportunities for advancement in my career.		
Rules and regulations in the workplace are too restrictive.		
I felt unappreciated for the work I did.		
I didn't get enough feedback on my performance.		
I have a positive relationship with my boss.		
My work is often monotonous or repetitive.		
I have a good relationship with my co-workers.		
It is often unclear what my responsibilities are.		
The training provided for my work is inadequate or of poor quality.		
The consequences of making mistakes in the workplace are severe.		
Sparepart Availability		
Spare parts suppliers are quite reactive to the needs of this project.	Likert	1 - 5 scale
Reasonable spare parts delivery time (not too long/short)		
Stock spare parts are managed efficiently.		
The use of stock spare parts is managed effectively.		
The stock of spare parts stored is enough to meet scheduled needs		
Stock spare parts stocked enough to meet sudden needs		
Personnel Capability		

I can use my knowledge and skills effectively in my work.	Likert	1 - 5 scale
My job provides enough opportunities for me to develop my knowledge and skills.		
I am involved in important decisions about my work.		
I can have or build good working relationships with others in my work.		
I can set my own goals in my work.		
I can make a good income in my work.		
I can contribute to creating something valuable in my work.		
Maintenance Performance		
The number of maintenance tasks with a deadline that has been completed is satisfactory.	Likert	1 - 5 scale
The number of re-maintenance tasks that have been completed has been satisfactory.		
The number of unplanned maintenance interventions is at an acceptable level.		
The duration of unplanned maintenance downtime is within acceptable tolerance limits.		
There are few accidents at work.		

Questionnaire Distribution

This research involves the use of questionnaires distributed online via Email, WhatsApp, and various other social networks using Google form links. The questionnaire distribution process was carried out in a span of about 1 (one) month with the aim of obtaining the participation of respondents in accordance with the goals that had been set.

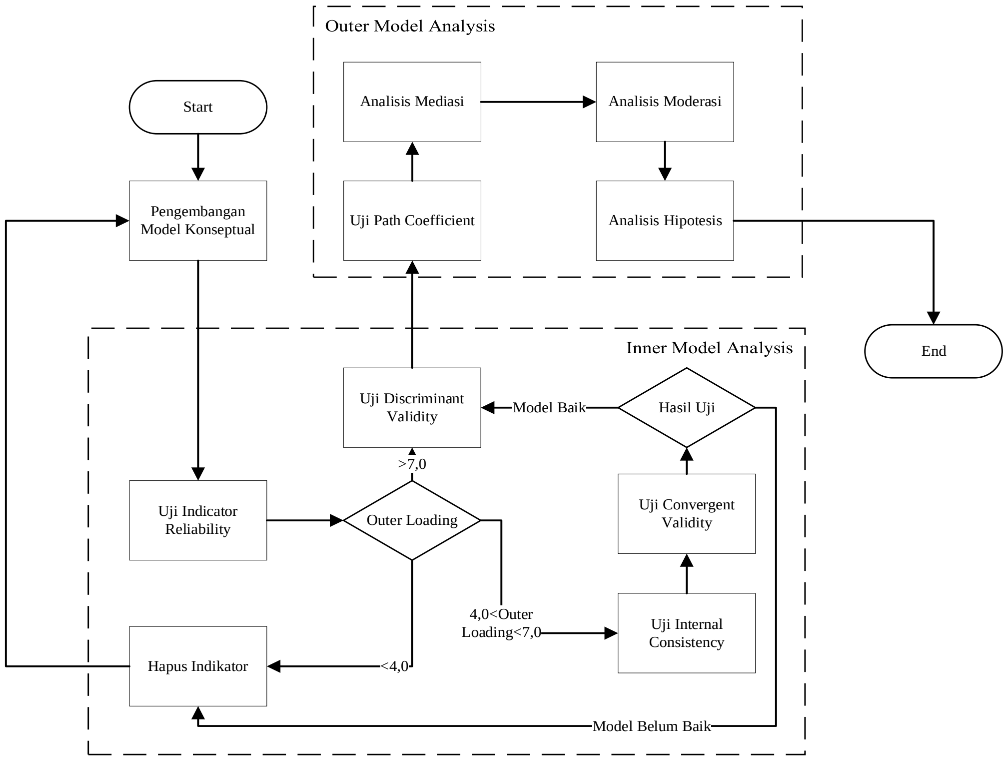
Data Processing

In this study, the trial process is carried out through several carefully structured stages, with the aim of answering research questions and achieving a predetermined problem formulation. After the conceptual model is formed, the next step is to conduct an analysis using the Partial Least Square - Structural Equation Modelling (PLS-SEM) method. This process is divided into two main stages, namely the testing of the measurement model (outer model) and the testing of the structural model (inner model).

