



Coupler Modification for Periodic Preventive Maintenance on Sakai SV526D and SV700TF Compactor Units to Improve The Efficiency and Reliability of Hydraulic System Inspection

Roni Supriyadi

PT Antareja Mahada Makmur, Indonesia

Emails: roni.supriyadi@amm.id

Keywords:	Abstract
Suggestion System; Periodic Preventive Maintenance; Hydraulic Coupler; Hydraulic System Reliability; Heavy Equipment Maintenance	Hydraulic pressure inspection is essential for the preventive maintenance of heavy equipment; however, incompatible diagnostic connections can prevent mechanics from completing scheduled inspections. At PT Antareja Mahada Makmur, Mifa Jobsite, the hydraulic test ports on Sakai SV526D and SV700TF compactors were incompatible with the available Komatsu pressure gauge equipment, while the procurement of dedicated Sakai diagnostic tools was constrained by uncertain availability. This study aimed to identify the hydraulic pressure inspection constraint, implement a hydraulic test coupler modification, and evaluate its implications for preventive maintenance activities. A descriptive qualitative case study was conducted using the Suggestion System framework, encompassing problem identification, improvement planning, technical implementation, and field evaluation. Data were obtained from maintenance documentation, component damage records, dealer quotations, and field observations conducted before and after the modification. The intervention involved replacing the original hydraulic test couplers with Genuine Komatsu couplers, thereby enabling the existing pressure gauges to be connected to the compactors. Field observations indicated that the modification restored hydraulic pressure inspection capability, improved test-port cleanliness, reduced the observed risk of hydraulic oil spillage, and facilitated easier connection and disconnection of the pressure gauge equipment. These findings suggest that adapting diagnostic interfaces can address equipment compatibility constraints while supporting scheduled hydraulic system inspections. However, reductions in breakdown frequency, improvements in equipment reliability, and financial savings were not quantitatively established. The study concludes that hydraulic test coupler modification represents a practical improvement for preventive maintenance activities; however, further quantitative evaluation is required to determine its effects on maintenance efficiency, operational performance, cost savings, and equipment reliability.

INTRODUCTION

Scheduled preventive maintenance, or periodic preventive maintenance (PPM), is a core element of total productive maintenance (TPM) practices aimed at sustaining equipment reliability through scheduled inspection, measurement, and assessment before failures occur (Agustiady & Cudney, 2018a). On the Sakai SV526D and SV700TF compactor units operated by the Plant Department of PT Antareja Mahada Makmur (AMM), Mifa Jobsite, one of the critical systems requiring periodic inspection during PPM is the hydraulic system, particularly the pressure in the main hydraulic circuits supporting the vibration, parking brake, and propulsion functions (Liu et

al., 2024; Mouhib et al., 2025; Qi et al., 2024; Sanchez-Londono et al., 2023; Utami & Sa'adah, 2024).

Under the existing conditions, mechanics were unable to perform hydraulic pressure measurements during PPM on the Sakai SV526D and SV700TF units. This constraint was attributed to three main factors: (1) compatible equipment for measuring hydraulic system pressure on the Sakai units was not available internally; (2) the availability of the required equipment from the dealer was uncertain; and (3) consequently, the Plant Department was unable to adequately monitor hydraulic system conditions, potentially increasing the risk of unscheduled breakdowns. Field records indicated failures involving the vibration motor seal, parking brake seal, and rear propulsion motor. These failures were suspected to be associated with inadequate hydraulic system monitoring because scheduled pressure measurements could not be performed consistently due to the limited availability of compatible diagnostic equipment.

As one technical option, the authorized Sakai dealer (SWI) offered a pressure gauge set specifically designed for the Sakai units at a price of IDR 8,696,215. However, the equipment was available only on a backorder basis, and the dealer could not provide a confirmed estimated availability date. Relying solely on the procurement of this equipment could therefore prolong the period during which hydraulic pressure monitoring could not be performed as scheduled. Such limitations involving manufacturer- or model-specific diagnostic equipment represent a challenge in multi-brand heavy equipment maintenance, where different machines may require specific interfaces or tools for condition-monitoring activities (Psarommatis et al., 2023; Silvestri et al., 2020; Werbińska-Wojciechowska & Winiarska, 2023; Yan et al., 2023). Hydraulic pressure measurement is particularly important for evaluating system condition and identifying abnormalities that may indicate developing component problems (Quatrini et al., 2020; Setra Werdaya et al., 2024).

