Implementing Sustainable Maintenance Best Practice: Some Myths & Realities

Peter Willmott-Non Executive Director ESS Ltd, Limerick
A Question for you..........

Which Environment would you prefer to work in?

....The ‘Before’ scenario or the ‘After’ one ?......
Before Maintenance Best Practice
After Maintenance Best Practice
The Factory floor should be the Mirror of the Equipment above it
Some Myths and Realities of Implementing Sustainable Maintenance Best Practice

- Securing Management Commitment
- The 3x Essential Ingredients
- Creating the Master Plan & Roll-out
- Audit & Review Processes
- Case Studies & Conclusions
Scene Setting: Maintenance and Lean Thinking

- Lean Manufacturing is **Not** going to go away!!

- So...first an Overview of What Maintenance can bring to the Lean Party.........
Lean Principles

1. Define value from the customer perspective;
2. Identify the steps which add value;
3. Reduce non value adding steps improve the rate of value flow;
4. Process in quantities which match customer demand;
5. Continually improve/Strive for perfection.

Understand what customers value and......

......remove anything that isn’t essential to providing it.
Traditional Batch Production System

Order

Inventory

Shape Batches

Production plan

Machining cell

Queue of Castings

“Push” supply to meet forecast demand

Inventory management

Batch Documentation

Production plan

Batch documentation

Batch documentation

Batch documentation
Lean Production System Benefits

- Less inventory in the process
- Quality issues dealt with immediately
- Empty Kanban space is signal to produce
- Less coordination

- Automatic “Pull” replenishment trigger
- Shape to order
- Kanban of interim stock
- Machining cell
- Castings
Lean Manufacturing Impact on Maintenance

- Lean Manufacturing is **not** going to go away

- Traditional manufacturing (in theory) made it easier to release equipment for maintenance

- Lean Manufacturing requires equipment to be available on demand so the successful adoption of Lean will lead to the revision of the traditional maintenance process

- The Maintenance function needs to implement plans to integrate and evolve its methods to meet the new demands placed on it by Lean Manufacturing

- Lean Thinking can help the Maintenance department to deliver improved departmental performance, lasting change and raise the profile of Maintenance as a value adding function rather than an overhead/cost.

**Maintenance practices needs to evolve to meet the challenge of Lean**
## Impact of Lean Thinking on Maintenance

<table>
<thead>
<tr>
<th>Value adding activities</th>
<th>Lean Impact on Maintenance</th>
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</thead>
<tbody>
<tr>
<td>Activities which, in the eyes of the customer make a product or service of value.</td>
<td>Stabilise and extend component life by controlling contamination and causes of human error</td>
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<table>
<thead>
<tr>
<th>Non value adding activities</th>
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<tbody>
<tr>
<td>Activities which do not provide product or service features which the customer uses. This includes the 7 classic wastes.</td>
<td>Focussed Improvement to analyse and removing unnecessary PM’s, waiting time, and other wastes</td>
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</table>

<table>
<thead>
<tr>
<th>Necessary non value adding activities</th>
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<tr>
<td>Non value adding activities which are difficult to remove but are essential to the running of the operation at least in the short term. This could include activities such as quality inspections.</td>
<td>Improve ease of inspection, reduce time to repair, engage operators with routine asset care and early problem detection</td>
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Impact of Maintenance on Lean

<table>
<thead>
<tr>
<th>Value adding activities</th>
<th>Non value adding activities</th>
<th>Necessary non value adding activities</th>
<th>Improve Quality, Cost and Delivery Capability</th>
<th>Stabilise Process Performance</th>
<th>Optimise Process Performance</th>
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**Lean Maintenance Impact on 7 Lean Wastes**

1. **Overproduction**
   - Too much too soon

2. **Quality Defects**
   - Not right first time

3. **Unnecessary inventory**
   - Work in progress buffers, spares, finished goods, Raw materials

4. **Inappropriate processing**
   - Using complex processes where simpler ones would be good enough

5. **Excessive transportation**
   - More than feeder to fed processes, double handling or indirect routing of products

6. **Waiting**
   - Inactivity for people, information or goods.

7. **Unnecessary motion**
   - Poor workplace organisation, excessive searching for information, tools, materials etc

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<tr>
<th></th>
<th>Improve Value (QCD)</th>
<th>Stabilise Process</th>
<th>Optimise Process</th>
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<tr>
<td><strong>Exercise</strong></td>
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<tr>
<td><strong>Assess the potential impact of Maintenance on the 7 Lean Wastes.</strong></td>
<td>1 = little/ none, 2 = some, 3 = Significant</td>
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Exercise:- Assess the potential impact of Maintenance on the 7 Lean Wastes.

