



Inspired Blended Learning™ Case Study
Implementation of MERP in the Body Shop
Reliability Improvement Project

Version 1.0

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Where Education Meets Application.

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INSPIRED BLENDED LEARNING™ CASE STUDY

ABSTRACT

Tightening production schedules, increased consumer demand, limited capital, and a finite skilled labor market coupled with a culture of continuous improvement drove Automotive Company X (ACX) to develop a Reliability Program in the summer of 2016. This program developed a roadmap with associated work packages to drive reliability and maintainability within ACX. Initially consisting of Maintenance Strategy (Criticality), Planned Maintenance Execution (PMX), Root Cause Analysis and Problem Solving (RCA) Pillars this program developed and piloted use cases in the main production bottle neck area of operations, the underbody welding process. Life after the pilot, the implementation and roll out of months of development and trial and error, proved that developing processes are the easy part. Its creating the habits, changing the culture, and adapting to external change both on the plant for and within the program itself that prove to be the hardest part – and the most valuable.

Keywords: Reliability, Maintainability, Improvement, Cost Savings, Efficiency, Root Cause Analysis, Maintenance Planning, Criticality, Project Management.

STRATEGIC ALIGNMENT OF OPERATIONAL RELIABILITY

THE DRIVE FOR RELIABILITY AND MAINTAINABILITY AT ACX.

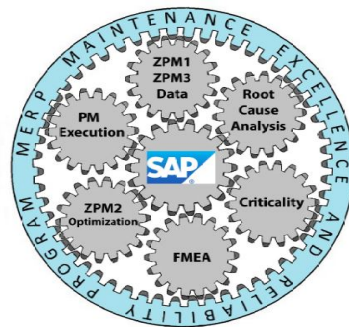
The Luxury SUV market globally is expected to grow 11% year-over-year from 2018-2022 (ResearchAndMarkets.com, 2018). This growth is due to the rising demand of higher seating, higher driving, and more capable automobiles. Combined with greater access and more capable infrastructure in emerging markets and increased access to, and want for, technology – the SUV market is poised to outgrow the conventional sedan market.

This increased demand directly effects the production and development of new SUV product being produced at the Daimler AG - Mercedes-Benz Cars US Subsidiary, Mercedes-Benz U.S. International manufacturing facility in Alabama. A facility which is ACX's only global producer of Type 1, Type 1-Coupe, & Type 2 model SUV's. Additionally these SUV's make up a major portion of the ACX's SUV product portfolio. A portfolio which accounts for 18% of Corporate's \$100,000+ Million euro of total revenue for calendar year 2016.

PRIORITIZING RELIABILITY WITHIN THE ORGANIZATION.

High consumer demand, along with product lifecycle timing, has caused Company X to experience an increased need for equipment availability and a tightening of available capitol as they build and launch a replacement SUV model line – The Automotive Type 3 (AT3).

Corporate has a culture of continuous improvement through the Company X Production System, but the



organization realized it needed a better maintenance system to meet customer demand under increased operating & capital expenditure constraints.

Simply put Company X needs to produce more for less to leverage a competitive advantage. The answer? To develop a reliability focused program Company X calls the:

“Maintenance Excellence and Reliability Program”, known as MERP.

