

Total Productive Maintenance

Implementing TPM in Baxter Aibonito

- TPM definition, elements overview, tools & expectations
- Continuous TPM improvement metric
- OEE definition & calculation
- Example of Daily Walk Around checklist
- Examples of TPM process certification
- Examples of OEE goals
- Example of TPM team

What is TPM?

Total Productive Maintenance

- The TPM concept was developed to support (JIT)
 - You can't be lean if you don't have reliable equipment
- Total Participation from top management to shop floor
- Relentless Root Cause Analysis and Elimination
- Prevention Philosophy
 - Autonomous Maintenance
 - Visual Controls
 - Kaizen Approach
- OEE is a metric to evaluate the effectiveness of your TPM improvements

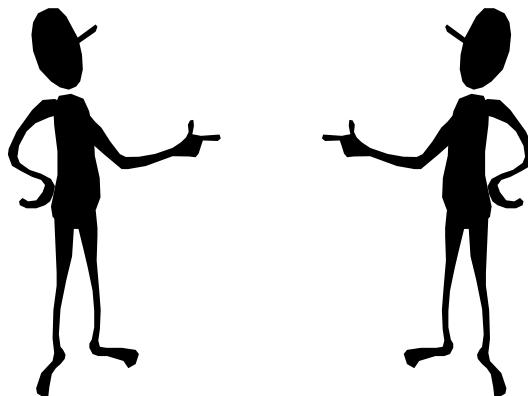
Autonomous Maintenance Philosophy

Old Attitude

“I operate, you fix.”

“I fix, you design.”

“I design, you operate.”



TPM Attitude

“We are all responsible
for our equipment.”



Management...Operators....Maintenance...
Engineers...EVERYONE!

Autonomous Maintenance

Pre-requisite level requirements

1. A cross functional TPM team is established and resourced appropriately from management. All team member have a defined role, team/individual PMO's are established and aligned, meeting frequency identified, and all team members participate consistently



TPM Team

Team Machine 408

Machine Operator – J. Alicea

Auto Technician - R. Torres

Manufacturing GL/Supv - W. Cintrón

Auto Eng – Y. Perez

Process Eng – L. Casiano

Quality Rep – M Guma

VS Manager – J. Blanco

Tec lead- aka planner role/activity coordinator - Ruben Morales

Pre-Requisite level requirements

3. A Daily walk –around checklist is developed and performed consistently for a period of 1 month. Operator and technician responsibilities need to be clearly defined.

RAB Standard Work Supervisor & GL

Daily

Gemba Walk TPM Program Machines (# 408 & # 488)

6S Daily Review

Weekly

OEE Review

TPM Meeting @ 13:30 hrs - Tuesday

Monthly

Kaizen Program monitoring

Pre-Requisite level requirements

4. A Visual Management system is in place to capture issues identified during Pre-Flight. Daily Walk Around. An Accountability processes established to address identified issues in a timely manner.



