“Reduction of 15% in Spare Parts Consumption Costs in Automated Non-Absorbable Suture Automated Process”

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IE 4995 Capstone Design Course | Luis Olivares, ME, MLSSBB | WI-2025
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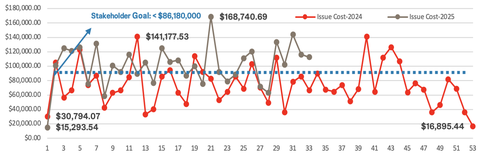
Define

Business Case

The Technical Operations and Engineering Management team seeks to reduce spare parts consumption costs to preserve budget availability for strategic and continuous improvement initiatives, while Manufacturing Operations requires consistent part availability to maintain production flow.

Problem Statement

During 2024, the ACE San Lorenzo Business Unit maintained an average weekly spare parts consumption cost of $74,263.85 across 53 weeks. However, in 2025, with only 33 weeks of operational data, the average weekly consumption cost has escalated to $101,388.49, representing a 26% increase compared to the previous year. This trend states a significant rise in cost, threatening budget availability for continuous improvement initiatives.

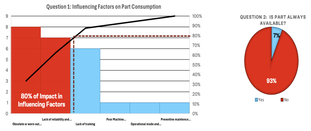


Project Goals	Project Scope
Goals: By Q4 2025, it is expected to **reduce** 15% of average weekly consumption cost for ACE San Lorenzo Business Unit.	**Scope:** Spare Parts Inventory Consumption for ACE San Lorenzo

Metric	Measurement Method
Consumption Cost (USD/week)	Weekly Consumption and Financial Reports from TechOps Spare Parts Team
Baseline	**Target**
$101,388.49	≤ $86,180

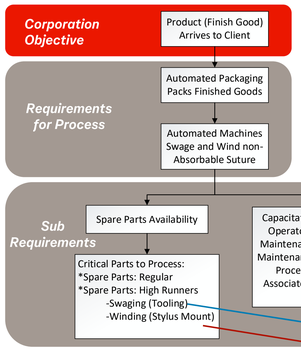
Constraints	Assumption
Increase in part costs, combined with reliance solely on “Maximo”, may reduce the accuracy of financial projections and hinder strategic-making in procurement and operations.	• Market conditions will remain stable through the evaluation period. • All historic data will be obtained from” Maximo.”

VOE: Cost vs. Issues

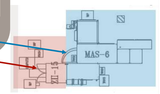


The VOE results showed that management is primarily focused on reducing escalating spare parts consumption costs to protect budgets and enable future continuous improvement initiatives, while manufacturing prioritizes reliable spare parts availability to avoid downtime and ensure stable, uninterrupted automated operations.

CTQ Analysis



The CTQ Tree was used to translate Management and Manufacturing needs into clear process requirements, linking reliable product delivery to continuous operation of the automated Swaging and Winding Process supported by spare parts availability and qualified maintenance personnel.



The analysis showed that while Manufacturing prioritizes part availability to prevent downtime and protect quality, Management focuses on reducing spare parts consumption costs, highlighting the need for standardized solutions that balance cost control with uninterrupted production.

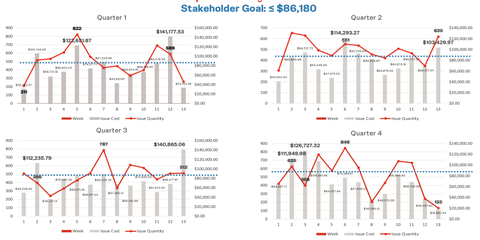
Measure

Consumption Costs: 2024 vs. 2025

The year-to-year comparison shows that spare parts consumption in 2025 increased significantly and exceeded the organizational target, indicating the need to further investigate drivers such as preventive maintenance practices, variability in replacement decisions, and potential changes in equipment behavior. Periods of usually low consumption in both years align with scheduled holidays and shutdowns, during which production is reduced, and preventive maintenance is postponed. Top consumption events are attributed to MAS Biweekly PMs, which represent 51% of Automated Machines.