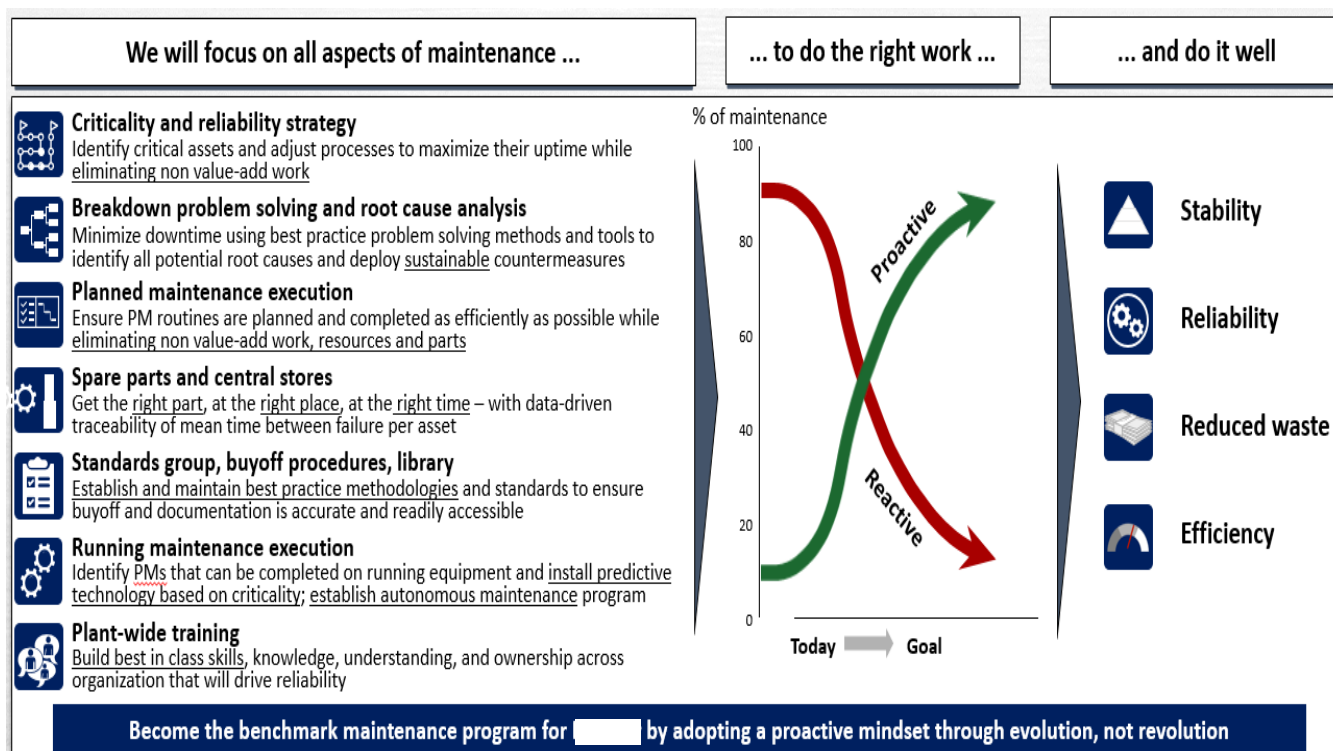
Forming a Project Management Office (PMO) a key Maintenance Stakeholder from every shop in the plant selected a dedicated team to develop the program. From every level in the organization from Team Member to Senior Manager and from production to maintenance – voice of the customer was key. It was at this time where every process was developed, piloted, debated, and approved by a dedicated team of more than 20 individuals over a several month time frame.

Additionally, for program sponsorship the organization showed its commitment to reliability with the formation of a MERP steering committee with stakeholders including the Plant Manager and key Vice Presidents involved with maintenance, engineering, and production related functions – including Finance and Human Resources.

MAINTENANCE EXCELLENCE AND RELIABILITY PROGRAM (MERP).

MERP was developed in the last half of 2016 consisting of three main pillars. The first being a maintenance strategy pillar that would focus on assessing and prioritizing assets and asset care through several process including assessing criticality, determining asset health, and developing equipment maintenance plans to mitigate, eliminate, and detect failures. The second pillar was a problem solving

pillar to focus on the organizations ability to affectively identify, analyze, and solve equipment and production related problem to root cause. This also included the integrity and quality of the data needed to understand the performance of the equipment. The Third pillar is the planned maintenance execution pillar which focused on maintenance work execution. The PMX pillar included all functions needed to address planned and corrective work to include material part kitting, work identification-entry- and approval, and taking input from the other associated MERP Pillars.