Departments accomplishments

4. Pitch Charts, Daily Accountability Board, TPM Team , Tier 2 Meeting

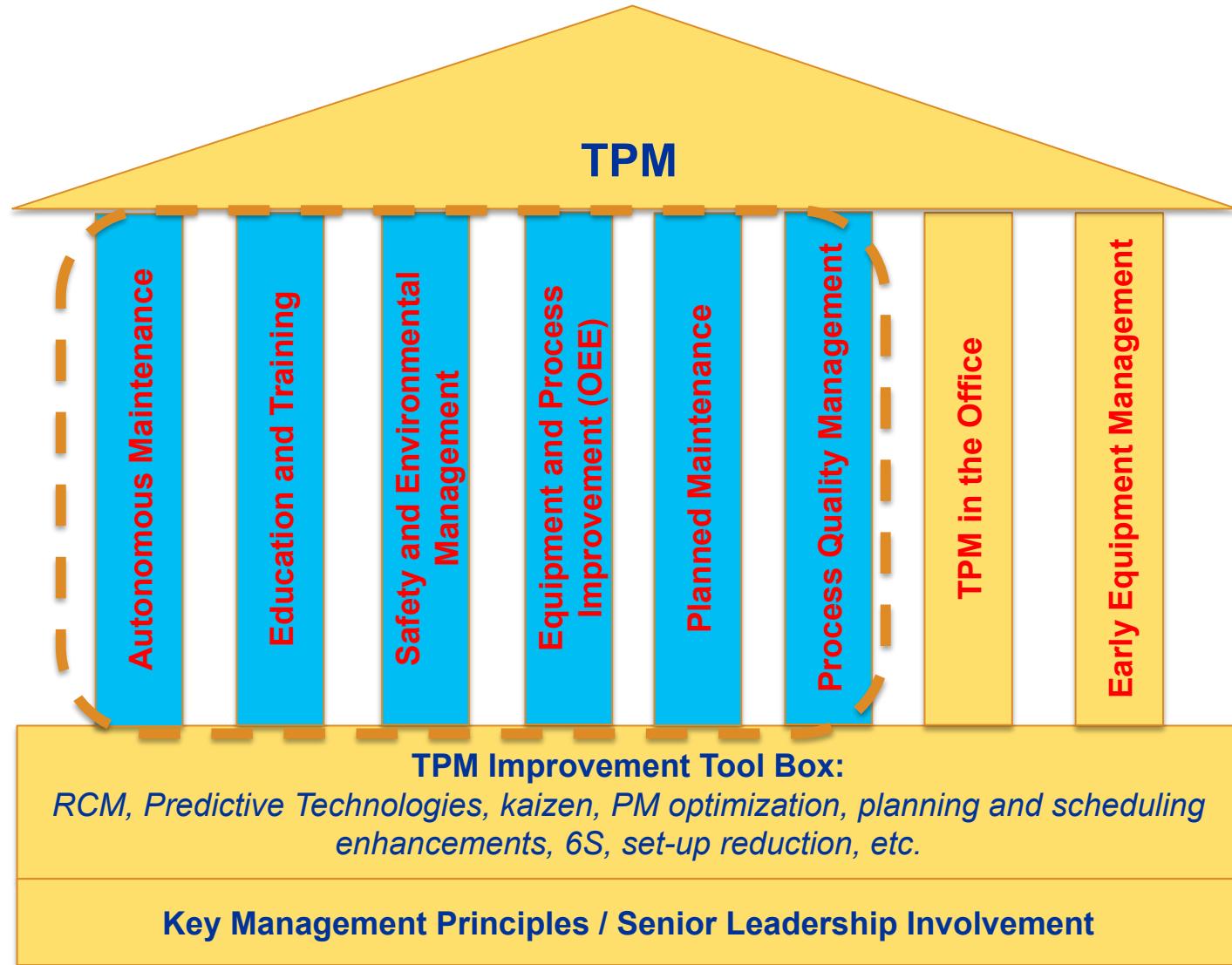


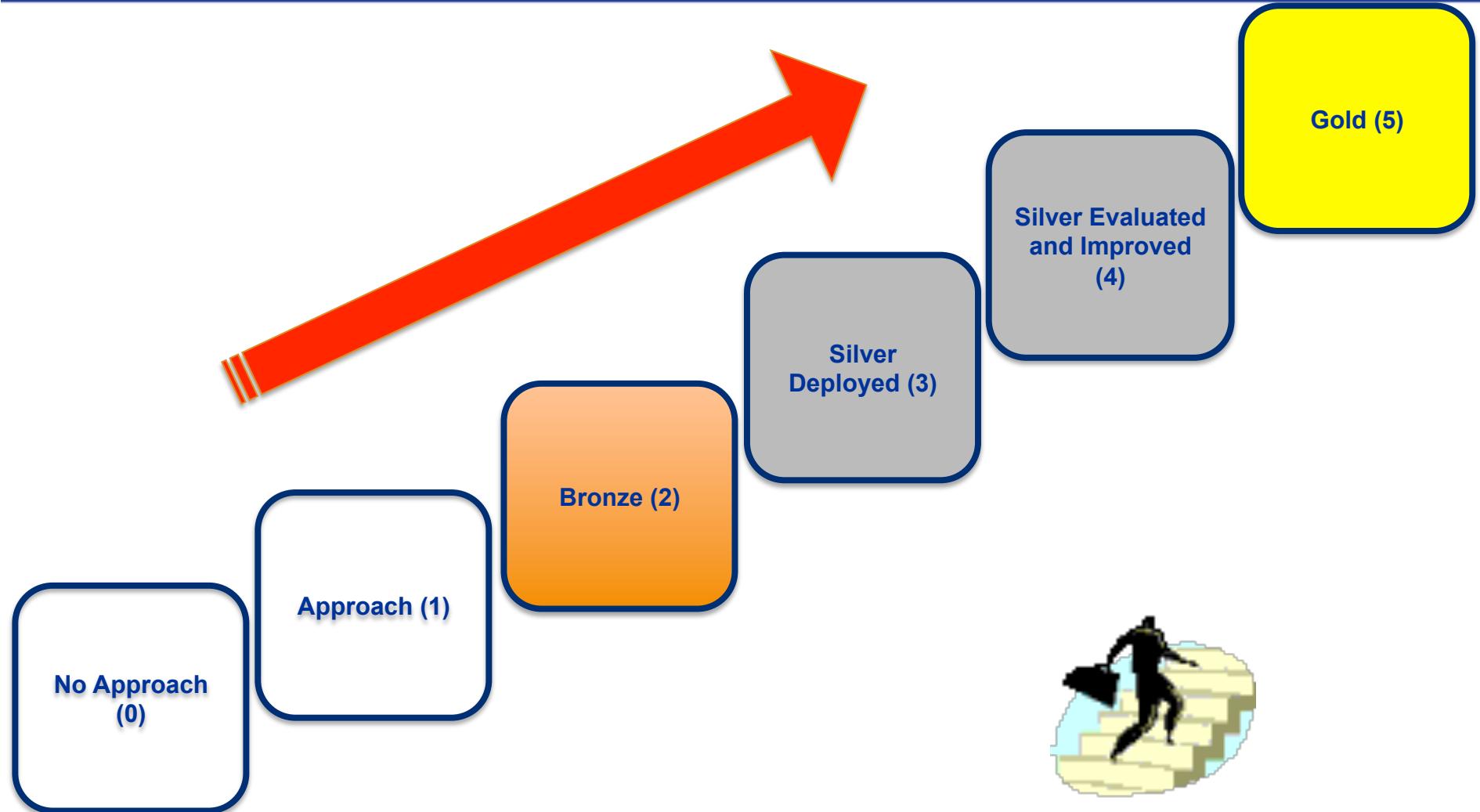
Key Themes / Tools / Elements of TPM

- Autonomous Maintenance
- Visual Controls
- 6s
- Utilize Predictive Technologies
- Reliability Centered Maintenance (RCM)
- Mistake Proofing
- Set-up Reduction
- Understanding your downtime losses (OEE, Loss Tree, etc)
- Return equipment and workplace to “ideal conditions”
- Workshops
- Kaizen...small continuous improvements

**Similar to Lean...you need to use the right tool as part of
TPM to drive sustained OEE improvements**

Eight major pillar of TPM





Key Aspects of implementing TPM

- A Plant TPM Steering Committee is formed to establish and drive a comprehensive plant wide PE focus.
- Senior Management involvement and leadership (essential!)
- This is NOT a Maintenance / Engineering Initiative
- Selection of critical equipment (pilot phase)
- Develop a Maintenance Master Plan to improve overall Maintenance capability / approach
- Need to ensure getting the most value for investment
 - *OEE improvements at the right cost!*
- Evaluate Predictive Technologies
- Adopt Early Equipment Management philosophy
- Drive improvements in Maintenance Planning / Scheduling

Planning and Scheduling Efficiency

Typical Job Planned On-the-Run (*Time*)



Same job if Professionally Planned (*Time*)



Typical Maintenance Craftsman's Day Planned vs. On The Run

| | | |
|---|------------|------------|
| Receiving instructions | 5% | 3% |
| Obtaining Tools and materials | 12% | 5% |
| Travel to and from job (both with and w/o tools and materials) | 15% | 10% |
| Coordination Delays | 8% | 3% |
| Idle at job site | 5% | 2% |
| Late starts and early quits | 5% | 1% |
| Authorized breaks and relief | 10% | 10% |
| Excess personal time (extra breaks, phone calls, smoke breaks, slow return from lunch and breaks, etc.) | 5% | 1% |
| Sub-Total | 65% | 35% |