The first stage, testing the measurement model (outer model), aims to ensure the validity and reliability of the constructs used in the research. This is done by checking the extent to which the measurement variable is able to represent the intended construct well. This method is also useful for identifying whether the measuring instrument used can measure the construct accurately and consistently. During this stage, statistical analyses such as convergence validity and construct reliability tests are carried out to ensure the quality of the measurements of the variables used in the study.

Furthermore, the second stage is the testing of the structural model (inner model). At this stage, the main focus is to test the relationships between the variables present in the conceptual model. This step allows researchers to evaluate the extent to which the proposed hypothesis can be supported by empirical data. Through PLS-SEM analysis, researchers can identify the strength and direction of the relationship between the variables studied. In addition, this stage also makes it possible to test the model as a whole, evaluate the significance and consistency of the proposed relationships, as well as examine the extent to which the model can explain variations in the observed data.

The results of the outer model and inner model tests can be used for action considerations for users. The actions taken aim to improve the maintenance performance of the equipment in the construction project. The following is a flow chart of the data processing method used.



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RESULT AND DISCUSSION

Profil Respond

The following is the profile of the respondents that the author has disseminated.

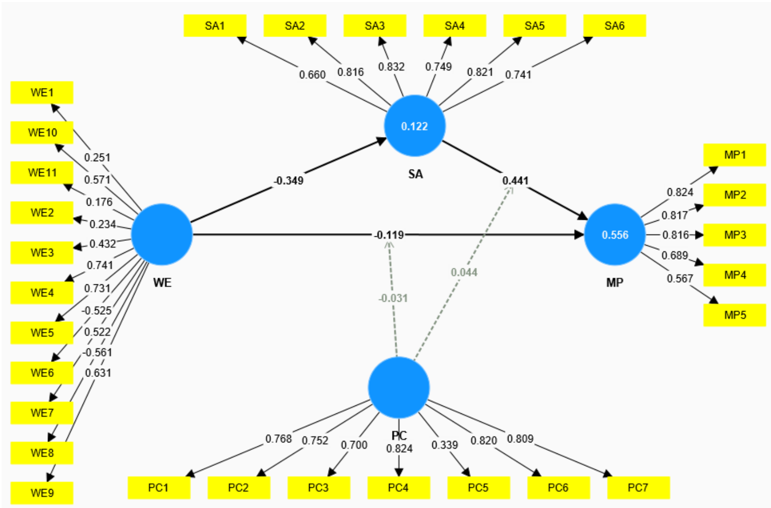
Profile	Frequency	Percentage
Gender		
Man	84	95%
Woman	4	5%

Position		
APT	2	2%
ARK	2	2%
Executive Assistant	1	1%
Drafter	4	5%
Engineer	3	3%
Field Engginer	4	5%
HR	1	1%
HSE	2	2%
Equipment Coordinator	1	1%
Maintenance Welder	1	1%
Manager	10	11%
Mechanic	9	10%
Operator Vibro	1	1%
Operator/Driver	42	48%
Executive	1	1%
Plans	1	1%
QS Supervisor	1	1%
Superintendent	1	1%
Surveyor	1	1%
Divided		
-	2	2%
Administration	1	1%
Engineering	2	2%
HSe	2	2%
MHR	4	5%
Operation	58	66%
Equipment	18	20%
Surveyor	1	1%
Project Involvement		
Pernah	69	78%
Never	19	22%
Understanding the Maintenance Process		
Very incomprehensible	5	6%
Lack of Understanding	1	1%
Understand Enough	32	36%
Understand well	30	34%
Very Understanding	20	23%
Understanding of Project Management		
Very incomprehensible	7	8%
Lack of Understanding	3	3%
Understand Enough	33	38%
Understand well	29	33%
Very Understanding	16	18%