1 = Little/none, 2 = Some, 3 = Significant

48/63 = 76%
The impact of **Maintenance on Lean Manufacturing** is its ability to improve the value adding capability by delivering:
- Stabilised performance to reduce unplanned events and waste
- Optimised performance to reduce quality defects, cost and delivery lead times

The Impact of **Lean Thinking on Maintenance** is its tools to guide the reduction of waste and non value added maintenance activities i.e.
- Stabilise and extend component life by controlling contamination and minimising human error
- Analyse and remove unnecessary maintenance procedures,
- Developing standard countermeasures to common problems
- Reduce time to repair and
- Engage operators in asset care
- Improve ease of inspection and early problem detection.
## Value of Lean Maintenance

### Case Study

<table>
<thead>
<tr>
<th>Plant</th>
<th>Year 1 Maintenance Improvement Potential (€k)</th>
<th>Lean Manufacturing Potential without Lean Maintenance</th>
<th>Lean Manufacturing Potential with Lean Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. Improve Reliability</td>
<td>B. Reduce Lean Wastes</td>
<td>A+B = Impact of Lean Maintenance</td>
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<tr>
<td>Plant 1</td>
<td>135.02</td>
<td>85.01</td>
<td>220.03</td>
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<td>Plant 2</td>
<td>285.04</td>
<td>196.27</td>
<td>481.31</td>
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<tr>
<td>Plant 3</td>
<td>391.30</td>
<td>865.11</td>
<td>1,256.41</td>
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<td>Average (€k)</td>
<td>€270.45</td>
<td>€382.13</td>
<td>€652.58</td>
</tr>
</tbody>
</table>

- **18%**
- **25%**
- **43%**
- **57%**
- **100%**

**Maintenance Reduction of Lean Wastes is worth 25% of the total benefits from Lean Manufacturing**

**Lean Maintenance impacts on more than 40% of the total benefits from Lean Manufacturing**
The Lean Maintenance Principles

- Develop standard practices to stabilise and extend component/tooling life and reduce quality defects
- Raise those standards to optimise process capability and extend the time between intervention for all personnel
- Manage the transferring of routine Asset Care activities to production personnel (Retain control of the quality of maintenance)
- Improve maintenance systems (stores, planning, reporting and analysis) to support continuous improvement of operations performance
- Early Management of projects and shutdowns to secure flawless (Stable) operation start up from day one
1. **Securing Management Commitment**
2. The 3x Essential Ingredients
3. Master Plan & Roll-out
4. Audit & Review Processes
5. Case Studies
A Typical MBP Implementation Process

PROGRAMME - IMPLEMENTATION

Secure Management Commitment

- SM ‘Buy-in’ W/S
- Scoping Study
- 4 Day Launch Workshop/Initial Training

Trial & Prove The Route

- Pilot Projects, Plant Clear & Clean, Training & Communication
- Feedback Mgt Review

Milestones 1-4

- Improvement Zone Partnership
  - With Top down/Bottom Up Audits & Reviews:
  - Operational Improvement
  - Project Improvement
  - Bus Process Improvement

POLICY DEVELOPMENT & DEPLOYMENT

1 Month

Pilot Process

2 - 6 Months

Roll-Out Evolution

7-24 Months +
<table>
<thead>
<tr>
<th>Business Drivers</th>
<th>Potential Impact of MBP</th>
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<tbody>
<tr>
<td>Health &amp; Safety</td>
<td>2</td>
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<tr>
<td>Profitability (Cost/Kg)</td>
<td>3</td>
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<tr>
<td>Cash Flow</td>
<td>3</td>
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<tr>
<td>Inventory Reduction</td>
<td>2</td>
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<tr>
<td>Delivery On Time In Full</td>
<td>2</td>
</tr>
<tr>
<td>World Class Levels of OEE</td>
<td>3</td>
</tr>
<tr>
<td>Conversion Cost</td>
<td>2</td>
</tr>
<tr>
<td>Level 3 Achievement of our POS</td>
<td>3</td>
</tr>
<tr>
<td>Staff Involvement in CI</td>
<td>3</td>
</tr>
<tr>
<td>Reduction in Customer Complaints</td>
<td>2</td>
</tr>
</tbody>
</table>

0 = None  1 = Some  2 = Significant  3 = Major  Total Score 25/30=81%
6x Myths & Realities of OEE

- An OEE of 85% is World Class
- OEE is a Management Benchmark Tool
- OEE should be Calculated by Computer
- OEE on Non-bottleneck Equipment is Un-important
- We don’t need more Output-so why Raise OEE
- The OEE is a limited Measure
## Question: What will stop MBP from “taking hold”? 

