



Lessons Learned in a Global TPM Standardization Effort

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Lessons Learned in a Global TPM Standardization Effort

- In 2011 a team of lean leaders and maintenance managers determined that standard work for Littelfuse TPM was critical to the company's success. Since then, Littelfuse has made tremendous progress. They've launched (and in some cases completed) ambitious efforts to overhaul 100% of the equipment to "like new" or "better than new" status in facilities that have 600+ complex machines and develop a "TPM Plan for Every Plant" that extends through 2015. This presentation will outline the eight aspects of Littelfuse Lean Enterprise TPM; lessons captured about the pain points in standardization efforts—and how to avoid them; and critical aspects of starting and continuing a TPM rollout, including how to get executive buy-in, how to prioritize, and the key points and successes of the "overhauling" kaizen blitz.



What We Will Discuss Today...

- Littelfuse, Inc.
- Littelfuse TPM definition and benefits
- The goal
- Management support and buy-in
- Training
- The Littelfuse TPM (Overhaul) Kaizen Blitz & OEE
- Littelfuse TPM System (our 8 elements)
- Re-launch: The 2014 plan, continuing in 2015
- Results
- Lessons learned and best practices
- Examples



The #1 Brand in Circuit Protection — Emerging Player in Power Control and Sensing

Electronics (49%)

- Passives
- Semis
- Sensors



Automotive (35%)

- Auto Fuse
- Commercial Vehicle
- Sensors



Electrical (16%)

- Power Fuse
- Relay/Custom



Littelfuse has the broadest and deepest portfolio of circuit protection products serving three major market segments.



Our Customers Are Global Market Leaders

LEADING OEMs



EMS/ODM



TIER 1 AUTO



Global Distribution Partners





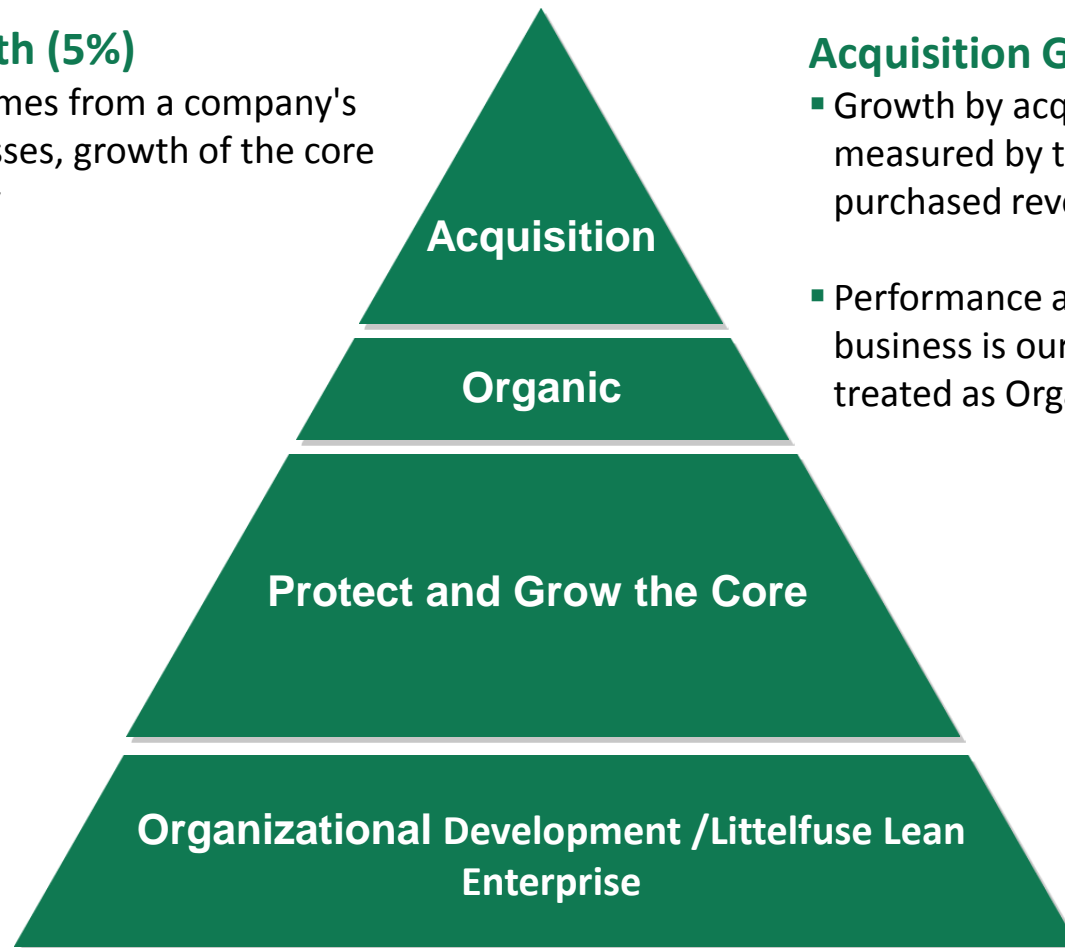
Purpose-Driven Excellence

Organic Growth (5%)

- Growth that comes from a company's existing businesses, growth of the core of the company

Acquisition Growth (10%)

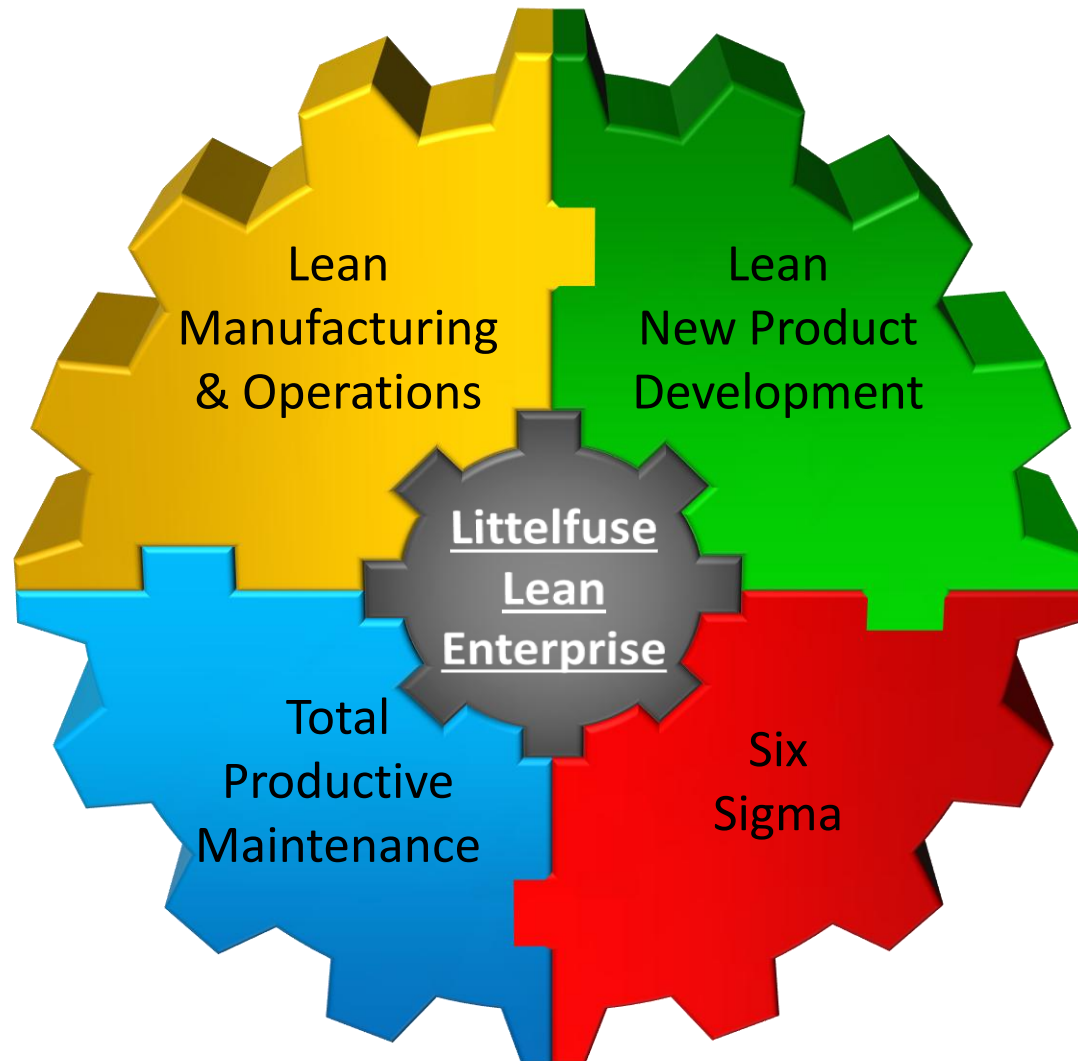
- Growth by acquiring businesses, measured by the amount of purchased revenue
- Performance after acquisition business is our responsibility and treated as Organic Growth



