Agora

Application Atlas

Edge AI and IoT Solutions

Our Mission

At Agora, we have embarked on a mission to digitize field operations by deploying edge AI solutions to improve productivity and sustainability

The oil and gas industry has been a driving force for the growth of humankind over several decades but immense pressure on gaining efficiency and operating at low cost has forced the industry to use digital technologies to transform itself.

To improve productivity and sustainability in oil and gas, the emergence of edge AI and Industrial Internet of Things (IIoT) technology are defining the next wave of digital transformation. With these innovative new technologies, we can gather more data types, in addition to the sensor-generated information (i.e. video, images, audio), to derive intelligence from a variety of data, while also enabling the ability to act in real time.

At Agora, we created an intelligent computing layer around legacy equipment on the operational site itself using AI, data, and domain science. By utilizing these distributed intelligent oilfield sites, we are addressing challenges associated with IIoT and centralized computing systems in the cloud. In another words, we are converting oilfield equipment into intelligent things. These intelligent things—which could be a pump, a compressor, or production system; are connected to a cloud services for orchestration—thus providing a true Internet of Intelligent Things (IoIT).

We believe that, Internet of Intelligent Things also synonymous with Intelligent Asset Solution or Artificial Intelligence of Things, will drive the much-needed productivity gains and will reduce the greenhouse gases emissions and footprints in field operations.

DYNAMIC INTELLIGENCE AT THE EDGE

Safety & Sustainability

Agora deploys edge and cloud solutions to enable remote operations, increase wellsite safety, and reduce carbon footprint.

DigiVision

Agora

Enable real-time vision with an Internet of Eyes approach

DigiVision is a range of solutions under the Internet of Eyes portfolio of services. DigiVision enables real-time vision of disconnected, aging and remote infrastructure. By connecting the Agora Edge gateway to an edge-empowered camera, real time monitoring of analog gauges is made possible thereby completely eliminating any human surveillance.

The DigiVision solution is based on a six step Internet of Eyes workflow that is based on deploying a computer vison (CV) algorithm on the AgoraGateway. The workflow is iterative and the algorithm is updated remotely Over the Air (OTA) as new information is added.

Internet of Eyes workflow

The workflow starts by identifying key elements of the deployment and a set of rules to generate exceptions are created. An initial configuration for deployment is created and the appropriate CV algorithm is selected. The model is then deployed on the AgoraGateway as a containerized application. Once deployed, the algorithm is tested by reconciling alerts with actual data captured by the camera. Once the appropriate confidence level is achieved, exceptions and alert rules are finalized.

Agora Platform

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Challenges

- High HSE risk due to manual data collection
- Infrequent data not allowing for equipment optimization
- Aging facility in a depleting field limiting customer ability to spend capex

Edge Solution

- Camera supporting ONVIF protocol is connected to the AgoraGateway
- The DigiVision application is deployed for real- time inferencing

Benefits

- 92% fewer manual tasks
- 16% reduction in flaring due to equipment optimization
- 76% reduction in NPT due to availability of real time data.

Case study: Visual Analytics

Location: Offshore Asia

Agora

Remote Visual Analytics Reduces HSE Exposure and Improves Production Surveillance and Optimization

Digitizing analog gauges for continuous remote visualization of aging assets enables data-driven decision making

An operator combined cameras with machine learning enabled by the AgoraGateway to significantly reduce HSE exposure and opex.

The operator's goal

An operator wanted to reduce HSE exposure of technicians who travel to a remote rig for manual data acquisition of analog gauges. There wasn't a distributed control system on the rig, resulting in inefficient process surveillance for immediate intervention and optimization.

Because of the manual process to collect the gauge data, there was a lack of continuous processing of the variable data, so troubleshooting and optimization were limited.

What Agora provided

Agora deployed cameras, connected to the AgoraGateway, to enable real-time visualization of analog gauge data on the rig. The cameras were positioned facing the multiple analog gauges to enable reading the production on the rig. Agora then applied a machine learning algorithm to digitize the analog gauge information into a real-time dashboard to process the continuous stream of variable data.

What was achieved

The solution delivered a remote interface that immediately improved production surveillance. The continuous processing of high-frequency data enabled new optimization workflows with fewer trips to the remote rigs for surveillance. This greatly reduced HSE exposure while lowering opex.

A camera is positioned facing the analog gauge, providing a continuous feed to the AgoraGateway running a machine learning algorithm to digitize the data in real time.

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Automated Flare Stack Monitoring

For Environmental Compliance, Improved Safety, and Reduced Maintenance Costs

In Partnership with:

Flare stacks are commonly used in many industries to safely burn off harmful waste gases and byproducts as operators manage plant safety and efficiencies. Oil and gas refineries and drilling operations are the most common, but chemical processing, gas distribution and waste disposal companies are also users of flare stacks. All of these industries have the challenge of minimizing harmful emissions, complying with regulations and managing the high cost of manual monitoring and maintenance.

FogHorn Lightning™ Edge Flare Monitoring Solution

FogHorn Lightning Flare Monitoring Solution was developed after years of experience working with some of the largest oil and gas producers. The solution processes live video streams of flares in various conditions (day/night or clear/cloudy skies) to provide real-time insights. Metrics include the size of the flare, smoke to flare ratio, and flare angle, empowering operators to make real-time decisions. More sophisticated metrics related to gas volume, chemical composition and business impact will be coming soon.

The Flare Monitoring solution contains pre-trained deep learning algorithms developed exclusively for flares. These algorithms can be further customized and refined for each deployment site using a simple graphical user interface.

While new insights are gained by analyzing live video, FogHorn's Flare Monitoring solution, enadbled by the Agora edge IoT platform, takes that a step further with sensor fusion technology. FogHorn can process multiple video stream with audio and vibration data at the edge using the AgoraGateway. This holistic view of edge operations makes previously unseen nuances of operations visible and can be used to continuously identify issues, such as compressor health or indicate potential environmental violations.

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Challenges

- Manual monitoring of a large number of flare stacks
- Limited communications and compute resources
- Ensure compliance with environmental and regulatory agencies
- Reduce large spend on maintenance and compliance

Edge Solution

- FogHorn Lightning™ Edge installed on Agora edge IoT platform
- Real-time audio and video analysis of flare feeds
- Convolutional neural network (CNN) for deep learning
- Easy-to-use GUI for model re-training and customization

Benefits

- Replace human monitoring with automation
- Lower open and maintenance costs
- Broad compliance monitoring capabilities
- Improved safety

Pipeline Monitoring

Agora

Leak detection and integrity management system for liquid and gas pipelines

In Partnership with:

Rheidiant

Detecting loss of integrity in real-time is essential in safe operations of hazardous pipelines across the operator's network. The need to implement smart pipeline monitoring system to identify small, undetectable leaks on existing aging assets has become imperative now as the safety of pipelines is of paramount importance in ensuring continued operation and profitability. Prevention of leaks before they turn into large environmental spills may save operators from incurring regulatory consequences along with huge reputation and monetary losses. While the operational goal of every leak detection systems are similar, only external systems using IoT sensors, edge analytics and cloud computing technologies can be effectively used to detect even the smallest leaks in remote areas at low operative cost.

Rhediant's Smart Sign Sensor™ and SecureWave IIOT™

The system is deployed in the field without requiring excavation or direct contact with the pipe. Rhediant's integrated solutions includes Smart Sign Sensors are deployed below ground to acquire acoustic output from pipeline. These sensors embed universal wireless nodes that communicates with our Agora Gateways with up to 15 miles of uplink and downlink range, enabling real-time monitoring of liquid and/or gas pipelines with a straightforward implementation. Upon aggregation, data is available for analysis at the Agora Gateway, using Rhediant's SecureWave IIOT that enables anomaly and leak detection, trend visualization and real-time corrective actions.

As a result, Rhediant solution powered by Agora can detect a wide range of leaks. The difference in time of arrival of acoustic waves on multiple sensor allows for leak localization at the edge, triggering the appropriate and customizable alarm systems. With synchronized capture on two sensors, the location of the leak can be captured within +/-5 feet. Thus upon detection, corrective action can often be taken without secondary surveying.

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Challenges

- Traditional internal monitoring solutions require extensive capex/opex expenditure and only detect large leaks
- Even a small pinhole leak can, in time, turn into a dangerous and costly rupture
- Large pipelines need to be monitored on a real-time basis

Edge Solution

- Easily deployable non-contact sensors on new and existing pipelines
- System sensitive to leaks too small for internal leak detection systems
- Turnkey monitoring-as-a-service
- System operates independently if desired, isolated from SCADA systems

Benefits

- Leaks with wide range of sizes are successfully detected
- Location of the leak can be captured within +/-5 feet
- Increase production and revenue while ensuring environmental and regulatory compliance

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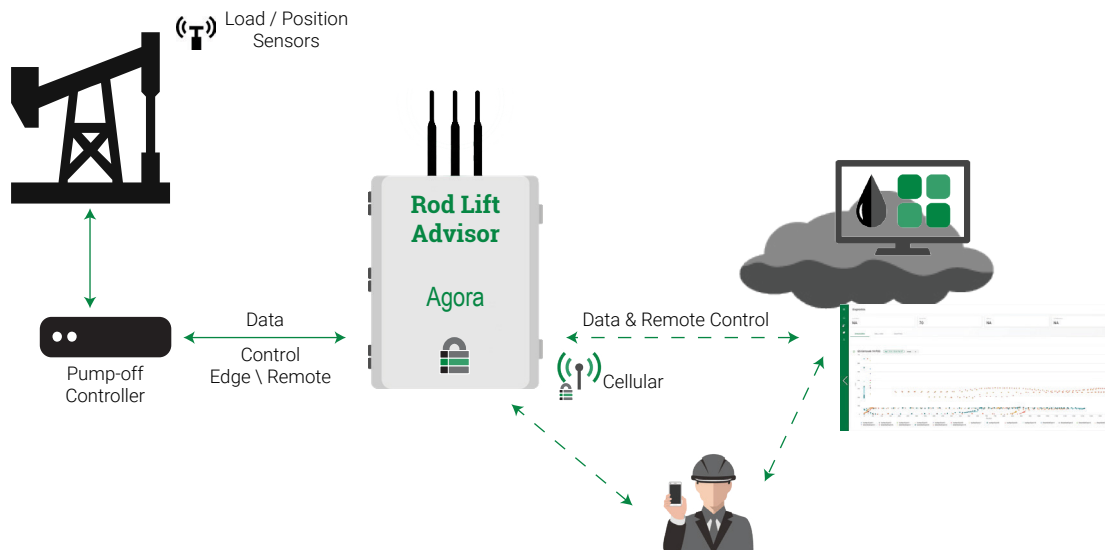# Completions & Production Operations

Enhance your completions and production operations with real-time dynamic edge intelligence to continually and sustainably optimize wellsite performance.