<table>
<thead>
<tr>
<th>Stoppers</th>
<th>Countermeasures</th>
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</thead>
<tbody>
<tr>
<td>Lack of Skilled Resource</td>
<td>Up-Skill selected People, + Recruit Staff with Potential</td>
</tr>
<tr>
<td>Lack of Management Time / CI Tech Time</td>
<td>Stick to POS Structure, Remove non-value adding Admin</td>
</tr>
<tr>
<td>No Training Time</td>
<td>Dedicated Asset Care Periods, Train the Trainers</td>
</tr>
<tr>
<td>Lack of Financial Budget</td>
<td>Input into Budget finance for Asset Care, Justify Finance on OEE Forecasts</td>
</tr>
<tr>
<td>Production Capacity v. Machine Availability</td>
<td>Agreed Outages / Downtime periods in the Production Plan</td>
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<tr>
<td>(P.I.G.)</td>
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<tr>
<td>Culture</td>
<td>Training, Involvement, Reward Success-Present as a ‘Single Agenda for Change’</td>
</tr>
</tbody>
</table>
1. What Is Our Highest Priority?

2. WE EXPECT FROM MANAGEMENT

4. OUR KEY ACTIVITIES:
5. TO ENCOURAGE THIS
6. TO DELIVER THIS:

3. WE EXPECT FROM OUR PEOPLE

World Class Performance in MBP
MBP “Spark To Start” - An Example

1. Eliminate Surprises!!

2. WE EXPECT FROM MANAGEMENT
   - Stable Teams
   - Ongoing Commitment & Proactive Support
   - Dedicated Improvement Time
   - Ensure Sufficient Resources of P,T&M
   - Ongoing Skill Development
   - Recruit Right People & Train

3. WE EXPECT FROM OUR PEOPLE
   - Take Responsibility & Speak up
   - Reliability & Enthusiasm
   - Process & Equipment Knowledge
   - Accurate Data Recording
   - Willingness to Share Ideas & Best Practice
   - Due Care & Diligence
   - 100 year Fix Mentality

4. OUR KEY ACTIVITIES:
   - Measure Performance & Set Targets
   - Train, Coach & Educate

5. TO ENCOURAGE THIS:
   - Support & Audit
   - Share Success & Best Practice
   - Regular Engineering Review
   - Show & Sell Benefits
   - Training Room Facility

6. TO DELIVER THIS:
   - Continually Remind Management
   - Keep MBP on the Agenda
   - Benchmark Across & Outside

World Class Performance in MBP
Making your Plant a ‘World Class’ Facility. Where the Future Drivers are:-

- Delivery through our People
- Maintenance Effectiveness
- Energy Efficiency
- Environmental Control
- Health & Safety Management
- Conservation
- 100% Conformance
- Teamworking
- Efficiency
- Zero Accidents

meeta
THE ASSET MANAGERS
Maintenance and Energy are tied partners:
Maintenance Effectiveness = Energy Efficiency

Maintenance and Safety are tied partners:
Less Interventions = Less Accidents + Proper guarding & Protection.

Maintenance and Environment are tied partners:
Less Spillage and Emissions = Less Environmental damage
1. Securing Management Commitment
2. *The 3x Essential Ingredients*
3. Master Plan & Roll-out
4. Audit & Review Processes
5. Case Studies
A **Sustainable** MBP Environment Demands 3x Essentials:-

- The Right Framework & Infrastructure
- The use of the Right Tools & Techniques
- To generate the Right Behaviours
The MBP Framework & Infrastructure

- Steering Group
  - FAC DEV
  - FLM COACHING
  - PUB’ & COMMS

- TOP DOWN TARGET DRIVEN MANAGEMENT
- LOSS MODEL
- LEARNING ORGANISATION
- BOTTOM UP/SHIFT TEAM ACTIVITY

- 9 STEP MBP PROCESS AND 5S / WPO
- MASTER ROLL-OUT PLAN

- PILLAR CHAMPIONS
  - OEE
  - OAC
  - PM/QM
  - SD
  - EEM
  - 5S
Essential Framework for a Sustainable MBP Environment

* A Comprehensive & fully Cost / Benefit MBP Master Programme which is relevant to the Business, robust and above all believable

- Visible Leadership
- A Desire to Challenge and Improve
- A Real Interest in Performance
- Focus and Enthusiasm

- Facilitated and Dedicated MBP Improvement Time
- Consistent Use of Data and Information
- Continual Check of Understanding to Target Improvement Effort via KPI’s
- Team-Based Working
- Ownership of Geographic Improvement Zones / Cells / Lines
- Regular, Evidence-based Audit and Review Processes
- Ability to Take Action and be Accountable

