WHITE PAPER

The Impact of Reliability Engineering on Sustainable Oilfield Operations

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Abstract

Predictability is crucial in the oil and gas industry because failure to predict, analyse, and correct equipment issues can lead to more than just financial losses. Sustainable operations are a fundamental requirement for any oil and gas facility to align with and meet its objectives, stakeholder expectations, and community requirements. Safety is consistently a top concern for direct and indirect stakeholders involved in oil and gas operations, thus, the reliability of all equipment directly influences the sustainable and safe operations of any facility, affecting profitability and long-term viability.

Oilfield Operations Management

Operations management in the oil and gas industry encompasses all processes in transforming crude oil and natural gas into usable products. The major elements of operations management are:

- Planning and Strategy
- Resource Coordination
- Technology Integration and Asset Integrity Management
- Risk & Environment Management
- Regulatory and Statutory Compliance
- Continuous Improvement

The development of an optimal maintenance plan and strategy is key for achieving sustainable oilfield operations management. This will ensure that all assets in the facility are well maintained, and the risks of failures and downtime are minimized to extend the life of the facility. The end result will be more stable and efficient operations, cost savings, and lower environmental impact.

Reliability Engineering

Reliability engineering is an engineering discipline that defines a complete production regime, focusing on the ability of a product to perform its required functions under specified conditions for a designated period.

Reliability engineering focuses on identifying potential failures, analyzing their root causes, and implementing measures to prevent or mitigate them. It is a scientific system of designing and testing that aims to improve the reliability, durability, and performance of an equipment or system.

The goals of reliability engineering are as follows:

- **Preventing Failure Modes**: Using engineering knowledge and techniques to prevent certain failure modes and reduce the likelihood and frequency of failures.
- **Correcting the Causes of Failures**: Identifying and correcting the causes of failures that occur despite preventive efforts.
- **Managing Failures**: Determining ways to handle failures if their causes have not been corrected.
- **Estimating Reliability**: Applying methods for estimating the likely reliability of new designs and for analyzing reliability data

Common Tasks and Techniques

Depending on how complex the system is and the type of the system we are looking at, various techniques can be applied as part of the reliability engineering efforts:

- Root cause analysis (RCA)
- Reliability centered maintenance (RCM)
- FMEA and FMECA
- Design FMEA and Process FMEA
- Physics of failure (PoF)
- Built-in self-test
- Reliability block analysis
- Field data analysis
- Fault tree analysis
- Eliminating single point of failure (SPOF)
- Human error analysis
- Operational hazard analysis
- Examining maintenance history to analyze failure rates and collect failure data
- Various data collection tests measure system/component performance under stress.

Ways To Improve Reliability

Helping With the Design and Development of Spare Parts for Legacy Equipment

Oil and gas assets require high availability of spares for sustainable operations, and most of the time, maintenance engineers stock spares by considering different operational factors like unplanned shutdowns, lead time for deliveries, and historic data. For legacy equipment, it can be difficult to source spare parts due to the age of the equipment, and this increases the risk of downtime when existing parts require replacement.

Reliability engineers can work closely with the maintenance team and custom part manufacturers to design, test, and produce quality replacement parts that will improve the

reliability of onsite assets with the help of different advanced technologies like reverse engineering, additive manufacturing, etc.

Performing Root Cause Analysis

Identifying and understanding failure causes is one thing that reliability engineers should be very good at. Because of that, they can be tasked with performing root cause analysis (RCA). This can be done by examining OEM manuals, maintenance practices, equipment maintenance logs, desired and existing operational conditions, and other documentation to find reasons why specific machines are failing and suggest how to eliminate and/or mitigate each of the found failure causes. One way to address potential causes is by applying RCM practices.

Conclusion

Implementation of reliability engineering through integration with other emerging technologies like Process Automation, Artificial intelligence, and Additive Manufacturing, brings sustainable results. It helps to reduce the frequency of breakdown of equipment or assets, thus, reducing maintenance costs, production and operations downtime, and Green House Gas Emissions.

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