Agora

Rod Lift Advisor

Dynamic, autonomous edge intelligence for rod lift operations

The overall effectiveness of rod lift operations can be limited by various factors that may result in deferred production or other operational efficiencies. Furthermore, rod lift wells have often been managed reactively, resulting in missed opportunities to maximize production. While increased access to rich data adds value, there is no direct impact on the effort required to take proactive measures to fully optimize rod lift operations.

The Rod Lift Advisor application delivers a step-change in production optimization by utilizing edge computing to enable analysis of dynacards and operating conditions. The app's machine-learning algorithms deliver dynamic intelligence by continuously analyzing pump behavior. As a result, operators can increase pump run-life and reduce mean-time between failures, while also minimizing deferred production.

The app enables operators to perform corrective actions either autonomously or via remote control. The role-based smart alarms and notifications ensure that production teams have access—through the desktop or mobile interface—to actionable intelligence that can be used to streamline operational efficiency.

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Challenges

- Deferred production
- Operational inefficiency
- Manual intervention
- Limited data and analysis

Edge Solution

- Real-time pump diagnostics
- Advanced analytics
- Control and automation
- Mobility and collaboration

Benefits

- Production optimization
- Reduce pump failure rate
- Enhance operational efficiency
- Minimize HSE exposure

Agora

Remote Monitoring and Control of Rod Pump Wells Increases Operational Efficiency and Production

Cairn utilizes edge computing intelligence and machine learning via Rod Lift Advisor to reduce downtime by immediately reacting to anomalies that trigger smart alerts

Cairn Oil & Gas, Vedanta Ltd. operates the majority of its satellite field wells with rod pumps and needs to regularly monitor the wells to reduce downtime. These satellite wells were not digitally enabled for continuous monitoring and management of the rod pumps, and the lack of data availability resulted in downtime and production loss.

What Cairn tried first

Cairn hired a third-party crew for maintenance and daily data monitoring for the satellite field and to deliver the rod pump data to the petroleum engineer. The third-party crew traveled over 50 km daily and still wasn't able to cover all the wells every day. Despite rigorous data collection by the third-party crew, only discrete data was available, which was insufficient for rod pump optimization, and all decisions were made based on the discrete data points.

What Agora recommended

To meet the challenges of continuous monitoring and optimizing the wells, Agora recommended the Rod Lift Advisor solution on its open and secure platform. The solution runs a machine learning algorithm at the edge to classify dynacards and enable smart alerts that proactively notify users if anomalies are found when monitoring data. Rod Lift Advisor also enables remote control of the rod pumps from anywhere.

What was achieved

Using the Rod Lift Advisor solution, Cairn leveraged the machine learning capabilities to feed a minute-by-minute dynamometer card of the pump through a deep-learning model to classify the status of the rod pumps in the field. Based on previous production data, Agora developed and implemented an algorithm to detect
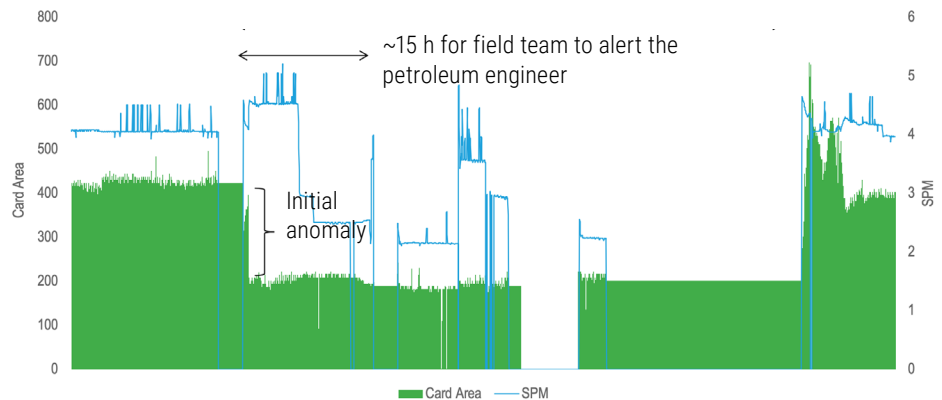
The data from the event on May 10, 2020, showing the existing monitoring scenario when the smart alerting feature was not in place and it took the operator 60 h to revive the well.
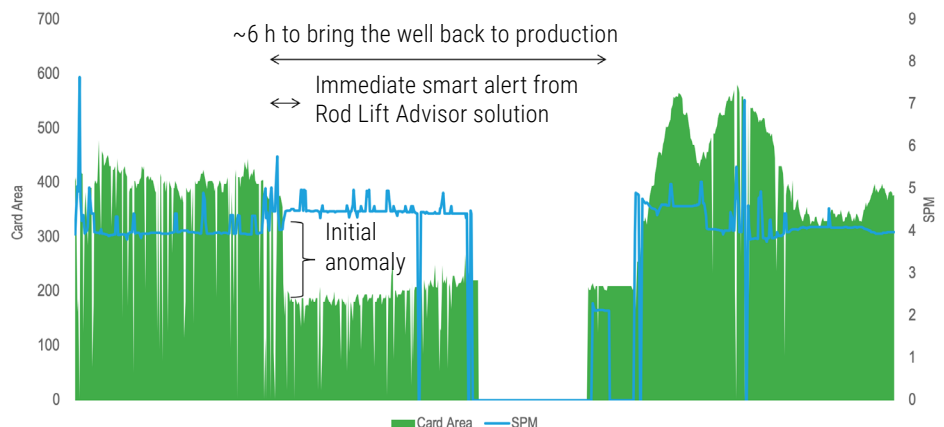
The data from the May 25, 2020, event where the Rod Lift Advisor smart alerts detected the event immediately and enabled the user to apply corrective action to revive the well in 6 h.

anomalies in the pumping operation and send smart alerts to designated users via e-mail. This process enabled a single petroleum engineer to have a 24/7 view of the pump's health and instead of spending their time in collecting, cleaning, and analyzing the data, they could directly implement corrective actions to optimize production.

Cairn was able to reduce anomaly downtime up to 70% for the Agora-connected wells. Because of the inherent flexible nature of the Agora platform, the operator can keep building upon the intelligent algorithms as additional anomalies arise. This gives operators the ability to scale the solution and to have confidence to optimize the operation of their remote fields.

AiRP Ai Response Prioritization for ESPs

Agora

In Partnership with:

sensia

Rockwell Automation + Schlumberger

Today, the ability to prioritize the relative importance of ESP-related events lies in people. Not in automated systems. And, as the number of events increases, it becomes increasingly more difficult for field engineers to qualify, prioritize and respond. With Sensia's AiRP Ai Response Prioritization for ESPs, events can be addressed in minutes rather than hours.

AiRP means you can capture, save and analyze events, in detail, in real time. The singleview workflow brings together the latest advances in AI and the most powerful data visualization to automate the prioritization process, uniting the time, date and context of the event in one consolidated system.

AiRP is much more than an app. It is an intelligent store for all of the accumulated knowledge that arises from each event, each response, and each outcome, empowering you to boost operational efficiency and optimize lift, without the costly down-time.

AiRP is bringing full lift autonomy within reach

AiRP is built on Sensia's connected oil & gas digitalization platform. The platform enables AiRP to provide detailed response prioritization and actions in real-time, in a single system. It processes huge amounts of data using analytics and machine learning algorithms presenting it instantly in a prioritized, comprehensive way, ensuring decision-making is simplified and accelerated.

What's more, AiRP builds knowledge and intelligence as it goes along, leading eventually to a fully autonomous system, freeing up hundreds of man-hours for other tasks.

Current systems are not producing more oil. But it's within your grasp to give your team the intelligence they need to make informed and timely decisions.

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Challenges

- Too many alarms for every important event
- Systems that produce unstructured lists of multiple alarms
- Large amounts of data stored in multiple applications
- Human intervention required to identify which event is important

Edge Solution

- In real-time: events captured, analyzed, classified and intelligently prioritized
- Advanced analytics and continuous machine-learning adapt to changing field conditions and build predictive capabilities
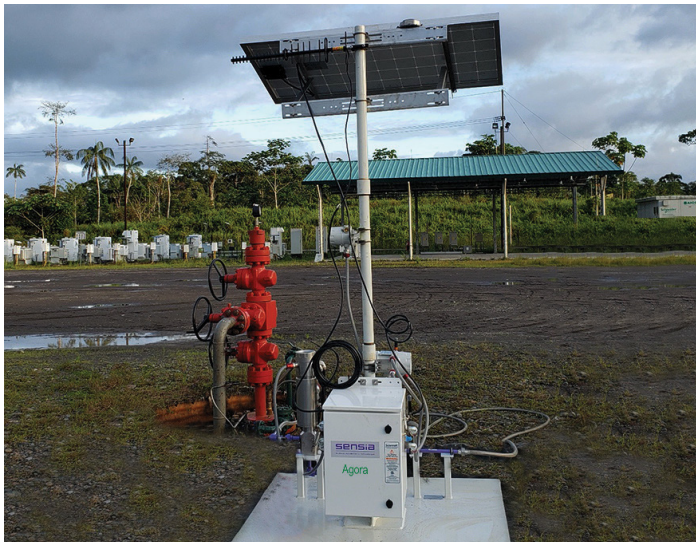
Benefits

- Detection-to-correction times reduced
- Domain knowledge that resides in a fully integrated system
- Field-management decisions empowered by real-time insights

Automated ESP Gas Handling

Innovative approach to produced gas minimizes downtime and deferred production

In Partnership with:

Rockwell Automation + Schlumberger

Electrical Submersible Pumps (ESPs) are designed for high volume lift in reservoirs with declining energy. While an ESP provides robust handling in challenging and harsh environments, its operation could be dramatically impacted by high gas content in the flow stream. A gas lock situation, where the pump is forced to run dry and eventually fails with a buildup of gas in the well, has devastating effects on well productivity and ESP run life. A personnel intensive and reactive workflow remains ineffective in managing large brownfield operations. With ability to run analytics models at the edge and taking control with real-time insights, Agora brings productivity gains along with eliminating the intervention expense and environmental impact due to manual approach.