Foundational Structure for Littelfuse Strategy 2013 to 2017



Littelfuse Lean Enterprise





Main Principle of Littelfuse TPM

- The last time a tool or machine is used, it should perform more effectively and with higher quality than the day it was released to production





Definition of Littelfuse TPM

- TPM is a process that maximizes the productivity of equipment for its entire life cycle
- Through the participation of all employees, TPM creates an environment that encourages improvement efforts in safety, quality, cost, delivery, and creativity
- TPM is a major tool in the pursuit of perfection: zero defects (and zero unplanned equipment stops)



TPM - Benefits of Increased Equipment Reliability

■ These items decrease:

- Scrap (\$)
- Mean Time to Repair (MTTR)
- Average cost to repair (\$)
- Number of emergencies, impact
- Maintenance overtime (\$)
- Emergency purchases, air freight (\$)
- Repair parts cost (\$)
- Spare parts inventory (\$)
- Equipment life cycle costs (\$)

■ These items increase:

- Quality
- Equipment Availability
- Mean Time Between Failures (MTBF)
- Spare parts inventory turns
- Equipment repeatability



Proposed Future State with TPM

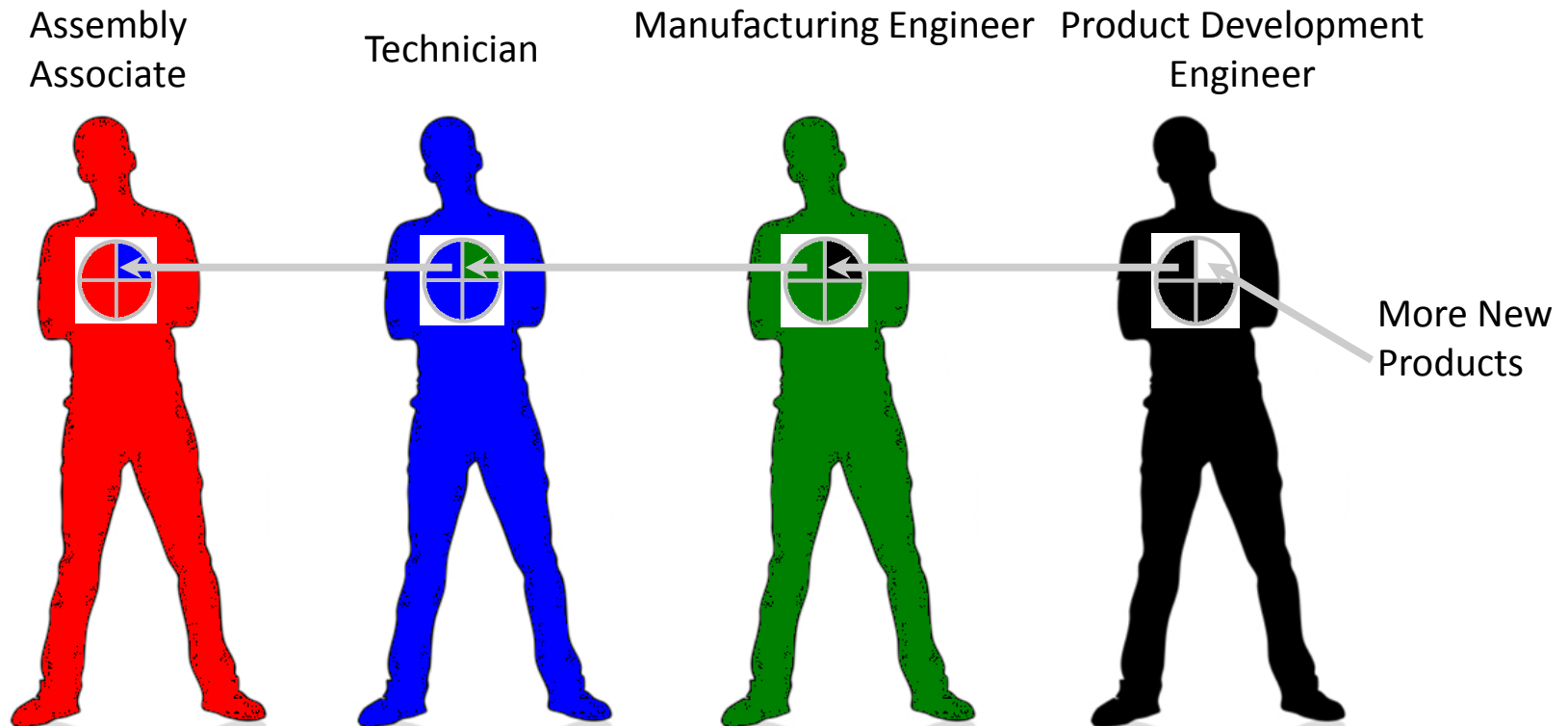
| Machine Skill | Present * | Future |
|---------------------|------------------|-------------|
| Process Development | Very Little Done | Technicians |
| Failure Prevention | | |
| Design Improvement | | |
| Rebuilding | | |
| Major Repairs | Technicians | Operators |
| Trouble Shooting | | |
| Minor Repairs | | |
| Minor Adjustments | | |
| Lubricating | | |
| Inspecting | | |
| Tightening | | |
| Cleaning | | |
| Operating | Operators | |

Technicians available to assist engineering with process development

*Present = 3.5 years ago for some sites, now for others



Big Picture Future State (Goal)





Littelfuse Management Support/Buy-In

What we did:

- Obtained management support by manufacturing site... or tried to anyway
- Launched TPM by site with separate goals and objectives
- Stumbled in North America, the Philippines, and Southern China and succeeded in Northern China
- Re-launched with executive sponsorship

What we should have done:

- Obtained executive team support using results data from outside of Littelfuse
- Launched TPM globally with standardized goals and objectives
- Used executive team support to implement faster and drive the support and reporting rigor that only an executive team can provide
- Focus on bottleneck equipment



Training

- TPM training is part of the Littelfuse lean training program
 - Phase 2 of 6
 - Covers the tools noted in the Littelfuse TPM system





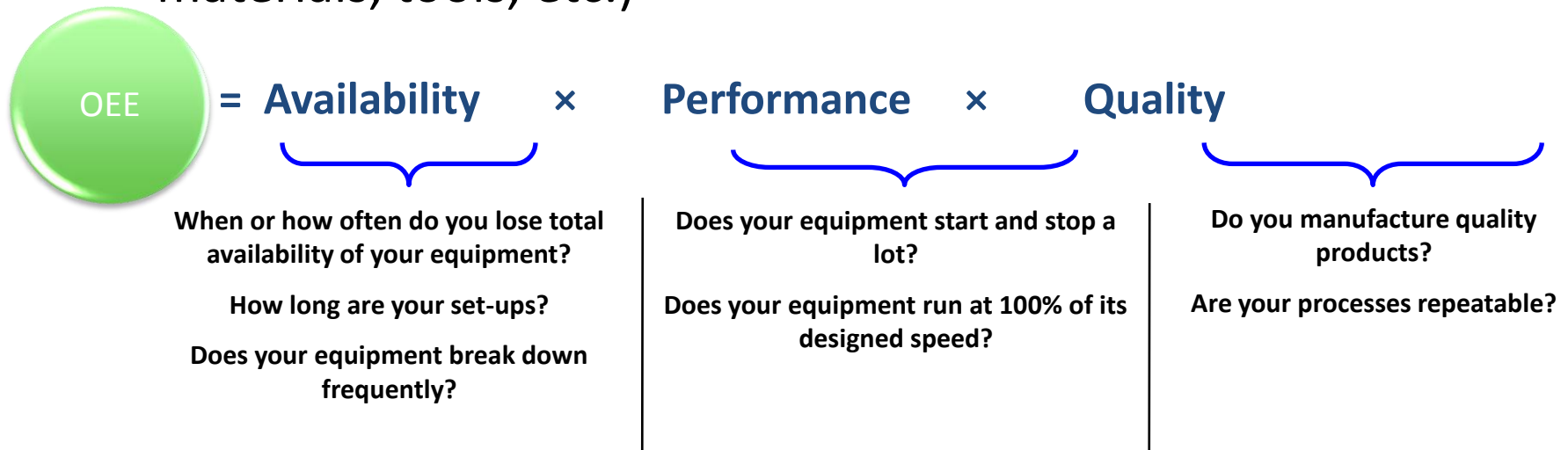
Phases of Core Lean Training

- **Phase 1** : Gemba Guide, Leader Standard Work, Tiered Meetings, A3, Hoshin Kanri, True North Metrics, Benchmarking, Assessments...
- **Phase 2** : The 8 wastes, LSGA, 6S, Standard Work, TPM, OEE, SMED, VOC...
- **Phase 3** : TQM, Quality at the Source, Jidoka, Value Stream Mapping, SIPOC, Kaizen...
- **Phase 4** : 3P, Supply Chain, Flow, Training Within Industry...
- **Phase 5** : Muri, Pull, Kanban, Level Loading, Project Management, VA-VE...
- **Phase 6** : Lean Product Development
- **Six Sigma** : Black Belt, Green Belt, Yellow Belt



Littelfuse TPM (Overhaul) Kaizen Blitz

- Before:
 - Data gathering (OEE, uptime, Pareto of downtime causes, operator input, etc.)
 - Gather needed materials for the target machine (new Plexiglas[®], pneumatic tubing and fittings, cleaning materials, tools, etc.)





