MUD PUMP DIGITAL TWIN

CANADA - ONSHORE
CASE STUDY

Driving Operational Excellence: The Impact of Digital Twin Technology on Super Single Rigs

PROJECT OVERVIEW

Objective:

- Enhance equipment monitoring and diagnostics for Super Single fleet.

Challenges:

- Operational pressure on components
- Real-time visibility into mud pump health

Technology:

Digital Twin system for real-time monitoring of pump performance and health:

- Early detection critical component issues
- 91% accuracy on our machine learning model
- Reduced operational costs.

THE CHALLENGE

The oil and gas industry is demanding faster and more efficient drilling operations, pushing rigs and components to their operational limits. The primary challenge included the need for improved equipment monitoring across our Super Single fleet, as well as enhanced visibility into the wear and downtime of critical mud pump (MP) components. Given the Super Single's dual-pump configuration, ensuring both pumps' health is essential for maintaining drilling efficiency and meeting operational demands.

The challenge was twofold: to intensively operate equipment without compromising reliability and to implement advanced technology that would provide real-time insights without requiring modifications to existing rig components. This required a solution that could handle the varying operating conditions while offering precise monitoring and diagnostic capabilities to minimize downtime and extend the operational life of key components.

THE SOLUTION

To overcome the challenges of intensified equipment use and limited visibility into critical mud pump components, we implemented a customized Digital Twin system for the Super Single fleet. This advanced technology provided real-time monitoring and diagnostics, allowing early detection of potential issues without requiring modifications to existing rig components. By leveraging insights from the Super Triple fleet and smart alarm systems, the Digital Twin package significantly improved equipment monitoring, preventing costly downtime and ensuring uninterrupted drilling operations. This solution enhanced overall drilling efficiency, reduced operational costs, and set a new industry standard for proactive maintenance and performance management.

PERFORMANCE HIGHLIGHTS

The Digital Twin system became fully operational on our Super Single rig by June 28, 2024, marking a key milestone in improving equipment monitoring. It quickly proved effective by identifying a critical swab failure in Mud Pump 1 well before it could lead to a complete component failure, preventing costly downtime. This early detection allowed for proactive issue resolution, ensuring uninterrupted drilling operations. With 4 billion points of data streaming daily, along with thousands of consumable data points feeding a machine learning model. We are providing more visibility to the field on component life that has never been seen before. Sitting at **91% accuracy** on our machine learning model for component life, crews can plan pump maintenance and sustain uptime on the pumps with greater consistency and efficiency, allowing us to deliver a more consistent product for our customers.

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FIGURE 1

Digital twin dashboard at the time of the failure. **Red** highlights are indication of the increased vibration signatures coming from the damaged swab.

FIGURE 2

Damaged swab that was identified prior to failure by the Digital Twin.

FIGURE 3

Smart alert that prompted, due to alarm state from elevated signatures over 20 min long.

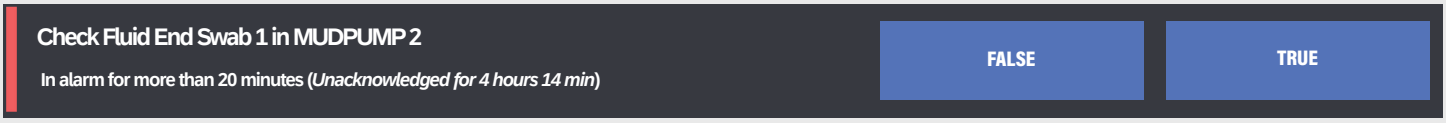
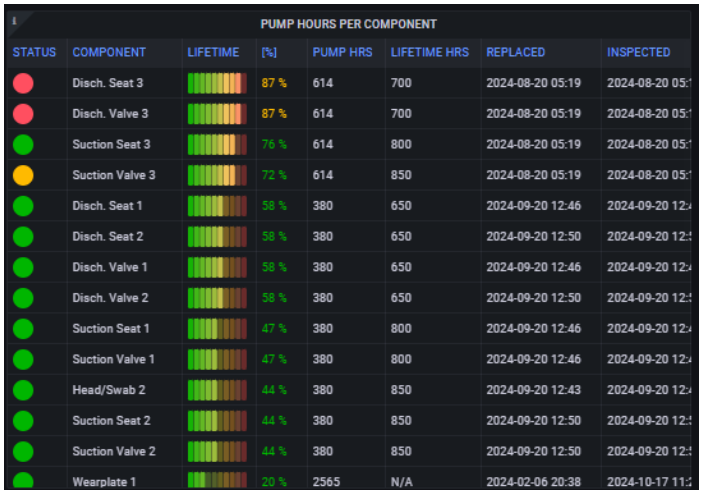