Edge AI and automated control for ESP well optimization

With the AgoraGateway as the brain of the fully automated solution for optimizing ESP performance, it synchronizes and transmits data to the cloud where flow simulations are run using a simulation engine to account for the effect of gas on ESP performance. The results are captured on the gateway with the ability of updating the models over the air. The gateway then identifes the correct opening of the casing annular valve from the flow simulation models and sends commands to the choke valve autonomously to adjust the casing valve preventing any unwanted gas lock conditions. Multiple data driven and well simulation models can be run on the gateway and the control variables are adjusted autonomously resulting in proper ESP optimization in hours, instead of days or weeks, with no manual intervention required.

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Challenges

- Gas accumulation impacting production and ESP run life
- Remote fields with lack of surveillance
- Wells that require frequent manual interventions

Edge Solution

- Edge AI algorithm on Agora IoT platform based on physics data
- Over-the-air updates for optimizing well prodouction and control of skids
- Intelligent automated control of annual gas pressure
- Turn-key solution on a solar powered skid

Benefits

- Proven increase in production
- Siginificant reduction in field crew visits to the wellsites
- Trackable improvement for reducing the carbon footprint of the operation

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Automated ESP Gas-Handling System Expected to Increase Production 400,000 bbl a Year

Innovative approach to handle produced gas in brownfield minimizes downtime and deferred production

Combining edge computing with automation enabled an operator to optimize their ESP performance and production in brownfields with a digital ESP gas-handling workflow.

The operator's concern

The gas coming from ESP wells that produce from high-GOR reservoirs has devastating effects on well productivity and ESP run life. The operator's workflow to handle the produced gas from these wells is personnel intensive and highly reactive.

Wells that needed intervention could take days to weeks to get back to the standard producing behavior. A field technician would need to be sent to the field to manually bleed off the casing head pressure and leave the annular casing valve cracked-open until the next gas event occurs.

What was recommended

An automated ESP gas-handling system—including an AgoraGateway, wireless sensors, and a solar-powered skid with a flow computer and an automated choke valve to control the annular gas flow rate—was used to optimize the well and ESP performance.

The AgoraGateway captures tubing head pressure and casing head pressure from the wireless sensors, gas flow rate from the skid, and ESP data, and then synchronizes the parameters prior to transmitting the data to the cloud. All this data is also consumed by a well model installed in the AgoraGateway which accounts for the effect of the produced gas on ESP performance and autonomously sends commands to control the fully automated skid supplied by our partner, Sensia.
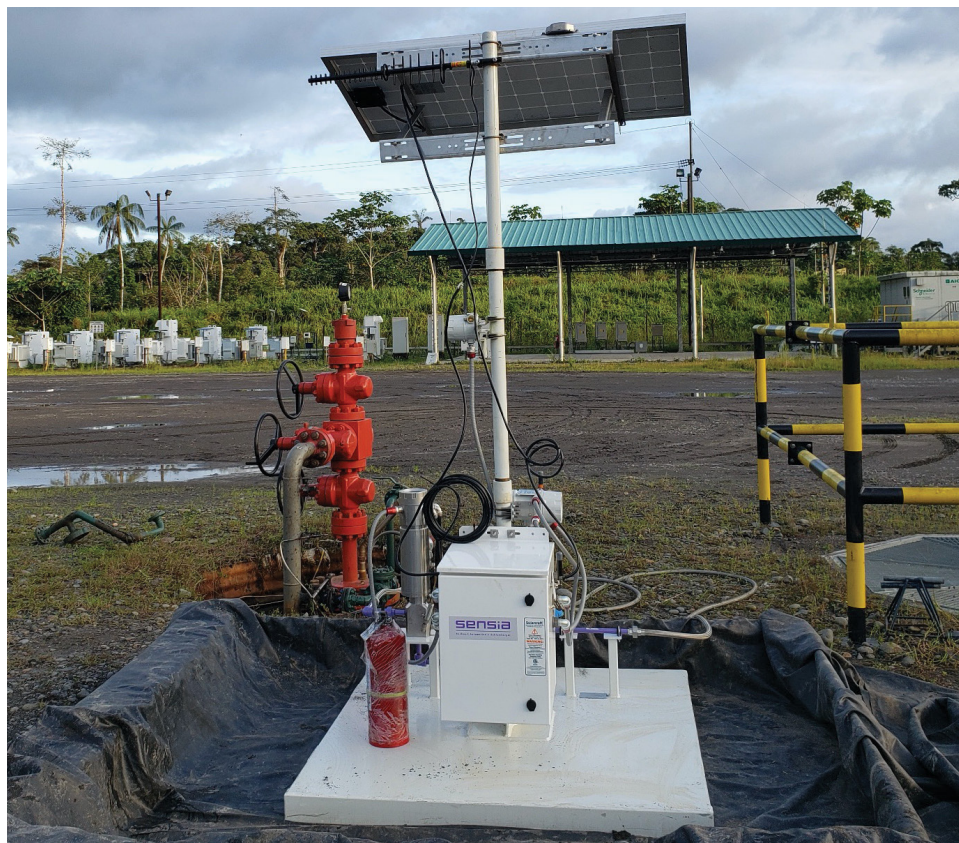
Fully automated, solar-powered skid ESP gas-handling system.

What was achieved

The AgoraGateway captures the gas rate measured by the flow computer and identifies the correct opening of the casing annular valve based on well-flow simulation models, with the ability to incorporate a physics-based model using the ECLIPSE industry-reference reservoir simulator and data-driven estimation using machine learning. The AgoraGateway sends commands to the automated skid to adjust the casing valve, preventing production-halting gas-lock conditions. This iterative process results in proper ESP optimization in hours instead of days or weeks, with no manual intervention required.

By deploying the automated ESP gas-handling system to over 40 high-GOR wells, the operator expects to gain 400,000 bbl/y (1,095 bbl/d more per well) and reduce 10,000 mi of driving in harsh environments within the next year. It also eliminates the intervention expense of sending a field technician to the field to investigate and remedy the persistent gas-lock issues.

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Plunger Control and Optimization

Agora

Enhancing lift performance, longevity, and improving production

In Partnership with:

lavoro
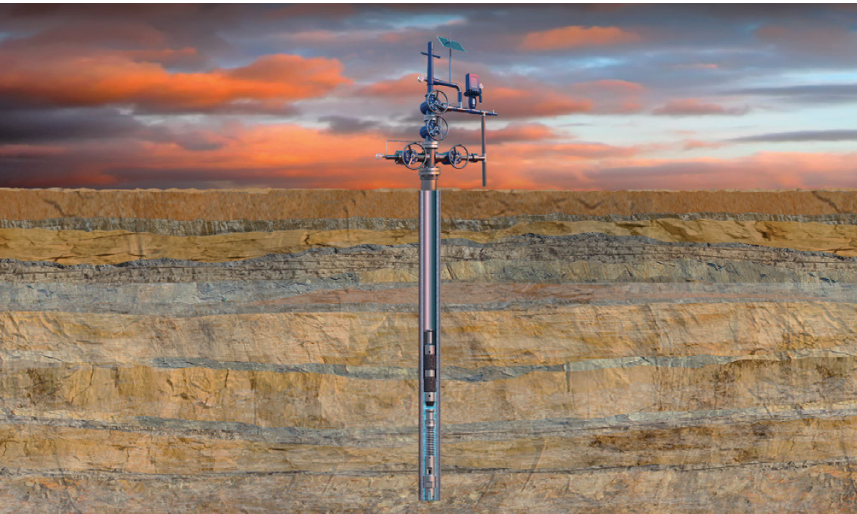
When a well is initially put into production, it flows oil, water, and gas on its own due to the high pressures of the formation. Over time, several factors impact this formation pressure reducing production volumes. Plungers can extend the productive life of a well by actively removing fluid build-up.

Manufacturer-specific plunger controllers are often limited in application and are too generic for some areas and formations. They also do not adapt well to changing characteristics that occur in a well over a long time period.

Lavoro's Plunger Control and Optimization Solution

Lavoro Plunger provides control and automated optimization of artificial lift wells utilizing plungers. It can be used with existing PLCs, RTUs, or can be used independently. Lavoro Plunger enables three operating modes for a well: manual, intermitter (timed), and plunger lift. There are many options for controlling the wells through various flow permissives, flow overrides, automatic tuning, and critical flow rate. Lavoro Plunger achieves an almost infinite capacity to adapt to specific situations when combined with Lavoro's edge analytics.

Lavoro provides customizable remote visibility into asset operations. Virtual operation centers are enabled by providing remote manage by exception capabilities and role-based visualizations of operational information. Use out of the box visualizations, or customize your own, to provide information with context to everyone who needs it. Real-time notifications are available to provide immediate awareness of specific operating conditions.

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Challenges

- Wells not producing to their full potential reducing operator revenue
- Lack of capability to adequately optimize performance in OEM controllers
- Market prices demand costs to be minimized

Edge Solution

- Auto mode avoids load up that compromises full plunger travel
- Autonomously optimizes the speed of the plunger to minimize wear in lubricator and springs, thus extending the life of the equipment
- Menu-driven applications solve a variety of current and future problems on the well-site without programing

Benefits

- Optimizes plungers to produce more
- Increases plunger maintenance intervals to reduce plunger maintenance costs
- Eliminates no-shows to reduce costly downtime, reduce well intervention, and, of course, improve and extend the productive life of the well
- Simplifies your well-site control schemes as you consolidate solutions on Lavoro applications to reduce your cost per site

Agora

Lavoro Plunger Increases Production and Lifetime of Wells While Reducing Operating Costs

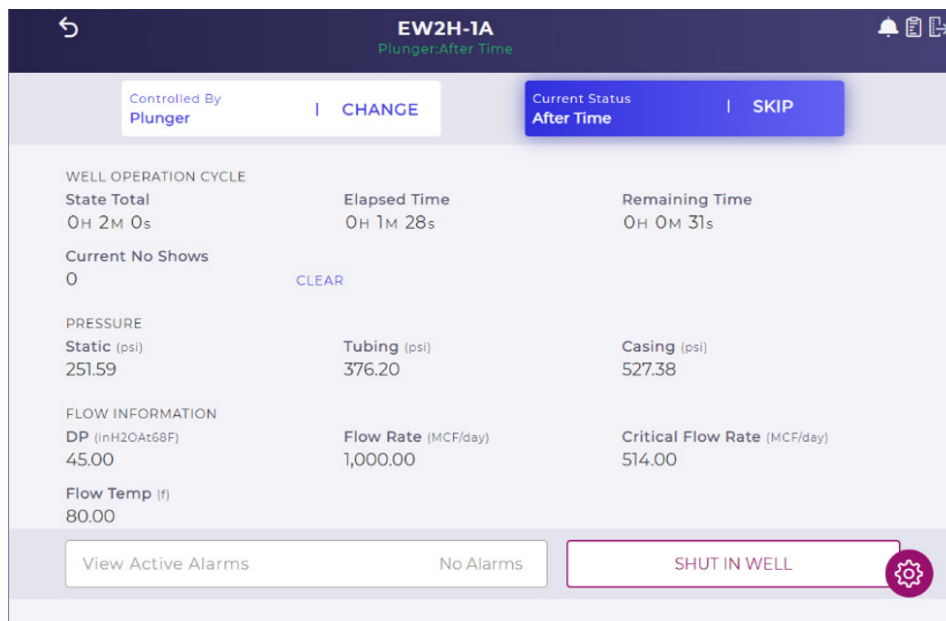## Operator experienced a 6% increase in production and 3 months longer maintenance intervals

An operator in the Barnett region implemented Lavoro Plunger to increase production through optimization that was beyond the plunger manufacturer's controller capability. To their surprise they also realized longer maintenance intervals as well.