Littelfuse TPM (Overhaul) Kaizen Blitz

- During:
 - Complete or review the machine/equipment or process FMEA
 - Complete/review/upgrade the preventive maintenance procedure (focus on high RPN items from the FMEA)
 - Compose the autonomous maintenance procedure (limit to 10 minutes per shift)
 - Best Practice: Recommend autonomous maintenance at end of shift with next shift providing verification prior to start
 - Overhaul the machine to like new condition (or better)
 - Develop “proper” spare parts list

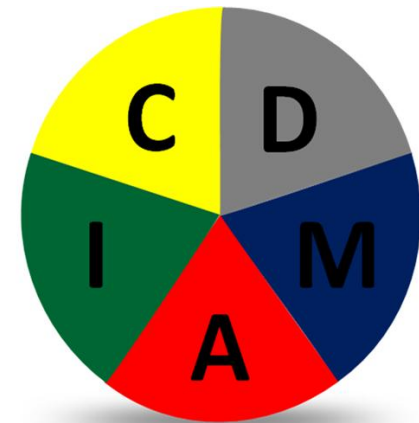
FMEA = Failure Mode and Effects Analysis

RPN = Risk Priority Number



Littelfuse TPM (Overhaul) Kaizen Blitz

- After:
 - Complete an A3 and enter it into Project Tracker
 - Monitor: uptime, performance, quality, availability, OEE
 - Consider constructing SPC charts for each of these attributes for critical machines
 - Update management periodically



SPC = Statistical Process Control



The Most Important Lesson Learned: Communication

“The single biggest problem in communication is the illusion that it has actually taken place.”

– George Bernard Shaw





The Most Important Lesson Learned: Communication

- Construct a communication plan and follow it!





The Most Important Lesson Learned: Communication

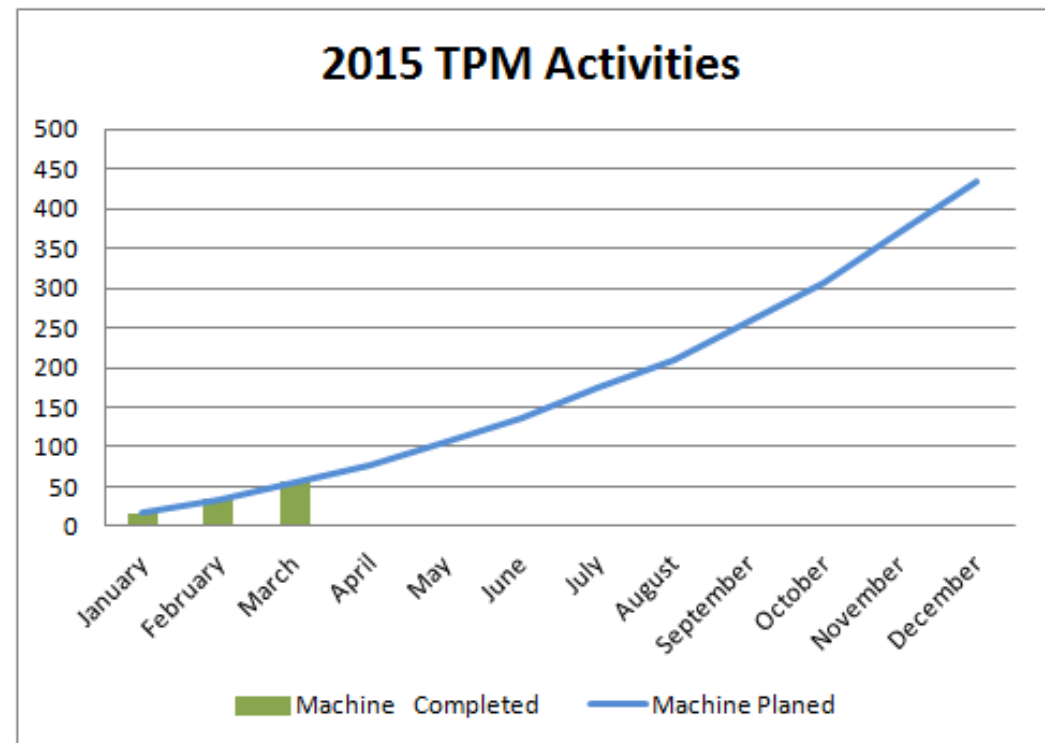
- Consider:
 - Weekly updates to departments involved
 - Monthly updates to management teams
 - Quarterly updates to the executive team
 - If needed, meet with each executive in person and review status updates



Monthly Update/Sharing Meetings

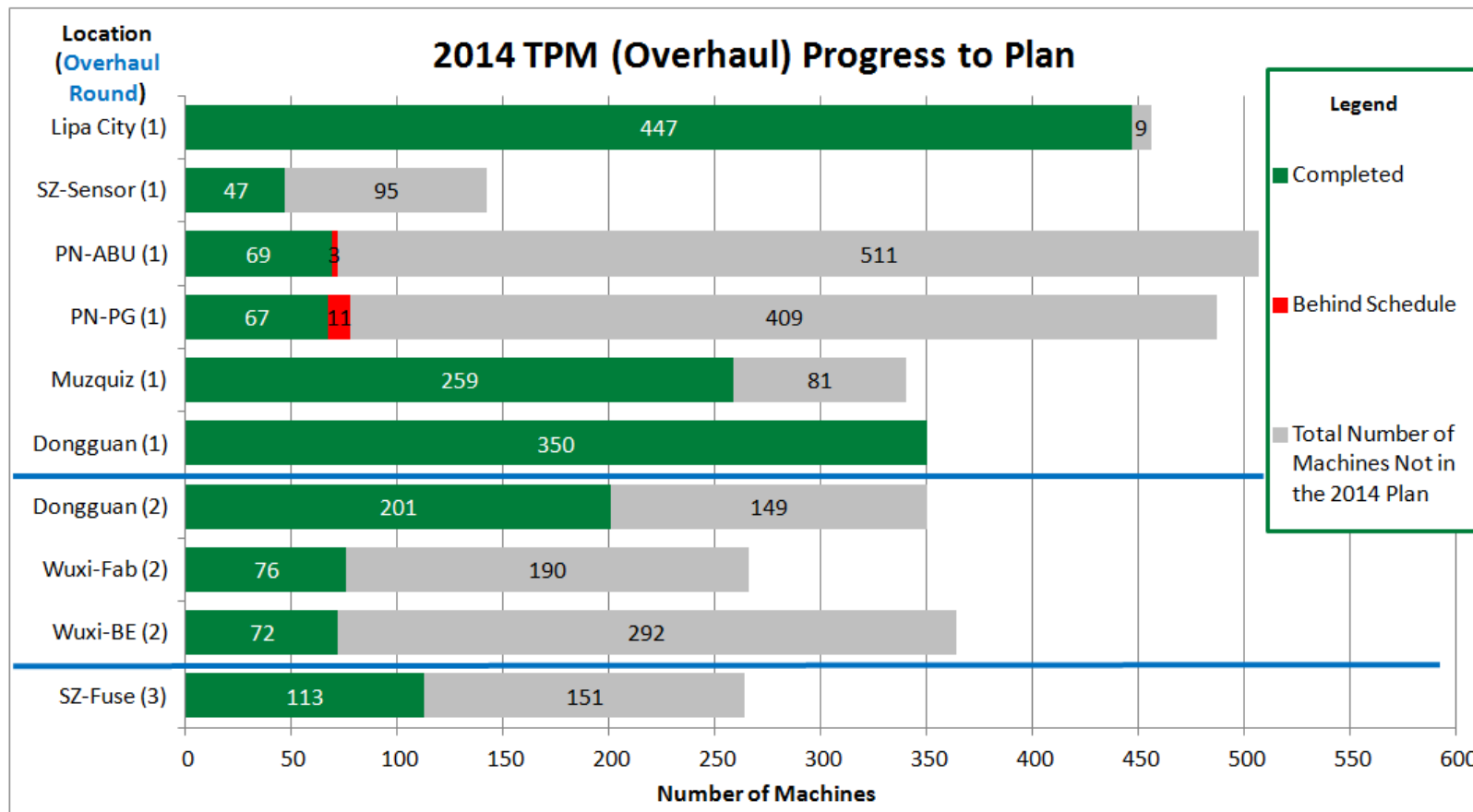
Matamoros, Mexico

| Month | Cumulative | |
|-----------|-------------------|----------------|
| | Machine Completed | Machine Planed |
| January | 17 | 17 |
| February | 34 | 34 |
| March | 56 | 56 |
| April | | 78 |
| May | | 107 |
| June | | 136 |
| July | | 173 |
| August | | 210 |
| September | | 259 |
| October | | 307 |
| November | | 371 |
| December | | 434 |
| | | 90% |





Monthly Corporate TPM Updates



52% of the 4,076 total LF machines have been through first round of their TPM overhaul!