Direct actual work accomplished (as a % if whole day)

| | Reactive WITHOUT Planning & Scheduling | Proactive with Planning & Scheduling |
|--|--|--------------------------------------|
| Direct actual work accomplished (as a % if whole day) | 35% | 65% |

Work Management

Maintenance Practice - Planning and Scheduling

Without Planning and Scheduling

| | |
|------------|-------------------------------------|
| 0 | Planner / Scheduler |
| 12 | Total Craftspeople |
| 35% | Direct Work percentage |
| 4.2 | Equivalent Full Time Workers |



With Planning and Scheduling

| | |
|-------------|-------------------------------------|
| 1 | Planner / Scheduler |
| 11 | Total Craftspeople |
| 65% | Direct Work percentage |
| 7.15 | Equivalent Full Time Workers |



The “Planner/Scheduler” role is a skilled position!

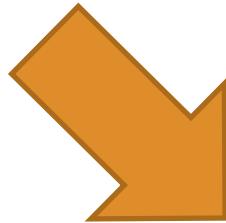
Through adopting this approach, you can significantly increase your EFT resources through the elimination of waste...not people!

Key Element For Success: *Planning & Scheduling*

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Move from this....



...to this!

The Overall Approach

- Establishes a common, comprehensive TPM approach
- Utilize existing mechanisms where applicable
 - Visual Boards, Accountability Processes, Operation Mechanism, etc
- Utilize the right problem solving and improvement tools
- Requires “systematic” approaches
- Equipment optimization requires total employee involvement from top to bottom
- Leverages best practices so we can all get better in quicker fashion
- Optimize what we have before adding new equipment (Maximize ROIC)
- Ensure we are driving total organizational value

OEE Standard Calculation

Measuring TPM Program Effectiveness

OEE Standard Calculation Highlights

OEE = Availability x Performance x Quality

$$\text{Availability} = \frac{\text{Actual Operating Time}}{\text{Planned Production Time}}$$

$$\text{Planned Production Time} = \text{Plant Operating Hours} - \text{Planned Shut Down Time}$$

