Venus: Jurnal Publikasi Rumpun Ilmu Teknik
Volume 3, Nomor 6, Desember 2025
E-ISSN .: 3031-3481; P-ISSN .: 3031-5026; Hal. 170-180
DOI: https://doi.org/10.61132/venus.v3i6.1232
Tersedia: https://journal.aritekin.or.id/index.php/Venus

Maintenance and Repair Planning For Wood Profiling Machine With 90 Meters/Hour Capacity Using The IRRO Method

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Abstract. *The problems encountered are damage to the rubber wheel mount and universal/cross joints on the 90 m/hour capacity wood profile making machine, which can affect the uniformity and speed of wood profile making. Maintenance and repair planning aims to be able to create a maintenance and repair schedule for the 90 m/hour capacity wood profile making machine for the period 2026, estimate maintenance costs and the ratio of maintenance and repair costs to machine profits. The maintenance planning method includes collecting maintenance data from previous maintenance periods, reviewing the specifications of the wood profile making machine, estimating the age and price of components that are estimated to be damaged, estimating the cost and duration of dismantling and installing components that have been repaired in accordance with the provisions of the requirements for usable components or replacement spare parts, scheduling maintenance and repairs, estimating maintenance and repair costs for the period 2026, and determining the ratio of maintenance costs to profits. The planning results in the form of a maintenance-repair schedule for the period 2026; maintenance and repair costs in 2026, the ratio of maintenance costs to profits, and their implications indicate that the machine is still prospective and usable.*

Keywords*: 90 M/H Capacity, Maintenance Cost To Profit Ratio, Rubber Wheel Mount, Universal/Cross Joint, Wood Profile Making Machine.*

1. INTRODUCTION

The development of the wood processing industry in Indonesia has increased in line with the growing demand for profiled products with high dimensional precision and surface quality. High-capacity wood profiling machines are an important part of the production chain in achieving this efficiency and quality, but machine reliability is often a major challenge because damage to certain components can significantly reduce the uniformity of cuts and production rates.

Maintenance is defined as the process of eliminasting or preventing the cause of damage before it occurs. This process can include cleaning, periodic lubrication, regular inspections, maintenance, and component adjustments to maintain machine performance at standard levels. Repair, on the other hand, is the treatment of the impact of damage after a failure has occurred. The difference between maintenance and repair lies in the timing of the implementation.

Naskah Masuk: 07 November 2025; Revisi: 30 November 2025; Diterima: 27 Desember 2025; Terbit: 31 Desember 2025

Maintenance is performed before damage occurs, while repair is performed after damage has occurred (Hadi, 2019).

Conventional maintenance approaches that are reactive or based solely on a calendar often result in unexpected costs and high downtime, disrupting production processes (Douri, 2019). Therefore, systematic maintenance planning based on strategies such as preventive, predictive, and condition-based maintenance is necessary to reduce the frequency of disruptions (Yang, 2022; Lemes & Hvam, 2019; Einabadi et al., 2023). Proactive maintenance has been proven to improve machine reliability and reduce long-term costs when supported by accurate condition data and prognostic models (Achouch et al., 2022; Zhu et al., 2019)

The 4.0 Maintenance Transformation, which integrates IoT, data analytics, and machine learning, improves the accuracy of component condition predictions, enabling maintenance decisions to be made more efficiently and in a timely manner (Firdaus 2023; Wojciechowska, 2023). Optimization models in modern maintenance also consider multi-objective aspects such as cost minimization, increased availability, energy consumption, and product quality (Einabadi & Mahdavi, 2022; Setiawannie & Marikena, 2022; Sutrisno & Priyono, 2024).

In industrial practice, component-based maintenance methods such as IRRO (Inspection, Replace, Repair, Overhaul) are an effective approach in planning maintenance activities, predicting component life, and predicting spare part costs, especially for machines that operate continuously (Hadi et al., 2021). Several studies show that IRRO can be combined with reliability analysis to determine when a component should be inspected, replaced, repaired, or overhauled, so that the maintenance schedule becomes more realistic and economical (Pratama and Puspitasari, 2024).