Inventing the Littelfuse TPM System

- Mission:
 - Obtain TPM program buy in from all sites
 - Kaizen: Gather volunteers from all sites to “invent” your program
 - “Invented here” = ownership
 - R&D (rob and duplicate) and benchmark
 - productivityinc.com, ame.org, local/state manufacturing partnership, etc.
 - Use best practices from within



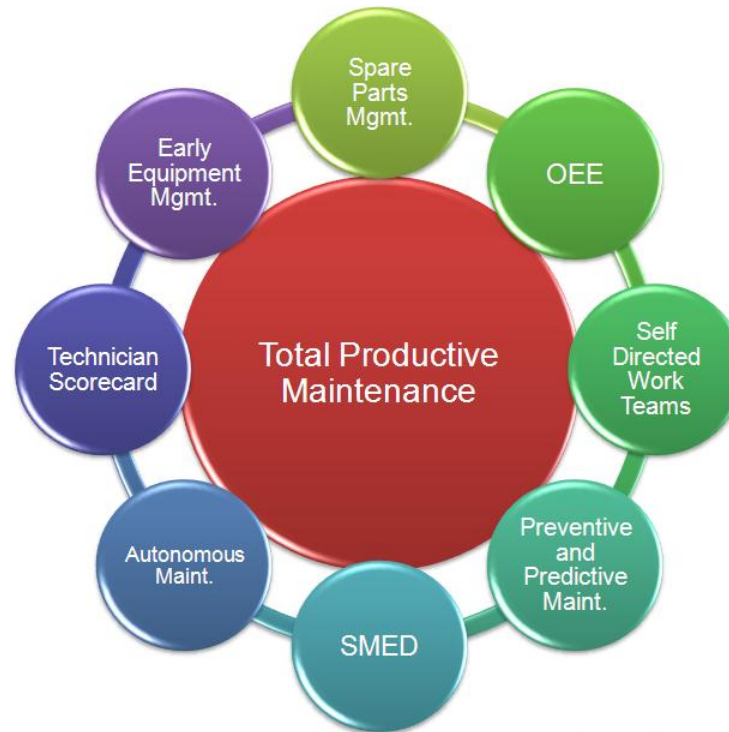
Inventing the Littelfuse TPM System

- Mission Accomplished:
 - The Littelfuse effort required 2 kaizen blitz events and ended with a ~50-page document detailing the Littelfuse TPM System
 - All sites now use the same vocabulary and equations (prior to standardization we had many ways to measure OEE)
 - We now have TPM standard work to share with acquired companies



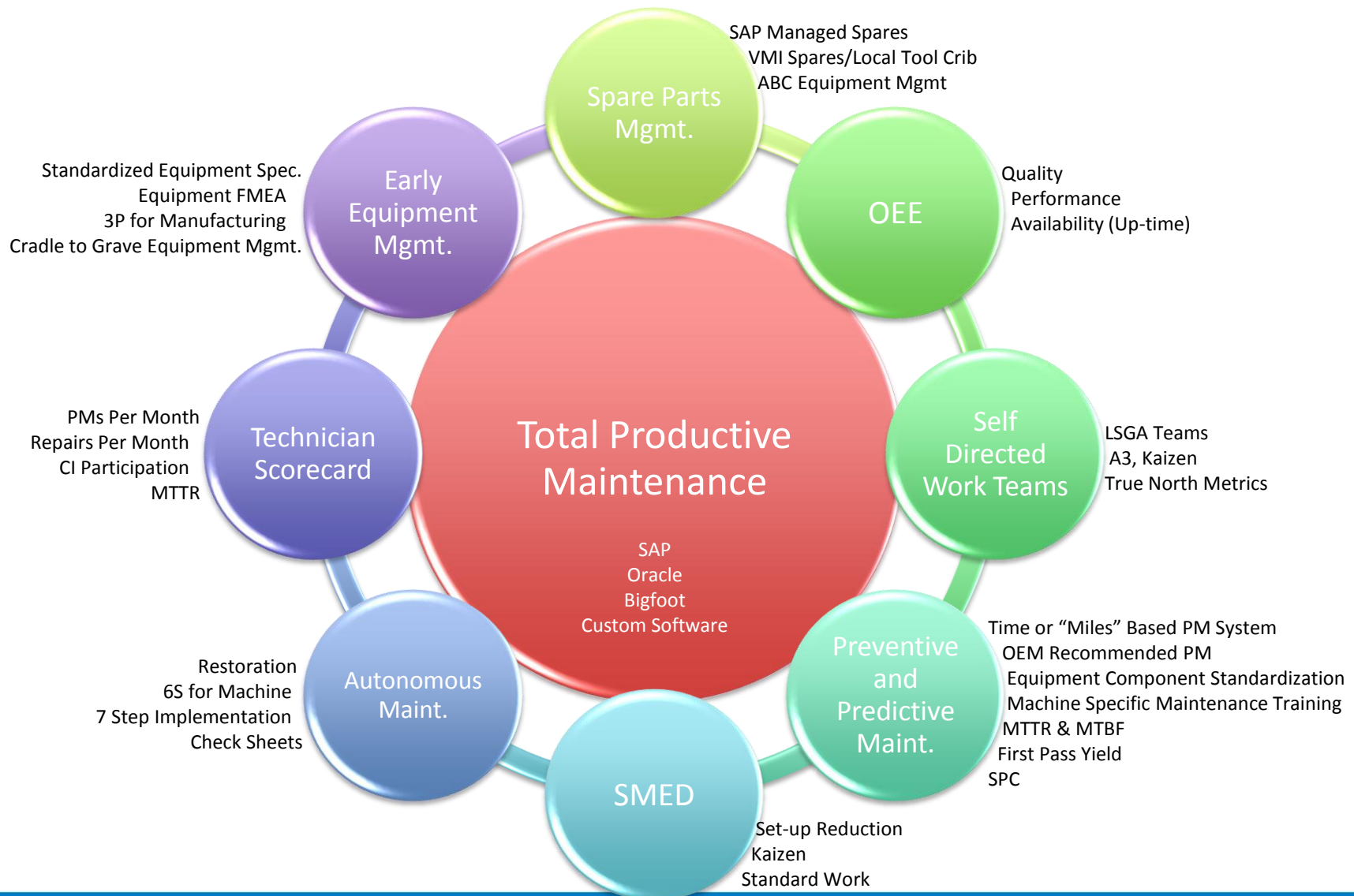
TPM Updates

- September 2011 TPM Started
- 2012 Littelfuse TPM Manual Completed
- Today on Revision 16





The Littelfuse TPM System





Inventing the Littelfuse TPM System

- Lesson Learned: Include all forms in the scope
 - Littelfuse initially considered consolidation of the SMED, Standard Work, Autonomous Maintenance, Preventive Maintenance, FMEA forms out of scope
 - Secondary effort was needed to standardize all forms

