Creating a lean culture: Reducing costs through maintenance activity reduction strategies

By

Mike Sondalini

Lifetime Reliability Solutions
The Concept of a Quality Loss Function

Loss Functions can take a range of shapes

- Minimum Loss
- Terrible Quality
- Optimal Quality
- Excessive Quality

Cost of Loss/Waste

A Variable Factor
Taguchi ‘Loss to Society’ Function

Losses from deficient quality

Taguchi Loss Function

Waste from needless quality

Concept First Developed in 1960
Bolt Tensioning Loss Function

OPTIMUM SERVICE

Cost of Loss/Waste

Minimum Loss

Terrible Bolt Tensioning  Optimal Quality  Excessive Bolt Tensioning

Bolt Tensioning

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Maintenance Planning Loss Function

Cost of Loss/Waste

Minimum Loss

Terrible Planning

OPTIMUM SERVICE

Optimal Quality

Excessive Planning

Maintenance Planning

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Maintenance Planning Cost Loss Function

Cost of Loss/Waste

Minimum Loss

Insufficient Time

Optimal Quality

Excessive Time

OPTIMUM SERVICE

Cost of Maintenance Planning

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How Work Practices Change Quality

This company destroys their own equipment
1) The Technician does not understand!
2) The Supervisor does not understand!
3) The Engineer does not understand!
4) The Manager does not understand!
5) The CEO does not understand!

But they are all doing their best...at wrong things!
Equipment Life vs. Operating Condition

Statistics on Early Life Failures
Newcastle Plants
48% of things we fix will fail again within 3 months!

4% < 1 day
30% < 1 month
14% < 3 months
52% rest

Close Enough is Not Good Enough!
Tolerable is nearly as bad as Extreme!

- High Misalignment
- High Out of Balance
- High Vibration (>5mm/s)
- Extreme Loads
- Free Water in Oil
- > 10,000 particles/ml oil
- > 100 Degrees C

- Within coupling supplier “tolerances”
- “Tolerable” Imbalance from standards
- “Tolerable” Vibration from standards
- “Tolerable” Overload from supplier
- “Acceptable” lab moisture ppm
- “Acceptable” supplier dirt levels
- 60 to 100 Degrees C

- No Misalignment
- No Out of Balance
- Low Vibration (<2mm/s)
- Design Loads
- No Free Water in Oil
- < 1,000 particles/ml oil
- < 60 Degrees C

We Must Be Over The Line to Make a Real Difference

‘Precise’
‘Smooth’
‘Tight’
‘Dry’
‘Clean’
‘Cool’
‘Repeatable’

‘Tolerable’ & ‘Acceptable’
just mean it will not fail immediately!

Source: Wayne Bissett, OneSteel Reliability Manager, Planning and Condition Management Presentation, Sydney, Australia, 2008
The ‘Loss to Society’ of Poorly Kept Machines

Unbalance: Offset Mass Centerline

Wrong Fit: Contamination

Distortion:

Bad Practice: Losses from deficient quality

Misalign: Lower specification

Vibration: Excessive Quality

Waste from needless quality

Optimal Quality

Lost Value

Target value
Distribution of Work Quality Performance

Unbalance: Off-center Mass Centerline
Geometric Centerline
Heavy Spot

Contamination
Wrong Fit:
Distortion:

Bad Practice:

Misalign:
Driver shaft
Driver shaft

Vibration:

Unbalance:

Contamination:

Distortion:

Misalign:

Vibration:

Frequency of Outcome

TERIBLE RELIABILITY
(Early Life Breakdowns)

TERRIFIC RELIABILITY
( Exceptional Service Life)

Maintenance Work Quality

LOSS VALUE

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Combining Work Quality and Loss Function

- Minimum Loss
- Cost of Loss/Waste
- Frequency of Outcome
- Lower
- OPTIMUM
- Upper
- TERRIBLE
- TERRIFIC
- Maintenance Work Quality

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Work Quality that Minimises Loss and Waste

Cost of Loss

Frequency of Outcome

Lower

OPTIMUM QUALITY

Upper

Minimum Loss

TERRIBLE

TERRIFIC

Maintenance Work Quality

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Work Quality that Optimises Reliability

Frequency of Outcome

Cost of Loss

Lower
OPTIMUM RELIABILITY
Upper

Minimum Loss

TERRIBLE

TERRIFIC

Maintenance Work Quality

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Work Quality that Makes Money

![Graph showing the relationship between work quality and cost of loss. The graph has three main sections: 'TERRIBLE', 'OPTIMUM', and 'TERRIFIC'. There are also two vertical lines labeled 'Lower' and 'Upper'.]
Where the Money is in Quality

Frequency of Outcome

- **More profits from top quality**
- **No losses from deficient quality**
- **No waste from needless quality**

Terrible Quality  Optimal Quality  Excessive Quality

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Where Does Lean Fit in This?

**Optimal Quality**

- **Terrible Quality**
- **Excessive Quality**

**Frequency of Outcome**

- **Lower**
- **Upper**

**LEAN**
How Does Lean Influence Cost?

Frequency of Outcome

Lower

Upper

Least Cost

Current Cost

Excessive Cost

LEAN

LEAN

LEAN

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The Lean Concepts

1. Demand = Production = Supply
2. Continuous Flow
3. Use Pull Flow
4. Maximise the Value Stream
5. Demand to Pacesetter
6. Prevention not Rework
7. Apply Statistical Process Control (SPC)
8. Use Single Minute Exchanger of Dies (SMED)
9. Minimise Variation (Supply Chain Demand Amplification)
10. First In First Out (FIFO)
11. Minimise Inventory
12. Link and Match Processes
13. Use 5S Methodology
14. Load Levelling to Capacity
15. Even Mix to Pacesetter
16. Equal Batches Every Time (EBIT)
17. Shorten the Financial Reporting Cycle
18. Team Up (Autonomous Work Teams)
19. Minimise Waste
20. Apply to the Entire Supply Chain
21. Remove need to Sequence Products
22. Optimise Supply (JIT)
23. Optimise Customer Response
24. Measure at the Source
25. Innovate Continuously
26. TPM (Operator Driven Reliability)
Lean for Maintenance Activity Reduction

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A Quality Variable

Cost Reduction

Variation Reduction
Deming’s 14 Points for a Quality Culture

1. Create Consistency of Purpose
2. Remove Variation
3. Build-In Quality at the Source
4. Minimise Total Life Cycle Cost
5. Continuous Improvement
6. Create Learning In the Workplace
7. Servant Leadership
8. Drive-Out Fear from the Workplace
9. Remove Departmental Barriers (Team-Up)
10. Eliminate Slogans and Work Targets
11. Eliminate Imposed Job Quotas and Goals
12. Generate Pride of Craftsmanship
13. Continuous Self-Improvement through Training
14. Take Action to Improve Every Process
14 Points Maintenance Activity Reduction

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14. Take Action to Improve Every Process
## Rio Tinto vs BHP Billiton: There is no evidence that Lean benefits Miners

### Rio Tinto Iron Ore

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<th>Year</th>
<th>Production (Tonnes) (Million)</th>
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28 MT capacity
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