In response to this issue, Tegar Tahanuji, Section Head of the Plant Department, requested assistance from the Plant Product Development (PPD) Instructor team to develop or modify an appropriate interface so that hydraulic system inspection and pressure measurement, particularly during PPM activities, could be performed using the available diagnostic equipment. A similar request was made by Dita Puspita, Group Leader of the Plant Department, to address the inspection constraint on the Sakai compactors. Based on these directions, an improvement was proposed through the Suggestion System (SS) under the theme “MOCO,” referring to the modification of the PPM couplers on the Sakai SV526D and SV700TF units. The proposed modification emphasized efficiency and practical resource utilization by enabling PPM activities to be performed according to the applicable standard operating procedure (SOP) without relying solely on the procurement of dedicated diagnostic equipment with uncertain availability (Mallioris et al., 2024; Ostrowski & Jagodziński, 2021; G. Tortorella et al., 2022; Wang et al., 2022).

Previous research suggests that employee participation can provide an organizational mechanism for addressing operational problems. (Męcfel, 2024), through a case study at OKNOPLAST, examined an employee suggestion system grounded in continuous improvement and identified declining rates of suggestion submission and acceptance as issues requiring

intervention. Management awareness, employee training, and technical support subsequently contributed to increases in the number of suggestions submitted and accepted. Similarly, (Salvadorinho et al., 2024) developed the DisneyHint employee suggestion system using a literature review and 30 interviews conducted across three partner companies. Their findings emphasized suggestion development, transparent evaluation, employee engagement, and the preservation of tacit organizational knowledge. Together, these studies support the relevance of structured employee suggestion systems for translating frontline experience into actionable operational improvements.

Taken together, the reviewed studies address complementary aspects of maintenance improvement but leave a specific question unresolved within the evidence considered in the present study. (Agustiady & Cudney, 2018b) explain the organizational principles of TPM; (Quatrini et al., 2020) investigate hydraulic degradation modeling; and Męćfel (2024) and (Salvadorinho et al., 2024) examine mechanisms for developing and implementing employee suggestions. However, these studies do not directly evaluate the field intervention examined in the present research: modifying hydraulic test couplers on Sakai compactors to enable compatibility with existing Komatsu pressure gauge equipment. The resulting research gap concerns how adaptation of the hydraulic measurement interface, implemented through a structured employee suggestion process, can restore pressure inspection capability during scheduled preventive maintenance. This represents a context-specific research gap rather than a claim that comparable coupler modifications have never been implemented in other settings (G. L. Tortorella et al., 2021, 2024).

Addressing this gap is important because the inability to perform hydraulic pressure measurements leaves maintenance personnel with incomplete information regarding system conditions during scheduled inspections. At AMM Mifa Jobsite, waiting for diagnostic equipment with uncertain availability would prolong the documented limitation in hydraulic pressure inspection capability. The proposed intervention, referred to as MOCO in this study, therefore focused on modifying the hydraulic test coupler configuration of the Sakai SV526D and SV700TF units through the company's Suggestion System. Its distinctive contribution lies in the contextual integration of hydraulic measurement-interface adaptation, utilization of existing pressure gauge equipment, and employee-led improvement practices. The study evaluated the intervention in terms of restored inspection capability and observed changes in the maintenance process, while recognizing that improvements in long-term equipment reliability would require additional quantitative evidence.

Accordingly, this study aimed to examine how hydraulic test coupler modification could restore pressure measurement capability during PPM activities on the Sakai SV526D and SV700TF compactors. The specific objectives were to identify the connection incompatibility underlying the inspection constraint, document the selection and installation of replacement couplers, and compare maintenance conditions before and after implementation. The descriptive qualitative assessment considered the feasibility of hydraulic pressure measurement, observed risk of hydraulic oil spillage, test-port cleanliness, coupler condition, connection and disconnection

activities, and mechanics' reported experiences. These objectives aligned the investigation with the available field documentation and distinguished directly observed process improvements from potential longer-term benefits, such as reductions in breakdown frequency, which would require extended observation and systematic quantitative measurement.

The expected contribution of this study is practical evidence linking preventive maintenance implementation with employee-led technical improvement in a multi-brand heavy equipment environment. For maintenance managers, the study provides a documented case for evaluating whether existing diagnostic resources can be utilized more effectively when interface incompatibility prevents scheduled inspections. For mechanics and technical personnel, it provides a basis for developing clearer inspection procedures and reducing recurring operational constraints. For researchers, the findings identify opportunities for future studies to quantitatively evaluate inspection duration, modification costs, pressure measurement consistency, hydraulic system performance, and subsequent component failure patterns. Ultimately, the study is intended to support more comprehensive hydraulic system inspections and better-informed maintenance decisions, while broader application of the modification requires separate verification of its technical compatibility and suitability for other equipment configurations.