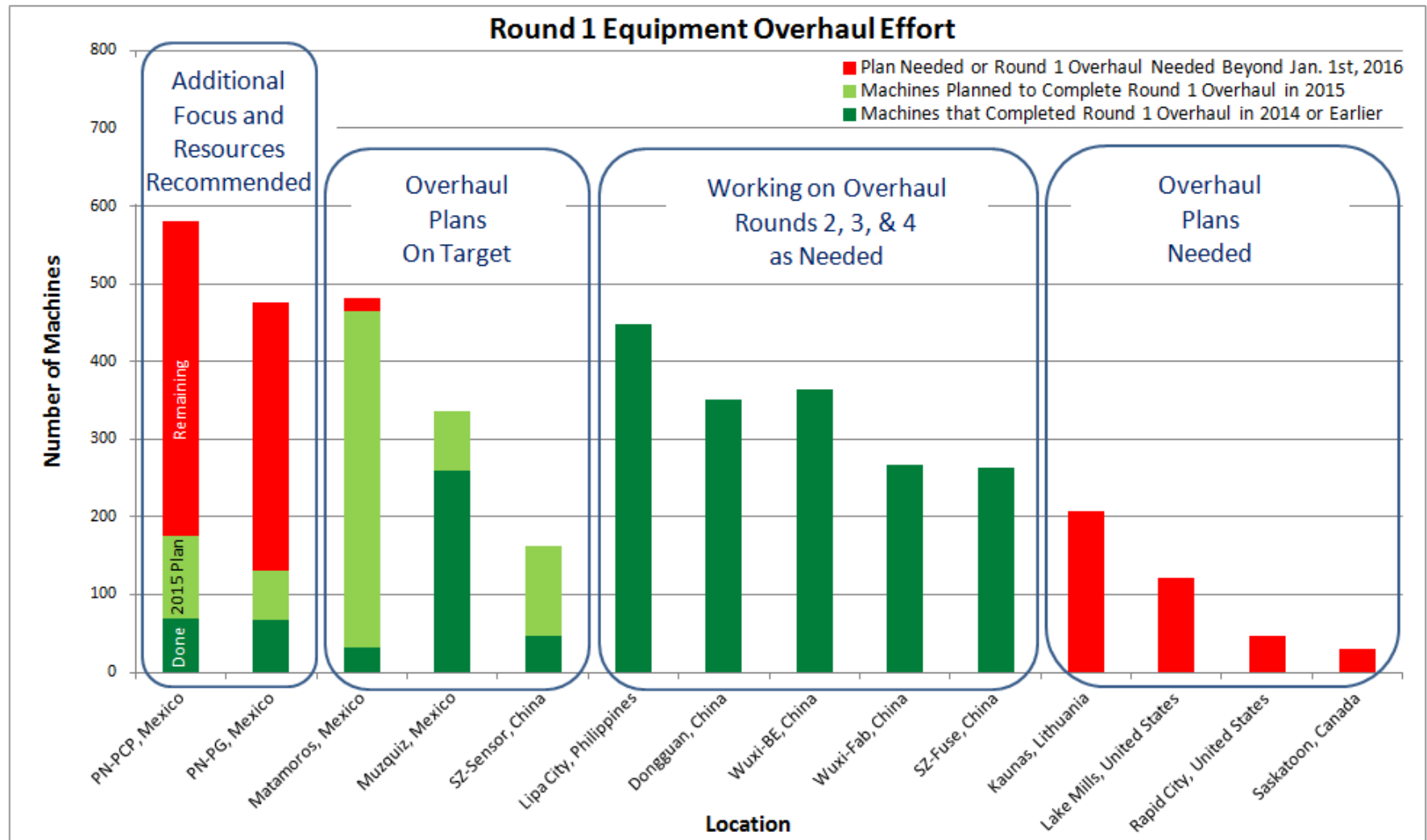


The New Plan with Executive Team Support

- Launch TPM at ALL locations (some done)
- Inventory all equipment and prioritize high-impact areas first
 - Work off of a pull system
 - Complete a TPM blitz on the target machine and then use the learning to overhaul all similar tools (FMEA, AM, and PM completed on the first machine)
- Staff appropriately and choose your most capable (re: TPM) local person to be in charge of the effort
- Monthly meetings and status updates



The 2015 Plan





One Facility's Results

- October 2011
 - First TPM Kaizen Completed
- End of 2012
 - Total Number of Machines Targeted for 2012 TPM
 $= 204$
 - Number of Machines Overhauled by November 2012
 $= 204$

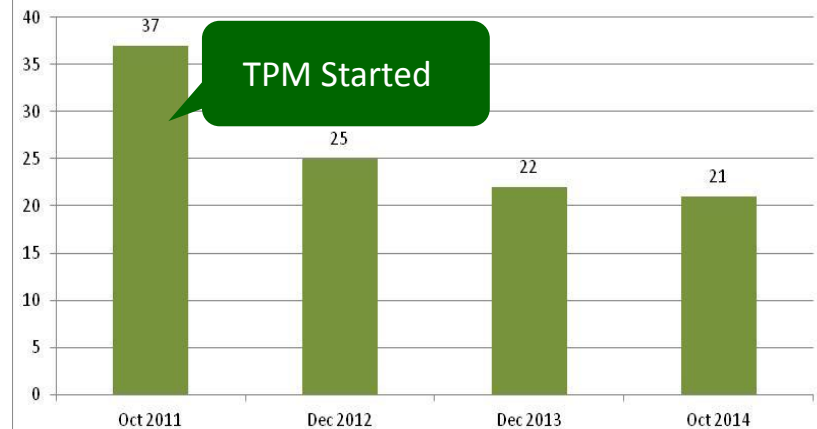


TNMs – Cost/Productivity

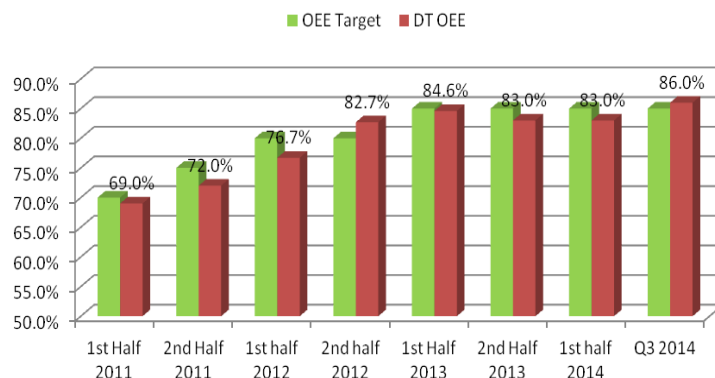
Cartridge Fuse DL vs Weekly Run Rate



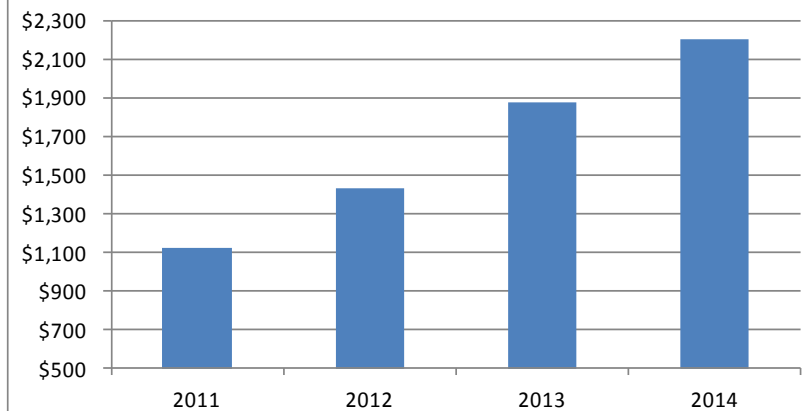
Cartridge Fuse Technicians



Dial Table OEE (Average of all 30 machines)



