Big Data and Knowledge: Are we doing enough to prevent Major Accident Events?

Mario Alonso, BHGE

IRF/OGUK Safety 30 Conference
The Journey to Digital Value in Oil & Gas

Operator value

Digital maturity

Level 0
Data collection & visualization
Control & Automation

Level 1
Monitoring & diagnostics
Process & Data Maturity

Level 2
Analytics
Informed Operations

Level 3
Optimization & prediction
Production Optimization

Level 4
Predictive Operations
Artificial intelligence

Level 5
Autonomous / De-manned operations

Autonomous Operations

Process & Data Maturity
Informed Operations
Production Optimization
Predictive Operations
Artificial intelligence
Autonomous Operations

Digital maturity
Are we doing enough?

https://hbr.org/2016/04/a-chart-that-shows-which-industries-are-the-most-digital-and-why

Which Industries Are the Most Digital (and Why)?
Harvard Business Review: By Prashant Gandhi, Somesh Khanna, and Sree Ramaswamy

Prevention of Major Events requires digitization of critical assets!!!
A Key Challenge for Oil & Gas: Predicting Equipment failure!

"Needle in a haystack"

Data science

Domain knowledge

Software

Traditional solutions

Critical play zone

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Digital Twins... our Reliable Crystal Ball

A live up-to-date digital representation of an asset, system, or process

Hybrid models

Physics based
- Known Issues (Known Knowns)

Probabilistic
- Uncertainty (Known Unknowns)

Deep learning (AI)
- Unknown Issues (Unknown Unknowns)

- Continuously tuned
- Scalable
- Adaptable
Key Enabling Technologies for Digital Twin

- **Domain Data Capabilities**
  - Automated Data Pre-Processing
  - Inspection Capabilities
  - Digital Thread

- **Physical + Digital Engineering Models**
  - Life & Operational Behavior
  - Matching Algorithm
  - Engine Model
  - Flight Sensor Data
  - Flight Data
  - Estimates
  - Model Management

- **Industrial Analytics**
  - Model Generation & Automation
  - Knowledge Extraction

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Digital Twins: Can we leverage technologies from other industries?

1,183,547 Twins and Increasing!!

Parts Twins
Rotor failure prediction

Product Twins
Steam turbine life optimization

Process Twins
Field engineer scheduling

System Twins
Model based optimizer
Optimization Digital Twin – Locomotive

Track Topology
Locomotive Data

Optimal Speed
and Horse Power

Digital Twin

32,000 Gallons / Locomotive-Year Saved
174,000 Tons Emissions Reduced/Year
Continuous Prediction Digital Twin: Aviation Engine

Environmental Conditions Per Flight Data Prior Condition

Digital Twin
Physics + AI Models

Optimized Inspection Time & Shop Time

Increased Availability to Customer
Saves Tens of $MM in Unnecessary Service Overhauls
# Active Asset Performance Management

**Digitization of Oil & Gas assets facilitates active integrity management, enabling prevention of Major Accident Events!**

<table>
<thead>
<tr>
<th>Reliability Management</th>
<th>Compliance and Integrity Management</th>
<th>Asset Strategy Optimization</th>
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<tr>
<td>Less unplanned downtime by predicting equipment issues before they occur.</td>
<td>Ensure asset integrity and compliance by monitoring changing risk conditions.</td>
<td>Optimize across availability, reliability, risk, and costs through intelligent asset strategies.</td>
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| - Predictive analytics  
- Case and collaboration management  
- Knowledge management  
- Production loss analysis  
- Root cause analysis  
- Reliability analysis | - Hazard analysis  
- Safety lifecycle management  
- Risk based inspection  
- Inspection management  
- Thickness monitoring | - Reliability centered maintenance  
- Failure mode effects analysis  
- Strategy management  
- Strategy library  
- Lifecycle cost analysis  
- Financial and risk simulation |

**Machine and Equipment Health**

Anytime, anywhere, unified view of your assets’ current state, and health.

- Connectivity  
- Data management  
- CMMS integration

- Condition monitoring  
- Data analysis and visualization  
- Criticality analysis

- Event management  
- Recommendation management  
- Benchmarking
Challenges and Opportunities

Key challenges within the Oil & gas industry include:

- Technology adoption rates (typically more evolution than revolution)
- Access to data

Opportunities:

- AI & Analytics are driving the pace... opportunities for a step change
- Digitalization augments value on all fronts (e.g. production optimisation, asset integrity, etc)