ASSOCIATED CULTURAL RISKS OF PROGRAM IMPLEMENTATION WITHIN BODY SHOP.

Performing the Pilot in the series running shop helped to understand the roadblocks and cultural aspects that needed to be addressed in order to make MERP a success.



Culturally the organization rewarded responding to emergencies and therefore performed really well in repairing equipment quickly. This reactive to proactive cultural change coupled with a senior and aging workforce provided the greatest challenge. Especially as technology and business systems such as SAP utilization and quality are vital to overall program success.

Additional cultural risks also lie in the new workforce that is entering the organization. New training programs to introduce a skilled labor force to reduce the age gap in maintenance brings fresh minds open to the ideas the program promotes, but requires more reinforcement due to the lack of experience in the field.

Lastly, because the implementation focus was on the new line the biggest cultural risks are that of project urgency and priority. Those stakeholders involved with both the new product line project and implementing the MERP Program provided the most risk to the implementation. This is because project deadlines and other variables often conflicted with the implementation of the MERP processes and practices.

THE IMPROVEMENT PROCESS

INITIATING THE ROLLOUT OF THE BODY SHOP MERP PROGRAM

The scope of the roll out for the body shop consisted of 3 separate current running production lines and one 1.3 Million sqft. plant expansion. The current expansion is replacing 2 of the 3 production lines which were currently passed their design operating lifecycle. Additionally minimal headcount expansion for maintenance had approved and no headcount changes for the Body Shop engineering departments. Instead, contract engineering services are being used to offset those engineers needed for

the expansion project. In total then the roll out of the MERP program need to effect 20,000+ assets, 130 maintenance personnel, 22 Engineering Personnel, and newly revamped operator care program that Company X calls “Cell Operators”.

Additionally, the initial MERP Pillar teams developed the tools and the processes but not the implementation plans. Therefore, due to the cultural differences between the shops the teams were split back where a shop Roll Out lead was named a long with Pillar representatives. This allowed for a quicker implementation and larger communication network to feed information back to the PMO. The Body Shop Roll Out Team consisted of myself (P. Parker) as the lead and 6 other individuals in various positions from Manager to Team Member with other supporting roles within the shop.

IDENTIFYING THE STRATEGY & KEY MILESTONES FOR BODY SHOP

The strategy for the Body Shop MERP Program had to two different aspects that had to be answered before the roll out began:

1. What the Process for rolling out MERP in the Body Shop was.
2. How to deploy MERP within Body Shop given the large scope.

It was determined from our core group that our best strategy for the implementation should follow the basic project management methodology of Initiate, Plan, Execute, Monitor & Control, and Close. Also, because of limited resources, amount of personnel effected, and the large geographic footprint of the Body Shop we needed to deploy MERP systematically. Weighing the cost-benefit of each shop using the Pilot Area Selection SWOT Analysis tool provided by Eruditio LLC it was

determined that the best are to begin the roll out was in the Automotive Type 3 (AT3) Shop. The decision factor was the lifecycle. It being a new product line, new shop, MERP had the greatest chance of making the largest impact long-term. Additionally, the new equipment provided the opportunity to establish a strong reliability based foundation for the new assets.

Lastly, to provide immediate value and return for the organizations investment the series running product line would execute the RCA processes, creating a problem solving culture that is transferrable to the new product line when it launches in fall of 2018.

The MERP roll out in Body Shop aligned with the Project Manager and Project Engineering team of the AT3 project to align timeline and therefore milestones. For example: At the start of Part 2 product quality standards dictate an equipment maintenance system must be in place although does not have to be complete; therefore we established a goal of having preventative maintenance built for 20-30% of the Type 3 asset base by July of 2018.

DEPLOYMENT ROADMAP

Understanding the scope and constraints such as personnel and time. A task list was created with each of the pillar representatives to understand what needed to happen to implement each aspect of MERP within the Body Shop. Taking these action items a work breakdown structure (WBS) was generated in Microsoft Project creating a roadmap to reliability for the Body Shop.