METHOD

This study employed a case study approach using the Suggestion System (SS) method (Mecfel, 2024; Schuring & Luijten, 2001). The improvement process consisted of four main stages: problem identification and collection of field evidence, formulation of the improvement plan using the 5W1H framework, implementation of the technical modification, and evaluation of the results through post-implementation field observations.

Data were obtained from documentation of hydraulic system component failures on the Sakai SV526D and SV700TF compactors, improvement instructions from Plant Department supervisors, technical information regarding the pressure gauge equipment provided by the authorized Sakai dealer (SWI), and field observations conducted by the implementation team during and after the modification. The improvement process involved four parties with specific roles, as summarized in Table 1.

Table 1. Roles of the parties involved in implementing the “MOCO” Suggestion System

Party	Role
Instructor (PPD)	Technical facilitator; directs the inspection, measurement, and examination process on the hydraulic system
Group Leader Plant	Facilitator and initial instructor for the Sakai Compactor PPM improvement work
Plant Engineer (PE) Team	Implementer; designs and proposes the appropriate replacement coupler specification
Wheel Team	Implementer; installs the replacement coupler on the unit in the field

The effectiveness of the modification was evaluated descriptively by comparing PPM conditions before and after the coupler modification. The evaluation included the feasibility of hydraulic pressure measurement, observed risk of oil spillage, test-port cleanliness, coupler condition, time required for removal and installation, and mechanics' reported work experience. The evaluation was based primarily on direct field observations conducted during the implementation process (Salvadorinho et al., 2024).

RESULTS AND DISCUSSION

Problem Identification and Field Impact

The field identification results show that the main root cause was a mismatch between the original Sakai manufacturer coupler on the PPM port of the SV526D and SV700TF units and the Genuine Komatsu pressure gauge tools already owned internally by the Plant Department. As a result, the only official option for checking hydraulic system pressure was to procure a special pressure gauge tool set from the Sakai dealer (SWI) priced at IDR8,696,215, which, at the time this study was conducted, remained on backorder with no certainty as to its arrival time. This condition caused the PPM process on the hydraulic system to be unable to be carried out optimally for a considerable period, as summarized in Table 2.



Quotation Form

Customer Name PT Antareja Mahada Makmur

Address Site MIFA

City -

Telp -

PT Star Wagen Indonesia

For reference please quote the following no.
Order no :046/SWI-JKT/V/2026

Keterangan Unit :

VIN / SN	-
Unit Model	-
Unit Code	-
Reff WO	-

We attach herewith the following:

a. Price Tools

Item	Description Part	Qty	Price	Total
1	TOOLS PRESURE GAUGE SET 0053-GRAN (Contains 4 Gauges : 10 MPa, 25 MPa, 40 MPa, and 60 MPa)	1	Rp 7,834,428	Rp 7,834,428
Total Part Cost				Rp 7,834,428

Sub Total	Rp 7,834,428
PPN 11% (11/12)	Rp 861,787
Grand Total	Rp 8,696,215

Figure 1. Price quotation form for the special pressure gauge tool set for the Sakai units from dealer SWI, valued at IDR8,696,215 and on backorder



Figure 2. Propulsion/drive motor component removed from the unit due to damage suspected to be related to the hydraulic PPM not running optimally

Table 2. Identification of problematic conditions in the hydraulic PPM process of the Sakai compactor units

Aspect	Identified Problematic Condition
Tool Availability	A suitable hydraulic system pressure-checking tool for the Sakai units is not available internally
Procurement Certainty	The dealer (SWI) pressure gauge tool set, priced at IDR8,696,215, is on backorder with no estimated arrival time
Component Monitoring	The Plant team cannot periodically monitor the condition of the hydraulic system, increasing the risk of unscheduled breakdown
Actual Field Impact	Damage was found in the vibration motor seal, parking brake seal, and rear propulsion motor due to the hydraulic PPM not running optimally

The findings in Table 2 show that the tool limitation was not merely an administrative constraint but had escalated into actual component damage at several critical points of the unit. This is consistent with the principle of condition-based maintenance, in which delayed or absent monitoring of key parameters such as hydraulic pressure can allow potential component failure to go undetected at an early stage, thereby increasing the risk of more severe damage and higher repair costs (Setra Werdaya et al., 2024).