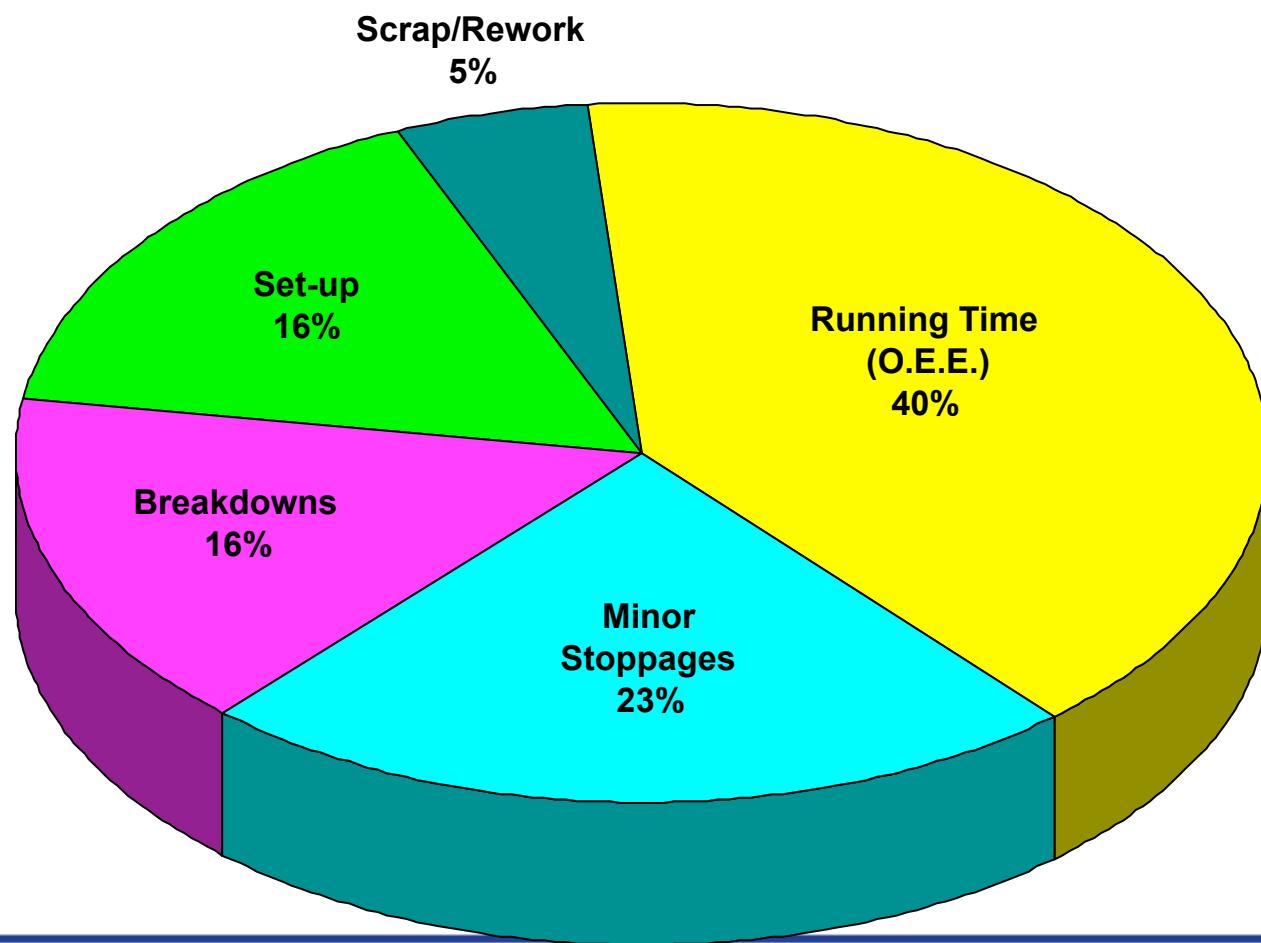
- **Planned Shut Down:** Periods when not scheduled (required) to produce (e.g. weekends, off-shifts, breaks, lunch, etc).
- Note: If your scheduled to run during breaks and lunches, this is not considered Planned Shutdown Time.

$$\text{Quality} = \frac{\text{Good Output}}{\text{Total Output}}$$

- **Total Output** is the total output produced (ie: units, eaches, ft, etc) including good, bad, reworked, QC Samples, and product produced during changeover.
- **Good Output** refers to the total number of good product produced through the process that is available for sale, without any type of rework or re-processing.

