GL Noble Denton

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

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Measuring Asset Performance – Which metric?

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

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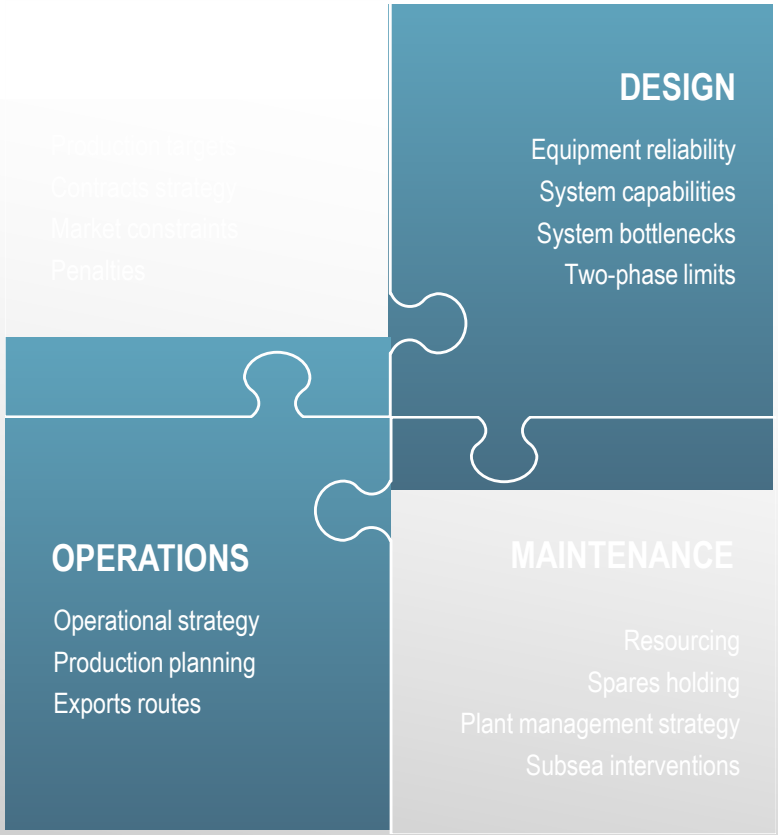
The Value of Production Optimisation

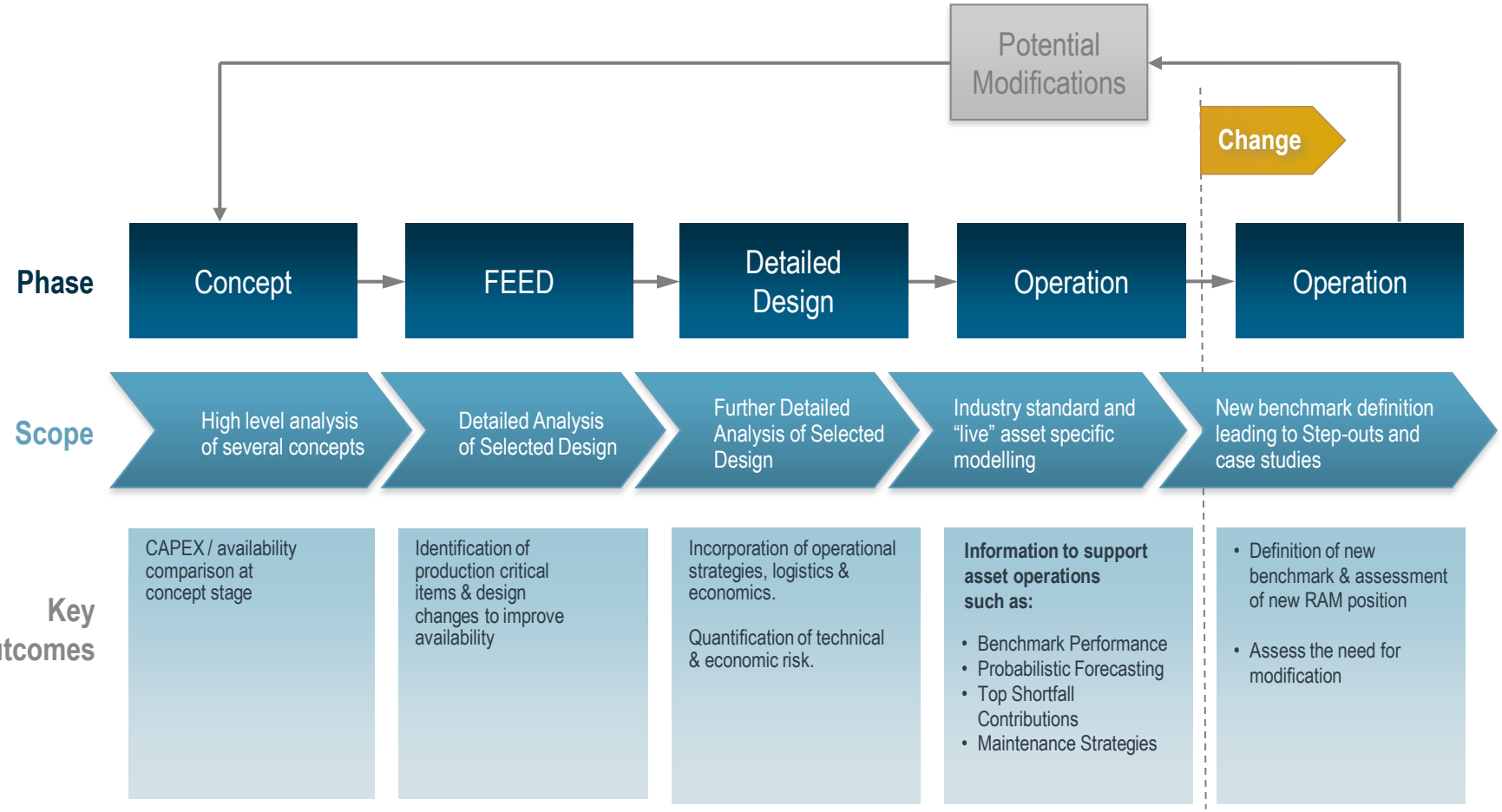
The key reasons for carrying out production optimisation are to:

- 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

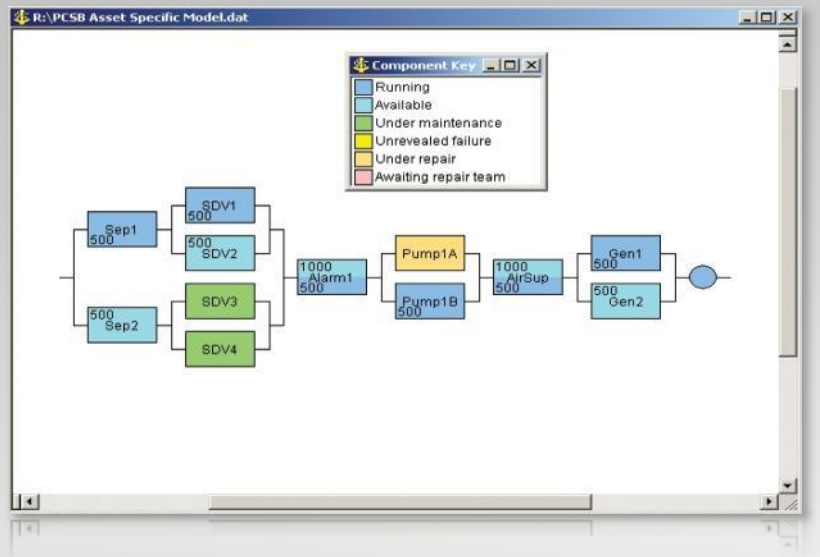


The GL Noble Denton Solution

"Full Life Cycle Applicability"

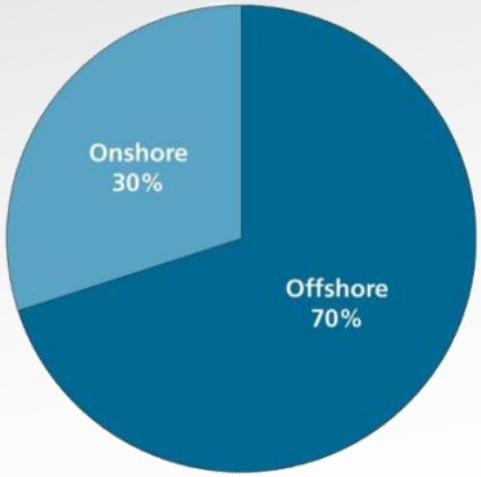


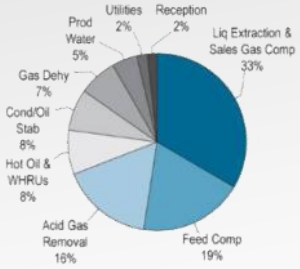
OPTAGON™



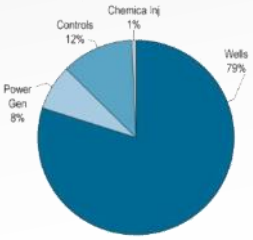
- Developed by GL Noble Denton
- Monte Carlo simulations to enable multiple streams and interactions to be modelled
- Systematic and consistent approach to assessing assets

- Risk based availability approach
- Developed to analyse performance of complex oil, gas & LNG asset chains
  - Optimise performance
  - Maximise profitability
  - Understand an quantify technical and commercial risk





Onshore



Offshore

How does your asset measure up?