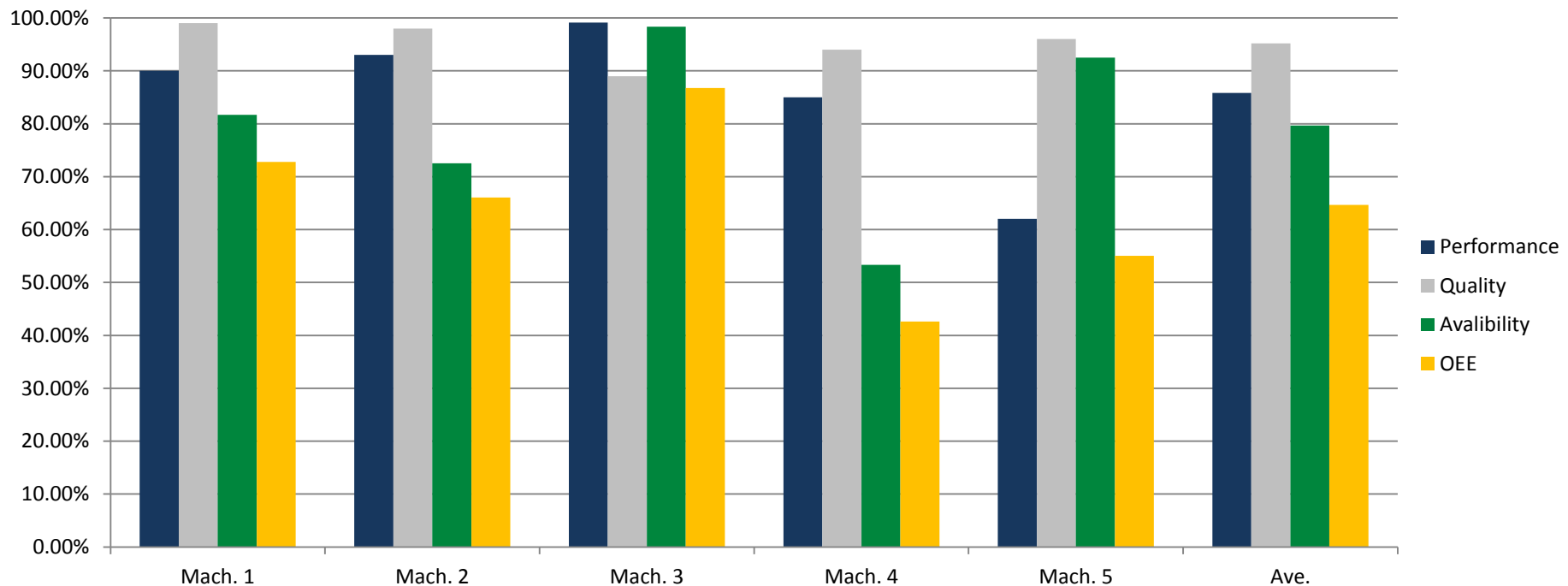
Suzhou Weekly Sales/Associate





OEE Example Graph

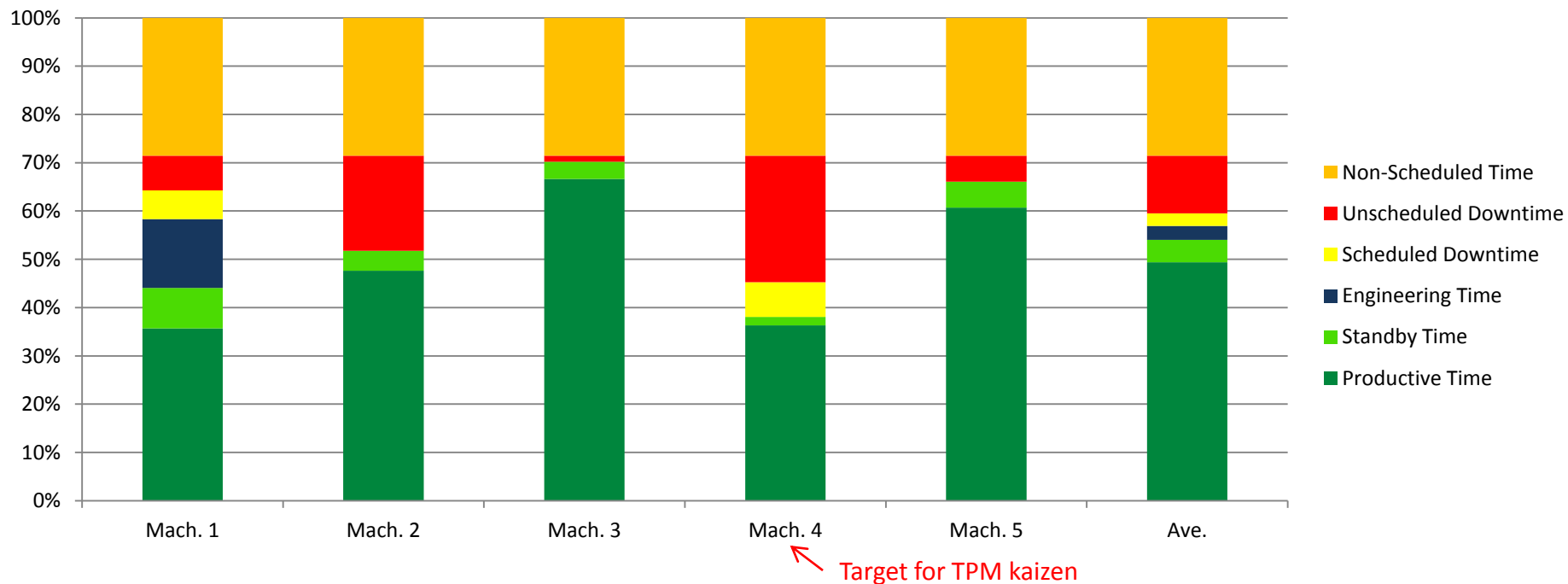
| SEMI E10 Status | Mach. 1 | Mach. 2 | Mach. 3 | Mach. 4 | Mach. 5 | Average |
|-----------------|---------|---------|---------|---------|---------|---------|
| Performance | 90.00% | 93.00% | 99.10% | 85.00% | 62.00% | 85.82% |
| Quality | 99.00% | 98.00% | 89.00% | 94.00% | 96.00% | 95.20% |
| Availability | 81.67% | 72.50% | 98.33% | 53.33% | 92.50% | 79.67% |
| OEE | 72.77% | 66.08% | 86.73% | 42.61% | 55.06% | 64.65% |





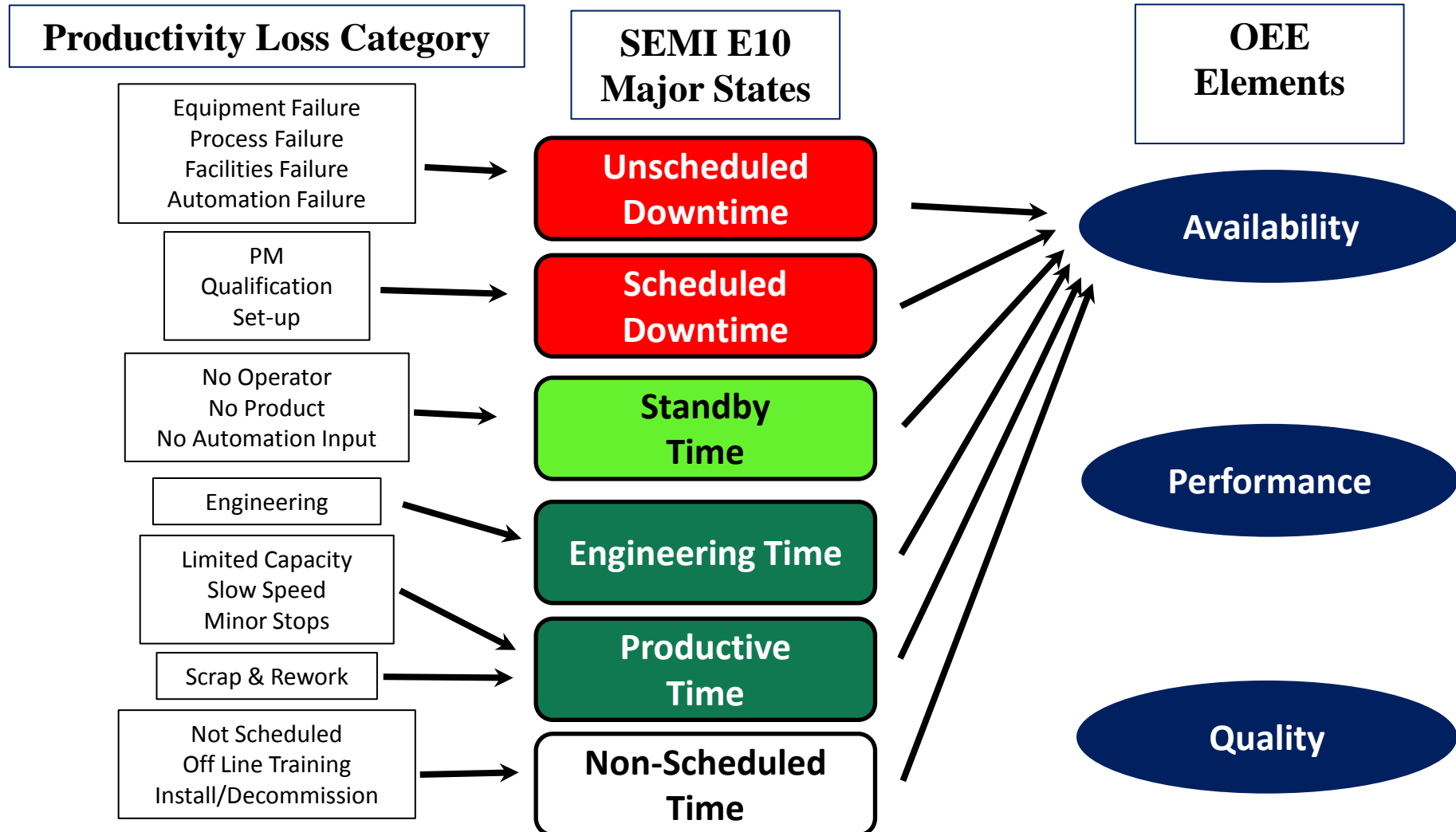
Availability: Machine Status Example Graph

| SEMI E10 Status | Mach. 1 | Mach. 2 | Mach. 3 | Mach. 4 | Mach. 5 | Average |
|----------------------|---------|---------|---------|---------|---------|---------|
| Productive Time | 60 | 80 | 112 | 61 | 102 | 83 |
| Standby Time | 14 | 7 | 6 | 3 | 9 | 7.8 |
| Engineering Time | 24 | 0 | 0 | 0 | 0 | 4.8 |
| Scheduled Downtime | 10 | 0 | 0 | 12 | 0 | 4.4 |
| Unscheduled Downtime | 12 | 33 | 2 | 44 | 9 | 20 |
| Non-Scheduled Time | 48 | 48 | 48 | 48 | 48 | 48 |





Traditional Productivity Losses and SEMI





TPM's Effect on Our Associates

- “In the past it was a struggle to make shipments. Now it is easy and operators are less stressed.”