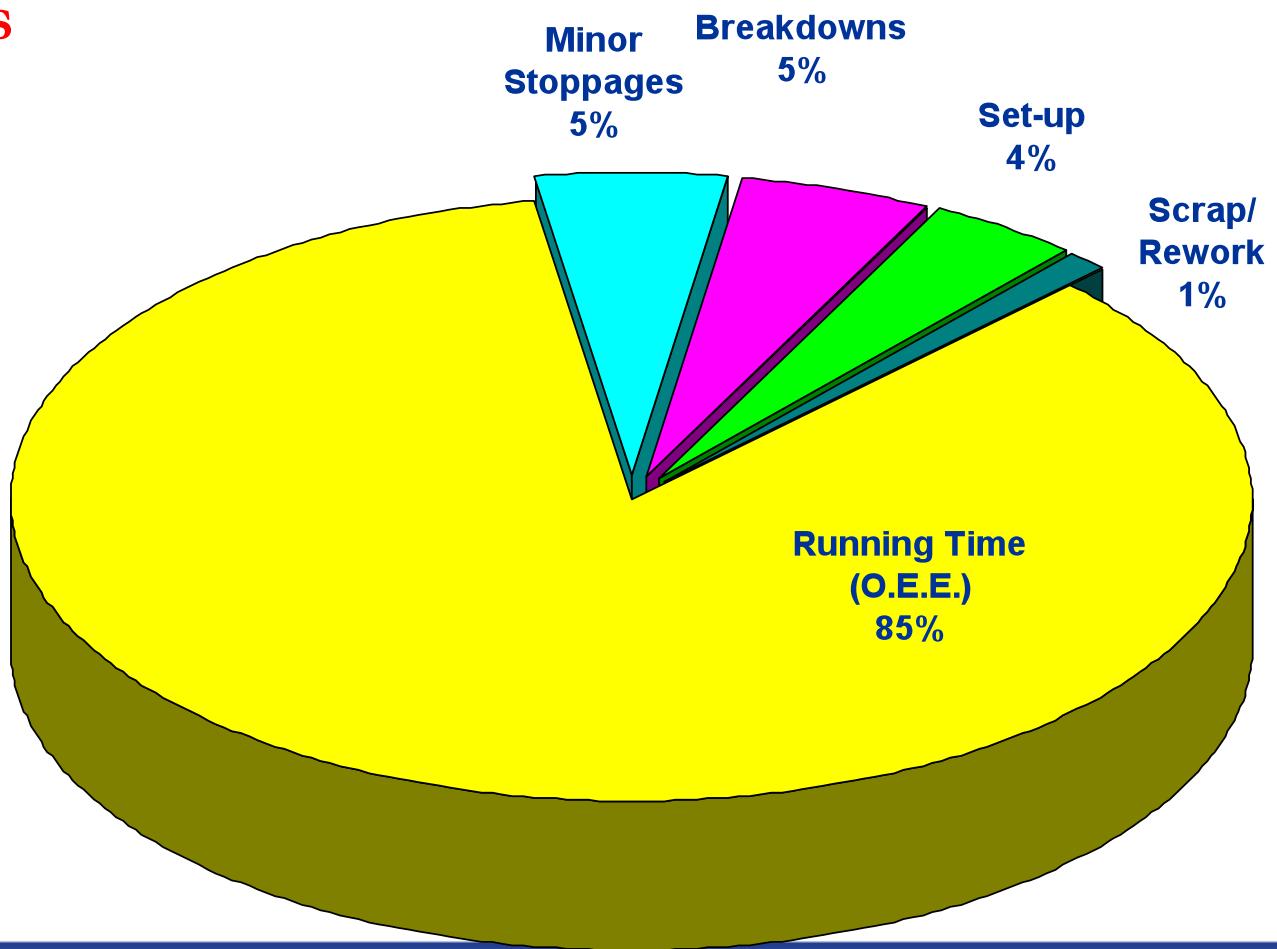
OEE Typical Distribution

United States Business



World-Class OEE Measurements

With World Class
OEE of 85%, The
Same Equipment
Has 112% More
Capacity



OEE Implementation Screen View Kiefel

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Measure your improvements

- Create an OEE baseline for each equipment on TPM program. At least 30 days data provides a better view of equipment and system performance
- Establish an OEE goal per equipment and expected dates. Each equipment has an accountable team that supports goal achievements.
- OEE needs to be understood by everyone- have a systematic training method to convey OEE calculation and understanding. Without this, OEE is just a number
- Steering committee supports activities towards improvements. They are at the Gemba when these activities occur

"OEE is a good beginning, and many organizations can use it to help themselves, but it's only part of the equation. As with anything, it can be applied well or not applied well. The critical thing people have to focus on is how to actually use OEE to drive change in an organization in an effective manner."

Ryan Hale, lead consultant with Stroud Consulting

Industry Week, "OEE: The Heart of the Matter", Feb. 01, 2009

Category Definitions

- Plants must assess all plant equipment (production, critical systems, critical testing equipment, etc) and assign it an appropriate TPM category based on its criticality to your operation. Utilize the following guidelines for determining the appropriate category level:

Category 1: Critical Plant Equipment

- *Equipment selected by the plant as critical plant equipment that affects either the entire plant or one of the Key Value Streams. Factors to consider may include:*
 - Does this equipment shutdown an entire Key Plant Value Stream or the entire Plant?
 - Is this critical equipment with no back-up capabilities?
 - Is this equipment capacity constrained?
 - Is this operation the bottleneck in the value stream?
 - Is this equipment critical from a supply / customer risk perspective?
 - Does this equipment has a significant impact on other Strategic imperatives (ie: quality issues, high conversion loss, etc)

Category 1A: TPM Pilot Equipment

- *Category 1A Equipment is a strategic sub-set of Category 1. These will be the “pilot” equipment strategically selected as most important to the plant, where TPM efforts will initially be focused in the plant. It is recommended to focus on 3-6 pieces of equipment as Category 1A.*