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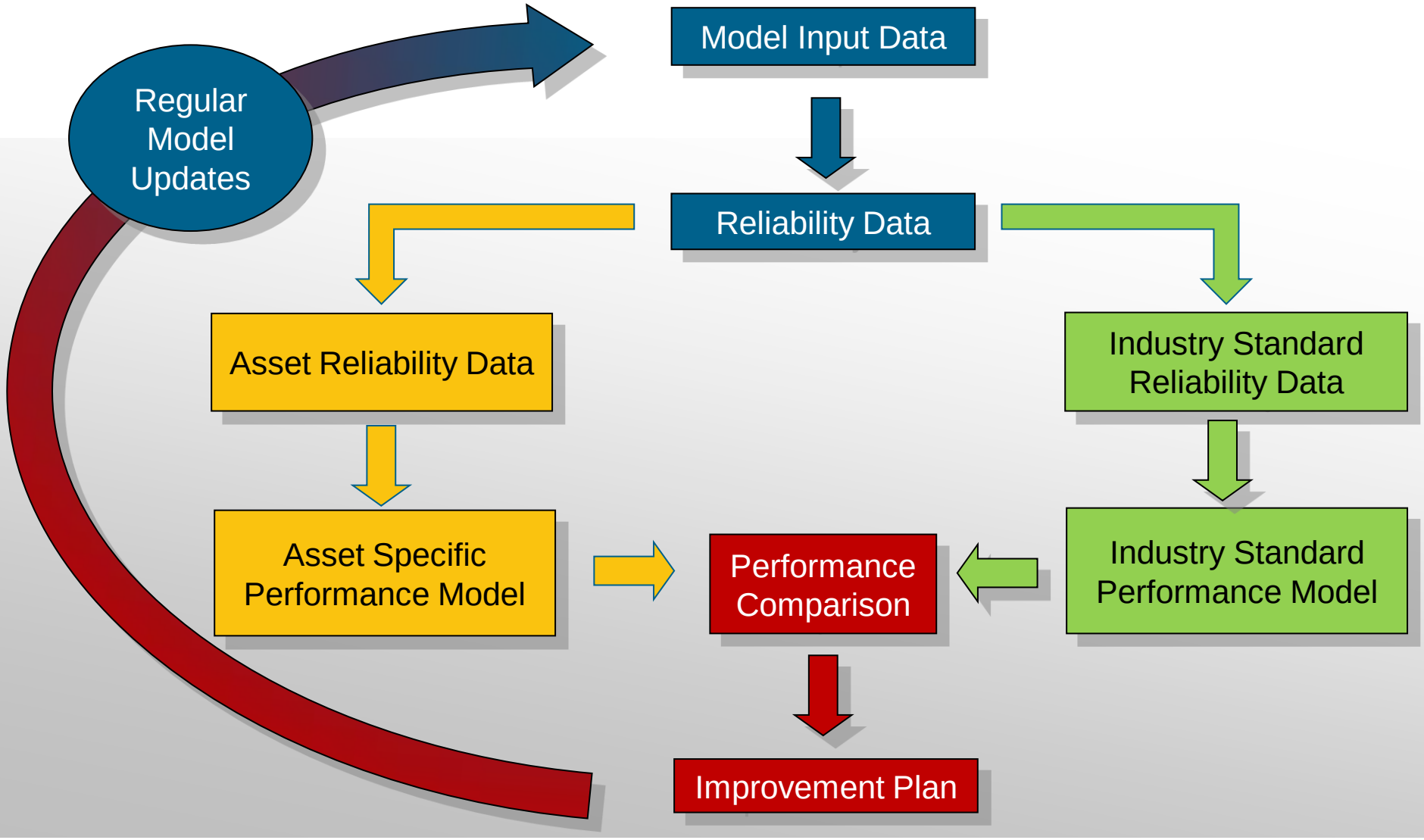
Asset vs. 'Industry Standard' OPTAGON Model



Model Input Data

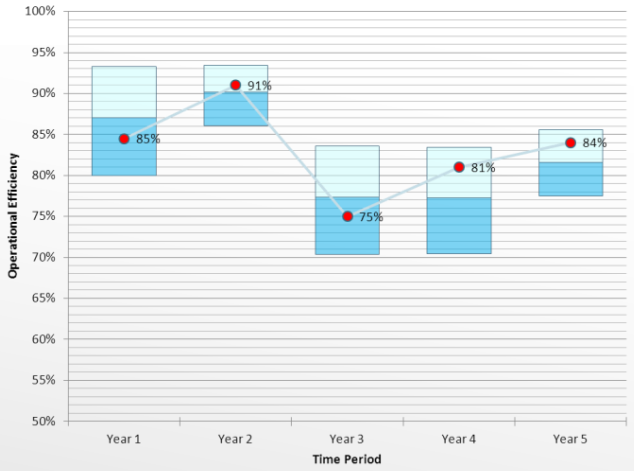
	Information	Source
Asset Data	• Equipment Configuration • Equipment Criticality • System Capacities • Production Targets • Planned Maintenance	• PFDs • FMECA workshop • Heat & Material Balance • Sales Contracts • PM Schedules