Consumption Analysis for 2024

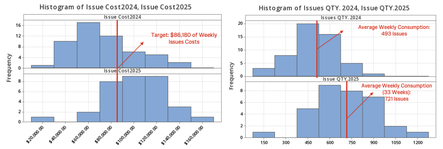
Stakeholder Goal: ≤ $86,180



Consumption Analysis for 2025

Stakeholder Goal: ≤ $86,180

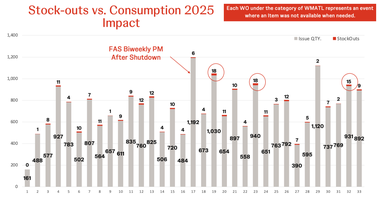
Issue and Consumption Costs Analysis



A comparative analysis of spare parts consumption for 2024 and the first 33 weeks of 2025 reveals a clear shift in operational behavior between the two years. In 2024, consumption remained relatively stable and predictable, with weekly issue quantities and costs generally clustered below their respective averages of 493 issues and $74,263.85, and mostly within the stakeholder target. In contrast, 2025 shows significantly higher variability, with an increased average weekly cost of $101,388.49. Histogram analysis confirms a rightward shift in both issue quantities and costs in 2025, including extreme peaks exceeding 1,000 issues, indicating abnormal consumption and changes in part usage patterns rather than pricing effects.

Stock-outs vs. Consumption 2025 Impact

Each WO under the category of WMATL represents an event where an item was not available when needed.

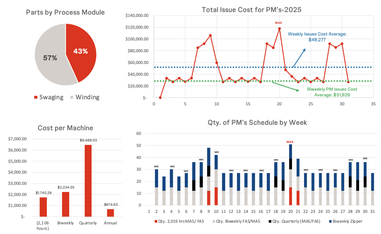


Stock-out analysis confirmed manufacturing’s concern that even limited part unavailability can significantly disrupt operations. Although stockouts represent a small fraction of total weekly issues and overall inventory reliability remains high, spikes above the acceptable threshold create delays, WMATL requisitions, and extended machine downtime, underscoring their disproportionately high operational impact.

Analyze

Spare Parts Consumed in Scheduled PM’s

Note: All issues not included as part of the scheduled PM are considered a CM issue

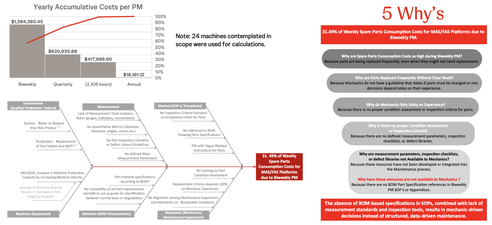


PM Weekly Issue Cost Average: **$49,277**

Current Weekly Issue Cost Average: **$101, 388**

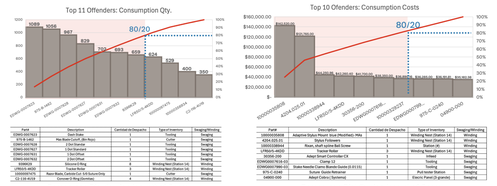
Difference of Average Weekly Issue Cost: $52,111

A detailed PM analysis showed that preventive maintenance activities, particularly Biweekly PMs on the MAS platforms, are a major contributor to spare parts consumption due to their high frequency and the larger number of machines impacted. While PM spare-driven costs account for less than half of the total weekly consumption, with biweekly PMs alone representing 31% of weekly costs, the analysis also revealed that corrective maintenance contributes a comparable share, confirming that both PM execution practices and unplanned maintenance behaviors must be addressed to reduce overall consumption.



The fishbone and 5 whys analyses revealed that the high spare parts consumption associated with Biweekly PMs is driven by a combination of cultural risk aversion, unclear PM Methods, lack of measurement standards, limited use of BOM specification, increased machine wear, and experience-based maintenance decisions. Together, these factors confirm that the root cause of overconsumption is the absence of standardized, BOM-based part inspection criteria and objective evaluation tools, which forces mechanics to rely on subjective judgment and leads to inconsistent and excessive part replacement.