Category Definitions

Category 2: Key Equipment

•This equipment is considered to have limited or minimal impact to your overall operations. Factors to consider include:

- Critical equipment with some back-up capabilities
- May shutdown a portion of a key value stream.
- Non-capacity constrained
- May have an limited impact on other strategic imperatives (ie: Quality, conversion loss, financials, etc)

Category 3: Non-Critical Equipment

•This includes all non-critical equipment

- Non-critical equipment
- Auxiliary equipment

TPM Pre-Requisite

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TPM Criteria

Pre-Requisite Level

Autonomous Maintenance

| | |
|---|--|
| 1 | A cross functional TPM team is established and resourced appropriately from management. All team member have a defined role, team/individual PMO's are established and aligned, meeting frequency identified, and all team members participate consistently. |
| 2 | A Pre-Flight checklist is developed for the equipment operators, and is performed consistently on all appropriate shifts for a period of 1 month. Technician responsibilities should also be included if appropriate. |
| 3 | A Daily Walk-Around checklist is developed and performed consistently for a period of 1 month. Operator and Technician responsibilities need to be clearly defined. |
| 4 | A Visual Management system is in place to capture issues identified during Pre-Flight / Daily Walk Arounds. An Accountability process is established to address identified issues in a timely manner. |

Education and Training

| | |
|---|---|
| 5 | All employees associated with the focus equipment value stream (Operators, Supervisors, Sr. Management, QA, Engineering, Maintenance, etc) receive TPM Awareness Training. Training is documented and ISO Train modules are updated to ensure new employees receive training. |
| 6 | All training / operating materials associated with equipment operation have been obtained (ie: Operating Manuals, Training Manuals, Job Instruction Breakdowns (JIB's), standard work, procedures, etc) |

Safety and Environmental Management

| | |
|----|---|
| 7 | 6s Pre-requisite, or higher, must be achieved for the area in which the equipment operates. |
| 8 | Review and update the EHS Risk Assessment associated with the equipment (Machine Guarding, electrical hazards, PPE assessments, etc) |
| 9 | All operators, mechanics, technicians (and others as appropriate), have been informed of all specific EHS hazards and associated control measures that must be maintained. |
| 10 | Review and update the LOTO procedure associated with the equipment. |
| 11 | LOTO Training has been completed for all appropriate personal (including operators). Training is documented and ISO Train modules updated to ensure new employees receive training. |
| 12 | Safety Checks have been incorporated into the daily walk-around (equipment, PPE, etc) |

Equipment and Process Improvement (OEE)

| | |
|----|--|
| 13 | A process is established and agreed upon by the team, to collect OEE data for the equipment. The process should have data sources, timing, and responsible parties identified. |
| 14 | OEE data is collected and a baseline established. A minimum of one month's complete data is required to establish the baseline. |

Planned Maintenance

| | |
|----|---|
| 15 | The following existing documentation / information related to the equipment is obtained (if available) : Equipment Manual, Spare Parts List, Spare Parts usage history, Preventative Maintenance requirements, Maintenance history. |
| 16 | A method to track spare parts usage is established. |
| 17 | Ensure Preventative Maintenance requirements have been established for the equipment at a defined frequency. |

TPM Criteria

Bronze Level

Autonomous Maintenance

| | |
|----------|---|
| 1 | Pictures / Names of the entire cross function TPM team are visually displayed. |
| 2 | The team utilizes a Visual Management / Daily Accountability process to track and resolve issues identified during Pre-Flight / Daily Walk Arounds. |
| 3 | Tools required to perform routine maintenance, checks, set-ups, etc, are identified and stored using 6s principles. |
| 4 | Pre-Flight Check lists and Daily Walk Arounds are completed consistently at the defined frequency. |
| 5 | A systematic process exists to review and update at a defined frequency, all Pre-Flight check lists and Daily Walk Arounds. Factors such as cleaning, lubrication, EHS, operator responsibilities, etc, should all be incorporated. |
| 6 | Employees down to the Supervisor Level of responsibility are fully empowered and embrace a "Stop and Fix" culture. |