The operator's concern

In an aging field, the operator sought to increase high value production. They found less than optimal results with standard plunger controllers. In addition, they wanted a system that would readily share information enabling remote analytics and tuning.

What was recommended

Lavoro's Plunger application was used in auto mode to automatically optimize plunger performance. Plunger speeds were optimized as well to minimize wear in lubricators and springs. All related process variables and operating statuses were sent from the edge to the cloud for remote visibility to performance and results. Additionally, the process variables and calculations were shared with the operator's historian and made readily available to Power BI in facilities engineering, enabling performance tuning.

Visualize and optimize plunger activity in real time, from anywhere and any device..

What was achieved

Lavoro Plunger delivered a 6% increase in production through optimized plunger performance for the operator. The liquids decline curve flattened, and the decline curve for the wells also slowed. On average, their optimized wells netted an additional two plunger runs per day compared to their attempts with timer-based control.

A side benefit was a reduction in maintenance costs for the wells. On average plunger spring life was extended more than 3 months over the timer-based control on adjacent wells.

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Lavoro helped an EOR operation enhance data visibility, automate workflows and optimize injection well efficiency

Operator reduced the latency of data critical to optimizing their gas lift from 48 hours to near real-time

	A	B	C	D	E	F	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
1		INDIVIDUAL WELLS							FACILITY METERS							
2		A-11X	A-27X	A-53X	A-61X	A-80H	A-08X	Total	UNIT-AA RECYCLE	UNIT-AB RECYCLE	UNIT-AC RECYCLE	Total	Purchased	Total	* Delta Variance	**% Var
3	Skid	C	B	B	A	F	J	Injection NA	NA	NA	NA		NA	Recycle+Purchase		
4		0	-287	0	0	-99	0	-2197	-15.32	-31	-27	-73.32	258.52	185.2	2382.2	132.79%
5	2020-10-12	0	1306	0	0	58	0	5798	13330.34	1454	6743	21527.34	6002.02	27529.36	21731.36	374.81%
6	2020-10-11	0	1593	0	0	157	0	7995	13345.66	1485	6770	21600.66	5743.5	27344.16	19349.16	242.02%
7	2020-10-10	0	4490	0	0	982	0	23837	14416.13	1413	6803	22632.13	3763.68	26395.81	2558.81	10.73%
8	2020-10-09	0	4486	0	0	1026	0	23266	14216.32	1502	6774	22492.32	3244.65	25736.97	2470.97	10.62%
9	2020-10-08	0	4267	0	0	972	0	23750	14720.86	1536	6810	23066.86	4429.44	27496.3	3746.3	15.77%
10	2020-10-07	0	4434	0	0	977	0	24792	14252.32	1687	6797	22736.32	4166.02	26902.34	2110.34	8.51%
11	2020-10-06	0	4500	0	0	948	0	25986	14737.33	1571	6827	23135.33	4587.79	27723.12	1737.12	6.68%
12	2020-10-05	207	4142	0	0	930	0	27183	15085.78	1679	6826	23590.78	5051.72	28642.5	1459.5	5.37%
13	2020-10-04	2097	0	0	0	1005	0	30366	15034.11	1810	6741	23585.11	7933.45	31518.56	1152.56	3.8%
14	2020-10-03	2252	0	0	0	961	0	29954	14878.32	1562	6761	23201.32	7990.87	31192.19	1238.19	4.13%
15	2020-10-02	2547	0	0	0	934	0	30544	15168.66	1755	6750	23673.66	8014.1	31687.76	1143.76	3.74%
16	2020-10-01	3219	0	0	0	1000	0	31079	15392.24	1670	6813	23875.24	7599.74	31474.98	395.98	1.27%
17	2020-09-30	2082	0	0	0	995	0	29335	13685.12	1738	6907	22330.12	8136.5	30466.62	1131.62	3.86%

An operator in the Permian Basin implemented Lavoro's Foundation application bundle to quickly integrate with their existing equipment, cost-effectively track thousands of tags, and timely produce a custom well injection report that helps the operator optimize its production. As the company continues to embrace automation, it will use additional existing Lavoro capabilities to control the injection optimization in real-time.

The operator's challenges

An independent oil and gas company with enhanced oil recovery (EOR) operations inside the Permian Basin was using a historian to track thousands of data streams. But as the team's operations evolved and the historian got older, issues began to surface. The historian was several versions behind, and its hardware was beginning to have issues. More importantly, the historian lacked key capabilities that the team needed to enhance its operations— including a report used to optimize CO2 and water injection wells. Without this capability, the team had to manually extract the data, import it to Excel and wait for it to be processed.

What the operator tried first

After assessing the upgrade process, the company knew it would not solve their challenges. The upgrade itself was expensive, with a recurring license fee that provided little flexibility. And even with the pricey upgrade, the historian would not meet the team's needs. At best, it would still take 48 hours for data to get from the field to the office—with many slow, manual processes in between. When the company decided to decommission its current solution, Lavoro was ready to help its team discover the power of a modern, cost-effective historian.

What Lavoro provided

Lavoro provided its Foundation application bundle that includes a modern, scalable, affordable historian solution. The Lavoro Foundation bundle makes it easy to integrate, collect, historize, contextualize, and analyze operational data—then share those insights in near-real-time from the edge to the enterprise. With Lavoro Foundation, the customer replaced its outdated, inefficient solution with a practical, scalable edge cloud platform. REFPROP density and volume calculations are now performed automatically in the field. Cloud-hosted dashboards allow the team to visualize all process variables in near-real-time, from any browser-enabled device. To eliminate manual processes and delays, the critical report the operator needed to optimize its CO2 and water injection wells is automatically produced.

What was achieved

By replacing its outdated historian with Lavoro Foundation, the operator achieved clear, immediate results. Its team can access field data from the office in near real-time and can receive notifications when conditions of interest are met.

The operator's connected injection wells are now able to be optimized as frequently as desired to minimize cost and maximize production, with the capability to automate 100% of the optimization in real-time on the platform in the future. Key reporting is fully automated, with no manual steps required.

As the operator continues to use the Lavoro Foundation, it is finding new value-adds. Case in point: when storms interrupted site connectivity to the cloud, Lavoro Historian on the edge ensured that no data was lost. The moment connectivity came back, the data was available in the cloud.

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Completions Vision

Agora

Holistic approach to wellsite management for fracturing, perforating, and valve management
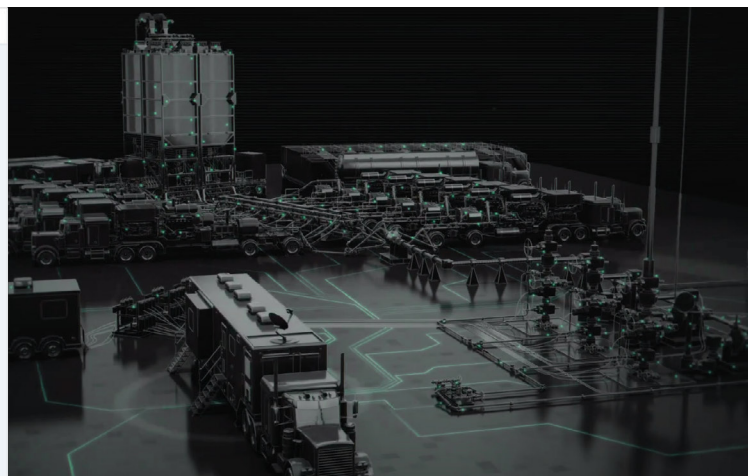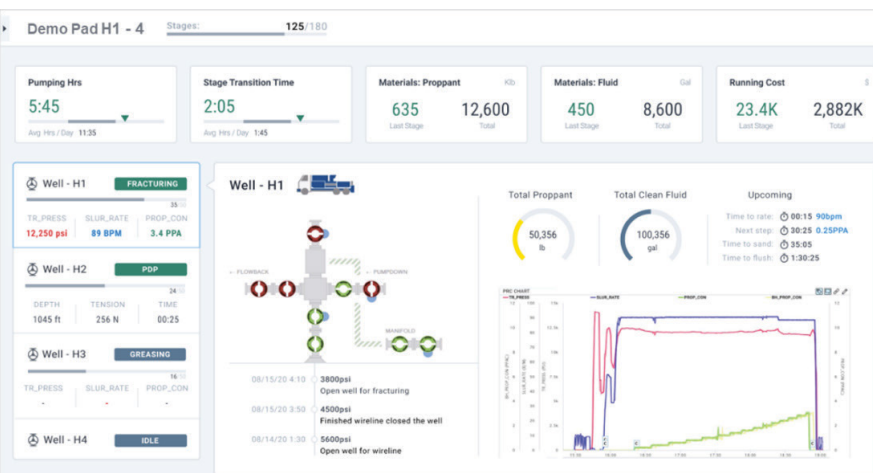
The modern completions wellsite is a fast paced, highly precise combination of service providers working together to stimulate a series of wells as efficiently as possible. Each vendor on the wellsite has dependencies on the other to ensure each stage and operation synchronizes together. For the most part, completions remain disconnected and vendors rely on archaic methods of communication to receive updates materials, valve position, volumes, pressures, or rates. This can create non-productive time or slowdowns in operations that could be avoided through better availability of the data. The sustainment of high efficiency operations is paramount to keeping costs under control.