Most Consumed Parts vs Most Costly Parts



Percentage Distribution (count) of Spare Parts by Process Based on Top Offenders

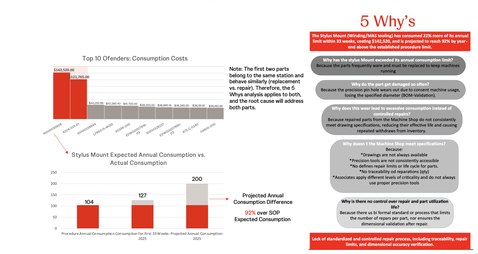
70% Swaging 30% Winding

Percentage Distribution (costs) of Spare Parts by Process Based on Top Offenders

67% Winding 33% Swaging

The Top Offender analysis revealed that, beyond PM-driven consumption, corrective maintenance is a major source of cost variability and inefficiency due to its reactive, unstructured nature. While Swaging dominates in physical part usage, Winding components drive the highest financial impact, with the top offender standing out as an extreme cost contributor, including a projected 92% overconsumption of Top Offender Part versus PM Executions, clearly identifying these components as priority targets for focused improvement.

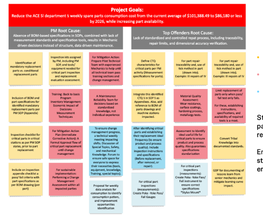
5 Why’s



A 5 whys analysis of the top offender part revealed that their excessive corrective-maintenance consumption is driven by accelerated wear compounded by an industrialized repair process. The root cause is the absence of a specification-based preparation and validation framework that includes dimensional verification, repair-life limit, traceability, and consistent use of drawings. And measurement tools, which force reliance on subjective judgment and lead to repeated premature replacements in the Winding module.

Improve

Brainstorming Workshop



A structured brainstorming workshop was conducted using the Post-it Note method, engaging key process SMEs, including maintenance supervisors, to collaboratively generate improvement ideas aligned with the root cause identification in the Analyze phase. The visual organization of ideas enables effective categorization, refinement, and traceability, supporting the development of standardized, training-focused, and sustainability-driven improvement concepts without impacting operational stability.

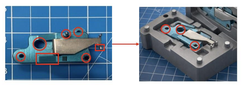
Action Plan Baseline

	Action	Action Type	Root Cause
1	*Back to basis training:* to used to reinforce standard work and ensure tasks are performed consistently according to established procedures. It helps reduce variability, errors, and rework by realigning all personnel to the same operational baseline.	Quick Win	*Man: Lack of Training and Comunication*
1a	*Establishing a Recurrent Weekly meeting within shifts (A, B, C, D) for technical Support; unify the team, and use the forum for special topics discussions as standardizations and new implementations*	Nice to Have	*Man: Lack of Training and Comunication*
1b	*Troubleshooting training (procedural refresh)*	Quick Win	*Man: Lack of Training and Communication Method: Non-clear Procedure*
1c	*Inventory Management Training: Impact of Decisions (From Operations Overview)*	Quick Win	*Man: Lack of Training and Communication Method: Non-existent Training*
2	*Identification of Pilot Technical experts for change management within the technical group (MS): Make them owners of heir shifts*	Quick Win	*Man: Non-expert process ownership*
3	*Identifying critical spare parts per Preventive Maintenance intervention. Ensure critically standardization not tribal knowledge (Mechanic Experience)*	Quick Win	*Method: Non-existent Procedure or Guideline Measurement: No Part Inspection Checklist, no defined wear specifications, and no reference to part dimension and specifications.*
3a	*Useful Life Assessment: After determination of (Ideal/Optimal) useful life, include replacement frequency in PMs with clear instructions.*	Major Project	*Method: SOP Reference and Instruction Method: Non-defined Evaluation Method Measurement: Non-defined dimension specifications or tools/equipment needed*
3b	*Replacement Instructions guideline: Inclusion of Replacement Instructions as Appendices of Spare Parts Specifications Controlled Documents (BOM), to ensure:* *0) Good Replacement Practices* *1) Standardized Replacement Instructions (Poka/Fail test)* *2) Correct use of Tools and Equipment needed when the Parts Physical Specifications Evaluation is Taking Place*	Major Project	*Method: SOP Reference and Instruction Method: Non-defined Evaluation Method Measurement: Non-defined dimension specifications or tools/equipment needed*
4	*Reference of Critical Parts (BOM Drawing and specifications) in Preventive Maintenance SOP for parameters, dimensions, and specifications. Access to specifications while performing PM, if needed (considered a working tool).*	Nice to Have	*Method: SOP Reference and Instruction Method: Non-defined Evaluation Method Measurement: Non-defined dimension specifications or tools/equipment needed*
5	*Documentation of Lessons learn from senior mechanics (creation of Matrix with documented parameters for alignment purposes)*	Nice to Have	*Method: No reference guideline for machine alignment or troubleshooting Man: No Change Management and Future Generation Prep*
6	*Scheduled PM Redistribution for Weekly costs Reduction: Distribute between Compliance Range*	Quick Win	*Method: Lack of Logistic and PM Scheduling*