The table of respondent profiles presented provides a comprehensive overview of the characteristics of the respondents involved in this study. Overall, the majority of respondents are men with a percentage of 95%, while women only account for 5% of the total respondents. In terms of positions, the variety of roles held by respondents is quite diverse, ranging from operators/drivers who dominate with a percentage of 48%, to managers who reach 11% of the total respondents. In terms of division, the majority of respondents were involved in operations (66%) and equipment (20%), indicating that most respondents had direct involvement in the operational and maintenance aspects of equipment in construction projects. In addition, the majority of respondents (78%) stated that they had been involved in a previous project, indicating a significant level of experience in the context of a construction project. When reviewing their understanding of the machine maintenance process and project management, most respondents stated a fairly good to very good level of understanding. As such, these respondent profiles provide valuable insights into their backgrounds and experiences, which will be an important basis for analyzing and interpreting the results of this study.

a. Outer Model Analysis

The assessment of the outer model is a measurement model that connects all indicators with their latent variables (Foeh et. al., 2019). The following is a proposed construct used for testing.



The outer *model* analysis focuses on evaluating the validity and reliability of indicator measurements. In this study, the *outer model* analysis uses *reliability indicators*, *internal consistency*, *convergent validity*, and *discriminant validity*.

1. Uji Indicator Reliability

The measurement of *reliability indicators* shows many similarities in the indicators of a construct. The higher the *outer loading* value, the more similarities in the indicators of a construct (Marliana, 2020). An indicator is considered *reliable* if the *outer loading* value is greater than or equal to 0.7, while an indicator with an *outer loading* value of less than 0.4 will be removed. If the *outer loading* value is in the interval of 0.4-0.7, the indicator has the possibility of being removed taking into account the *internal consistency* and *convergent validity values*. The following is the outer *loading matrix table* obtained from the PLS Algorithm Report SmartPLS.

	MP	PC	HIS	WE	PCxWE	PCxSA
MP1	0,824					
MP2	0,817					
MP3	0,816					
MP4	0,689					
MP5	0,567					
PC1		0,768				
PC2		0,752				
PC3		0,7				
PC4		0,824				
PC5		0,339				
PC6		0,82				
PC7		0,809				
SA1			0,66			
SA2			0,816			
SA3			0,832			
SA4			0,749			
SA5			0,821			
SA6			0,741			
WE1				0,251		
WE10				0,571		
WE11				0,176		
WE2				0,234		
WE3				0,432		
WE4				0,741		
WE5				0,731		
WE6				-0,525		
WE7				0,522		
WE8				-0,561		
WE9				0,631		
PCxSA						1.000
PCxWE					1.000	

Based on the outer loadings matrix table obtained from the PLS Algorithm Report SmartPLS, it can be concluded that the indicators in each construction have various levels of reliability. High outer loading values, as seen in the MP1, MP2, and MP3 indicators, indicate a high degree of similarity between the indicators and the constructs they represent. In contrast, indicators with low outer loading values, such as PC5 and WE11, show a lack of similarity with the construct in question and may need to be considered for removal from the analysis. In addition, the relationship between the constructs can also be observed from the outer loading values between the PCxSA and PCxWE indicators, which show a perfect value (1,000), confirming a strong relationship between the maintenance construct (PC) and the working environment (SA) factors and the availability of spare parts (WE).

After evaluating the outer loading value in accordance with the provisions described earlier, several indicators were found to have values that did not reach the desired level of reliability, which was below 0.7. Indicators that have an outer loading value below 0.4, such as PC5, WE1, WE11, WE2, WE6, and WE8, were removed from the main model because they were considered unreliable. After the removal of the indicator, a recalculation is carried out that results in a new table.

	MP	PC	HIS	WE	PCxWE	PCxSA
MP1	0,824					
MP2	0,817					
MP3	0,818					
MP4	0,689					
MP5	0,565					
PC1		0,778				
PC2		0,752				
PC3		0,69				
PC4		0,834				
PC6		0,822				
PC7		0,815				
SA1			0,651			
SA2			0,822			
SA3			0,826			
SA4			0,747			
SA5			0,83			
SA6			0,743			
WE10				0,662		
WE3				0,545		
WE4				0,777		
WE5				0,769		
WE7				0,615		
WE9				0,622		
PCxSA					1.000	
PCxWE						1.000

The new table shows the outer loading values that have been adjusted after the unreliable indicator is removed from the model. This process aims to improve the reliability and validity of the models used in the analysis. From the table, it can be seen that the remaining outer loading values of the indicators have reached or exceeded the limit of 0.7, indicating a sufficient degree of similarity between the indicators and the constructs they represent.