Data Collection and Connectivity

Agora has proven track record of reliably collecting, organizing, and storing high frequency data for multiple oil and gas workflows including completions. Our solution is agnostic meaning we can seamlessly connect to any fracturing or wireline vendor on the market.

Fracturing, Perforating, and Valve Monitoring

The Completion Vision platform has a versatile real-time feature that is customizable for the user. Users can overlay previous stages, annotate plots, or view comments generated from our machine learning algorithms. Your entire wellsite operation is visible within our platform. Users can easily transition between frac, perforating, and valve activities. The combination of these datasets into a single platform enables users to make more informed decisions in real-time.

Analytics and Machine Learning

Agora's intelligent systems use deep learning models to detect events during fracturing and perforating operations that unlock insights to improve efficiency and save costs during completions. Our models are tested on over 10 years of fracturing data and are combined with expertise from industry domain leaders to provide the most accurate recommendations on the market. Our platform is capable of building a post stage treatment report from time series data, optimizing chemical costs in real-time, and recommending design changes to improve efficiency or lower costs.

Challenges

- Multiple data types
- Lack of synchronization between service providers on location
- Archaic methods of communication
- Siloed operations between service providers
- Lack of connectivity

Edge Solution

- Agnostic solution for any service provider
- Agora IoT platform
- Safe, secure, and organized
- Seamlessly connect any sensor, asset, or device

Benefits

- Lower completion costs
- Improve operational efficiency
- Organized, structured, and secure

Autonomous Setpoint Optimization

Dynamic, autonomous edge intelligence for production operations

For typical production operations management, minimal to zero historical data analysis is used to adjust the controllers or intermitters in a SCADA operated system. This process cannot be optimized due to some common challenges such as a high amount of wells, increasing individual workload, and lack of high frequency data. When these wells become liquid loaded, the operator must travel to the wellsite to unload the wells to atmospheric pressure. Until the wells are unloaded, there is no production from them. The frequency of manual unloads can sometimes be once in a day per wellsite which creates significant loss of production, high carbon emissions, and an increase in NPT.

Edge AI to Autonomously Increase Production

By deploying our data-driven and physics-based approach for autonomously managing choke setpoints via the Agora Platform on each wellsite, we can convert the wellsite into an intelligent and autonomous production system. Agora's edge AI solution dynamically controls well setpoints to continually optimize production during changing well conditions.

These production wellsites are also connected to a cloud service for management and over-the-air updates. Once deployed, this application increases production and reduces trips for manual unloading which significantly reduces operational carbon footprint.

Agora Platform

Agora is an open, secure, and scalable platform which enables oil and gas industry to connect physical assets to the digital world. E&P operators face constant challenges of choosing the appropriate IIoT provider out of many that are coming from various industries. Agora is solving this challenge by working with multiple IIoT, automation, and instrumentation companies as well as application providers in order to create the biggest ecosystem of oil and gas specific applications in the Agora Marketplace.

Challenges

- Deferred production
- Operational inefficiency
- Manual intervention
- Limited data and analysis

Edge Solution

- Operate well setpoints autonomously
- High-frequency data monitoring and smart alerts to detect anomalies
- Remotely update setpoints to adjust and examine well behavior
- Test multiple open/close scenarios for fine tuning well optimization
- Identify key parameter trends and thresholds

Benefits

- Production optimization
- Reduce manual unloads and wellsite visits for controller intervention
- Enhance operational efficiency
- Minimize HSE exposure

Case study: Production

Location: Haynesville

Agora

Autonomous Setpoint Optimization Increases Production by 10% and Reduces Manual Interventions by 80%

Data-driven approach autonomously manages choke setpoint to increase production and reduce manual interventions on gas wells in Haynesville

Agora's edge AI solution enabled autonomous operation of gas wells–without manual interventions that challenges project economics and the sustainability of operations. The data driven and physics-based approach dynamically controlled well setpoints to continually optimize production operations.

The operator's challenges

Management of hundreds of wells on intermitters did not permit the operator time to optimize their choke setpoints in real time for each individual well. This led to a high frequency of liquid loading events each month that require the operator's production team to visit the wellsite and unload the well manually so it can return to normal operation. This tedious process consumed resources and increased production costs. The operator wanted to find a solution that improved the efficiency of their personnel, autonomously managed their choke setpoints, provided incremental production gain, and reduced or eliminated the need to manually unload the wells.

What Agora recommended

The AgoraGateway–an intelligent edge computing device–was deployed on 10 wells to capture, monitor, and control the choke setpoint. An algorithm developed by Agora was deployed on the AgoraGateway to autonomously manage the choke setpoint and flow the wells without human intervention.

Improving operations with edge AI

As the well's naturally decline, the algorithm adapts to learn new thresholds to manage the choke setpoint, maximizing the amount of time the wells flow in steady state. In addition to improved gas rate, the algorithm proactively identifies potential liquid loading scenarios mitigating them before they occur, and alerting the user to wells that will still require manual intervention. The unloading procedure prevents or minimizes liquid loading by utilizing multi-parameter threshold criteria and a self-unloading mechanism to remove water from the wells and create enough differential pressure to allow the wells flow normally.

What was achieved

Over the three-month production period, Agora improved production by 10% and reduced manual unloading up to 82% across 10 wells. The operator projects to realize a total increase of 135,000 MCF of gas in one year.

In addition to the production increase, the sustainability of operations were improved via the edge algorithm management. The reduction in manual unloads will substantially reduce the need for field technicians to make trips to the wellsite for liquid loading events, significantly reducing the operator's carbon footprint.

AgoraGateways automate and optimize the choke setpoint on gas wells in the Haynesville Shale.

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ProdOps
tuned production operations solution

Schlumberger

Digitally enabling production operations for faster, better decisions

Applications
- Production surveillance, analysis, and diagnostics
- Well and field-scale production and artificial lift optimization
- Flow assurance risk identification
- Pipeline integrity management
- Capacity planning
- Production forecasting
- Candidate selection for workovers and interventions

Key benefits
- Provides a single-source view of operations for clarity in analysis and decision making
- Delivers automated insights that give continuous guidance and recommendations based on the latest operating conditions
- Enables integrated machine learning and AI for continuous learning and value extraction
- Offers integrated self-service analytics to support personalization and adding your own IP
- Enables quick and easy data connections to rapidly prototype new solutions, including cross-domain work processes beyond operations
- Supports new applications and solutions with an open framework and scalability

- Delivers consistency across assets and the standardization of best practices
- Leverages your existing data sources and software technology and increases the return on investment while lowering the cost of ownership

Enhancing operations and production performance
The ProdOps* tuned production operations solution enables you to optimize production performance and continuously create value at scale. Powered by the open, cloud-based DELFI* cognitive E&P environment, ProdOps solution seamlessly connects people, data, and models across the entire production space—streamlining your operations and delivering greater insight for faster and better decision making.

Unifying data in a shared production advisory system
ProdOps solution delivers unity by bringing together data and work processes from across your organization to set new standards. Underpinned by a robust, industry-proven data infrastructure and ingestion framework, the solution brings together live, contextualized data from structured and unstructured sources, calibrated first-principle physics models of wells and networks, and data

analytics into a shared, collaborative environment.

The net result is the instant identification of underperforming assets, issues, and opportunities for improvement, as well as confidence in recommendations and decision making at the right time.

Your teams can proactively manage assets by reviewing advisory insights. Insights run continuously and automatically in the background using data-driven or physics-driven models or in combination as hybrid models. Insights provide recommendations that can be ranked based on metrics, such as potential gains and chances of success.

The ProdOps solution enables engineers to share data, store models, and track and manage models as they mature over time. Engineers can easily evaluate alternatives using consistent models for design, engineering analysis, and operations.

Empowering asset teams
ProdOps solution enables asset teams to track production metrics, analyze performance, and manage tasks more easily and with greater clarity compared with using conventional methods. Teams have access to an up-to-date and comprehensive view of the entire

Integrated
Streamlined ingestion, integration, and orchestration of data and models across your organization and from third-party sources

Collaborative
A single environment to review and analyze performance, assign tasks, and track activities

Automated
Data-driven and first-principle models for continuous, automated insights and value creation
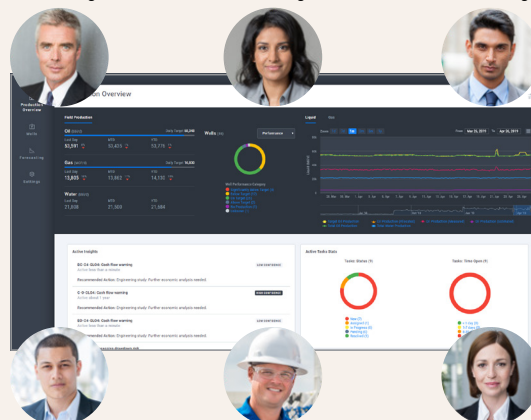
Open
Liberation of data and workflows; capability to connect systems and differentiate with your own IP

Asset managers   Production engineers   Surveillance engineers

Facilities engineers   Field operators   System technicians

Key attributes of ProdOps solution.

ProdOps

asset to quickly understand reasons for underperformance. By automating data gathering, ProdOps solution delivers significant quality improvements and time savings, freeing up time for deeper analysis and the identification of opportunities.

After solutions or opportunities are identified, tasks can be assigned and moved to resolution through collaboration on task assignments, verification, tracking, and up to final closure.

Automating data and analytics
The solution transforms well production management and surveillance by automating the execution of workflows through machine learning and advanced AI. This provides

engineers and asset managers with actionable insights and customized analytics for proactive decision making without having to be data science experts.

Data, workflows, and business logic are integrated to autodetect trends and well events, remove data outliers, and automate processes, such as decline curve fitting.

Maximizing ROI and enabling innovation
The scalable ProdOps solution enables you to readily connect to data and build your own workflows and applications. It is a cost-effective solution that lowers the total cost of ownership compared with conventional production surveillance and analysis

solutions—providing you instant access to data, models, and analytics for continuous value creation while maximizing ROI.

ProdOps solution combines deep petroleum engineering domain science, innovative digital technologies, and more than 20 years' experience in digital oilfield projects worldwide. From pilot projects to enterprisewide implementation and postimplementation support, Schlumberger is committed to helping you achieve your full potential with the ProdOps solution by guiding you every step of the way. We work in partnership with you and third parties to deliver solutions that help you remain competitive.


