HUB TECH IA

AI and IAGEN Application Use Case

Optimization of Equipment Maintenance in Vaca Muerta through Machine Learning

Executive Summary – Application of AI for Predictive Equipment Maintenance in Vaca Muerta.

This executive summary presents a strategic application of artificial intelligence (AI) in the energy sector, specifically in maintenance optimization of teams in the Vaca Muerta formation. This is a relevant opportunity for Improve operational efficiency, reduce downtime and extend service life of critical assets in one of the world's largest unconventional reserves.

Use case classification

The report classifies this application of AI based on four axes:

1. By main resource: oil and gas.
2. By activity: optimization of production processes.
3. By technology: machine learning algorithms (supervised, unsupervised, reinforcement), data integration platforms and big data, and systems based on intelligent agents.
4. By strategic impact: optimization of production and infrastructure.

1. Opportunities for using AI and IAGEN in the sector

AI offers a robust framework to transform maintenance management in the oil and gas industry. Specific opportunities include:
Early detection of failures in critical equipment (frac pumps, drills, compressors), prediction of the time remaining before a failure, proactive scheduling of interventions, and integration with IoT sensors for
real-time monitoring. These tools allow you to anticipate events that

Traditional methods fail to predict, adapting to variable conditions
operation.

2. Expected benefits

The implementation of AI-based predictive maintenance enables:

- Minimize unplanned downtime through alerts
  early.
- Extend the useful life of equipment through timely interventions.
- Increase operational safety by avoiding catastrophic failures.
- Optimize resource allocation by reducing maintenance
  unnecessary.
- Automate complex or dangerous tasks, reducing exposure to
  staff.
- Reduce dependence on expert knowledge, facilitating scalability.

3. Application of AI

The proposed approach integrates machine learning models trained with data
historical and real-time data to analyze operating conditions. Techniques are used
of regression, classification, anomaly detection and time series for
diagnose and predict faults. The system is powered by data collected by IoT sensors
(vibration, pressure, temperature, etc.) and continuously evolves thanks to a feedback
system, adapting to new operating conditions.
operation.

4. Proposed AI Agent

The report proposes the implementation of an intelligent agent composed of
four interconnected modules that operate autonomously in the environment
Vaca Muerte industrial park. First, the IoT sensors installed in the equipment
Such as fracturing pumps, drills, and compressors collect critical variables such as
temperature, pressure, vibration, and flow rate in real time. This data
are processed by machine learning models, capable of detecting
anomalous patterns and predict specific failures in advance, such as
fatigue cracking, valve failure or bearing wear.

Once a risk is detected, the system issues automatic alerts to the maintenance teams, indicating the affected component and the intervention recommended. In addition, it incorporates a feedback mechanism that adjusts the predictive models based on the results obtained after each repair or intervention. This agentic flow allows for dynamic, precise, and scalable management maintenance, reducing dependence on human diagnostics and optimizing the operational availability of critical assets.

5. Conclusion

The adoption of AI-based predictive maintenance solutions represents a key transformation for the energy industry in Vaca Muerta. This Technology allows us to move from reactive approaches to proactive strategies, based on data and automated decisions. Their implementation favors a more efficient, safe and profitable operation, consolidating the role of Vaca Muerta as a strategic axis in the country's energy security and economic development.