Thus, the results of the removal of unreliable indicators and the adjustment of the outer loading values have been in accordance with the necessary steps to improve the model. Furthermore, further testing is carried out on the improved model to ensure the validity and sustainability of the analysis carried out. This process includes testing the structural model (inner model) to find out the relationship between latent variables as well as testing hypotheses that have been made based on the conceptual model. Thus, these steps will provide a deeper understanding of the factors that affect maintenance performance in the context of a construction project.

2. Uji Internal Consistency & Convergent Validity

The outer model value in the indicator reliability test which is in the range of 0.4-0.7 is then tested for internal consistency and convergent validity. This test is used to determine which indicators need to be removed and retained based on composite reliability, Cronbach's Alpha, and Average Variance Extracted (EVA) values. The measurement of internal consistency in this study uses composite reliability and Cronbach's Alpha. The higher the value of both, the higher the reliability (Marliana, 2020). An indicator is considered reliable and has sufficient internal consistency if the composite reliability and Cronbach's Alpha values are greater than or equal to 0.7.

Meanwhile, convergent validity is used to measure convergent validity. The convergent validity calculation uses the Average Variance Extracted (EVA) value which has a minimum limit greater than 0.5. Average Variance Extracted (EVA) is the variance value of each indicator. The smaller the EVA value indicates the more mistakes a construct makes. The following is a table of construct reliability and validity obtained from the PLS Algorithm Report SmartPLS.

	Cronbach Alpha	**Rho a**	**Rho c**	**AVE**
MP	0,799	0,821	0,863	0,562
PC	0,873	0,876	0,905	0,614
HIS	0,866	0,891	0,898	0,597
WE	0,753	0,757	0,828	0,449

The calculation *of construct reliability* can be seen from the composite *reliability* and *Cronbach's Alpha values.* The *composite reliability* and *Cronbach's Alpha* values for all indicators show a number greater than 0.7. It can be concluded that the construct has a fairly high internal consistency.

Meanwhile, the calculation of convergent validity can be seen from the Average Variance Extracted (AVE) value. Based on the calculations and provisions of the value limit that has been explained earlier, the WE variable has an AVE value below 0.5 so it is necessary to make improvements to the indicators used. Following up on this, the indicator with the lowest outer loading value, namely WE3, was removed.

Next, a recalculation was carried out and the following table was produced:

	Cronbranch Alpha	**Rho a**	**Rho c**	**AVE**
MP	0,799	0,822	0,863	0,562
PC	0,873	0,876	0,905	0,614
HIS	0,866	0,891	0,898	0,597
WE	0,773	0,794	0,845	0,523

It can be seen in the new table that the convergent validity calculation produces a conclusion that all indicators that can be said to be valid because they have values above 0.5. Therefore, it can be concluded that all indicators can reflect their variables validly.

3. Uji Discriminant Validity
   a. Fornell-Larcker Criterion

      The Fornell-Larcker Criterion compares the square root of Average Variance Extracted (EVA) with the correlation between one construct and another (Hutabarat & Malau, 2022). The Fornell-Larcker value is considered satisfied if the square root value of the Average Variance Extracted (EVA) is greater than the value of the correlation between constructs (Foeh et. al., 2022). The following is a Fornell-Larcker Criterion table obtained from the PLS Algorithm Report SmartPLS.

	MP	**PC**	**HIS**	**WE**
MP	0,750			
PC	0,598	0,784		
HIS	0,644	0,447	0,772	
WE	-0,334	-0,392	-0,255	0,723

      Based on the value of the Fornell-Larcker Criterion in the discriminant validity test, all variables that have met the requirements are the correlation value between constructs that is smaller than the square root value of AVE. This indicates that all indicators are valid