Well operations
Optimization through continuous monitoring and automated identification of operational issues

- Quickly view and understand underperformance
- Reliably diagnose problems and confidently recommend solutions at the right time
- Support a range of artificial lift types

Network operations
Immediate guidance for better field-scale production management decisions
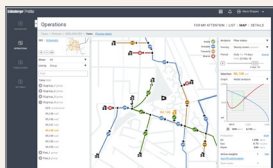
- Optimize production and artificial lift
- Identify flow assurance risk
- Manage pipeline integrity
- Enable capacity planning

Production forecasting
Intelligent production forecasting

- Automatically identify wells that need updates
- Rapidly update large well counts with batch runs

Well portfolio optimization
Automated, rapid screening and ranking of workover candidates

- Automate engineering best practices and business logic
- Proactively manage assets with automated recommendations, potential gains, and likelihood of success

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ProdOps solution applications can be augmented with your own IP.

What is the DELFI cognitive E&P environment?
The secure, scalable, and open cloud-based DELFI environment provides seamless access to software across exploration, development, drilling, production, and midstream applications—all delivered via a flexible and personalized SaaS subscription model. Combined with domain expertise, digital technologies in the DELFI environment help solve challenges across the E&P life cycle.
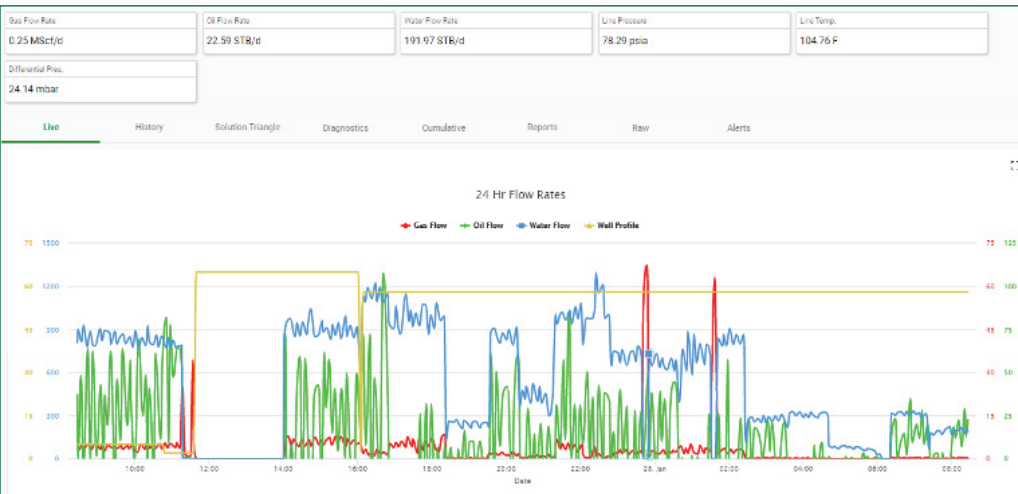
slb.com/ProdOps

Schlumberger

MPFM Advisor

Remote management and production optimization for multiphase flowmeters

Agora

Multiphase flowmeters provide production and reservoir specialists with the data required to understand and optimize well performance without separating a flowstream into individual oil, gas and water phases. Mobile flowmeters help operators in well testing, fiscal allocation and optimizing production operations. With its edge computing capabilities, Agora enables Intelligent monitoring with remote management and real-time flowmeter diagnostics to ensure reliable metering with minimum downtime and manpower needed.

Intelligent, realtime well management enabled remotely

MPFM Advisor enables fast, intelligent and secure transmission of data from flowmeters along with a cloud-native approach to establishe a smart user interface for the field operators and engineers providing reliable data and insights access to any registered devices in the field as well as the office. A seamless data integration allows the operator to advance the production optimization workflows and push relevant algorithms to the edge for cumulative rate calculations and remote update of meter well profiles.

Agora Platform

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Challenges

- Frequent field visits, high opex
- Reliability and calibration issues
- Updating well profiles

Edge Solution

- Intelligent monitoring with smart alerts
- Anomaly detection, available meter diagnostics
- Remote well profile update

Benefits

- Minimize meter downtime, opex
- Reduction in miles driven
- Production optimization with edge-enabled workflows

Agora

MPFM Advisor Enables Remote Management and Production Optimization Workflows for Multiphase Flowmeters

Operator reduces field visits by 30% and increases production by 14,000 bbl after implementing a cost effective real-time workflow for surveillance and diagnostics

An operator in the Permian Basin utilized remote monitoring and edge computing of multiphase flowmeter data to prioritize anomalous wells, proactively schedule field visits to minimize downtime, and enhance optimization workflows.

The operator's challenges

Meters not connected to a SCADA system require manual data gathering. An operator was sending personnel to the field every day to read data from flowmeters, resulting in unnecessary HSE exposure and occasional human error in the reporting. A third-party service provider was also regularly sending people to the field to check the health and calibration of the meter. Because of the quantity of meters in the field and the need for a constant data stream to manage their fiscal allocation, the information the operator was able to capture was limited and infrequent, resulting in failed equipment or deferred production.

What Agora recommended

With cellular coverage avaliable at the well site, Agora recommended installing an AgoraGateway and running the MPFM Advisor application to remotely visualize the data from the flowmeters, granting easy access to the data for production engineers to optimize their artifical lift strategy. The MPFM Advisor application enables operators to visualize minute-by-minute high-frequency data from any mobile device or computer along with setting up intelligent alerts based on well condition parameters. The edge application on the AgoraGateway uses analytics to identify if a meter has lost memory or been reset.
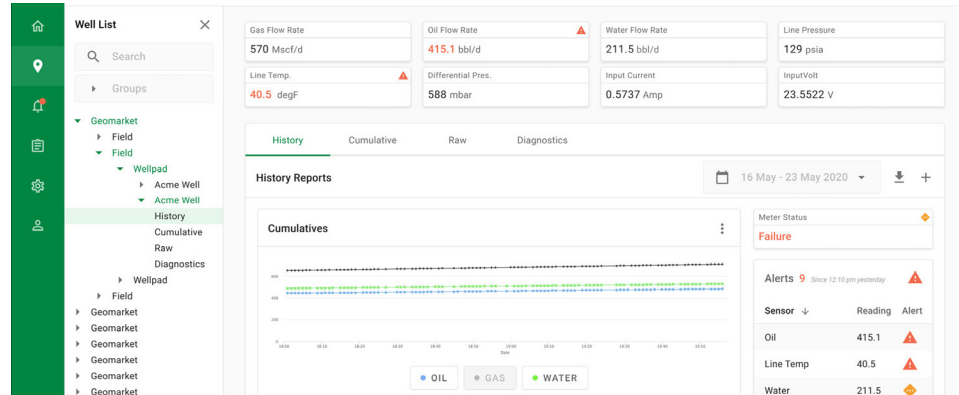
The MPFM Advisor application visualized a multitude of data from the flowmeter and derived KPIs to provide accurate reporting of flow rates.
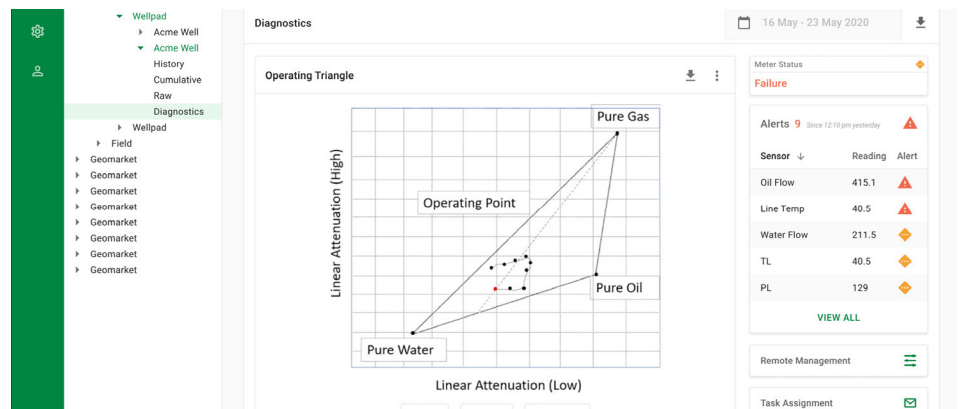
A flowmeter solution triangle can be enabled to ensure reliable diagnostics and proactive well management.

What was achieved

With minimal capex involved, the solution from Agora was implemented, and the operator began running the MPFM Advisor application with intelligent alerts. The operator was able to prioritize data from the flowmeters to proactively manage the well conditions while reducing field visits. The minute-by-minute visualization was easily available on mobile devices, and well profiles could be switched within the application. The service provider also benefited from access to the data, and enabling proactive recalibration of the meters to reduce fiscal allocation errors. The solution reduced field visits by 30% per month, resulting in minimized HSE exposure. Due to the increased uptime, the operator realized a 3% improvement in production on 20 wells, an increase of 14,000 bbl over the first year.

agoraiot.com

Electrostatic Oil Treater Performance

Agora
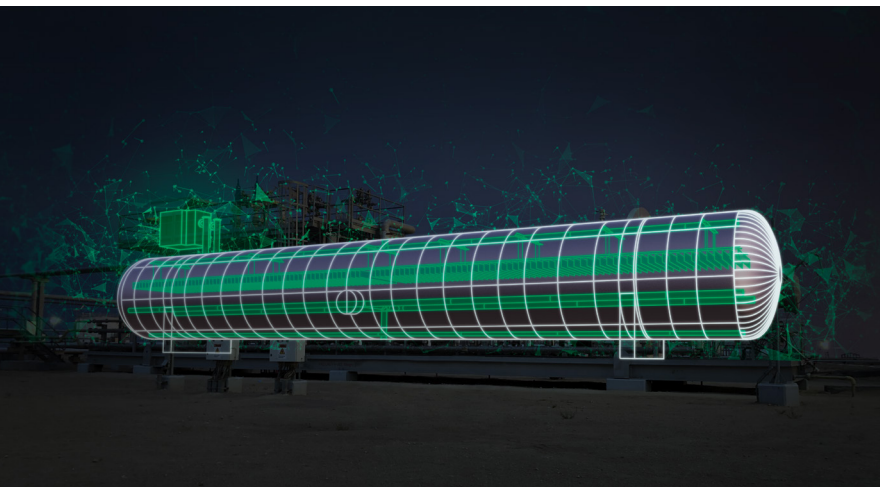
In Partnership with:

Schlumberger

Process Live service is the software-as-a-service digital solution that maximizes electrostatic desalting and dehydrating performance and reliability.