For 90 m/hour capacity wood profiling machines, high operating speeds increase the rate of wear on elements that come into direct contact with wood, such as rubber wheels, blades, and other components. This requires planned maintenance that includes periodic inspections, scheduled replacements, repairs of damaged components, and planned overhauls to maintain production performance while reducing downtime costs.

2. METHODS

The application of the IRRO method in planning includes collecting previous maintenance data from wood profile machine component failures, checking wood profile machine specifications, estimating component damage for the 2026 period, making a list of components that must be replaced or repaired, predicting component life, predicting spare part prices, predicting repair costs, predicting maintenance duration and costs for component

assembly, scheduling maintenance and repairs, estimating total maintenance costs for 2026, and determining the ratio of maintenance costs to profits.

Figure 1. Wood Profiling Machine with 90 m/hour Capacity.

The maintenance and repair planning object is a Wood Profile Making Machine shown in Figure 1, where the wood board is placed on the input table on the right side and gripped by a rubber-coated input roller that advances the wood board into the machine, then the board passes through one or more cutting heads where the profiling knife forms the wood board profile, and finally the workpiece from the profiled wood board comes out onto the input conveyor to be forwarded to the next process on the left side of Figure 1 (Anonymous, 2018; Anonymous, 2023).

The Wood Profiling Machine specification is shown in Table 1.

Table 1. The Wood Profiling Machine Specifications .

No.	Unit		Description
1	Capacity	:	90 m/hour
2	Length	:	2500 mm
3	Height	:	1500 mm
4	Width	:	500 mm
5	Cutting Tool Diameter	:	150 mm
6	Cutting Tool Quantity	:	4 blade
7	Driver Motor	:	2.5 kW
8	Motor Rotation Speed	:	2900 rpm
9	Frame Material	:	Stainless Steel
10	Transmission System	:	Flat and V-Belt Drive

The components to be maintained and repaired are shown in Figure 2.

1	Bearing	6	Rubber Wheel
2	Gear Box	7	Rubber Wheel Mount*
3	Gear Box Seal	8	Universal/Cross Joint*
4	Electric Motor	9	Belt
5	Cutting Tool		

*) Repaired Components

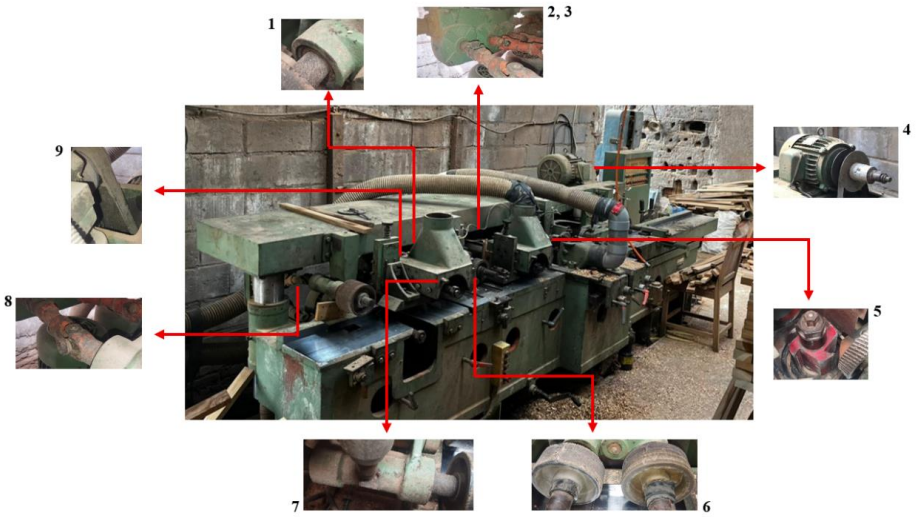

Figure 2. Components to be Maintained and Repaired.

3. RESULT AND DISCUSSION

The purpose of maintenance and repair planning for wood profiling machines is to achieve stable performance through machine performance inspections, component replacement, and component repairs where feasible. An overhaul was not performed because it was only planned for 2026, so it was not yet necessary to dismantle the entire machine. Major turnarounds are typically scheduled over a period of several years. Smaller procedures may occur more frequently, while major turnarounds involving extensive inspections and overhauls are generally performed every 3-5 years (Kaltungo & Mahdavi, 2024; Tai et al., 2024).

