Using risk based maintenance

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Improving offshore facilities management, operations and maintenance
Lloyd’s Register – A Group Overview

• Celebrated our 250 year anniversary in 2010
• 8,000 employees of 90 nationalities
• 237 offices globally
• Four business divisions:
  • Marine
  • Energy
  • Management Systems
  • Transportation
• 2011/12 turnover £893m
• A Registered Charity
• Supports the Lloyd’s Register Educational Trust (LRET)
Energy - Upstream

Example applications:
- fixed offshore platforms
- pipelines (offshore / onshore)
- semi-submersibles / drilling ships
- FPSO / FSO / FLNG

Example services:
- optimised risk-based inspection
- fitness for service
- classification guidance
- design appraisal
- conformance assessment
Energy - Downstream

Example applications:
- storage (tank farms, underground gas storage)
- petrochemicals
- bulk chemicals

Example services:
- optimised risk-based inspection
- life extension studies
- corrosion risk assessment
- risk consultancy
Organisational risk

Overall Risk
Operating a Facility

Organisation Integrity

Asset Integrity

50%

50%

LINKAGE

15%

Chemical Company 1
"85% of availability losses over previous 5 years were associated with Mechanical Integrity related failures."

85%

Oil Company 2
“Approximately one third of all the major and high potential incidents reported in the group are related to integrity management – in other words, incidents where there has been loss of containment or failure of an engineering system.”

66%

33%
... the Issues

- AM Policy & Strategy Development
- Risk Management
- Procurement
- Knowledge Management System
- AM Organisation & Communications
- Asset Production Operations
- Knowledge Management
- AM Leadership
- Sustainable Performance/Development
- Human Resources
- Maintenance & Reliability
- HSE & Risk Management System
- Measurement & Continuous Improvement
- Quality Management System
- Engineering & Project Management
Asset Performance Management

1.0 APM Managing Elements

1.1 AM Policy & Strategy Development
1.2 AM Organisation & Communications
1.3 HSE & Risk Management Systems
1.4 Quality Management System
1.5 Asset Production Operations

2.0 APM Functional Elements

2.1 APM Leadership
2.2 Engineering & Project Management
2.3 Maintenance & Reliability
2.4 Risk Management
2.5 Knowledge Management
2.6 Measurement & Continuous Improvement

3.0 APM Supporting Elements

3.1 Human Resources
3.3 Knowledge Management
3.4 Sustainable Development

Functional

Managing

Leadership Commitment to Quality
Quality Process Model
Measurement & Control
Corrective Actions
QA & QC
Project Quality Plans
AM Performance Assessment

Maintenance Objectives
Maintenance Plans & Budgets
Work Selection
Application of New Technology
CMMS Reporting
Maintenance & Reliability Improvement
Spares Management
Maintenance Deferral
Reporting
Fitness for Service Assessments
Contractor Management
Emergency Work
Risk based maintenance software for reliability improvement

Risk: the 4th Generation Approach

Reactive
- Fix it when it breaks

Preventive
- Maintain it before it breaks
- Regular, time-based maintenance routines based on manufacturer's recommendations

Proactive
- Maintain based on extensive data collection and predictive models
- RCM leveraging expert judgment and condition monitoring

Risk Based
- Maintain based on risk profile and dynamic (iterative) risk-based maintenance plans
- Forecast repair, refurb or replacement date based on acceptable risk
- What-if analysis for future dates or different maintenance regimes through to end of life

Moubrays' 3 Generations of Maintenance
Why this approach?

• Improve critical asset availability
• Optimise maintenance costs
• Analyse future risks and maintenance costs
• Provide justification for equipment renewal and repairs
• Promotes regulatory compliance
Knowledge Based Asset Integrity (KBAI™)

Likelihood of Failure (events per year)
- Equipment type and items used
- Age, usage, environment, etc
- Equipment condition (based on visual inspection, past maintenance, failure causes and condition monitoring, etc)

Consequence of Failure (impact per event)
- Disruption to business
- Environmental + Health and Safety impacts
- Reputation – Public/Political

Consequence Ranking
- HIGH
- MED HIGH
- MEDIUM
- LOW

Probability Ranking
- E
- D
- C
- B
- A

Maintenance and Inspection Task Plan optimised to the equipment and the business (£ impact per event)
- Includes industry best practices
- May increase or decrease current maintenance
Case study – Port Cranes

- **Breakdown duration reduced**
  - Quay Side crane (QS) -24%;
  - Rubber Tyred Gantry cranes (RTG) -12%
- **Maintenance cost savings:** QS 17%; RTG 32%
- **Significant commercial operational benefits:**
  - Crane efficiency enhanced
  - Containers handled and related safety all improved
  - Equals: Reduced ship delays
Case study – Oil refinery piping

- Pilot study on fixed equipment on eight process units led to $1.5m in turnaround cost savings and $7m in risk reduction.
- Rolled out to 6 further refineries resulting in over $160m in risk reduction and ongoing savings in turnaround plans. Achieved within 3 years.
- Key lesson learned is the need to continually audit and manage the system to ensure the alignment of people processes and technology.

The small branch connection on the line was found to be corroded nearly through-wall. Continued operation without finding and repairing the damaged connection would have resulted in a failure with potentially serious effect.
Case study – Elevators

- 511 elevators at Royal Mail Group
- Many used to move mail as part of sorting process
- **Planned maintenance cost savings - 51%**
- Reduced reactive maintenance events - 60% target on key elevators
- **Improved elevator availability and quality of service**
- For first time, prediction of number of elevator breakdowns
- **Reduction in consequential losses – estimated £5m per year**
The Process

Integrate Information Systems → Identify Assets → Define Organisational Requirements

Gather Asset Information → Determine Criticality

Plan

Correct Deficiency Replace or Refurbish → Add New Refurbished or Replaced Equipment to KBAI™

Maintenance Strategies

Spare Parts Strategies

Repair or Redefine Acceptance Criteria

Identify Deficiencies

Update

Training

Perform

Evaluate

Business Process Analysis
Configuration: Risk Units & Probability Factors are identified for each asset type.
Configuration: Consequence factors - Economic, Safety, Environmental & Reputational
This year 4 risk units in the asset are medium-high criticality.
Next year prediction shows criticality has further changed for one risk unit – undertake pre-emptive work on this.
Use ‘Reports’ to identify changes required to reduce individual criticalities and ENFs.

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<th>Probability Group/Consequence Group</th>
<th>Risk Unit</th>
<th>ENF</th>
<th>Consequence</th>
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<th>Criticality</th>
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Failure history, completed tasks, usage data, condition data, feedback etc – modifies probability
Summary – Using Risk Based Maintenance

- Structured approach to bring various elements of information and data together to make more informed maintenance decisions including pre-emptive change out of components
- Improves reliability
- Software helps manage the process especially with large volumes of disparate data
- Use to update prediction utilising operational experience
- Provide effective failure mode management in response to changing equipment condition
- Operating knowledge is retained even if staff change
- Consistent with requirements of PAS 55 (ISO 55000)
Questions?

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