CASE STUDY | Global Energy Operator

C3.ai

AI-Driven Operational Efficiency for Energy Leader

A multinational, vertically integrated energy operator was motivated to shift to a risk-based approach for its offshore platforms. While the operator has developed an effective monitoring methodology with a central surveillance team and a wide set of tools, they saw an opportunity for increased operational and production efficiency with AI.

While the existing monitoring approach was effective, it was time-intensive and inefficient due to siloed systems. The central surveillance team used multiple systems to monitor asset health, including data dashboards, sensor analyses, maintenance logs, and case management systems. Similarly, when on-site engineers received an alert from the central surveillance team, they had to navigate different systems to understand alerts and related sensors and evaluate individual sensor trends. Moreover, the existing systems flooded central surveillance with false alerts, compounding the time and effort required for risk identification and triage.

As the global energy operator expanded this monitoring approach, they recognized the need for a more holistic and risk-based approach that provides them with an accurate view of process system risk, enabling them to do the right maintenance at the right time, and allocate precious engineering resources to the highest-risk systems and other high-value activities.

Additionally, in anticipation of forthcoming government regulations on carbon emissions taxation, the company sought a digital solution to decrease power and fuel consumption, lower carbon emissions, adhere to regulatory requirements, and improve operational efficiency.

In 2022, the energy operator chose to partner with C3 AI to implement both the C3 AI Reliability and C3 AI Process Optimization applications to drive operational efficiency for one of its offshore platforms with advanced AI. The operator evaluated tools from different providers, and C3 AI was selected because of its ability to rapidly deploy and scale AI-enabled applications, and its domain expertise in the energy sector.

The initial deployment was focused on two turbine-driven gas compression trains. In 16 weeks, the C3 AI team successfully unified and integrated 3 years of historical data and live data, and developed 20 ML models in C3 AI Reliability to deliver near-real-time interpretable and predictive alerts for asset anomalies. As well, the team configured an advanced optimizer in C3 AI Process Optimization to drive enhanced fuel efficiency for the company.

With C3 AI Reliability, the global energy operator reduced alert noise by 99% (from ~3,600 annual alerts to 34) and alert triage time by 90% (from 10 hours to 1 hour). With the time and effort saved by C3 AI Reliability, the on-site team can focus on higher-value initiatives such as fuel gas optimization. With C3 AI Process Optimization, the company could save up to $4.7 million in annual carbon tax for just one platform.

Project Objectives

- Integrate and unify data from disparate data sources (e.g., sensor data, work orders, vibrational data)
- Apply machine learning algorithms to predict asset health in near real-time, and generate interpretable alerts to allocate precious engineering resources
- Leverage AI and machine learning technology to optimize production processes, driving energy efficiency of platform equipment

Results

99%
Reduction in alert noise

90%
Reduction in alert investigative time

$4.7M
Estimated annual carbon tax saving for one platform

Challenges

Over the past few years, the energy operator had embarked on a journey of digital transformation, striving to harness the power of several digital solutions to drive innovation and efficiency across its operations. As part of this transformation, the operator developed a time and routine-based strategy to maintain its offshore platforms. Despite the effectiveness of the current approach in detecting most issues, scaling it out to meet the demands of the operator's expanding operations has presented several challenges.

Data Siloes in Distributed Systems

The machinery teams responsible for the asset health of offshore platform equipment used multiple systems to monitor asset health. The team navigated between data dashboards, sensor analysis, maintenance logs, and case management systems. As each system stores different sets of data, when a machinery engineer received an alert from the central surveillance team, he would have to spend significant time and effort piecing together data from various systems to create a maintenance plan.

High Volume of False Alerts

The existing systems flooded central surveillance and platform machinery teams with false alerts every year. The central surveillance team received a staggering 3,600 distinct alerts in a year (on average 10 alerts per day), 360 of which were passed onto the machinery engineer for further investigation. The machinery engineer would then spend upwards of 10 hours going through the investigating process for each alert. The alerts severely limited the capacity of both teams to work on higher-value activities.

Lack of Feedback Loop

Furthermore, the manual process of gathering and piecing together data from multiple systems lacked a feedback loop, making it a challenge to drive continuous improvement. The system was unable to learn from its past alerts and field feedback and adjust to improve the accuracy of future alerts. These limitations led to potential over-maintenance of equipment, which was not only costly but also high-risk.

Regulatory Compliance and Operational Efficiency

In addition, with governmental authorities in the region prepared to implement a carbon emissions tax of $50 per ton in 2022, with the potential to increase to $170 by 2030, the company wanted to minimize power consumption, fuel consumption, and emissions to meet regulatory requirements while improving operational efficiency.