Education and Training

| | |
|----------|--|
| 7 | All employees associated with the focus equipment value stream (Operators, Supervisors, Sr. Management, QA, Engineering, Maintenance, etc) receive TPM Enhanced Training. Training is documented and ISO Train modules are updated to ensure new employees receive training. |
| 8 | A systematic process exists to review and update at a defined frequency all training / operating materials associated with equipment operation (ie: Operating Manuals, Training Manuals, Job Instruction Breakdowns (JIB's), standard work, procedures, etc) |
| 9 | Identify technical training gaps created by expanding autonomous maintenance activities for all appropriate personal (operators, technicians, mechanics, etc). Develop plans to address. |

Safety and Environmental Management

| | |
|-----------|--|
| 10 | 6s Bronze Level, or higher, must be achieved for the area in which the equipment operates. |
| 11 | A plan exists to address all machine guarding gaps. |
| 12 | A plan exists to address all other EHS related gaps as identified and prioritized through the EHS risk assessment process. |

Equipment and Process Improvement (OEE)

| | |
|-----------|--|
| 13 | Overall OEE data and its 3 components are tracked, trended, and visually displayed to identify actual performance against goals. |
| 14 | The TPM team and Senior Management have agreed upon appropriate OEE goals. |
| 15 | Root Cause and Action plans have been identified to address 3 of the top OEE/downtime issues. A Visual Management / Accountability process exists to ensure completion of action plans. Tools such as pareto analysis, fishbone, FMEA, A3 Management, loss tree, set-up reduction, RCM, predictive technology, PM optimization, planning and scheduling enhancement, etc, are utilized where and if appropriate. |
| 16 | An initial equipment Cleaning/Renewal event is conducted to return the equipment to original, "like new", condition. Participants should include the TPM team and a cross functional mix from all shifts. The event should focus on things such as; Cleaning, tightening, lubrication, repair, defective parts replacement, fix leaks, good wire/air line management, etc) |
| 17 | TPM Workshops are identified and conducted as necessary based on OEE data and analysis to drive OEE improvements. |
| 18 | Equipment OEE is improved based on the targets established in the Improvement Target Matrix and your initial baseline. |

Planned Maintenance

| | |
|-----------|--|
| 19 | A systematic process exists to review and optimize at a defined frequency, all PM's associated with the equipment. PM's should either be deleted, re-assigned, replaced, revised, or kept, based on factors such as; downtime, spare parts usage, OEE data, etc. |
| 20 | A systematic process exists to review and update at a defined frequency, the spare parts list and associated safety stock targets for the equipment. |
| 21 | Critical Spare Parts have been identified and are stored near the equipment (as appropriate) using 6s principles. |

Process Quality Management

| | |
|-----------|--|
| 22 | Existing Quality Management systems and tools are used to identify and resolve issues affecting the Quality factor of OEE. |
|-----------|--|

OEE Improvement Target Matrix

Based on your OEE baseline, the following matrix illustrates the minimum OEE target for the various TPM levels of achievement.

| OEE Baseline | Bronze | Silver | Gold |
|--------------|--------|--------|------|
| 0-30% | 45% | 60% | 80% |
| 30-49% | 55% | 65% | 80% |
| 50-59% | 65% | 75% | 82% |
| 60-69% | 70% | 80% | 84% |
| 70-79% | 80% | 83% | 86% |
| 80-85% | 85% | 86% | 88% |

Autonomous Maintenance Example

BaxterTPM Walk Around: **Emplex**

Performed by: _____

Effective Date 10/08/04

Date: _____

Check The Following Items Daily:

- 1. Do the green belts have tears or separations?**
- 2. Are the pulleys worn or have bearing Noise?**
- 3. Are the Teflon Belts worn or separated?**
- 4. Are any of the heating or cooling dies damaged or do any contain debris?**
- 5. Do any of the wires or air lines show sign of external wear or corrosion? Do any wires or air lines need tie wrapped or rerouted?**
- 6. Do any of the shafts, love joys or gear boxes contain debris from wear or have noises?**
- 7. Are there any noises with the drum rollers? Any separations or tears in the drum conveyer belts?**

| Yes | No |
|-----|----|
| | |
| | |
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