Formulation of the Improvement Idea

The improvement idea was formulated based on the principle of Customer to Quality (CTQ), namely keeping the PPM process on the Sakai SV526D and SV700TF units quality-focused while also making it faster, more efficient, and SOP-compliant. The formulated solution was named MOCO, an acronym for “modifying the PPM coupler of the Sakai SV526D and SV700TF,” with the core idea of replacing the original Sakai manufacturer coupler with a Genuine Komatsu PPM coupler, so that the Komatsu pressure gauge tools already available internally could be used directly on the Sakai units without waiting for the procurement of a special tool from the dealer. The detailed formulation of the improvement idea using the 5W1H framework is presented in Table 3.

Table 3. Formulation of the MOCO improvement idea using the 5W1H framework

Element	Formulation
What	Maximize the PPM process with a spirit of smart and safe work to obtain the best possible check results
When	Carried out by replacing the original Sakai coupler with a Genuine Komatsu PPM coupler
Where	Applied to every PPM process on the Sakai SV526D and SV700TF units
Why	Applying the “learning by doing” principle so that hydraulic pressure data collection becomes more consistent and efficient during PPM
Who	Facilitators: instructor and group leader plant. Implementers: Plant Engineer (PE) team and Wheel team

Implementation of the Coupler Modification

The solution was implemented by procuring Genuine Komatsu PPM couplers with part number 799-101-5230, with a requirement of five coupler units per machine, to be installed in place of the original coupler on the PPM port of the Sakai SV526D and SV700TF units. The Genuine Komatsu coupler was selected based on the compatibility of its dimensions and locking mechanism with the Komatsu pressure gauge tools already available internally, so that the adaptation process could be carried out without requiring investment in a new tool. This modification also aimed to reduce the lost-time duration arising from the coupler removal-installation process, which had previously been less efficient with the original port configuration.

The approach of modifying a coupler to match the measurement-point connectivity with already-available pressure gauge tools is a common practice in efforts to reduce maintenance costs without sacrificing condition monitoring capability, as widely applied across various quick-connect hydraulic coupler configurations to speed up the connect-disconnect process during inspection and maintenance activities (Setra Werdaya et al., 2024). With this modification, the Plant Department of AMM Jobsite Mifa is no longer dependent on the uncertain availability of dealer-specific Sakai tools, while also making optimal use of its existing investment in Genuine Komatsu tools.



Figure 3. The original Sakai manufacturer PPM coupler (left) and its incompatible connection with the Genuine Komatsu pressure gauge tools, before modification.



Figure 4. Genuine Komatsu pressure gauge tool set (four gauges and coupler connectors) already available internally in the Plant Department.



Figure 5. Genuine Komatsu PPM coupler (part number 799-101-5230) after installation on the PPM port of the Sakai compactor unit

Table 4. Technical parameters of the MOCO coupler modification implementation

Implementation Parameter	Description
Component replaced	Original Sakai manufacturer PPM coupler on the SV526D and SV700TF units
Replacement component	Genuine Komatsu PPM coupler, part number 799-101-5230
Requirement per unit	5 pcs of coupler per machine
Supporting tools used	Genuine Komatsu pressure gauge tools already available internally
Installation implementer	Wheel team, under the direction of the Plant Engineer (PE) team

Evaluation of Implementation Results

Post-implementation field evaluation was carried out by comparing the condition of the PPM process before and after the coupler modification. The evaluation results show consistent improvement across five main aspects, as summarized in Table 5.



Figure 6. Process of checking hydraulic pressure using the Genuine Komatsu tools on the Sakai compactor unit after the coupler modification

Table 5. Comparison of PPM process conditions before and after implementation of the MOCO coupler modification

Evaluation Aspect	Condition Before	Condition After Modification
Feasibility of pressure checking	Could not be performed because dealer tools were unavailable/on backorder	PPM on the hydraulic system can be performed using the already-available Genuine Komatsu tools
Risk of oil spillage	High potential due to the imprecise configuration of the original coupler during removal-installation	Risk of oil spillage from PPM coupler removal-installation is reduced
PPM port cleanliness	Prone to contamination due to a suboptimal removal-installation process	PPM port cleanliness is better maintained
Physical condition of the coupler	At risk of thread and housing damage due to manual adjustment	No damage found on the coupler thread or housing
Process duration (lost time)	Removal-installation duration tends to be uncontrolled due to difficulty adapting the coupler	Lost-time duration during removal-installation is better maintained/controlled

The results in Table 5 show that the coupler modification successfully addressed the main root cause, namely the unavailability of pressure-checking tools, without requiring investment in an expensive new tool of uncertain availability. In addition to restoring hydraulic system monitoring capability, this solution also provided additional benefits in the form of improved work cleanliness and better control of process duration, which indirectly supported compliance with the established PPM SOP.