Reliability Data	• Mean Time Between Failure
	• Mean Time to Repair
	• Logistic Delays
	• Resource Constraints
		• Asset Specific (Historical)
		  • Production Loss Accounts
		  • Maintenance Logs
		• Industry Standard
		  • OREDA
		  • GL Database

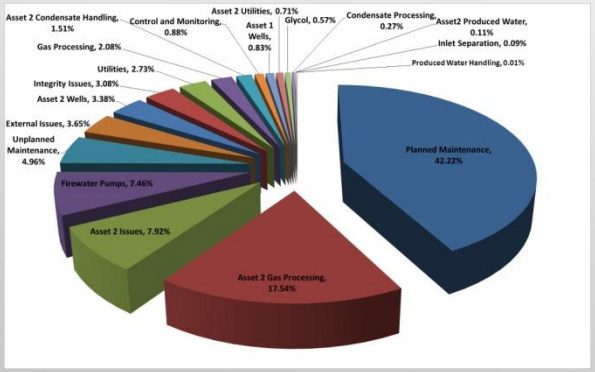
Asset Specific Model

Key Outputs

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



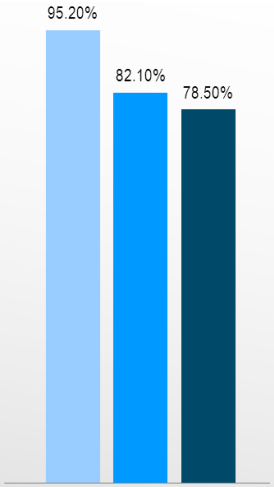
- Production loss contributor analysis
  - Identification and quantification of main loss sources
  - Year-on-year trending of equipment loss contributions

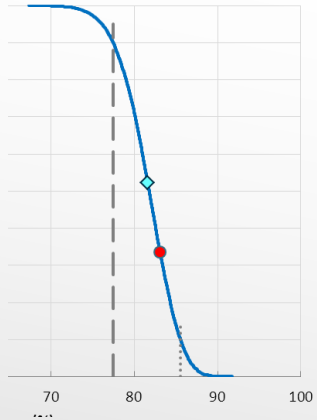


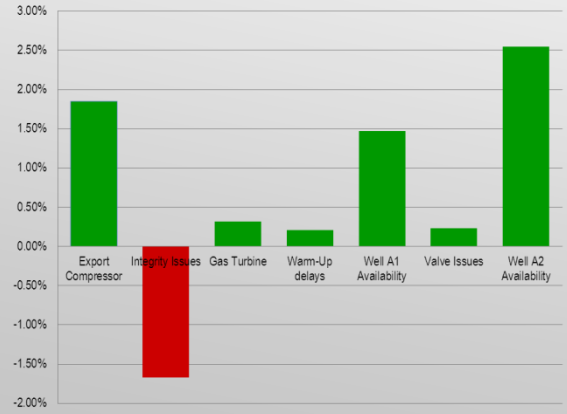
Comparison with Industry Standard Model

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

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An Ageing North Sea Platform