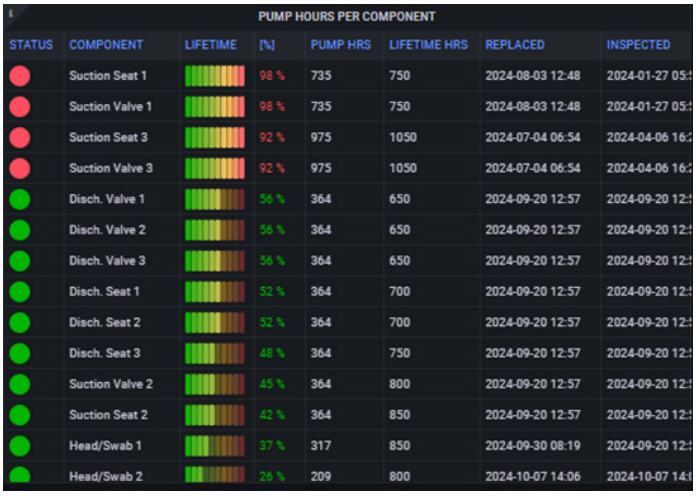
FIGURE 4

Machine Learning Component life Dashboard



PUMP HOURS PER COMPONENT

STATUS	COMPONENT	LIFETIME	[%]	PUMP HRS	LIFETIME HRS	REPLACED	INSPECTED
	Disch. Seat 3		87 %	614	700	2024-08-20 05:19	2024-08-20 05:
	Disch. Valve 3		87 %	614	700	2024-08-20 05:19	2024-08-20 05:
	Suction Seat 3		76 %	614	800	2024-08-20 05:19	2024-08-20 05:
	Suction Valve 3		72 %	614	850	2024-08-20 05:19	2024-08-20 05:
	Disch. Seat 1		58 %	380	650	2024-09-20 12:46	2024-09-20 12:
	Disch. Seat 2		58 %	380	650	2024-09-20 12:50	2024-09-20 12:
	Disch. Valve 1		58 %	380	650	2024-09-20 12:46	2024-09-20 12:
	Disch. Valve 2		58 %	380	650	2024-09-20 12:50	2024-09-20 12:
	Suction Seat 1		47 %	380	800	2024-09-20 12:46	2024-09-20 12:
	Suction Valve 1		47 %	380	800	2024-09-20 12:46	2024-09-20 12:
	Head/Swab 2		44 %	380	850	2024-09-20 12:43	2024-09-20 12:
	Suction Seat 2		44 %	380	850	2024-09-20 12:50	2024-09-20 12:
	Suction Valve 2		44 %	380	850	2024-09-20 12:50	2024-09-20 12:
	Wearplate 1		20 %	2565	N/A	2024-02-06 20:38	2024-10-17 11:



PUMP HOURS PER COMPONENT

STATUS	COMPONENT	LIFETIME	[%]	PUMP HRS	LIFETIME HRS	REPLACED	INSPECTED
	Suction Seat 1		98 %	735	750	2024-08-03 12:48	2024-01-27 05:
	Suction Valve 1		98 %	735	750	2024-08-03 12:48	2024-01-27 05:
	Suction Seat 3		92 %	975	1050	2024-07-04 06:54	2024-04-06 16:
	Suction Valve 3		92 %	975	1050	2024-07-04 06:54	2024-04-06 16:
	Disch. Valve 1		56 %	364	650	2024-09-20 12:57	2024-09-20 12:
	Disch. Valve 2		56 %	364	650	2024-09-20 12:57	2024-09-20 12:
	Disch. Valve 3		56 %	364	650	2024-09-20 12:57	2024-09-20 12:
	Disch. Seat 1		52 %	364	700	2024-09-20 12:57	2024-09-20 12:
	Disch. Seat 2		52 %	364	700	2024-09-20 12:57	2024-09-20 12:
	Disch. Seat 3		48 %	364	750	2024-09-20 12:57	2024-09-20 12:
	Suction Valve 2		45 %	364	800	2024-09-20 12:57	2024-09-20 12:
	Suction Seat 2		42 %	364	850	2024-09-20 12:57	2024-09-20 12:
	Head/Swab 1		37 %	317	850	2024-09-30 08:19	2024-09-20 12:
	Head/Swab 2		26 %	209	800	2024-10-07 14:06	2024-10-07 14:

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