PT ANTAREJA MAHADA MAKMUR Coal Mining Contractor & Trading Site MIPA - Muallatuh, Aceh									
UNIT		ENGINE		ATTACHMENT		Machine Condition Report			
Model	Serial No.	Model	Serial No.	Model	Serial No.				
SV52DG	VS23PPA	4861							
Customer Name: PT. ANTA						INSPECTION Name: M. R. H. H.			
Machine Location: SITE MIPA						Date: 22/06/2016			
Time: 14:00 - 16:00						22/06/2016 18:00			
ITEM	CONDITION	UNIT	STANDARD	ACTUAL	CORRECTION MADE	FINAL ANALYSIS			
ENGINE									
Engine Speed	Eng. Low (Idle)	Rpm	900 ± 25	995					
Eng. Low (Idle)	Rpm	1000 ± 25	1075						
Eng. High	Rpm	1500 ± 25	1575						
Eng. High	Rpm	1500 ± 25	1575						
Eng. High	Rpm	1500 ± 25	1575						
Oil Pressure	Eng. High	Oil Temp 40°C	min 120	100					
Oil Pressure	Eng. High	Oil Temp 40°C	min 120	100					
Water Temp	Eng. Low	Water Temp 70-80°C	80°C	75					
Water Temp	Eng. Low	Water Temp 70-80°C	80°C	75					
Water Temp	Eng. Low	Water Temp 70-80°C	80°C	75					
PROPULSION PUMP									
Charge Pressure	Eng. High	MPa	1.2 ± 0.2	—		Tools tidak sesuai			
Back Pump Pressure at Peak	Eng. High	MPa	42.0 ± 1.0	—					
Back Pump Pressure at Peak	Eng. High	MPa	42.0 ± 1.0	—					
REAR MOTOR									
Eng. High	Eng. High	MPa	1.2 ± 0.2	—					
Eng. High	Eng. High	MPa	1.2 ± 0.2	—					
VIBRATION PUMP									
Charge Pressure	Eng. High	MPa	1.2 ± 0.2	—		"			
Back Pump Pressure at Peak	Eng. High	MPa	42.0 ± 1.0	—					
Back Pump Pressure at Peak	Eng. High	MPa	42.0 ± 1.0	—					
EXCITER SHAFT SPEED									
Frequency	Rpm 1800	Hz	30.51	—		Tidak Ada Tools			
Frequency	Rpm 1800	Hz	30.51	—					
STEERING PUMP									
From The Steering	Eng. High	MPa	16.4 ± 1.0	—					
VIBRATION MOTOR									
Lookups Oil Rate	Speed High	L/min	8.9	—					
DRUM DRIVE MOTOR									
Lookups Oil Rate	Speed High	L/min	10	—					
PARKING BRAKE									
Eng. High	Eng. High	MPa	1.5 ± 0.2	—					
FINAL DRIVE									
Eng. High	Eng. High	MPa	1.5 ± 0.2	—					
ELKS DRIVE									
Eng. High	Eng. High	MPa	1.5 ± 0.2	—					
TIME									
Time Condition	Eng. High	Kpa	137	OK		Good Condition			
Time Condition	Eng. High	Kpa	137	OK					
ADDITIONAL									
Attachment Frame & Drive	Check Detection	No Check	No Check			Good Condition			
Attachment Frame & Drive	Check Detection	No Check	No Check						

Figure 7. Machine Condition Report for the Sakai SV526D unit before the coupler modification — the pressure-check columns for the propulsion pump, vibration pump, and exciter shaft speed were recorded as “Unsuitable Tools/No Tools Available.”

PT ANTAREJA MAHADA MAKMUR
Coal Mining Contractor & Trading
Site MIPA - Mandaboh, Aceh

Machine Condition Report

Inspector: **M. RICHARD**
Machine Location: **SITE MIPA**
Time: **11:00 - 12:00**