As a result, the energy operator sought a comprehensive, scalable AI solution that could do the following:

1. Leverage large amounts of data from disparate sources and systems.
2. Provide predictive and configurable alerting mechanisms to drive and allocate precious engineering resources.
3. Provide actionable insights to optimize energy efficiency, minimizing power usage by the compressors on the trains, without compromising performance.

About the Global Energy Operator

- Multinational oil and gas corporation
- $200+ billion annual revenue
- 20+ manufacturing sites globally

Project Highlights

- 16 weeks from kickoff to pre-production
- 2 enterprise applications
- 3 years, 100M+ rows of historical data
- Live data integrated in 3 weeks, with >1.2B rows ingested to date
- C3 AI Reliability – 20 ML models developed to detect equipment failure and anomalies
- C3 AI Process Optimization – 10 iterations of an advanced optimizer

Approach

Over the course of 16 weeks, the C3 AI team collaborated closely with subject matter experts from the energy operator, including the machinery lead, R&D lead, and maintenance lead, to configure the C3 AI Reliability and Process Optimization applications to meet the operator's specific challenges and needs. The applications would provide advanced predictive and prescriptive insights into asset maintenance and minimization of power consumption required for the two turbine-driven gas compression trains, driving significant improvements in operational efficiency and cost-effectiveness for theenergy operator.

Overcoming Data Siloes

The C3 AI team unified over 100 million rows of historical operational data for more than 800 tags on compression trains spanning over two years. The data, alongside process and instrumentation diagrams (P&IDs), were automatically integrated into the C3 AI platform and mapped to the C3 AI Reliability asset data model, where users can visualize the relationships and hierarchy of the asset. Additionally, C3 AI ingested 3 years of historical work orders from the energy operator and modified these to be editable and integrated with SAP, demonstrating the capability of C3 AI to act as a unifying data layer for end-to-end surveillance.

Move From Historical to Live Data

In close partnership with the IT and data engineers from the energy operator, C3 AI further configured and implemented a live data connection to operator's data cloud, allowing for seamless ingestion of operational timeseries data for all relevant tags at a 30-minute interval. Ordinarily, this integration would require several months to complete and productionize; however, thanks to the robust and flexible C3 AI Platform that underpins C3 AI applications, the process was streamlined and efficient, with the initial connection configured in 3 weeks. This unified data was laying the groundwork for end-to-end maintenance management and process optimization workflow using both C3 AI Reliability and C3 AI Process Optimization applications.

C3 AI Reliability: Rich and Interpretable Alerts

Through the C3 AI platform, all timeseries data were automatically normalized, treated, and processed for machine learning analytics. In 14 weeks, the C3 AI team configured 20 semi-supervised machine learning models to detect equipment failure and anomalies on the most critical equipment of the compression trains, with an additional 150+ threshold-based alarms for monitoring anomalies on auxiliary equipment, such as dry gas seals, lube oil systems, and air inlet systems. These models were able to identify 24 significant events in the 2-year historical dataset, which were validated by the asset team as a comprehensive set of events worth detecting. Significantly, three of these events were not detected by the company's existing approach, underscoring the value and effectiveness of C3 AI Reliability.

These events were identified via 34 rich and interpretable alerts, a 99% reduction in alert noise from an estimated 3,600 alerts that central surveillance engineers contend with annually, and a 95% reduction from the 360 alerts that are distilled down to the on-site engineering teams for evaluation. In addition, by unifying monitoring systems and data in one place, C3 AI estimated a reduction in alert triaging time from 10 hours to 1 hour, enabling the customer to reallocate precious engineering resources to higher-value activities.

Actionable Recommendations for Fuel Gas Minimization

The considerable time savings generated by the C3 Reliability application enable the energy operator to focus on new opportunities for equipment improvement and optimization. One such opportunity is fuel gas minimization with insights provided by the C3 AI Process Optimization application.

The C3 AI team configured an advanced optimizer in C3 AI Process Optimization that incorporated 25+ system variables and 50+ operating constraints to recommend ideal equipment setpoints for the compression trains that maintain compression while minimizing power input. In turn, this minimized the fuel gas input to the turbines and the overall emissions of the asset.

Within 12 weeks, C3 AI team configured 11 iterations of this optimizer, each with increasing complexity, more variables and constraints, such as compressor inlet pressures and separator gas flow. The final iteration, tested on the 10 most recent months of historical data, recommends hourly fuel gas savings of up to 29.1%. Extrapolated annually and translated to carbon tax savings, these recommendations can generate up to $4.7 million in annual savings for a single platform asset alone, with projections of up to $16.2 million per year by 2030 based on proposed carbon tax rates. The optimizer was generating setpoint recommendations every hour on live data, which were actively reviewed with the energy operator to drive continued improvements in operational efficiency and sustainability.