Electrostatic crude oil dehydrators and desalters are widely used onshore and offshore to lower basic sediment and water (BS&W) and pounds of salt per thousand barrels (PTB) from crude oil; however, maximizing electrostatic performance of these flexible, compact systems depends on manual intervention by operations personnel to optimize performance.

If the electrostatic desalter is not optimized, the result is overspending on demulsifier dosing, heat, freshwater, and accelerated refinery catalyst poisoning, which add to the operational expenses required to meet outlet specifications and avoid contractual penalties or loss of throughput.

Realize opex savings you are missing and plan turnarounds

Process Live service automatically optimizes electrostatic dehydration using active machine learning of optimal power unit operating parameters and crude oil quality feedback to deliver the desired outlet specifications with fewer iterations in less time. Continuous and systematic optimization of electrostatic separation enables reduction of demulsifier injection, washwater, and heating operational expenses. Reducing heat and potable water requirements has an environmental stewardship benefit by decreasing consumption of fuel gas and desalinated water—which may be in short supply.

Also, data streaming gives multiple stakeholders a single point of truth to evaluate performance and accelerate corrective actions.

There is a high price for loss of reliability and throughput. The Process Live service lets you proactively manage power unit reliability with prognostic health monitoring and to identify critical events. Electrical system feedback allows proactive maintenance of the power unit and the treater.

Agora Platform

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Challenges

- Loss of rebiability and throughput
- Manual data extraction and handling
- Overspending on demulsifier dosing, heat, freshwater, and accelerated refinery catalyst poisoning

Edge Solution

- Enables real-time monitoring of production facility equipment
- Improve equipment performance and efficiency

Benefits

- Reduce consumption of emulsion breaker
- Conserve freshwater
- Reduce fuel gas consumption and CO_2 emissions
- Maximize savings and reliability

Schlumberger

Proactive Diagnosis of Damaged USD 1 Part on Desalter Power Unit Saves Processing Facility Millions

Process Live service experts discover voltage imbalance in electrostatic treater unit, enabling rapid and inexpensive correction without lost production, Middle East

The operator of a Middle East oil production facility eliminated desalter downtime by using Process Live* data-enriched performance service to enhance expertise in analyzing data from the facility's numerous monitoring and control systems.

The operator's concerns
A Middle East heavy oil production facility operates in an environment with wide variations in temperature and production. The process must deliver on-specification oil with basic sediment and water (BS&W) below 0.5% and salt content less than 10 lbm/1,000 bbl. The produced fluid contains high-salinity brine with salt content in excess of 100,000 ppm.

The process system uses NATCO DUAL FREQUENCY* electrostatic treaters to meet the requirements and accommodate the variations. However, the availability of local technical maintenance support and expensive long-lead-time spare parts is limited. Any downtime for the heater treaters and desalter would result in reduced throughput and revenue.

How was desalter performance monitored?
Like most processing facilities, this one used redundant independent monitoring instrumentation systems for process safety and operations. Individual process equipment and systems had specific instrumentation and operational controllers, so only highly trained employees could monitor all of the instrumentation and processes. However, at this newly commissioned facility, the operations team had undergone formal training but lacked familiarity with the specific technology.
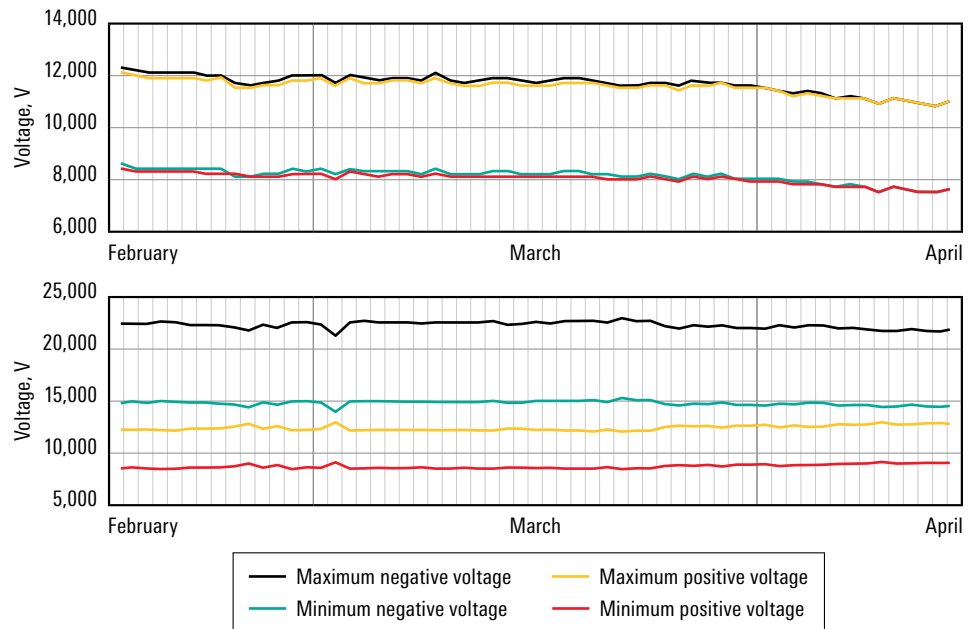
A Process Live service expert compared voltage data from optimized electrostatic processing equipment (top) and inefficiently operating equipment (bottom) to identify a problem, find the root cause, and eliminate it.

What Schlumberger recommended
Process Live data-enriched performance service improves equipment reliability and simplifies data analysis by integrating electrostatic power unit measurements, live process measurements, electrostatic treater domain intelligence, and application and technology expertise with cloud-based process optimization software. The service eliminates familiarity gaps by automatically detecting and notifying the operator of events such as gas breakout, input power supply fluctuations, and operation upsets.

How the facility benefitted
Within a week of deploying the Process Live service, a remote expert noticed a significant nonconformance in the streaming data related to the power unit secondary voltage operating parameters for one of the treaters. After a thorough review of the data, the root cause was identified as a poor contact alignment due to a failure of an internal connector, which led to an output voltage imbalance that, if not remediated, could have severely damaged the treater and slowed facility output. Further investigation determined that the connector had been overtightened with a wrench—rather than only hand tightened—which caused it to break. The connector, which cost USD 1, was replaced without loss of production or damage to the power unit.

slb.com

Compressor Monitoring

Compressor station real-time monitoring and preventative maintenance
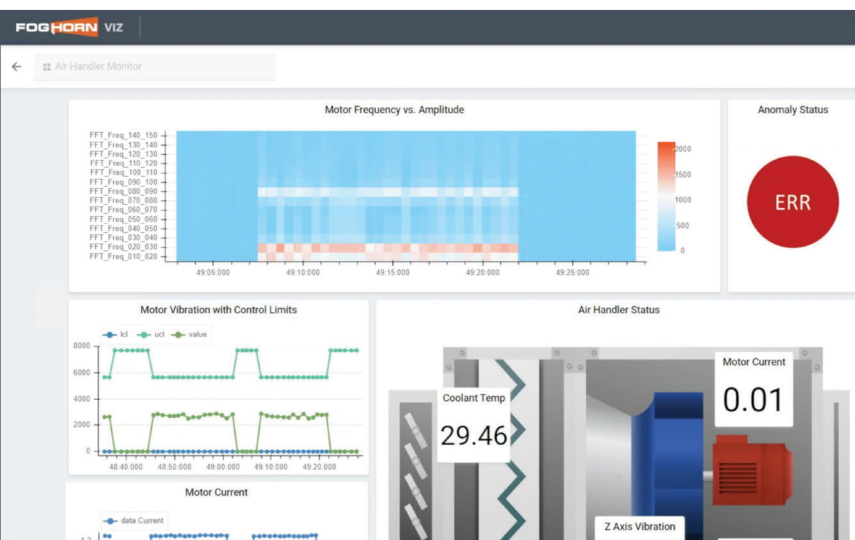
In Partnership with:

Compressors are key components of oil and gas pipeline networks. It is a fact that when a gas reciprocating compressor goes down, so does the associated oil production. Compressor Monitoring represents a challenge as limited resources of compressors' expertise and experience are available to field operators at any give point of time. Automation and scaling are key to overcome adoption challenges. Compressor Monitoring using proper edge analytics and machine learning technologies is proven to increase production revenues by reducing downtime and efficiencies while reducing field operations, ultimately resulting on increase profits.

FogHorn Lightning™ Compressor Monitoring Solution

FogHorn Lightning Compressor Monitoring Solution was developed after years of experience working with some of the largest oil and gas producers. The solution uses a multivariable anomaly machine learning detection model to predict optimal compressor maintenance. The Anomaly Detection model monitors specific states of the compressor under normal operations using edge computing technology using the AgoraGateway.

When deviation of that state occurs, operators can be alerted via email or SMS based on specified threshold for anomaly deviation, and severity, along with monitoring the compressor overhold health by using the FogHorn solution's customizable dashboard. The Lightning Compressor Solution dashboards provide several widgets that gives real-time status updates of the compressor available to operators via the Agora edge IoT platform, including parameters like the motor efficiency heat map, the motor vibration and motor current line graphs.

This FogHorn solution is sensor agnostic, and fully flexible to integrate to any existing equipment/machinery setup independently of the manufacturer.

Agora Platform

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Challenges

- Compressor monitoring is a resource intensive task, compounded with each additional unit at a station
- Field operators have limited expertise and experience diagnosing compressor behavior
- Different compressor equipment in different fields may require different operation models

Edge Solution

- FogHorn Lightning™ Edge installed on Agora edge IoT platform
- Real-time sensor analysis used for multi variable anomaly machine learning detection model
- Easy-to-use GUI for model re-training and customization
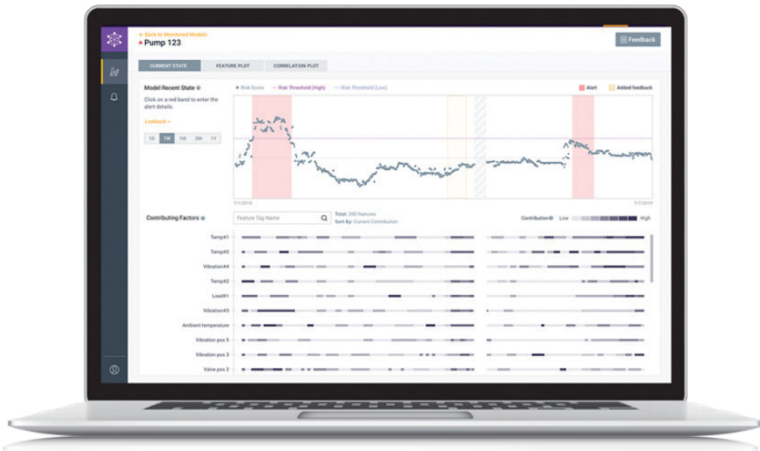
Benefits

- Aggregate data and unified control system thru AgoraGateways
- Reduce equipment failure through preventive intervention
- Stations can be monitored remotely to reduce staffing and unnecessary travel

SparkPredict

Agora

Total asset protection and optimization

In Partnership with:

sparkcognition™

Predictive Analytics for Anomaly Management

Scheduled asset maintenance is costly and inefficient, but failures can be devastating to the bottom line. In large operations, these costs are no longer sustainable. The SparkPredict® predictive analytics product from SparkCognition is proven to minimize asset downtime and deliver operating cost savings by deploying quickly and efficiently at scale. The SparkPredict product analyzes sensor data and uses machine learning to return actionable insights, flagging suboptimal operations and identifying impending failures before they occur.