UNIT: **VS23PPA** ENGINE: **4B61** ATTACHMENT: **Drum**

SERVICE METER: **15000,6** INSPECTION DATE: **15/08/26**

ITEM	CONDITION	UNIT	STANDARD	ACTUAL	CORRECTION MADE	FINAL ANALYSIS
ENGINE						
Engine Speed	Eng. Low (Idle)	Rpm	950 ± 25	800		GOOD CONDITION
Engine Oil Temp.	Eng. High	°C	95 ± 10	120		
Engine Pressure	Eng. High	mm Hg	100 ± 10	100		
Engine Deflection	Eng. High	mm	10 ± 1	10		
Charge Pump	Eng. High	Water Temp. 50-80°C	80 ± 5	80		GOOD CONDITION
MA Part Press at Fwd	Eng. High	MPa	1.5 ± 0.2	2.1		
MA Part Press at Rev	Eng. High	MPa	0.1 ± 0.1	0.1		
MA Part Press at Rev	Eng. High	MPa	0.1 ± 0.1	0.1		
REAR MOTOR						
Low Load	Eng. High	MPa	1.0 ± 0.2	2.0		GOOD CONDITION
High Load	Eng. High	MPa	1.0 ± 0.2	2.0		
VIBRATION PUMP						
Charge Pressure	Eng. High	MPa	1.5 ± 0.2	2.1		GOOD CONDITION
High Amplitude	Eng. High	MPa	20.0 ± 1.0	20		
Low Amplitude	Eng. High	MPa	20.0 ± 1.0	20		
EXCITER SHAFT SPEED						
Frequency	Rpm 1800	Hz	30/35	-		TOOLS JUDAH ADA
WHEEL PUMP						
From The Steering	Eng. High	MPa	18.4 ± 1.0	16.2		
VIBRATION MOTOR						
Leakage Oil Rate	Speed High	L/min	8.0	-		TOOLS JUDAH ADA
DRUM DRIVE MOTOR						
Leakage Oil Rate	Speed High	L/min	10	-		TOOLS JUDAH ADA
PARKING BRAKE						
Eng. High	Eng. High	MPa	1.5 ± 0.2	2.1		GOOD CONDITION
FINAL DRIVE						
Eng. High	Eng. High	MPa	1.5 ± 0.2	2.1		GOOD CONDITION
ELECTRICAL						
Electrical Function	Function Check	Normal Function	27 ± 20	27		GOOD CONDITION
TIRE						
Tire Condition	Visual Check	Standard	137	137		GOOD CONDITION
OPTIONAL						
Attachment Frame & Drive	Crack Detection	No Crack	No Crack			GOOD CONDITION

Inspector: **M. RICHARD** (Mechanic)
Approved by: **M. RICHARD** (Mechanic)
Acknowledged by: **M. RICHARD** (Mechanic)

Galaxy A17 5G

Figure 8. Machine Condition Report for the Sakai unit after the coupler modification — pressure-check results for the propulsion pump, vibration pump, and parking brake were recorded in full with a “Good Condition” status

Implementation Benefits and Impact on Stakeholders

The implementation of the MOCO solution provided benefits across various operational aspects of the Plant Department at AMM Jobsite Mifa. First, the PPM process could be carried out more effectively, so the overall maintenance process ran in a more controlled manner. Second, with periodic monitoring of the hydraulic system condition restored, this solution has the potential to prevent more severe component damage, thereby reducing repair costs compared with a scenario in which damage is left undetected until it causes larger functional failure. Third, the PPM process could proceed more quickly while still producing maximal inspection data in accordance with the applicable SOP. Fourth, the reduced risk of oil spillage from coupler removal and installation also helped prevent potential workplace environmental contamination. Fifth, the increased ease and speed of the PPM process contributed to greater job satisfaction and proficiency among mechanics in carrying out their routine tasks.

From a stakeholder perspective, this solution delivers layered benefits: for the Plant Department institutionally, it reduces dependence on the unpredictable availability of proprietary dealer tools; for the Plant Engineer and Wheel teams as implementers, it provides experience in applying the “learning by doing” principle in designing a simple yet effective technical solution;

and for the mechanics carrying out PPM in the field, it directly reduces daily work obstacles and increases confidence in carrying out complete hydraulic inspection procedures.

The findings of this study reinforce the argument in the heavy equipment maintenance literature that pressure checking is a relatively simple yet important condition monitoring index for detecting potential hydraulic component failure at an early stage (Setra Werdaya et al., 2024; Quatrini et al., 2020). Compared with an automatic sensor-based predictive maintenance approach, which requires a more complex infrastructure investment, the coupler modification solution in this study shows that the reliability of the preventive inspection process can be restored through a simple technical intervention at the measurement point, without having to wait for the availability of third-party proprietary tools. This approach is consistent with the autonomous maintenance philosophy within Total Productive Maintenance (TPM), which emphasizes the active involvement of operators and internal technicians in maintaining equipment reliability through small-scale, continuous improvement activities (Agustiady & Cudney, 2018).

From an innovation management perspective, the success of the MOCO solution also reflects the effectiveness of the Suggestion System scheme as a bottom-up channel for frontline employees to propose and implement improvements to their own work processes. This is consistent with findings from studies on the application of Employee Suggestion Systems in the manufacturing sector, which show that employee involvement in identifying and resolving day-to-day operational problems can improve process efficiency while strengthening a culture of continuous improvement (kaizen) in the workplace (Męcfel, 2024; Schuring & Luijten, 2001; Salvadorinho et al., 2024).