Additionally, the following information was captured from each MERP pillar representative and captured within the project:

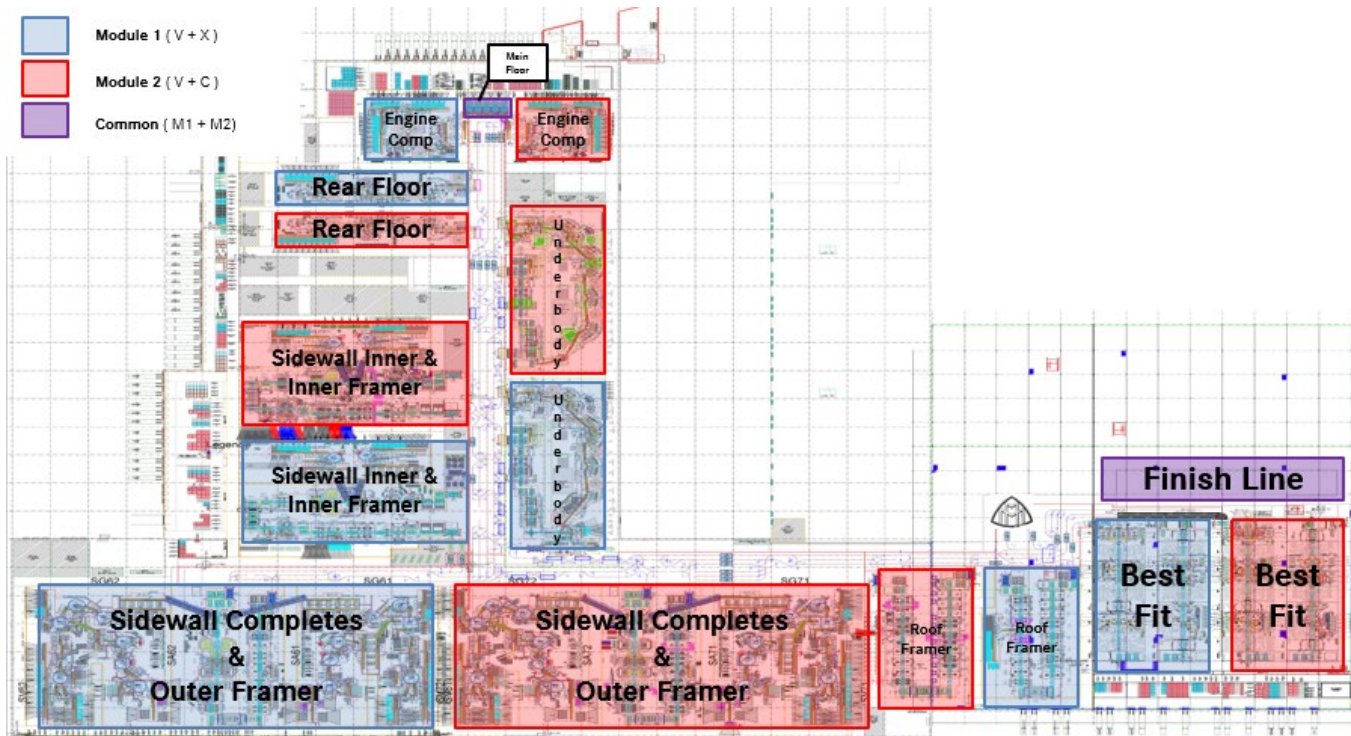
1. Project Precedents
2. Estimated Length of Time to complete the task.
3. Resources Needed
4. Key Milestone start and end dates.

BODY SHOP STAKEHOLDER ENGAGEMENT

Stake holder engagement was deemed key to a successful roll out. Following project management best practices a thorough communication plan, quality management plan, and resource management plan were generated and communicated to all stakeholders with approval from Body Shop management and the PMO.