NOTE! The **first one** is the essential Planning Stage to gain ‘buy-in’ and commitment from all concerned. The **next four** are non-optional attributes/behaviours of the Plant Leader / Manager / Process Owner
Tools & Techniques can Include:

- MBP
- TPM
- Lean Maintenance
- 5S
- Changeover Reduction (SMED)
- OEE Measurement
- Failure Modes & Effects Analysis
- Problem Solving (5 Why’s etc)
- Cost & Loss Deployment
- Facilitator Development
- TL & Team Coaching
- Maintenance Strategy
- Early Equipment Management
- Lean Six Sigma
- SPC
- Value Stream Mapping
9x Step MBP Improvement Plan

**THE MEASUREMENT CYCLE**

1. Collect Process History & Performance Information
2. Define OEE Measurement & Potential Review Progress
3. Assess Hidden Losses/Waste. Set Improvement Priorities

**THE CONDITION CYCLE**

4. Carry Out a Critical Assessment of the Equipment
5. Carry Out a Condition Appraisal
6. Plan the Refurbishment, Spares & Manpower
7. Develop Future MBP

**THE PROBLEM PREVENTION CYCLE**

8. Develop Best Practice
9. Improve Low Cost/No Cost Solutions

FEEDBACK
CLEAR OUT

ARRANGEMENT

NEAT & CLEAN

DISCIPLINE

ONGOING IMPROVEMENT

THE WESTERN 5S’s
Generating the Right Behaviours:-

As an Employee, I Will Do Something Different If You........

- Ask My Opinion about the Best Way.
- Include it in the Future Ways of Working.
- Feedback the Result to Me.
- Train Me and Coach Me.
- Give Me Dedicated Improvement Time.....
- ...And It Results in a “Trouble Free” Shift
Greater Involvement and Ownership

Enthusiasm to do things better
- attitude

Effective team and cell based working

Robust continuous improvement system
1. Securing Management Commitment
2. The 3x Essential Ingredients
3. **Master Plan & Roll-out**
4. Audit & Review Processes
5. Case Studies
MBP Implementation Process

PROGRAMME - IMPLEMENTATION

Secure Management Commitment

Trial & Prove The Route

Milestones 1-4

POLICY DEVELOPMENT & DEPLOYMENT

SM ‘Buy-in’ W/S
Scoping Study
4 Day Launch Workshop/ Initial Training
Pilot Projects, Plant Clear & Clean, Training & Communication
Feedback Mgt Review
Improvement Zone Partnership
With Top down /Bottom Up Audits & Reviews:
-Operational Improvement
-Project Improvement
-Bus Process Improvement

1 Month || 2 - 6 Months || 7-24 Months +

Pilot Process

Roll-Out Evolution
Roll Out Evolution

Initial Pilot:
- Trial & Prove the Route
- Everyone Involved
- Get the Basics Right

Milestone 1:
- Introduction

Milestone 2:
- Refine Best Practice & Standardise
- Innovation

Milestone 3:
- Build Capability

Milestone 4:
- Strive for Zero Losses
- Achieve Spark to Start Vision

TIME 3 - 5 YEARS

CAPABILITY

INPUT
- EFFORT
- OWNERSHIP
- RESPONSIBILITY

CONSULTANT

MBP FACILITATOR

MANAGEMENT SUPERVISION

OPERATOR AS TECHNICIAN

MAINTAINER AS ENGINEER

FIRST LINE MANAGER

MANAGER AS ENTREPRENEUR
### Typical Pilot Timetable & Resource Plan

#### Schedule of Activity & Resources to Secure Management Commitment
**Trial and Prove The Route**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Mth 1</th>
<th>2</th>
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<td>Secure commitment</td>
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<td>Project Mgt/Steering Committee</td>
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<td>Awareness &amp; Communication</td>
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<td>Plant Clear and Clean</td>
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<td>Pillar Champion working groups.</td>
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**FLM/ Pillar Champion Coaching**

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**Audit/Coaching**

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**ENGINEERS IRELAND**
Some Myths and Realities of Implementing Sustainable MBP

1. Securing Management Commitment
2. The 3x Essential Ingredients
3. Master Plan & Roll-out
4. **Audit & Review Processes**
5. Case Studies
Milestone 4: Strive for Zero Targets
- Achieve Optimum Conditions
- Reduce Effort
- Increase Customer Responsiveness
- Reset Vision

Milestone 3: (Build Capability)
- Define Optimum Conditions
- Use P-M Analysis
- Improve Equipment Precision
- Improve the Quality of Maintenance
- Achieve skill levels for zero targets