This study has a number of limitations that warrant attention in both practical application and further research. First, the evaluation of the solution's success in this study is descriptive-qualitative, based on field observation, without accompanying formal quantitative data such as breakdown frequency before and after implementation or an explicit cost-saving calculation, so further research that quantitatively measures this impact would strengthen the evidence of the solution's effectiveness. Second, this solution is specific to addressing the coupler mismatch on two models of Sakai compactor units (SV526D and SV700TF), so generalization to other unit models or heavy equipment brands would require a separate technical compatibility study. Third, the sustainability of this solution's benefits depends on consistent use of the Genuine Komatsu coupler in every subsequent PPM process, so standardization and dissemination of the procedure are needed to prevent a reversion to the original manufacturer coupler configuration.

CONCLUSION

The implementation of the MOCO solution through the Suggestion System addressed the incompatibility of the available hydraulic pressure measurement equipment during periodic preventive maintenance (PPM) of the Sakai SV526D and SV700TF compactors operated by the Plant Department of PT Antareja Mahada Makmur (AMM), Mifa Jobsite. Replacing the original Sakai hydraulic test coupler with a Genuine Komatsu coupler (part number 799-101-5230) enabled the existing Genuine Komatsu pressure gauge equipment to be connected to the hydraulic test ports without relying on the procurement of dedicated Sakai diagnostic equipment with uncertain

availability. Field observations indicated that the modification restored hydraulic pressure measurement capability, reduced the observed risk of hydraulic oil spillage, improved test-port cleanliness, facilitated connection and disconnection, and reduced the potential for damage to the coupler threads and housing. The modification also supported compliance with applicable standard operating procedures (SOPs) and improved the practicality of scheduled hydraulic system inspections. However, its effects on component failure rates, maintenance time, equipment reliability, financial savings, and mechanics' job satisfaction require further quantitative evaluation.

Based on these findings, the MOCO coupler modification may be considered for standardized implementation on compatible Sakai SV526D and SV700TF compactors at AMM Mifa Jobsite, subject to verification of technical compatibility and applicable safety requirements. Future evaluations should systematically record quantitative indicators, including hydraulic system failure frequency, inspection duration, maintenance downtime, modification costs, and subsequent component failures, to provide measurable evidence of the modification's operational effectiveness and reliability benefits. The principle of adapting hydraulic measurement interfaces to compatible diagnostic equipment already available within the organization may also be evaluated for other multi-brand heavy equipment experiencing similar compatibility constraints. In addition, the Plant Department should consider strengthening the Suggestion System as a mechanism for continuous improvement by encouraging technically verified, practical, and resource-efficient solutions developed by frontline maintenance personnel.

REFERENCES

- Agustiady, T. K., & Cudney, E. A. (2018a). Total productive maintenance. *Total Quality Management & Business Excellence*. <https://doi.org/10.1080/14783363.2018.1438843>
- Agustiady, T. K., & Cudney, E. A. (2018b). Total productive maintenance. *Total Quality Management & Business Excellence*. <https://doi.org/10.1080/14783363.2018.1438843>
- Liu, H., Yan, S., Huang, M., & Huang, Z. (2024). A fault diagnosis method for hydraulic system based on multi-branch neural networks. *Engineering Applications of Artificial Intelligence*, 137, 109188. <https://doi.org/10.1016/j.engappai.2024.109188>
- Mallioris, P., Aivazidou, E., & Bechtsis, D. (2024). Predictive maintenance in Industry 4.0: A systematic multi-sector mapping. *CIRP Journal of Manufacturing Science and Technology*, 50, 80–103. <https://doi.org/10.1016/j.cirpj.2024.02.003>
- Męcfel, E. (2024). Case study: Development of employee suggestion system at OKNOPLAST manufacturing company as element of process improvement. *Decision Making in Manufacturing and Services*, 49–58. <https://doi.org/10.7494/dmms.2024.si.6690>
- Mouhib, Z., Gallab, M., Merzouk, S., Soulhi, A., & Di Nardo, M. (2025). Total Productive Maintenance and Industry 4.0: A Literature-Based Path Toward a Proposed Standardized Framework. *Applied System Innovation*, 8(4), 98. <https://doi.org/10.3390/asi8040098>