Inspection activities include checking the cleanliness of the machine's working system, checking the operating condition of components, checking for adequate lubricant or grease, and checking for the presence of contaminants. Inspection activities must be carried out in accordance with the established maintenance and repair schedule. The inspection activities that need to be carried out include:

1. Inspect the entire machine without having to disassemble it and make notes on damage, deficiencies, and the operating condition of the machine;
2. Clean dirt from machine components;
3. Check for noise or abnormal sounds occurring while the machine is operating;
4. Check for leaks and oil levels;
5. Check the sharpness of the blade;
6. Check the tightness of the bolts on each connected component;
7. Check the condition and tightness of the belt;
8. Check the drive motor and ensure that its components are in good condition;
9. Check the rubber wheel; and
10. Check for air pressure leaks in the pneumatic cylinder seal.

Spare part replacement is determined based on the predicted component life in the previous period assuming normal operational conditions, and the predicted price of wood profile machine components expressed in IDR units and their service life are shown in Table 2. In maintenance planning, component replacement is often based on the estimated remaining service life (Zheng et al., 2024). Components with a relatively short service life require a larger spare part inventory to avoid operational disruptions (Zhang, 2021).

The price prediction of a spare part can be obtained from: 1) Proof of purchase of spare parts in the previous period, 2) Information from suppliers or shops selling spare parts, 3) Price information obtained through the website, 4) Workshops where components are replaced that order spare parts, and 5) Predictions from a maintenance planner can be initiated based on component function (Hadi, 2019).

Table 2. Price and Life Time Prediction of Wood Profiling Machine Components.

No.	UNIT/PART		PRICE (×1,000 IDR)	PCS	LIFE TIME	
					HOUR	WEEK
1	Bearing	Cutting Tool Mount	46	5	43,800	261
		Rubber Wheel Mount	51	11		
		Universal/Cross Joint	35	24		
		Ball Bearing	52	9		
2	Gear Box				43,800	261
		Tappered Bearing	150	8		
3	Gear Box Seal		15	17	43,800	261

4	Electric Motor	Ball Bearing	56	6	43,800	261
5	Cutting Tool		92	5	26,280	156
6	Rubber Wheel		300	3	122,640	730
7	Rubber Wheel Mount		550	3	245,380	1460
8	Universal/Cross Joint		425	12	26,000	464
9	Belt	V-belt	70	1	13,870	83
		Flat Belt	188	5		
10	Oil		50	2	2000	36
11	Grease		72	1	500	9

The costs of dismantling components and assembling components or replacing spare parts on a wood profile machine and the duration of dismantling and assembly are shown in Table 3.

Table 3. Costs and Duration of Disassembly and Assembly of Wood Profiling Machine.

No.	**UNIT/PART**		**TECH. LEVEL**	**DURATION (HR/PART)**	**COST/HR (×1,000 IDR)**
1	Bearing	Cutting Tool Mount	SHS	1	19
		Rubber Wheel Mount	SHS	2	19
		Universal/Cross Joint	SHS	4	19
2	Gear Box	Ball Bearing	SHS	2	19
		Tappered Bearing	SHS	2	19
3	Gear Box Seal		SHS	5	19
4	Electric Motor	Ball Bearing	SHS	1.5	19
5	Cutting Tool		SHS	1	19
6	Rubber Wheel		SHS	1	19
7	Rubber Wheel Mount		SHS	5	19
8	Universal/Cross Joint		SHS	5	19
9	Belt	V-belt	SHS	0.5	19
		Flat Belt	SHS	1.5	19
10	Oil		SHS	2	19
11	Grease		SHS	2	19

*SHS : Senior/Vocational High School

On the wood profiling machine, repairs were made to the rubber wheel mount and universal/cross joint. The rubber wheel mount often breaks at the bolt. Meanwhile, the couple joint on the shaft and housing, as well as the cross joint, are damaged. The couple joint detaches from the shaft or housing, and the cross joint itself breaks because the joint housing is bent due to high torsional forces and prolonged wear. As a result, the efficiency of the profiling process decreases because the machine does not work optimally. If this condition is left unchecked, the productivity of wood profile cutting will not be maximized.