In 16 weeks, C3 AI helped the energy operator enable a proactive, risk-based asset maintenance strategy to free up engineering resources and drive operational optimization of its offshore platforms.

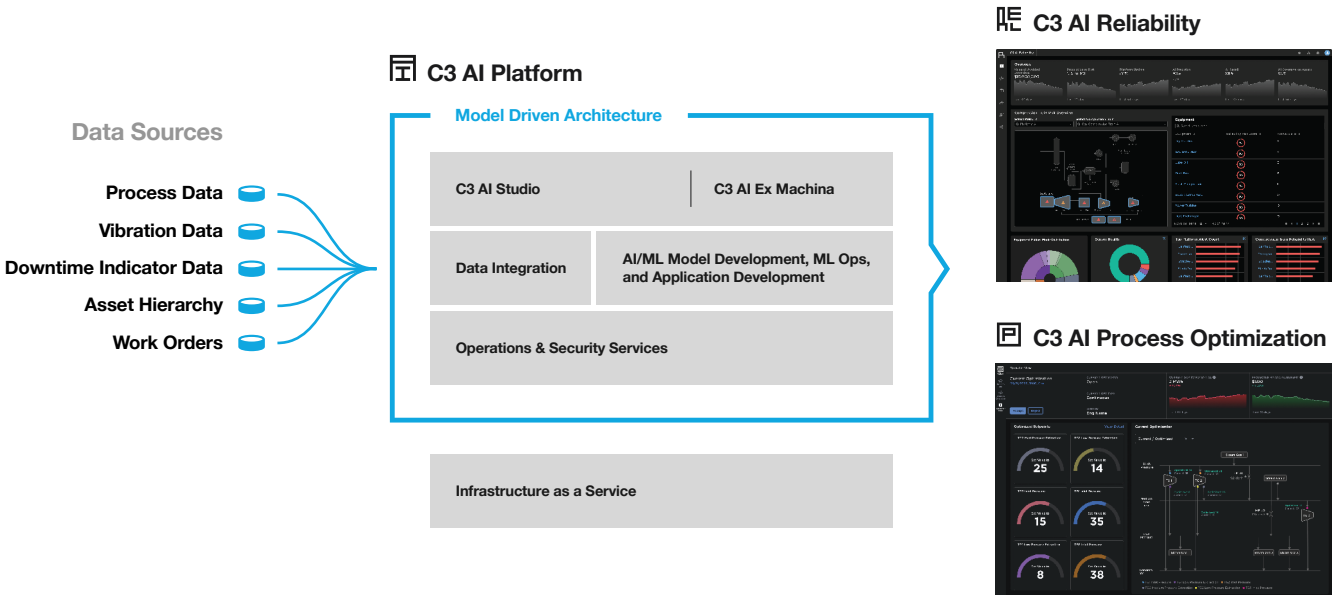
Initial Results

The successful collaboration between C3 AI and the energy operator was characterized by a continuous feedback loop. The C3 AI team made a concerted effort to maintain open lines of communication with the energy operator, visiting the customer 3 times throughout 16 weeks, including a kick-off meeting, a mid-project check-in, and a final pilot read-out. Additionally, the subject matter expert review process was employed, with the C3 AI team sending results for validation before promoting models live to production.

This collaborative approach fostered an environment of mutual trust and transparency, enabling both teams to work together effectively towards a common goal. As a result, the C3 AI team was able to deliver impressive results that drove significant improvements in operational efficiency and sustainability for the energy operator including:

- 99% reduction of central surveillance alerts
- 90% reduction in investigative time per alert
- $6.5M estimated annual carbon tax saving per year
- $22.2 Million estimated annual carbon tax saving per year by 2030
- Integrate large amount of data from disparate data sources into a single virtualized data layer that can be leveraged for various AI use cases
- Utilize advanced ML techniques to enable holistic monitoring of high-value assets and prioritized AI-driven insights

Solution Architecture



Looking Ahead

Looking ahead, the initial success of the C3 AI Reliability and C3 AI Process Optimization deployments presents a unique opportunity for the energy operator to leverage AI-based equipment surveillance and optimization across all its assets. Establishing a long-term partnership, the global energy operator continues to expand the scale of its initial deployment of C3 AI applications and plans to leverage the C3 AI Platform for additional AI use cases. By continuing to develop and refine the AI technology, the energy operator can increase efficiency, increase sustainability, and reduce downtime across its operations.

Proven Results in 8-12 Weeks | **Visit c3.ai/get-started**