These actions are intended to serve as standardized guidelines for addressing any identified top offender, promoting continuous improvement in spare parts consumption costs. When consistently applied across current and future improvement projects, these guidelines enable immediate impact mitigation while delivering sustained cost avoidance benefits, including evaluating station conditions and part design when design improvements are required.

Implementation of Actions: Impact

Identified Top Offender Spare Part

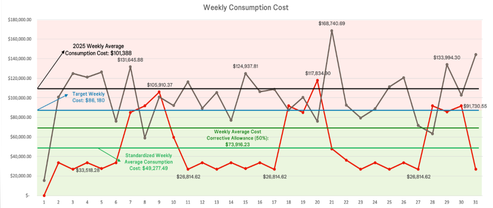


Actions:

- For Critical Measurements: Creation of Reverse Engineering Cavity, Structure Mold (negative Mold) to facilitate measuring dimensions. This will be applied using the Poka-Yoke principle to ensure a Pass/Fail Criterion for replacement evaluation.
- For Possible Repair: Create a traceability plan to document the number of repairs the part has had. With this, we can ensure a replacement disposal frequency (example: Tally Marks)

Financial Analysis

Standardization: Spare Parts Replacement per PM



27% Average Weekly Cost Reduction
Projected Annual Cost Reduction: **$2,252,066.49**

A benefit analysis comparing current consumption to a standardized scenario showed that standardization delivers significant and sustained cost reductions while also reducing weekly consumption variability. Under conservative assumptions, average weekly costs decrease from $101,388 to $73,916, representing a 27% reduction and approximately $2.25M in projected annual savings, while enabling more stable budgeting, improved forecasting, and lower operational risk through consistent maintenance practices.

Control

Proposal: Small Cost Avoidance Continues Improvement Projects

We propose forming a small, dedicated interdisciplinary team to lead continuous improvement initiatives, such as the Stylus Mount Project, to drive sustained cost reduction and process optimization across automated platforms. The team would combine inventory management expertise for data-driven, lowest cost availability decisions with automation SMEs to assess part criticality, utilization, and SOP optimization, including design improvement opportunities. Supported by mechanics and technical drawing experts, this group would enable effective part evaluation, redesign, and life extension while safeguarding process performance and product quality, shifting the organization from reactive fixes to proactive, sustainable improvement.

Example of Improvement Project

ONU Goals: Project Impact

This project supports UN Sustainable Development Goal 12 by reducing unnecessary spare parts consumption through standardized preventive maintenance criteria and data-driven decision-making, thereby minimizing material waste while preserving equipment reliability and product quality. In parallel, the project contributes to UN SDG 9, by strengthening governance, standardized processes, and evidence-based control of spare parts consumption, supporting sustainable and efficient industrial operations.

Conclusion

This project demonstrated that implementing standardized, data-driven maintenance criteria is essential to controlling spare parts consumption while protecting equipment reliability and product quality. By addressing variability in preventive maintenance execution, the initiative achieved a 27% reduction opportunity, equivalent to approximately $2 million in projected annual savings, while establishing a repeatable governance framework. The results confirm that standardization delivers both immediate financial impact and long-term operational stability, enabling sustainable continuous improvement across automated manufacturing platforms.

Aknowledgement

We would like to express our sincere appreciation to Ethicon San Lorenzo and the Automation Center of Excellence (ACE) Business Unit for providing the opportunity, data access, and operational support necessary to develop and execute this Capstone project within a real industrial engineering environment. Special recognition is extended to Luis García Reyes, Automation Maintenance Supervisor, whose guidance, technical insight, and continuous mentorship were instrumental to the project's development, serving not only as the project sponsor but also as a mentor and coach throughout the entire project lifecycle.