   b. Cross Loadings

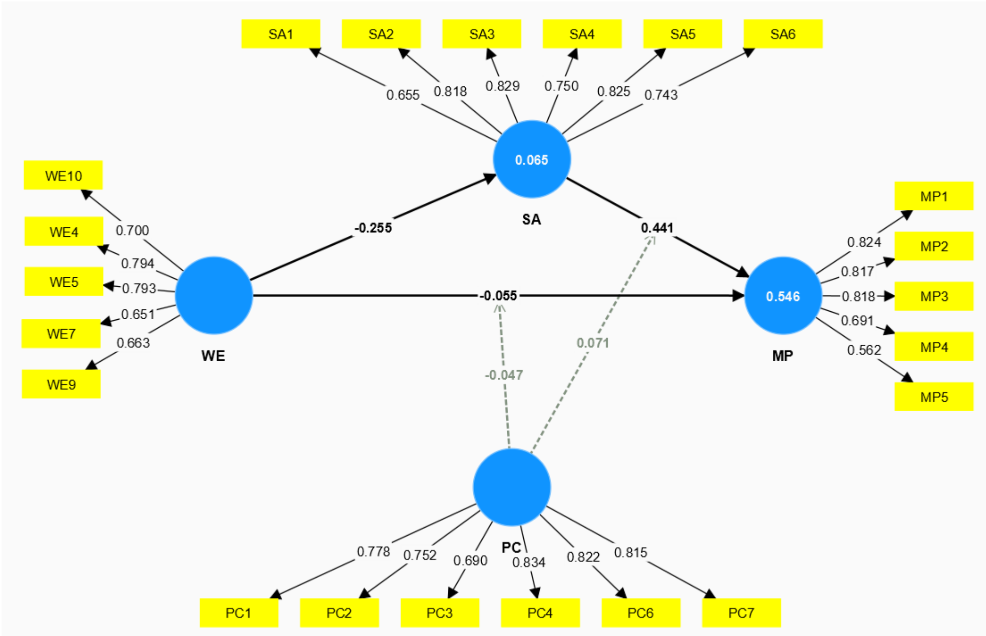
      Cross loadings is the correlation between indicators and variables. In general, the outer loading value of an indicator variable must be greater than all the *outer loading* values of the indicator variable against other constructs (Marliana, 2020). The following is a table *of Cross Loadings* obtained from the PLS Algorithm Report SmartPLS.

	MP	**PC**	**HIS**	**WE**	**PCxWE**	**PCxSA**
MP1	0,824	0,478	0,57	-0,323	-0,141	0,038
MP2	0,817	0,453	0,621	-0,33	-0,094	-0,074
MP3	0,818	0,488	0,45	-0,201	-0,082	0,026

MP4	0,691	0,229	0,488	-0,112	-0,196	0,024
MP5	0,562	0,584	0,225	-0,242	-0,012	-0,215
PC1	0,466	0,778	0,423	-0,387	-0,028	-0,376
PC2	0,404	0,752	0,385	-0,422	0,029	-0,269
PC3	0,475	0,69	0,324	-0,217	-0,218	-0,089
PC4	0,504	0,834	0,4	-0,308	-0,047	-0,306
PC6	0,5	0,822	0,335	-0,302	0,011	-0,34
PC7	0,445	0,815	0,23	-0,217	-0,166	-0,199
SA1	0,337	0,252	0,655	-0,153	-0,122	0,092
SA2	0,461	0,157	0,818	-0,117	-0,221	0,094
SA3	0,515	0,406	0,829	-0,228	-0,167	-0,009
SA4	0,669	0,561	0,75	-0,281	-0,074	-0,144
SA5	0,514	0,321	0,825	-0,199	-0,12	0,052
SA6	0,329	0,208	0,743	-0,135	-0,058	0,082
WE10	-0,246	-0,227	-0,245	0,7	0,061	-0,095
WE4	-0,283	-0,39	-0,156	0,794	-0,114	-0,037
WE5	-0,315	-0,315	-0,199	0,793	-0,112	-0,199
WE7	-0,143	-0,22	-0,184	0,651	-0,046	-0,169
WE9	-0,165	-0,246	-0,119	0,663	-0,026	0,008
PCxSA	-0,139	-0,09	-0,163	-0,068	1.000	0,183
PCxWE	-0,047	-0,338	0,011	-0,144	0,183	1.000

The results of the data analysis show that the correlation value between indicators that measure variables and the variables themselves is always higher than the correlation between indicators and other variables. This shows that there are no significant discrepancies in the processed data, and the developed model is valid for processing to the next stage.