To manage stakeholder engagement a weekly review was established where key topics to the AT3 equipment readiness were tracked and communicated. This allows to us to escalate issues and roadblocks to key stakeholders within the AT3 Project and within the PMO.

Also, due to the large size of the AT3 product line, which is a dual line production concept to increase throughput and slow takt time, a tracking method was created to understand progress as criticality was assessed, FMEA's built, and Equipment Maintenance Plans and task lists developed for ~10,000 new assets.



RESULTS

BODY SHOP ORGANIZATIONAL CULTURE CHANGE

The Body Shop culture has shifted positively because of the results we have experienced and the effort behind them. Involving team members has allowed them to see the intrinsic value in what we are trying to accomplish with the new line and with the MERP program. The organization continues to support the effort as well. Steering committee meetings continue to address the new product line and key stakeholders have MERP implantation goals documented for their annual reviews. These acts not only show commitment to the program but a change in their belief system and therefore a change in their culture. A change from reactive to proactive maintenance.

THE IMPACT OF RELIABILITY TO BODY SHOP

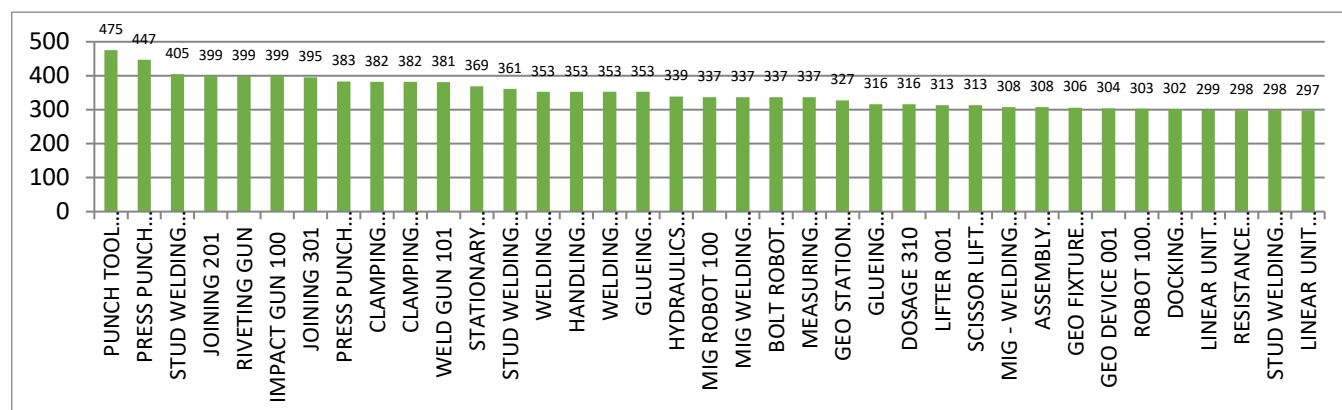
Root Cause Analysis

The RCA Pillar has been deployed through the 3 series running shops – The Automotive Type 4 model line, Automotive Type 5 model line, and the Automotive Type 6 model line. There are currently anywhere from two to five RCA's occurring at any given time and twenty RCA's completed, in-progress, or pending closure. In all 468 downtime occurrences have been mitigated, over 2000 minutes of downtime avoided in 2018. This equates directly to \$1.2 Million in opportunity gained.