- Ostrowski, D., & Jagodziński, J. (2021). Operation of an employee suggestion system in administration and production departments of a remanufacturing company. *Journal of Remanufacturing*, 11, 107–120. <https://doi.org/10.1007/s13243-020-00095-7>
- Psarommatis, F., May, G., & Azamfirei, V. (2023). Envisioning maintenance 5.0: Insights from a systematic literature review of Industry 4.0 and a proposed framework. *Journal of Manufacturing Systems*, 68, 376–399. <https://doi.org/10.1016/j.jmsy.2023.04.009>
- Qi, J., Qi, Y., Luo, S., & Zhang, J. (2024). Hydraulic System Fault Diagnosis Based on Dual-Channel Convolutional Neural Network and Improved D-S Evidence Theory. *Shock and Vibration*, 2024, 1528224. <https://doi.org/10.1155/vib/1528224>
- Quatrini, E., Costantino, F., Pocci, C., & Tronci, M. (2020). Predictive model for the degradation state of a hydraulic system with dimensionality reduction. *Procedia Manufacturing*, 42, 516–523. <https://doi.org/10.1016/j.promfg.2020.02.039>
- Salvadorinho, J., Pintor, P., Bastos, T., & Teixeira, L. (2024). DisneyHint: Lean and coaching-based employee suggestion system for the human challenges of Industry 4.0. *Journal of Industrial Engineering and Management*, 17(2), 516–541. <https://doi.org/10.3926/jiem.6314>
- Sanchez-Londono, D., Barbieri, G., & Fumagalli, L. (2023). Smart retrofitting in maintenance: a systematic literature review. *Journal of Intelligent Manufacturing*, 34(1), 1–19. <https://doi.org/10.1007/s10845-022-02002-2>
- Schuring, R. W., & Luijten, H. (2001). Reinventing suggestion systems for continuous improvement. *International Journal of Technology Management*, 22(4), 359–372.
- Setra Werdaya, N. M., Hendriana, D., & Nasution, H. (2024). *Optimizing condition-based maintenance for assessing failure indicators in heavy equipment components*.
- Silvestri, L., Forcina, A., Introna, V., Santolamazza, A., & Cesarotti, V. (2020). Maintenance transformation through Industry 4.0 technologies: A systematic literature review. *Computers in Industry*, 123, 103335. <https://doi.org/10.1016/j.compind.2020.103335>
- Tortorella, G. L., Fogliatto, F. S., Cauchick-Miguel, P. A., Kurnia, S., & Jurburg, D. (2021). Integration of Industry 4.0 technologies into Total Productive Maintenance practices. *International Journal of Production Economics*, 240, 108224. <https://doi.org/10.1016/j.ijpe.2021.108224>
- Tortorella, G. L., Saurin, T. A., Fogliatto, F. S., Sreedharan, V. R., Sena, S. A., Forstner, F. F., & Macias de Anda, E. (2024). Digitalization of maintenance: exploratory study on the adoption of Industry 4.0 technologies and total productive maintenance practices. *Production Planning & Control*, 35(4), 352–372. <https://doi.org/10.1080/09537287.2022.2083996>
- Tortorella, G., Saurin, T. A., Fogliatto, F. S., Tlapa, D., Moyano-Fuentes, J., Gaiardelli, P., Seyedghorban, Z., Vassolo, R., Mac Cawley, A. F., Sunder, M. V., Sreedharan, V. R., Sena, S. A., & Forstner, F. F. (2022). The impact of Industry 4.0 on the relationship between TPM and maintenance performance. *Journal of Manufacturing Technology Management*, 33(3), 489–520. <https://doi.org/10.1108/JMTM-10-2021-0399>

- Utami, P. D., & Sa'adah, N. (2024). Pengaruh faktor resiliensi terhadap ketahanan individu setelah kejadian traumatik. *Jurnal Mahasiswa BK An-Nur: Berbeda, Bermakna, Mulia*, 10(2), 99–109. <https://doi.org/10.31602/jmbkan.v10i2.13951>
- Wang, L., Liu, Y., Yin, H., & Sun, W. (2022). Fault diagnosis and predictive maintenance for hydraulic system based on digital twin model. *AIP Advances*, 12(6), 065213. <https://doi.org/10.1063/5.0098632>
- Werbińska-Wojciechowska, S., & Winiarska, K. (2023). Maintenance Performance in the Age of Industry 4.0: A Bibliometric Performance Analysis and a Systematic Literature Review. *Sensors*, 23(3), 1409. <https://doi.org/10.3390/s23031409>
- Yan, W., Shi, Y., Ji, Z., Sui, Y., Tian, Z., Wang, W., & Cao, Q. (2023). Intelligent predictive maintenance of hydraulic systems based on virtual knowledge graph. *Engineering Applications of Artificial Intelligence*, 126, 106798. <https://doi.org/10.1016/j.engappai.2023.106798>