A Simple Spreadsheet Technique for Removing Future Operating Risk and Costs During Feasibility and Design

ICOMS 2007 Conference

Mike Sondalini
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www.lifetime-reliability.com
Failure Costs Surge thru the Company

- Curtailed Life
- Labour
- Waste
- Product
- Administration
- Services
- Consequence
- Materials
- Capital
- Equipment

Equipment Failure Cost Surge
Clearly, repeated plant and equipment failures and stoppages destroy the profitability of an operation.

![Graph showing effects on profitability of repeated failure incidents]

- Accumulated Wasted Variable, Fixed and Failure Costs
- Revenue
- Profits forever lost
- Total Cost
- Fixed Cost
- Wasted Fixed Costs
- Variable Cost

Effects on Profitability of Repeated Failure Incidents
Benefits of Reducing Operating Risk

Risk ($/yr) =
Frequency (/yr) x
Consequence ($)

Risk ($/yr) =
Frequency (/yr) x
Consequence ($)

Accumulated Wasted Variable and Failure Costs
Fewer profits lost, but ‘fire-fighting’ is high
Total Cost
Fixed Cost
Wasted Fixed Costs
Variable Cost

Effects on Profitability of Reducing Consequence Only

Revenue
Fewer Profits Lost
Total Cost
Fixed Cost
Wasted Fixed Costs
Variable Cost

Effects on Profit of Reducing Chance Only
Plant and Equipment Life Cycle

Equipment Life Cycle (say 20 years)

~ 10% of Life Cycle (~ 2 years)  ~ 85% of Life Cycle (~ 17 years)  ~ 5%

Idea Creation  Feasibility  Preliminary Design  Approval  Detail Design  Procurement  Construction  Commissioning  Operation  Decommissioning  Disposal

Profits come from this stage of the life cycle, and are maximised when operating costs are minimised.
“Of concern is that up to 95% of operating costs are predicated during the capital phase. Once a plant is operating there is very little that can be done to reduce costs because they are substantially fixed by the plant’s design.

It is clear that low operating costs are designed into the plant and equipment during feasibility, design and construction. “

*Mike Sondalini*
Maximising Life Cycle Profits

Equipment Life Cycle (say 20 years)

~ 10% of Life Cycle (~ 2 years)  ~ 85% of Life Cycle (~ 17 years)  ~ 5%

Idea Creation  Feasibility  Preliminary Design  Approval  Detail Design  Procurement  Construction  Commissioning  Operation  Decommissioning  Disposal

The Project Phase is the time to control the future costs of failure
Life Cycle Risk Management Strategy

**Optimised Operating Profit Method**

- Design Drawings
- Assume Equipment Failure
- DAFT Costs Spreadsheet
- Failure Cost Acceptable?
  - N
  - Y
- Frequency Achievable?
  - N
  - Y
- Applicable Project Strategies
  - FMEA/RCM
  - HAZOP
  - Precision Standards
  - Precision Instlln
  - Reliability Eng
  - Etc.
- Applicable O & M Strategies
  - Quality Procedures
  - Precision Maint
  - Predictive Maint
  - Preventive Maint
  - RCFA
  - Maint Planning
  - Etc.

- Projected R & M Costs
- Business Risk Based Equipment Criticality

Profit Optimisation Loop
- Redesign with FMEA; Revise O & M Strategies, Revise Project Strategies
Calculating DAFT Costs

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[www.lifetime-reliability.com](http://www.lifetime-reliability.com)
DOCTOR uses risk analysis of operating failure to optimise the design so operating costs can be minimised and life cycle profits maximised.
Risk – Reduce Chance or Reduce Consequence?

Risk = Chance \times Consequence

### Chance Reduction Strategies
- Engineering and Maintenance Standards
- Failure Design-out - Corrective Maintenance
- Failure Mode Effects and Criticality Analysis (FMECA)
- Statistical Process Control
- Hazard and Operability Study (HAZOP)
- Root Cause Failure Analysis (RCFA)
- Precision Maintenance
- Hazard Identification (HAZID)
- Training and Up-skilling
- Quality Management Systems
- Planning and Scheduling
- Continuous Improvement
- Supply Chain Management
- Accuracy Controlled SOPs
- Design, Operation and Cost Total Optimisation Review (DOCTOR)
- Defect and Failure True Cost (DAFTC)
- Oversize/De-rate Equipment
- Reliability Engineering

### Consequence Reduction Strategies
- Preventative Maintenance
- Predictive Maintenance
- Total Productive Maintenance (TPM)
- Non-Destructive Testing
- Vibration Analysis
- Oil Analysis
- Thermography
- Motor Current Analysis
- Prognostic Analysis
- Emergency Management
- Computerised Maintenance Management System (CMMS)
- Key Performance Indicators (KPI)
- Risk Based Inspection (RBI)
- Operator Watch-keeping
- Value Contribution Mapping (Process step activity based costing)
- Logistics, stores and warehouses
- Maintenance Engineering

Done to reduce the chance of failure  
Done to reduce the cost of failure
The Necessary Practices

Enterprise Asset Performance Excellence Pathway

- **Reactive, Breakdown Maintenance**
- **Enterprise Asset Performance**
- **Planning and Scheduling, Materials Management**
- **Predictive Maintenance (PdM)**
- **Maintenance Management, Historic Performance Measures**
- **Planning and Scheduling, Materials Management**
- **Preventive Maintenance (PM), Operations Management**
- **Reactive, Breakdown Maintenance**
- **Reliability Management (FMECA, RCFA), Reliability Data Analysis**
- **Risk Management, Proactive Performance Measures**
- **Total Productive Maintenance (TPM), Up-skill Workforce**
- **Operational Vision**
- **Failure Prevention, Defect Elimination**
- **Organisational Excellence**
- **Don't have the problem in the first place**
- **Don't just improve it, optimise it**
- **Don't just fix it, improve it**
- **Fix it before it breaks**
- **Fix it after it breaks**

- **DOCTOR**
  - Enterprise Asset Management, Quality Management
  - Precision Maintenance, Standards and Specifications
  - Reliability Management (FMECA, RCFA), Reliability Data Analysis
  - Risk Management, Proactive Performance Measures
  - Total Productive Maintenance (TPM), Up-skill Workforce
  - Occupational Health and Safety, Shutdown Planning
  - Predictive Maintenance (PdM)
  - Maintenance Management, Historic Performance Measures
  - Operations Management

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The Necessary Financial Methods

- Financial Accounting
- Computerised Maintenance Management System (CMMS)
- Cost Accounting
- Historic Financial Performance Measurement
- Enterprise Resource Planning (ERP)
- Activity Based Costing (ABC)
- Distributed Technical and Asset Performance Information
- Supply Chain Management
- Predictive Financial Performance Measurement
- Life Cycle Profit
- DAFT Incident Based Costing
- Profit Contribution Mapping
- Financial Vision

Operating Cost Control

High Costs

"What's it cost?"

"Are we doing it efficiently?"

"Are we doing it smart?"

"Are we doing it effectively?"

Least Costs

"Can we remove all waste?"

Enterprise Asset Management Cost Control

Financial Performance

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DOCTOR and DAFT Costs are insightful tools that project people can use to prevent operating failures and maximise operating profit.

Now we can connect the designers and the operators together throughout the life cycle.