‘Live’ OPTAGON model updates since 2008

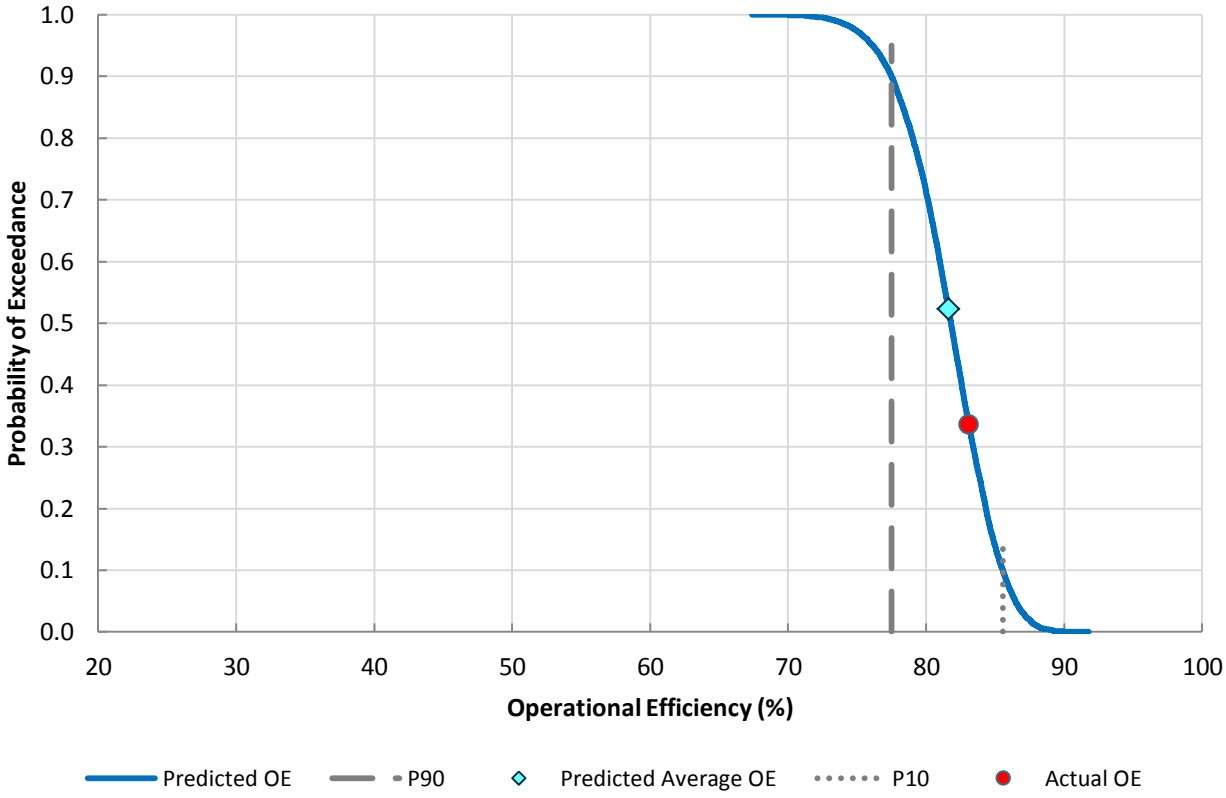
Quarterly updates to the model considered:

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

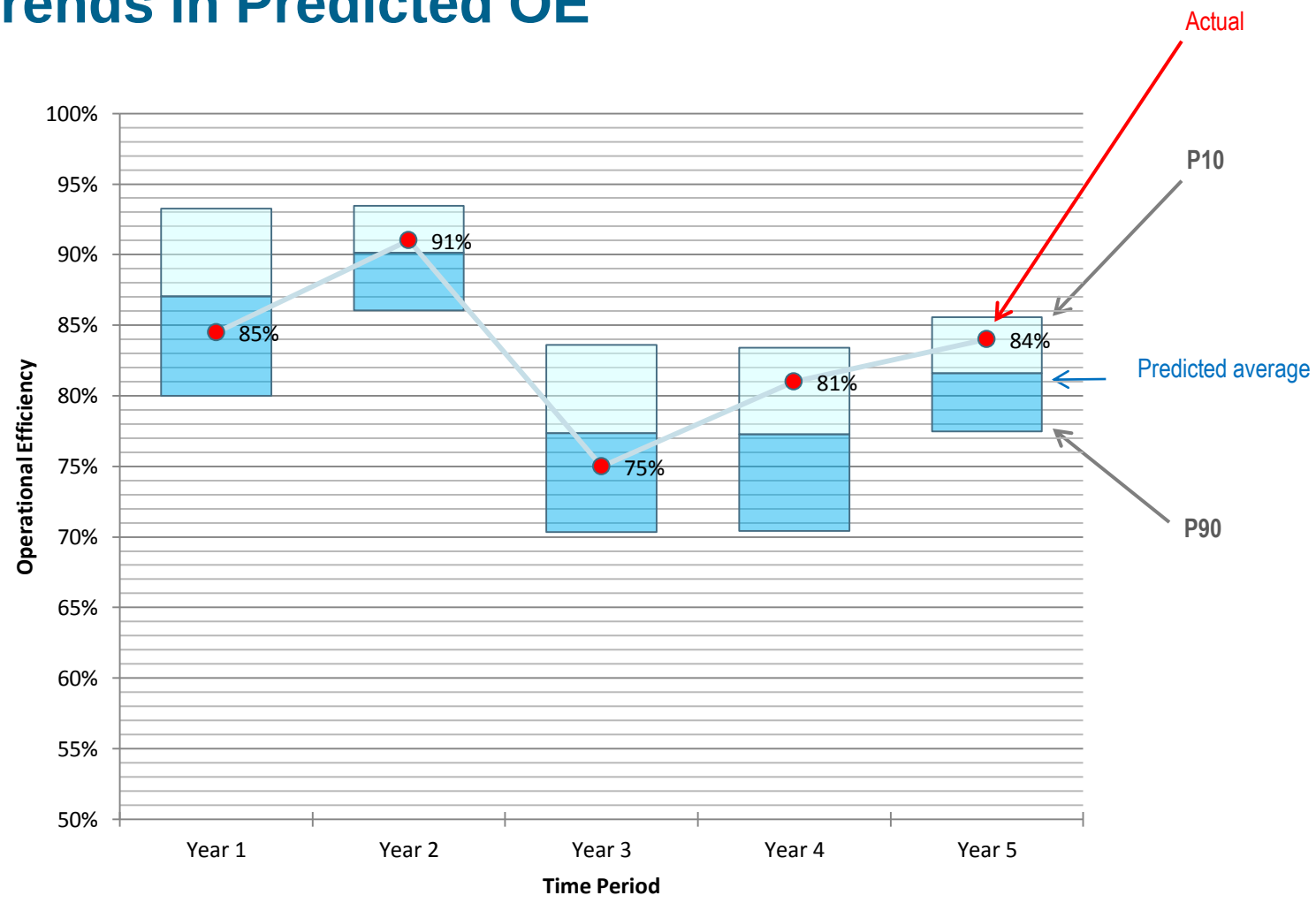
Key outputs from the analysis included:

- Shortfall contributors at equipment and system level
- Comparison of asset performance vs. industry standard
- Identify underperformance of individual equipment items

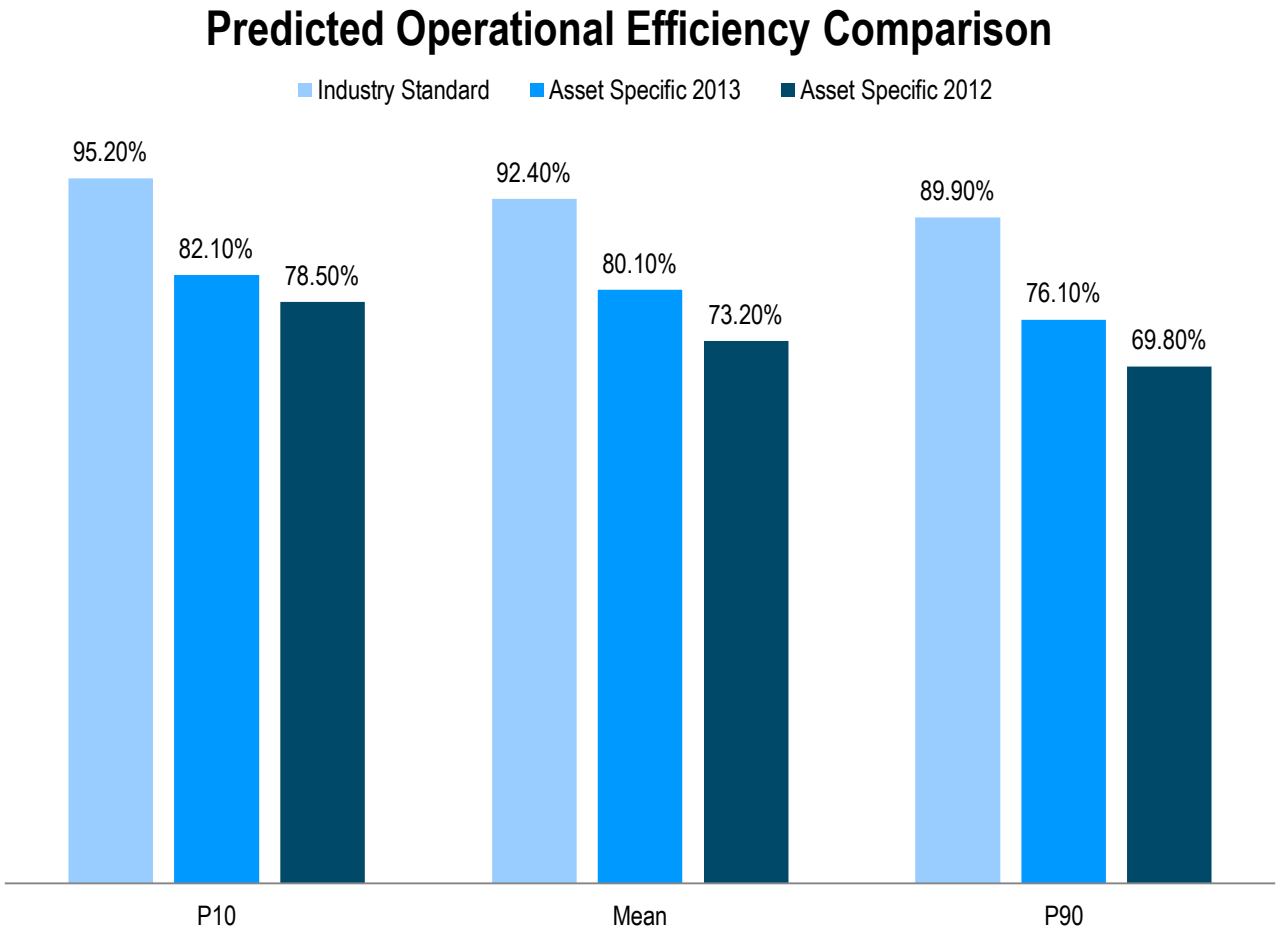
2013 Predicted OE Performance – Exceedance Curve