-Sr. Director of Operations

- “the machine” → “my machine”

-Associates



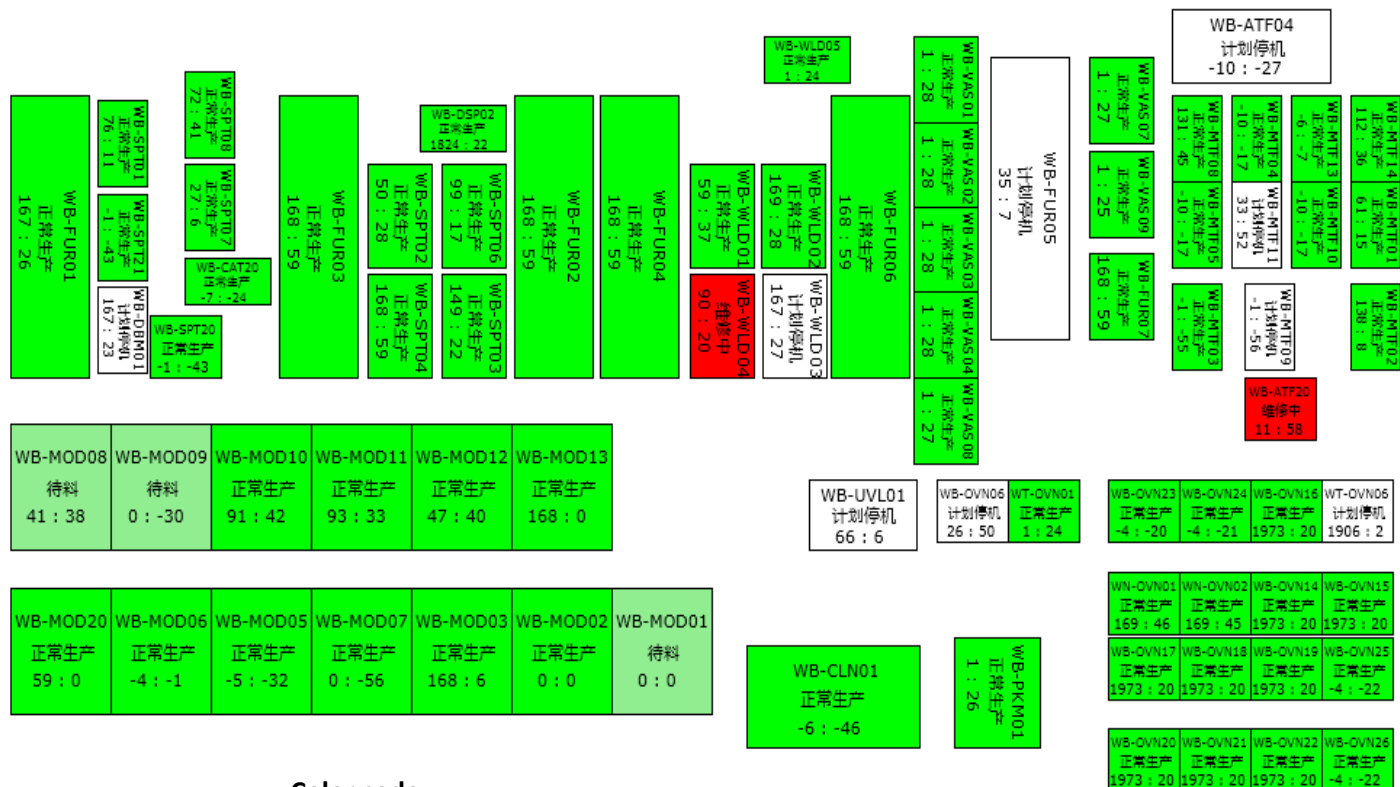
A Few Littelfuse Best Practices

- TPM Standard Work: The Littelfuse TPM System
 - Use of a custom Littelfuse Equipment Management System (EMS) to calculate OEE for all equipment (not deployed at all locations... yet)
 - LSGA = Lean Small Group Activity
 - All operators are on a CI team and part of their team charter is to improve TPM



A Few Littelfuse Best Practices

- Visual Equipment Management (by dept.)



Color code:

White = Non-Scheduled (off line; no parts or no operator)

Bright Green = Running Production

Light Green = Available

Yellow (not shown) = Machine Down/Under Repair

Red = Machine Down

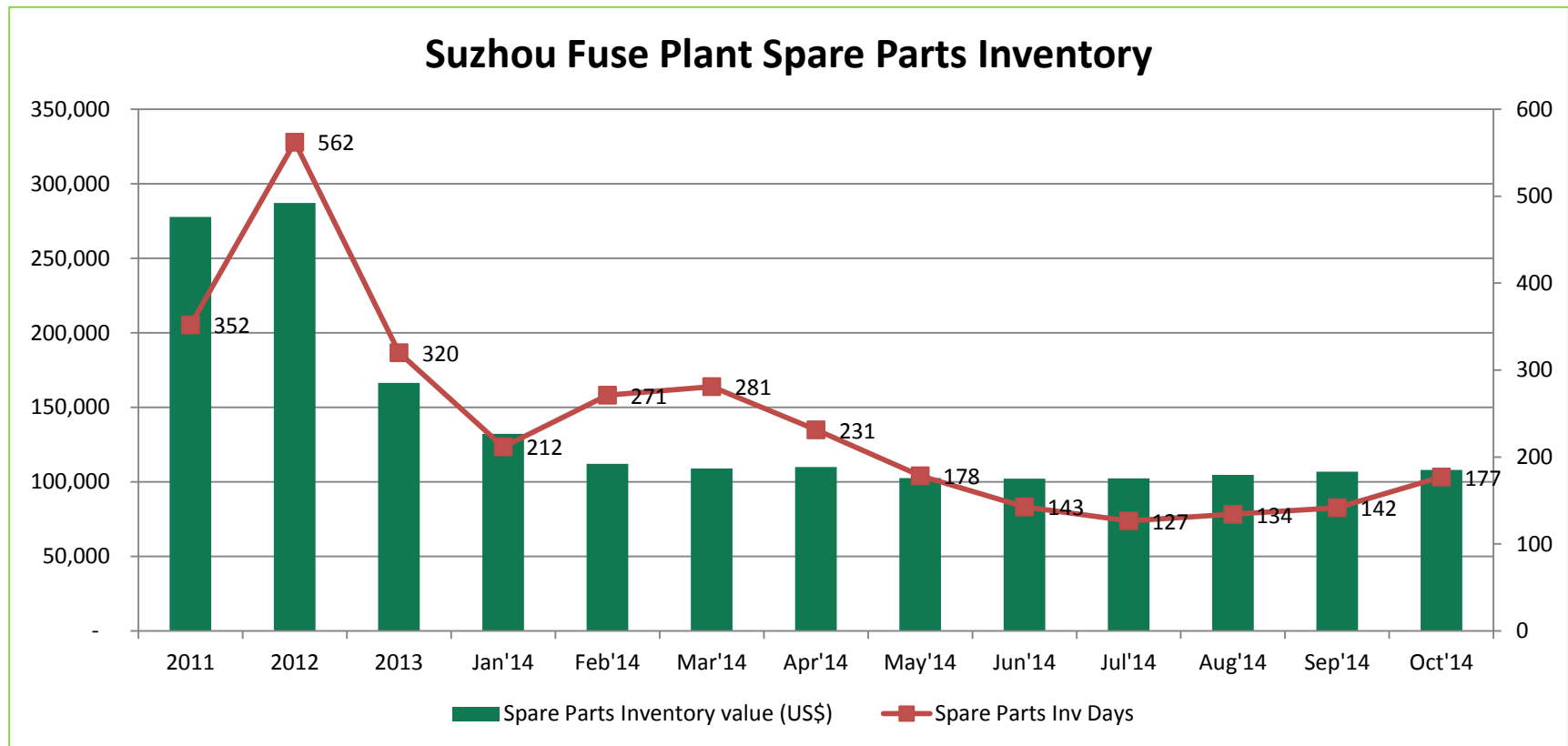


Examples

- The next slides are a few examples of TPM related projects



Spare Parts Inventory Management

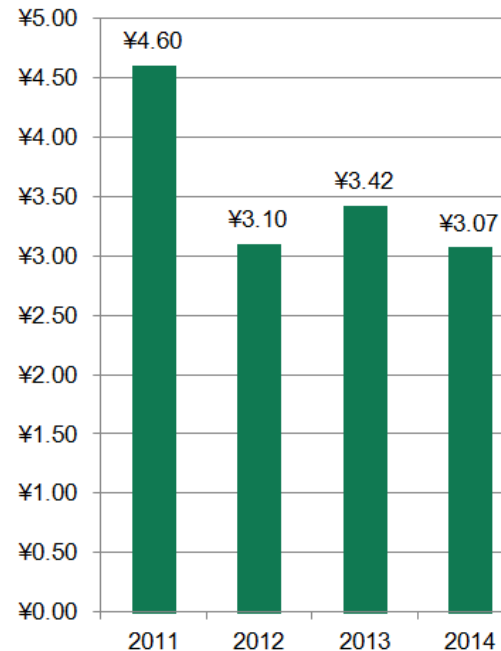


- Spare Parts ABC management
- Spare Parts Inventory Standardized
- Spare Parts Life Cycle Improvement
- Timely Spare Parts Inventory Review by Maintenance Engineering