Milestone 2: (Refine Best Practice & Standardise)
- Define Training Needs
- Make it Easy to Do Right
- Involve Support Departments
- Set up Early Warning System
- Achieve Adherence
- Stabilise Equipment Perf'

Milestone 1: (Introduction)
- Set Fast Track Priorities
- Get Everyone Involved
- Define Accountabilities
- Move to Roll-out

Organisational Learning Milestones: Delivering The Production Response thro’ 10 Pt Audits / Reviews
From Project to Routine through 4x MBP Milestones

OEE

85% +

50%

Intro          Refine Best Practice          Build Capability          Strive for Zero Targets

MBP Pilot Projects

MBP Routine
Some Myths and Realities of Implementing Sustainable MBP

1. Securing Management Commitment
2. The 3x Essential Ingredients
3. Master Plan & Roll-out
4. Audit & Review Processes
5. Case Studies
4x Examples of Financial Benefits from MBP

**CASE A**
Chemical Processing Plant
- By-product output constrained by capacity
- 5% increase in OEE to 90%
- Worth Euro’s 900,000 in increased contribution per annum

**CASE B**
Manufacturing Machining Cell Pilot Project
- OEE increased from 40% to 72% over 6 months.
- Best of Best OEE of 92%
- 47% reduction in set-up and changeover times
- 100 hours per month liberated via MBP improvements.
- Additional manufacturing potential worth Euro’s 120,000 per year by bringing sub-contracted off-load work in-house.

**CASE C**
Automotive Manufacturer
- 15 year old wheel balancer
- Average OEE before LM = 45%
- Cost of refurbishment = Euro’s 18,000
- OEE achieved after 3 months = 70%
- Worth Euro’s 40,000 per annum

**CASE D**
Polymer-based Material Producer
- Production Line from Raw Material input to Bulk Reels.
- Reference Period OEE = 77%
- Consistent Achievement of Best of Best OEE = 82%
- Value of achievement = Euro’s 600,000 per annum in reduced costs.
- One off cost of improvements = Euro’s 45,000
3x Further Examples of Financial Benefits from MBP

CASE E
Cement Plant

- Weigh Feeder Mechanism unreliability
- Reference period OEE = 71%
- Best of Best OEE achievement = 82%
- Worth Euro’s 130,000 in energy saving / yr
- Other Pilot Improvements saved Euro’s 675,000 per annum, plus avoidance of capital expenditure of Euro’s 270,000.

CASE G
Pharmaceutical Manufacturer

- MBP project actioned as part of a 4 day facilitator/practitioners training workshop.
- Additional revenue generated worth Euro’s 4.5 million per annum.
- One off cost of implementation Euro’s 7,000
- MBPChampion: “I am glad we did not agree to a fee based on a percentage of the profits generated!”

CASE F
Offshore Oil Platform with Declining Reservoir

After 2 years of using MBP Principles:
- October achieved longest production run without shutdown, since 3 yrs
- Gas lift now at greater than 90% efficiency compared to 40% 3 yrs ago and 60% 2 yrs ago
- OEE Reference Period 60%, current levels 75%.
Example No 8-MBP Benefits from a Metals Processing Plant

**Output**
- 3,000 Tonnes in Nov
- 4,700 Tonnes in April

**Output Contribution**
- Euro 420,000/yr

**Lining Life of Furnace**
- June: Euro 260,000/yr Benefit
- April: x7

**Breakdowns per month**
- 74 in Oct
- 20 in April

**Benefit**
- April 20: 360,000/yr

**OEE Av %**
- May: 40%
- April: 58%

**Total Benefits Of Euro’s 2,360,000 per Year**
3M - Best Factory Award Winner

- Site OEE 1995: 48%
- Site OEE 2001: 67%

- 40% Real Increase in Productive Capacity

- Net margins 18%+, ROCE 19%+
Site – wide OEE now consistently over 70%

Attracted Multi-Million New Product / Plant Investment (which could have gone elsewhere in 3M Global)

95% Adherence to c.25,000 annual Operator Asset Care Check Lists, plus 850 Mechanical & 270 Electrical PM Schedules per year
Key Success Factors

Clear/Transparent Leadership and Direction

- **Priority**
- Sufficient **Resources** of People, Money & Time
- Resultant **Pace** of CI Activity

Full Time Facilitator(s) & PC Coaches

Business Unit’s **Ownership & Delivery** of Relevant Business Drivers
Learning And Understanding - a Chinese Proverb:

Tell Me and I Forget

Show Me and I Believe

Let Me Practice and I Understand

Let Me Improve and I Take Care

Let Me Innovate and I Master