RCA's													8/2/2018						
Open RCA													Planned Work		Monitoring				
ID	Location/Equipment	Issue	Responsible	Date Opened	WFO Number	RPI TYPE	RPI Score	Days Open	Start Date	Finish Date	Timeline	Review Date	RPI TYPE	New RPI Score	Target RPI Score	Results	Date Closed		
1	4580_R03_205_4C25_0808_100	Red Pinks Part Present	Willy Brown	2/28/2018	100011425426	Countdown	53	127	5/3/2018	5/7/2018	20	5/8/2018	Countdown	0	20	Good	5/8/2018		
2	803 F011 STA 010 GRP 141 GRIPPER ENDOFF	Broken End Effector	Willy Brown	2/28/2018	100011329685		48	180	4/26/2018	7/30/2018	30	10/28/2018	0						
3	803 R01 STA 000 RXTURE 501	Recent Broken Cylinder	Stavie Anderson	2/28/2018	100011385391		110	184	2/28/2018			1/0/1800	0				4/11/2018		
4	803 R01 STA 010 R01 SPOT WELD GUN	Pulled Caps	Stavie Anderson	3/6/2018	100011336682	Occur	15	149	3/28/2018	4/1/2018	20	5/1/2018	Occur	0	5	Good	5/1/2018		
5	803 R01 STA 072 R02 ENDOFFECTOR	Gripper Faults	Stavie Anderson	4/3/2018	-	Occur	17	121	4/7/2018	4/8/2018	20	5/6/2018	Occur	0	10	Good	5/6/2018		
6	803 R01 STA 100 R02 ENDOFFECTOR	Gripper Faults	Stavie Anderson	4/17/2018	-	Occur	16	107	4/21/2018	4/23/2018	20	5/23/2018	Occur	0	15	Good	5/23/2018		
7	803 L01 STA 080 ELEVATOR (501)	Equip. Overcycle	Willschrick	10/25/2017	100011399513	Occur	22	181	3/8/2018	5/8/2018	14	5/17/2018	Occur	2	5	Good	5/17/2018		
13	803 F01 STA 000 5116 FRAUDER RUGATE	Roof Bow Part Present	Joel Caldwell	1/20/2018	100011327494	Occur	43	184	2/20/2018	5/25/2018	20	5/24/2018	Occur	2	5	Good	5/25/2018		
9	803 L01 STA 10 P100 USION COGNEX CAMERA	Vision Issues	Joel Caldwell	2/18/2018	100011394346	Occur	37	170	2/18/2017	5/25/2018	20	5/24/2018	Occur	1	5	Good	5/25/2018		
12	803 F01 STA 040 R02 ENDOFF TAG 8010-11	Tag Band on Rear Header	Joel Caldwell	2/18/2018	100011337311	Occur	43	142	2/20/2018	5/25/2018	20	5/24/2018	Occur	2	4	Good	5/25/2018		
11	803 OF0 STA 170 R03 R04 RPN ENDOFF W	Pick/Grasp Issues	Joel Caldwell	2/28/2018	100011303251	Occur	41	127	4/6/2018	5/25/2018	20	5/24/2018	Occur	1	4	Good	5/25/2018		
8	803 C78 STA 000 FACILITY ROLLERWAD	Motor Channel Faults	Joel Caldwell	4/11/2018	100011442947	Occur	55	113	3/28/2018	6/25/2018	20	7/25/2018	Occur	0	5	Good	7/25/2018		
10	803 C78 STA 000 LIFTER 100011442947	Body Position Faults	Joel Caldwell	4/11/2018	100011442947	Occur	40	113	4/24/2018	6/25/2018	20	7/25/2018	Occur	4	4	Good	7/25/2018		
14	80166 DC1 Station 27 Sealer System	Sealer Faults	Willschrick	6/5/2018	1000035542	Occur	110	58	6/7/2018	6/10/2018	20	7/10/2018	Occur	7	45	Good			
15	803 R01 STA 030 R02 8110 6FFECTOR	Misalignment Faults	Stavie Anderson	7/5/2018				28				1/0/1800	0						
16	803 L01 STA 180 R03 STUD WELD GUN	No SCW Faults	Willschrick	7/5/2018				28				1/0/1800	0						
17	803 OF0 STA 110 LH	Bumper Bracket PP	Joel Caldwell	7/26/2018		Countdown	156	7				1/0/1800	Countdown						
18	803 OF0 STA 10140 CONVEIOR LIFTER	Motor Encoder Wiring	Jason Bowlers	7/30/2018		MTTR	840	3				1/0/1800	MTTR						