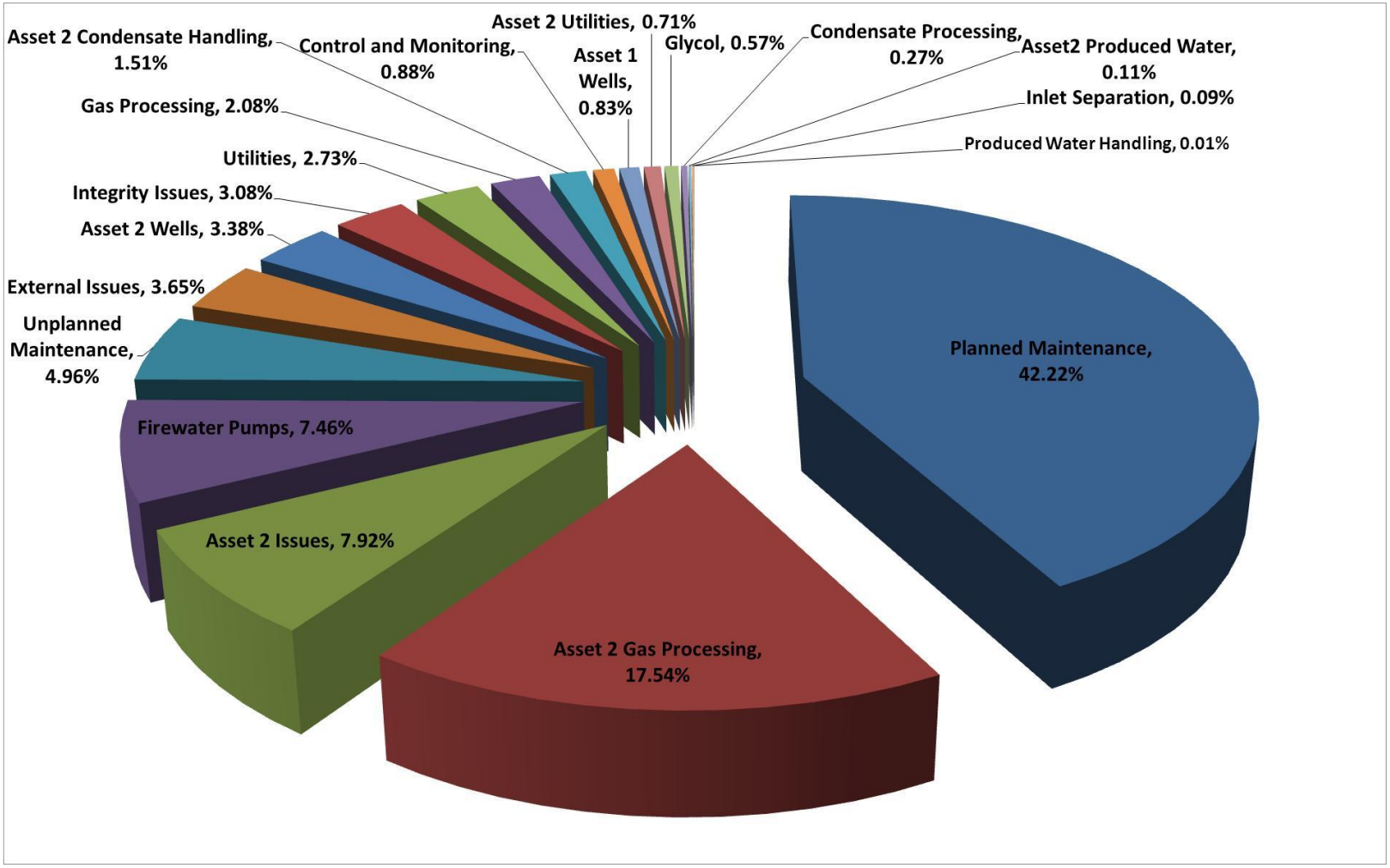
Trends in Predicted OE



2013 Predicted OE Performance – Mean, P10 & P90



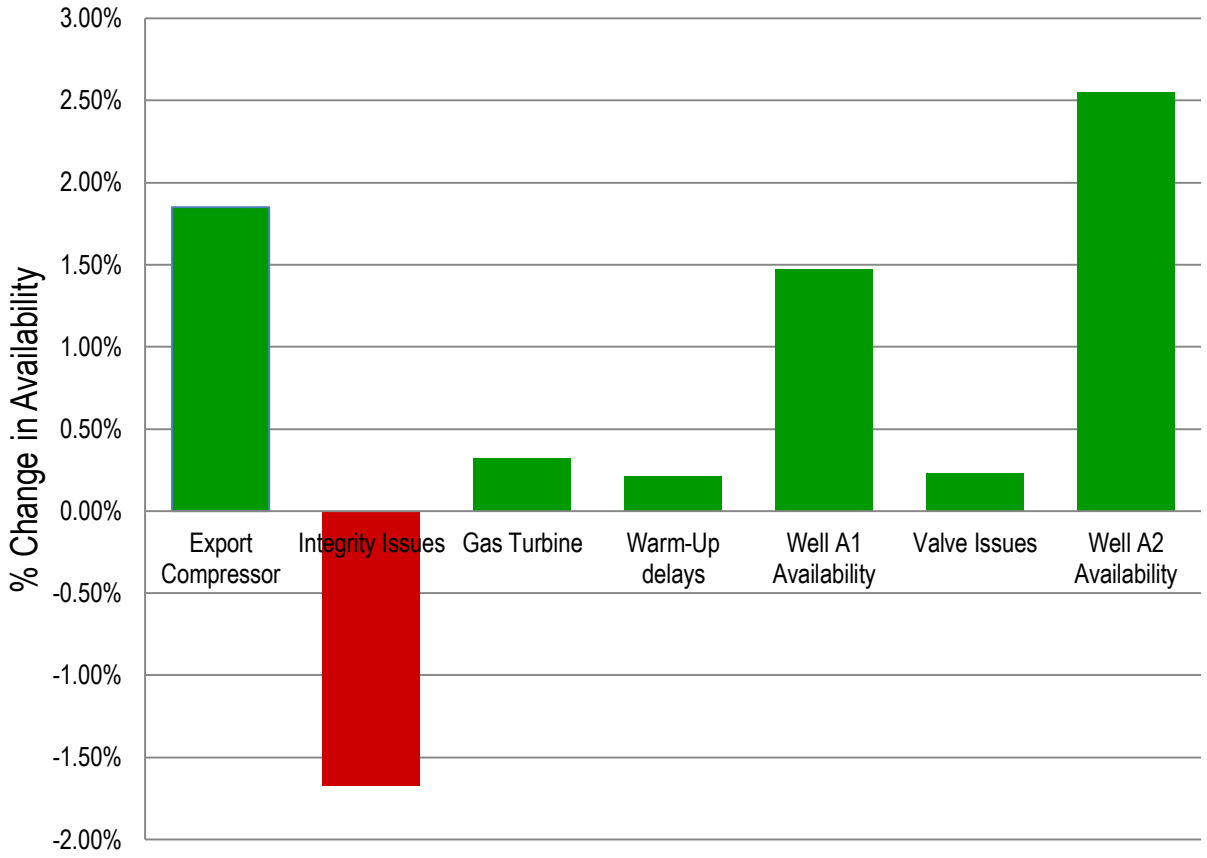
Lost Production Wheel by System



Asset 2 Predicted Main Loss Sources

Component	Asset Specific Model Predicted Loss (MMscf)	Industry Standard Model Predicted Loss (MMscf)	2012 Calculated Availability	2011 Calculated Availability	Change in Availability	Change in overall OE if Working at Industry Standard
Export Compressor	1900	74	84.1%	81.9%	2.2%	7.5%
Integrity Issues	550	N/A	93.2%	95.1%	-1.9%	2.0%
Gas Turbine	390	532	98.0%	97.5%	0.5%	-0.4%
Warm-Up Delays	485	N/A	98.1%	97.7%	0.4%	1.5%
Well A1 Availability	305	N/A	90.0%	88.4%	1.6%	1.1%
Valve Issues	232	N/A	98.8%	98.4%	0.4%	0.8%
Well A2 Availability	195	N/A	89.5%	87.2%	2.3%	0.7%
Condensate Pumps	175	3	98.1%	98.4%	-0.3%	0.6%
Platform Availability	150	N/A	99.1%	98.6%	0.5%	0.5%
Other Restriction	110	N/A	99.5%	99.4%	0.1%	0.5%

Biggest Swings - Changes in Availability



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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