Spare Parts Cost Improvement

Cartridge Fuse Maintenance Cost RMB/1000pcs Fuses



- OEE improvement helps decrease cost
- Spare parts life cycle improvement
- Focused improvement project for the expensive parts



Overhaul Event

During



After



- Machine scrap reduced 50%
- Annual PM reduced from 16 hours to under 4 hours



TPM Highlights

Before



- Cycle time per piece: 4 min and 13 sec. to 4 min and 40 sec.
- Due to wait time for electrode cool down
- Parts per hour: 14

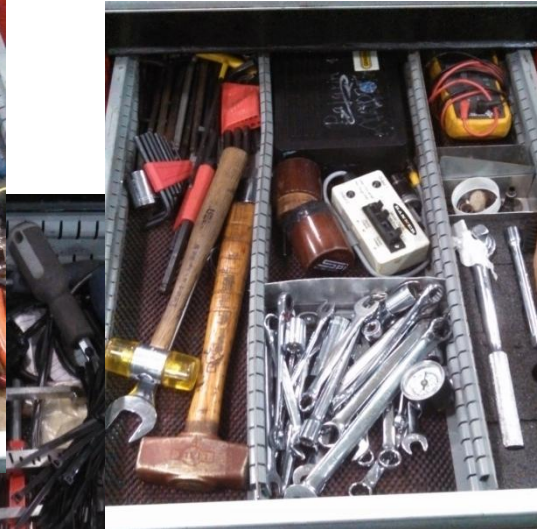
After



- Cycle time per piece : 34 seconds
- No need to wait for the electrodes to cool down
- Parts per hour: 90



TPM Highlights





TPM Highlights

Guide Post & Bushing Cost

- Stamping knife consumption ↓ by \$30K/yr
- Guide post and bushing resourced from Steinel to Misumi, \$31K/yr savings



Stamping Knife
(\$48 ea)



Consumption of stamping knife ↑ from Apr - June 2014; one cause: worn-out guide post and bushing

Compressed Air

- 240 min/day idle or \$463/machine/yr
- \$10K/yr savings for 22 m/c



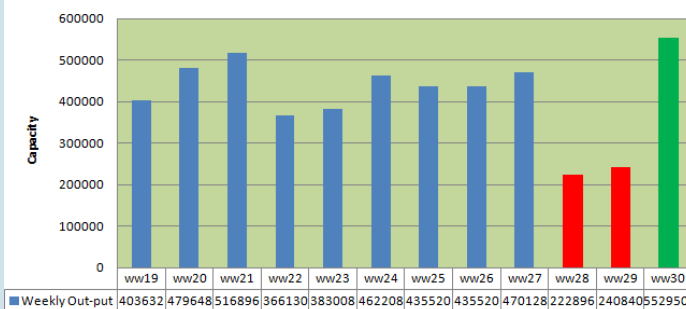
Added shut-off valve when idle



Dicing Spindle Motor Cost

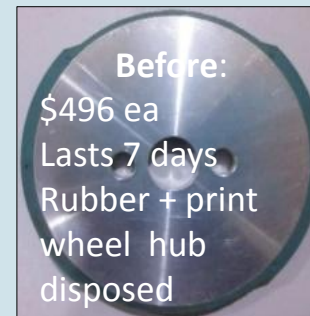
- From purchased to refurbished in-house: \$6.5K x 3 motors = \$19.5K savings

Dicing Machine #51 Weekly Out put



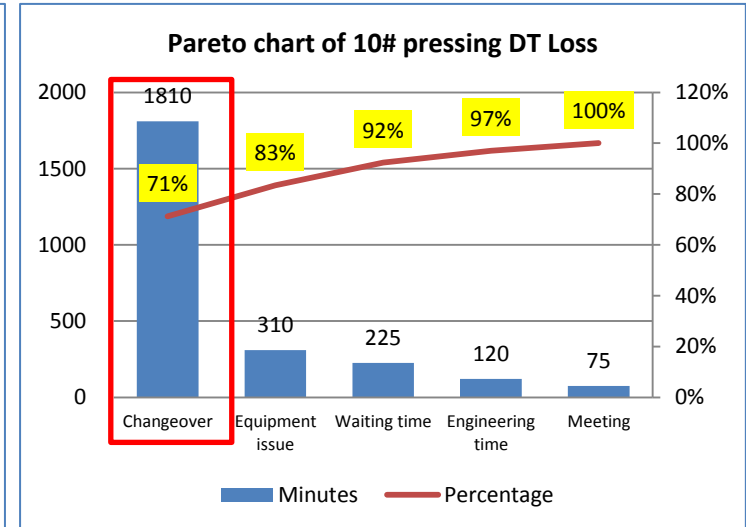
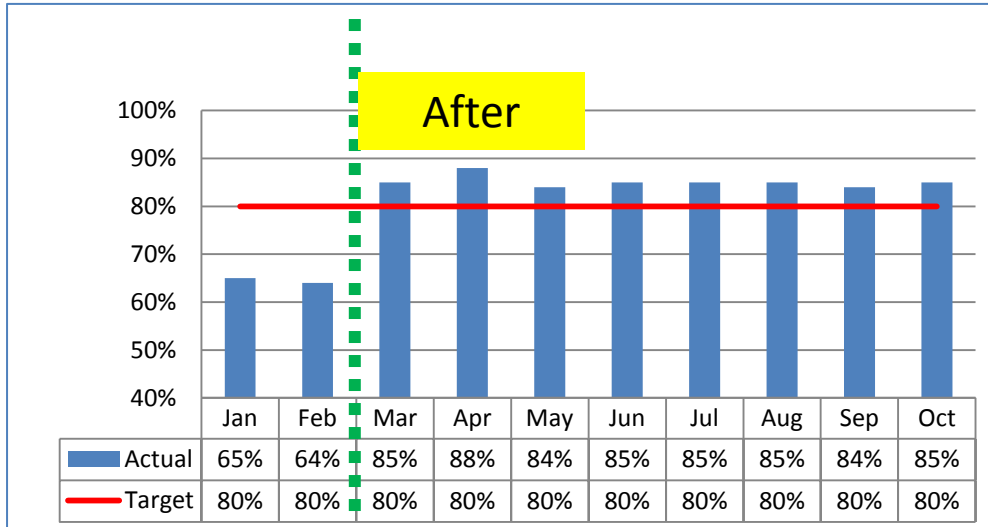
Barrier Print Wheel Cost

- Print wheel consumption to be reduced by \$21K (2015)

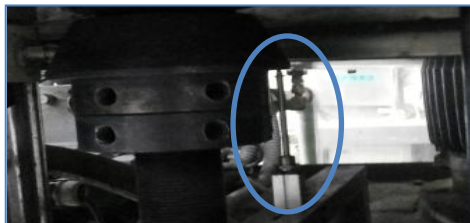




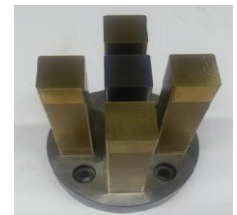
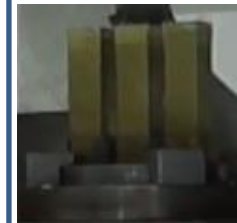
Pressing Machine OEE Improvement



Action: SMED Event - reduced the C/O time from 60 minutes to 40.



Action: Assess the pressure capability of the machine, upgrade the 25S mould count from 3 to 5.





Summary

- TPM is foundational
 - Creates the basic stability for continuous improvement
- Management support is critical to success
 - But remember, it is contingent on communication of results



Questions?





Thank You!

Your opinion is important to us!

Please take a moment to complete the survey using the conference mobile app.

Session: (i.e. TP/16 - # to be advised)

Lessons Learned in a Global TPM

Standardization Effort

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