CRITICALITY

The criticality process involved first prioritizing all the new assets. This was done by executing the criticality assessment process developed by the criticality pillar. Accounting for various factors including Production Impact, Quality, Maintainability, and MRO all the newly listed assets were assessed with a dedicated team from August to December of 2017. Totaling over 10,000 assets, 100 different technologies, and 55 product variants the assessment allowed for a technology roadmap to develop effective and detailed FMEA's. The assets were then divided into technology and grouped and ranked from high to low – accounting for process/product variance.



MERP strategy and cost benefit analysis warranted only 20% of assets receive an FMEA, the other 80% of assets follow a task optimization process. The FMEA's and optimized tasks then feed the equipment maintenance plans which are entered into SAP by the maintenance planner to be executed.

Although there is no realized value yet (Start of Production is slated for October 2018) there is still some intrinsic and quantifiable value. To date close to 20% of the maintenance organization in the

Body Shop has been involved directly with helping build their new maintenance system through the criticality, FMEA, and EMP processes.

Additionally 21 different technologies have had a new maintenance plan that is derived from a failure mode based analysis method. An act that has never before been accomplished at Company X.

These technologies include:

- | | | |
|---------------------|-----------------------------|---------------------|
| • Shock Tower | • Geo-Fixture | • Kuka Robot |
| • Piercing Unit | • Tool Drop Off | • Robot Controller |
| • Tox Piercing | • System | • and Teach Pendant |
| • Stud Welding | • Conveyor | • AGV |
| • Riveting | • Cap Changer | • Roll Up Door |
| • Spot Welding | • Elevator | • Safety Gates |
| • Framing Gate | • Cross-Chain | • HMI's |
| • System | • Conveyors | • LCA Pull Out |
| • Confix | • Electrical Panels | • CART/Drawers |
| • Markator Scribing | • 7 th Axis Rail | |
| • End-Effector | • System | |

Of the task lists common with current technology and assessing current vs. projected work, labor has been reduced on average by 50% per technology. This is large, considering the current series SUV production equipment experienced in the last year - 26,376 hours of preventative maintenance and 18,463 hours of confirmed corrective maintenance. With labor rates at \$58/hour this a direct savings of \$765,000. Lastly, the real value lies in the type of work maintenance will be able to focus on. Reducing PM waste in this fashion will shift labor to allow for more corrective work, offline repairs, job planning, and other types of work that will directly affect equipment availability and production throughput.

SUSTAINABILITY

In order to sustain our progress we continue to execute our plan and address issues and roadblocks as they occur. Having entered new territory these issues are not common, especially with the external variables from the project and organizationally but from macroeconomic view as well as trade tensions and supplier emergencies directly impact our daily operating conditions.

Steering committee meetings still occur monthly with in-depth reviews quarterly for each shop. Weekly the PMO and MERP Pillar and shop leads meet to address status, open items, and any changes or issues that occurring. Additionally, the rollout still meets frequently with the AT3 team to ensure MERP is progressing and any project roadblocks such as documentation are addressed. Lastly, processes and procedures are documented and monitored by an internal auditing function and subject to TUV and ISO audits.

The launch of the AT3 will continue through 2019 but MERP will continue to monitor, analyze, take action, and review the reliability of the Body Shop

LESSONS LEARNED

1. Take an agile perspective in the role out. Too many outside variables exist to systematically roll out a program of this scope and scale.
2. Foundational success starts in the bid process for new product lines. Documentation, specifications, equipment & system designs to be addressed by the reliability program in scope of work. This ensures key reliability aspects are addressed at the front-end and not during design reviews or buy-offs where projects are constrained and capital is tight.

3. Dedicate resources fully. Fully commit the resources necessary to get the assessments, FMEA's, and EMP's built. Changing resources or pulling resources away is detrimental to the process, progress, and to the culture.