An example of a Broken Rubber Wheel Mount from the Previous Period is shown in Figure 3.

Figure 3. Example of a Broken Rubber Wheel Mount from the Previous Period.

The prediction of material prices for wood profiling machine repair activities is shown in Table 4.

Table 4. Predictions of Material Prices for Wood Profiling Machine Repair Activities.

No.	UNIT/PART	PRICE (×1,000 IDR)	PCS
1	Brass Rod 1 m (+ Welding Service)	400	4
2	Water Displacement-40	57	1

An example of Welded Rubber Wheel Mounting Results from the Previous Period is shown in Figure 4.

Figure 4. Example of Welded Rubber Wheel Mounting Results from the Previous Period.

In the previous maintenance records, no overhaul has ever been performed on the wood molding machine. Maintenance was performed on an unscheduled basis or only when the machine experienced damage to one of its components. Inspection and lubrication of the wood profiling machine is generally performed every 2 weeks. A well-organized and clear maintenance and repair schedule is essential to keep the machine performing optimally.

The maintenance and repair schedule for the Wood Profiling Machine for the 2026 period is shown in Table 5. For effectiveness, Table 5 displays only columns with activity.

Table 5. Wood Profiling Machine Maintenance and Repair Schedule in the 2026 Period.

No.	UNIT/PART		YEAR OF 2026													
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OKT	NOV	DES		
			24	6 8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52
1	Bearing	Cutting Tool Mount	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
		Rubber Wheel Mount	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
		Universal/Cross Joint	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2	Gear Box	Ball Bearing	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
		Tappered Bearing	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

3	Gear Box Seal			Rc		I		I		I		I		I		I		I		I		I		I		I		I
4	Electric Motor	Ball Bearing		Rc		I		I		I		I		I		I		I		I		I		I		I		I
5	Cutting Tool			Rc		I		I		I		I		I		I		I		I		I		I		I		I
6	Rubber Wheel			Rc		I		I		I		I		I		I		I		I		I		I		I		I
7	Rubber Wheel Mount			Rr		I		I		I		I		I		I		I		I		I		I		I		I
8	Universal/Cross Joint			Rr		I		I		I		I		I		I		I		I		I		I		I		I
9	Belt	V-belt		Rc		I		I		I		I		I		I		I		I		I		I		I		I
		Flat Belt		Rc		I		I		I		I		I		I		I		I		I		I		I		I
10	Oil		I	Rc	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	Rc	I	I	I	I	I	I
11	Grease			Rc			Rc			Rc			Rc			Rc			Rc			Rc			Rc			Rc

Remarks: I: inspection, Rc: Replace, Rr: repair, O: Overhoul

The ratio between the maintenance and repair costs of the Wood Profiling Machine for the period 2026 to its profit is shown in Table 6.

Table 6. The ratio between maintenance cost and profit.

YEAR	MAINTENANCE COST (×1,000 IDR)	ANNUAL PROFIT (×1,000 IDR)	RATIO (%)
2026	19,104.5	140,400	0.14

A wood profiling machine with a capacity of 90 m/hour was purchased second hand in 2010 for IDR 50,000,000. The price of a new machine for first use in 2005 was IDR 92,000,000. The machine is operated 6 days a week for 5 hours a day. Depreciation

calculations using the straight-line method show that the machine's depreciation value is IDR 1,400,000/year.

4. CONCLUSION

The conclusion of the maintenance planning is a maintenance-repair schedule for a 90 m/hour capacity wood profile machine for the period 2026, the maintenance-repair costs for the period 2026 are IDR 19,104,500, and the ratio between maintenance costs and profits for the period 2026 is 0.14, which implies that the machine is still suitable for use and prospective.

ACKNOWLEDMENT

The authors gratefully CV. Tulus Karya Malang for the support of information and data related to maintenance and repair planning for the wood profiling machines with 90 m/hour capacity.

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