Measuring Up - How does the performance of your facility rank within the industry?

Neil Wragg
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1. How do we measure Asset Performance?
2. Production Optimisation
3. RAM Software - OPTAGON™
5. Case Study – An Ageing North Sea platform
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## Measuring Asset Performance – Which metric?

<table>
<thead>
<tr>
<th>Category</th>
<th>Metrics</th>
</tr>
</thead>
</table>
| Safety            | • Lost Time Incidents  
                    | • Near Misses                                |
| Environment       | • Carbon emissions  
                    | • Flare volumes                              |
| Production        | • Operational Efficiency  
                    | • Production Volumes                         |
| Commercial        | • Revenues  
                    | • Penalties                                  |
| Corporate Image   | • Public Perception  
                    | • Media Reports                              |
Production Optimisation
The Value of Production Optimisation

The key reasons for carrying out production optimisation are to:

- Maximise revenues through increased production
- Benchmark performance and quantify ‘lost’ production potential
- Reduce CAPEX and OPEX investment
- Optimise design and operation
- Target investment and maintenance activity
- Reduce contractual penalties by optimising commercial strategy
- Assess availability of export routes
The GL Noble Denton Solution
“Full Life Cycle Applicability”

Potential Modifications

Change

Phase

Concept → FEED → Detailed Design → Operation

Scope

High level analysis of several concepts → Detailed Analysis of Selected Design → Further Detailed Analysis of Selected Design → Industry standard and “live” asset specific modelling → New benchmark definition leading to Step-outs and case studies

Key Outcomes

CAPEX / availability comparison at concept stage
Identification of production critical items & design changes to improve availability
Incorporation of operational strategies, logistics & economics. Quantification of technical & economic risk.
Information to support asset operations such as:
• Benchmark Performance
• Probabilistic Forecasting
• Top Shortfall Contributions
• Maintenance Strategies

Definition of new benchmark & assessment of new RAM position
Assess the need for modification

Information to support asset operations such as:
• Benchmark Performance
• Probabilistic Forecasting
• Top Shortfall Contributions
• Maintenance Strategies
OPTAGON™

- Risk based availability approach
- Developed to analyse performance of complex oil, gas & LNG asset chains
  - Optimise performance
  - Maximise profitability
  - Understand and quantify technical and commercial risk
- Developed by GL Noble Denton
- Monte Carlo simulations to enable multiple streams and interactions to be modelled
- Systematic and consistent approach to assessing assets
How does your asset measure up?
Asset vs. ‘Industry Standard’ OPTAGON Model

Regular Model Updates

- Model Input Data
  - Reliability Data
    - Asset Reliability Data
      - Asset Specific Performance Model
        - Performance Comparison
          - Improvement Plan
    - Industry Standard Reliability Data
      - Industry Standard Performance Model
Model Input Data

**Asset Data**
- Equipment Configuration
- Equipment Criticality
- System Capacities
- Production Targets
- Planned Maintenance

**Reliability Data**
- Mean Time Between Failure
- Mean Time to Repair
- Logistic Delays
- Resource Constraints

**Source**
- PFDs
- FMECA workshop
- Heat & Material Balance
- Sales Contracts
- PM Schedules

- Asset Specific (Historical)
  - Production Loss Accounts
  - Maintenance Logs
- Industry Standard
  - OREDA
  - GL Database
Asset Specific Model

Key Outputs

- Probabilistic production forecasts
  - Realistic production targets (Mean, P10, P90)
  - Maximum production potential
  - Year-on-year trending

- Production loss contributor analysis
  - Identification and quantification of main loss sources
  - Year-on-year trending of equipment loss contributions
Comparison with Industry Standard Model

Benchmark actual operation against industry standard performance

- Quantify realistic asset potential
- Identify lost production potential
- Identify systems that are underperforming
- Compare average durations between unplanned shutdown
Improvement Plan
Where to focus time and resources to close gap between current and industry standard performance

• Set achievable goals supported by quantitative assessment
• True cost-benefit analysis
• Identify ‘quick wins’
• Targeted OPEX investment
• Regular review with model update
Regular Updates – ‘Live Modelling’

Maintain a model that represents current asset performance

- Up-to-date probabilistic production forecasts
- Year-on-year performance trending
- Capture latest equipment reliability and operating philosophy
- Incorporate planned modifications / CAPEX projects
- Identification of equipment / system deterioration
- Assess impact of future design and operational issues:
  - Reservoir depletion
  - Changes to platform configuration
  - New field tie-backs
  - Equipment redundancy levels
  - Planned Maintenance schedules
Case Study: An Ageing North Sea Platform
An Ageing North Sea Platform

‘Live’ OPTAGON model updates since 2008

Quarterly updates to the model considered:

• Equipment reliability based on production loss accounts
• Revised well profiles
• Changes in equipment configuration and reliability

Key outputs from the analysis included:

• Shortfall contributors at equipment and system level
• Comparison of asset performance vs. industry standard
• Identify underperformance of individual equipment items
2013 Predicted OE Performance – Exceedance Curve

- Predicted OE
- P90
- Predicted Average OE
- P10
- Actual OE
Trends in Predicted OE

Operational Efficiency

Year 1 | Year 2 | Year 3 | Year 4 | Year 5
---|---|---|---|---
85% | 91% | 75% | 81% | 84%

Time Period

Actual

P10

Predicted average

P90
2013 Predicted OE Performance – Mean, P10 & P90

Predicted Operational Efficiency Comparison

- Industry Standard
- Asset Specific 2013
- Asset Specific 2012

<table>
<thead>
<tr>
<th></th>
<th>P10</th>
<th>Mean</th>
<th>P90</th>
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<tbody>
<tr>
<td>P10</td>
<td>95.20%</td>
<td>92.40%</td>
<td>89.90%</td>
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<tr>
<td>Mean</td>
<td>82.10%</td>
<td>80.10%</td>
<td>76.10%</td>
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<tr>
<td>P90</td>
<td>78.50%</td>
<td>73.20%</td>
<td>69.80%</td>
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## Asset 2 Predicted Main Loss Sources

<table>
<thead>
<tr>
<th>Component</th>
<th>Asset Specific Model Predicted Loss (MMscf)</th>
<th>Industry Standard Model Predicted Loss (MMscf)</th>
<th>2012 Calculated Availability</th>
<th>2011 Calculated Availability</th>
<th>Change in Availability</th>
<th>Change in overall OE if Working at Industry Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export Compressor</td>
<td>1900</td>
<td>74</td>
<td>84.1%</td>
<td>81.9%</td>
<td>2.2%</td>
<td>7.5%</td>
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<tr>
<td>Integrity Issues</td>
<td>550</td>
<td>N/A</td>
<td>93.2%</td>
<td>95.1%</td>
<td>-1.9%</td>
<td>2.0%</td>
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<tr>
<td>Gas Turbine</td>
<td>390</td>
<td>532</td>
<td>98.0%</td>
<td>97.5%</td>
<td>0.5%</td>
<td>-0.4%</td>
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<tr>
<td>Warm-Up Delays</td>
<td>485</td>
<td>N/A</td>
<td>98.1%</td>
<td>97.7%</td>
<td>0.4%</td>
<td>1.5%</td>
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<tr>
<td>Well A1 Availability</td>
<td>305</td>
<td>N/A</td>
<td>90.0%</td>
<td>88.4%</td>
<td>1.6%</td>
<td>1.1%</td>
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<tr>
<td>Valve Issues</td>
<td>232</td>
<td>N/A</td>
<td>98.8%</td>
<td>98.4%</td>
<td>0.4%</td>
<td>0.8%</td>
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<td>Well A2 Availability</td>
<td>195</td>
<td>N/A</td>
<td>89.5%</td>
<td>87.2%</td>
<td>2.3%</td>
<td>0.7%</td>
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<tr>
<td>Condensate Pumps</td>
<td>175</td>
<td>3</td>
<td>98.1%</td>
<td>98.4%</td>
<td>-0.3%</td>
<td>0.6%</td>
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<tr>
<td>Platform Availability</td>
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<td>0.5%</td>
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<tr>
<td>Other Restriction</td>
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<td>99.5%</td>
<td>99.4%</td>
<td>0.1%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Biggest Swings - Changes in Availability

- Export Compressor
- Integrity Issues: -2.00%
- Gas Turbine: -1.50%
- Warm-Up delays: -1.00%
- Well A1 Availability: -0.50%
- Valve Issues: 0.00%
- Well A2 Availability: 0.50%
- Well A3 Availability: 1.00%
- Well A4 Availability: 1.50%
- Well A5 Availability: 2.00%
- Well A6 Availability: 2.50%
- Well A7 Availability: 3.00%
Improvement Plan – Clear Recommendations

1. Targeted areas for improved maintenance
   - Highlighted poor compressor performance – Significant performance improvement through adopting a revised maintenance strategy

2. Identified equipment for replacement or repair
   - Identify areas performing below industry expected levels – by replacing, repairing or sparing specific equipment items, there was a significant reduction in production shortfall

3. Implement subsea tieback projects
   - Quantified the benefit in operational efficiency of implementing additional subsea tiebacks

4. Optimised spares holding
   - Reduce production losses by implementing optimum spares holding for specific equipment items

5. Planned Maintenance Strategy
   - Adopting a revised maintenance strategy resulted in an increase in production equating to approximately $6M per annum
Any Questions?

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