After conducting *indicator reliability*, *internal consistency* & *convergent validity*, and *discriminant validity*, the results were obtained that all tests had met the minimum limit requirements. Therefore, it can be concluded that the model made is valid and *reliable*.



c. Inner Model Analysis

Structural model assessment or inner model is a model that connects a latent variable with other latent variables (Aurellia & Perdana, 2020). The analysis of the inner model is carried out to answer the hypothesis that has been made before. In this study, the inner model analysis was carried out using path coefficient.

The path coefficient assessment is seen from the original sample value and p-values. A p-value of less than 0.050 indicates that one variable has a significant effect on other variables. Meanwhile, if the original sample has a negative value, it can be concluded that one variable weakens other variables. The following is a table of path coefficients from SmartPLS Bootstrapping calculations.

	Original Sample	Sample mean	STDEV	T Statistics	P Value
PC -> MP	0,404	0,398	0,093	4.331	0
SA -> MP	0,441	0,437	0,099	4.433	0
WE -> MP	-0,055	-0,074	0,096	0,57	0,569
WE -> SA	-0,255	-0,283	0,127	2.009	0,045
PC x WE -> MP	-0,047	-0,029	0,076	0,612	0,54
PC x SA -> MP	0,071	0,09	0,074	0,957	0,339

Based on the original sample values and p-values listed in the path coefficient table from the results of the SmartPLS bootstrapping calculation, several conclusions can be drawn regarding the influence between variables in the model being observed. First, very low p-values (less than 0.050) for PC -> MP and SA -> MP indicate that the PC (Personnel Capability) and SA (Spare Parts Availability) variables have a significant influence on the MP (Maintenance Performance) variables. This indicates that these factors play an important role in determining maintenance performance. However, there is a WE (Working Environment) variable that has a negative original sample value for MP, which indicates that WE tends to weaken maintenance performance. Furthermore, the analysis of the interaction between variables shows that the interaction between PC and WE, as well as PC and SA, has no significant influence on MP, as indicated by the high p-values. However, the interaction between WE and SA showed a significant influence on MP, with a p-value of 0.045. This suggests that the interaction between WE and SA has an important role in improving maintenance performance, even though the path coefficient value for the interaction is negative, which indicates that the interaction between WE and SA tends to reduce maintenance performance.

Furthermore, it is necessary to understand the influence of moderation that may affect the relationship between variables in the model that has been prepared. To see more on this, the following table of specific indirect effects provides an overview of how the Working Environment (WE) variable moderates the relationship between Spare Parts Availability (SA) and Maintenance Performance (MP).

	Original Sample	**Sample mean**	**STDEV**	**T Statistics**	**P Value**
WE -> SA -> MP	-0.113	-0.123	0.063	1.795	0.073

In the table, the original sample value shows that there is a negative influence of WE on the relationship between SA and MP, with a path coefficient value of -0.113. However, it should be noted that a p-value of 0.073 slightly exceeds the conventional significance threshold value of 0.05. This suggests a potential moderation of WE on the relationship between SA and MP, although this effect has not been significantly confirmed in the context of the sample used. Therefore, further analysis and additional research may be needed to understand the role of WE moderation in more depth.

CONCLUSION

In the context of the analysis that has been carried out, it is important to evaluate the results of the hypothesis tests that have been carried out. The following are the conclusions of the hypothesis test carried out.

Hypothesis		**Significance**	**Relationship**
H1	WE has a direct influence on MP	Insignificant	-
H2	SA mediates the relationship between WE and MP	Insignificant	-
H3	SA has a direct influence on MPs	Signifikan	Positive

H 4	PC moderates the relationship between WE and MP	Insignificant	-
H 5	PC moderates the relationship between SA and MP	Insignificant	-

This table provides an overview of the significance of the relationships between the variables that have been tested in this study. The results showed that the H1 and H2 hypotheses, which relate to the direct influence of WE on MP and the mediating role of SA in the relationship between WE and MP, respectively, were not found to be significant. However, the H3 hypothesis shows a significant direct influence of SA on MP, with a positive relationship direction. This emphasizes the importance of the availability of spare parts in improving maintenance performance. Meanwhile, the H4 and H5 hypotheses relating to the role of PC moderation in the relationship between WE and MP, as well as between SA and MP, also show no significance.

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