Early Issue Identification and Resolution

Using leading-edge machine learning technology, the SparkPredict product delivers predictive visibility, optimization, and anomaly management for actionable insights. The SparkPredict product has shown unmatched results in detecting anomalies and predicting asset failures, with advance warning on the order of days or even weeks—not hours. This not only provides more time for necessary maintenance tasks, but also allows for root cause analysis at an extremely granular level.

Optimize Data Usage

By leveraging edge computing capabilities, the analysis of asset performance is done on-site vs. streaming volumes of data back to a centralized location for analysis. This reduces overall transmission payloads and optimizes the network so that only "need to know" information is communicated.

Agora Platform

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Challenges

- Recurring failures in assets and subcomponents, which drive unexpected downtime and lost production
- Identifying and predicting performance anomalies, or analyzing patterns in the components, to take proactive measures
- Efficiently predict, plan, and perform asset maintenance on operations with enough lead time to avoid costly downtime
- Prevent catastrophic asset failures that threaten operations and worker safety

Benefits

- Increases the ability to identify production-impacting events by as much as 75%, thereby minimizing unplanned downtime and delivering reduced risk exposure for workers
- Provides asset failure predictions with days of advance notice
- Drives millions of dollars in increased annual production output and significantly reduces maintenance costs
- Machine learning models can be developed in hours, not weeks, and without advanced data science expertise
- Improves platform production efficiency by as much as 40% by dramatically reducing downtime

PROBLEM

Recurring failures in production subcomponents resulted in >10% downtime and **millions of dollars of lost production**.

PROJECT

Predict impending failures **at least 4 days in advance** using a machine learning model.

RESULTS

SparkPredict® successfully identified 75% of production-impacting events **an average of 8 days in advance.**

The oil supply chain starts at the production well, and the complexities of offshore operations necessitate thoughtful innovation. McKinsey estimates that only 77% of full petroleum production potential is being realized, which represents an annual $60B gap* between maximum capacity and actual offshore production.

Leading oil companies know that the path to harvest this opportunity exists through data and analytics. They are actively exploring how best to apply machine learning methods to maximize platform availability and optimize maintenance processes that lead to profits, stability, and insulation from the next industry downturn.

THE EVALUATION

One major oil platform operator faced significant bottlenecks in their fluid separation process with a direct impact to production. Annually, it observes 5 to 10 unique failure events which result in an estimated 10-15% downtime and up to $8M in lost production per event. 80% of these failure events are attributed to three subcomponents—one glycol system and two export compressors—each of which is instrumented differently and operating at different stages in their lifecycle.

The operator was already measuring sensor data and had attempted to use regression-based analytics to predict failures in these subcomponents previously. However, the rarity of similar, repeating failures (necessary to train a high-performing regression model) meant their operations team was constantly observing false positives that further complicated the maintenance process. In effect, the plant engineers relied on their domain expertise to try to predict impending failures, but still experienced multiple unplanned downtime events each year. This operator turned to SparkCognition™ to implement a machine learning approach that could predict failures with more accuracy and less noise than their regression model.

THE PROJECT

In May of 2017, the operator shared two years of blind sensor data from their gas system with SparkCognition to build the initial model. In order to keep the results as unbiased as possible, the operator purposely did not offer any additional insights about operating states or observed events during the time period.

Their main objectives were to:

- See if SparkPredict® could identify failures in this data with at least 4 days of advance notice
- Improve visibility into the timelines and key contributing features for the known failures
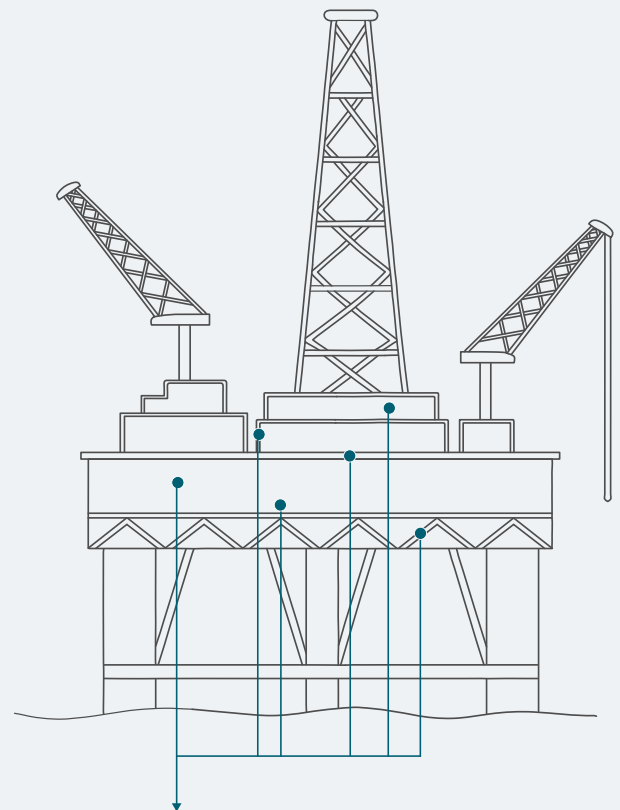
Applying unsupervised learning to detect anomalies for an offshore gas production system

- *Monitoring over 600 tags to anticipate production loss events*

SparkPredict® data scientists started with thousands of tags, including pressure, vibration, and temperature, and reduced these to about 130 useful tags per subsystem. This sample was further reduced via dimensionality reduction techniques to remove noise in the data. This high quality data set was used to build unsupervised learning models for each subcomponent that identify new, previously unknown operating states. With this information, a SME can predict and diagnose impending failures and prioritize work orders.

THE RESULTS

Within three months, SparkCognition had completed the unsupervised models that characterized the system behavior over the two years of given data. These are being used in production with notable successes:

With these promising results, the platform operator is expanding predictive analytics to other platforms in the Gulf of Mexico and North Sea in a phased approach over the next five years.
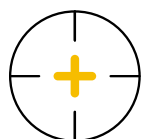
Accurate Detection of Operating States:

Using only the provided, unlabeled data, Spark-Predict precisely identified the signatures that define the various operating states of the asset. This includes being able to detect subtle irregularities, for example, periods of personnel training, which are not readily observable. Identifying these operating states adds to the credibility of the model and accuracy of clusters.
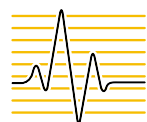
Improved Advance Failure Warnings:

During validation, SparkPredict accurately detected new anomalous clusters in blind data which mapped to unique, known failure events. The new clusters appeared with an average of 8 days' advance notice, exceeding the expectations set for the project.

Explainable Insights:

Accompanying these failure warnings are additional insights used by the engineering team to diagnose root cause and streamline repairs. For example, SparkPredict surfaced a prioritized list of data features pointing to issues in the glycol reboiler heater, disconnect switch, and export compressor.
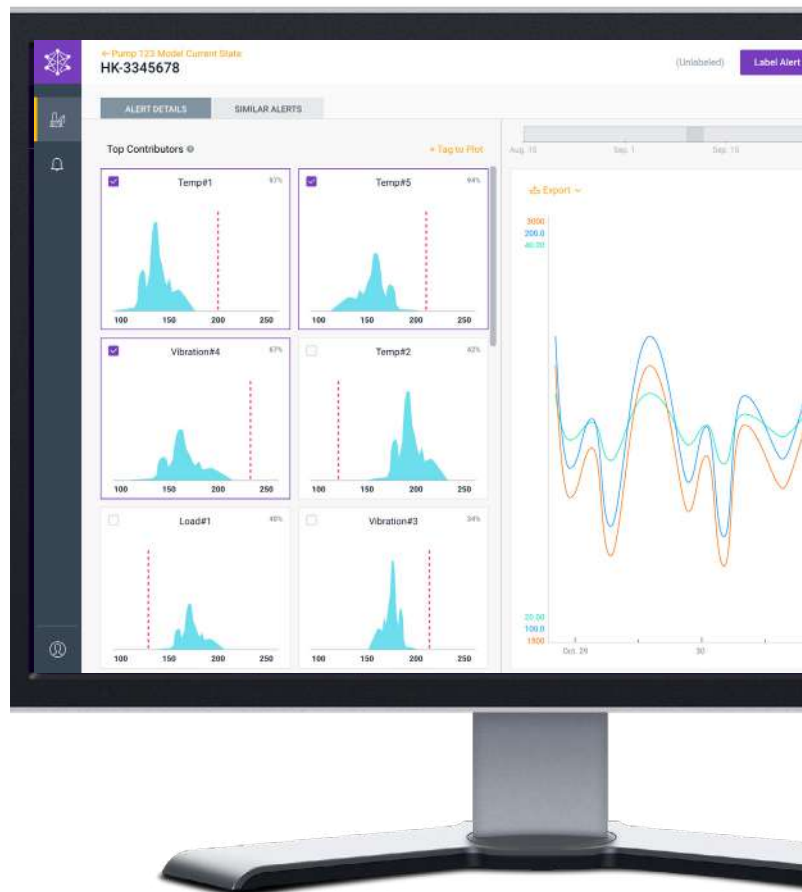
ABOUT SPARKCOGNITION™

SparkCognition builds leading artificial intelligence solutions to advance the most important interests of society. We help customers analyze complex data, empower decision making, and transform human and industrial productivity with award-winning machine learning technology and expert teams focused on defense, IIoT, and finance. For more information, visit www.sparkcognition.com
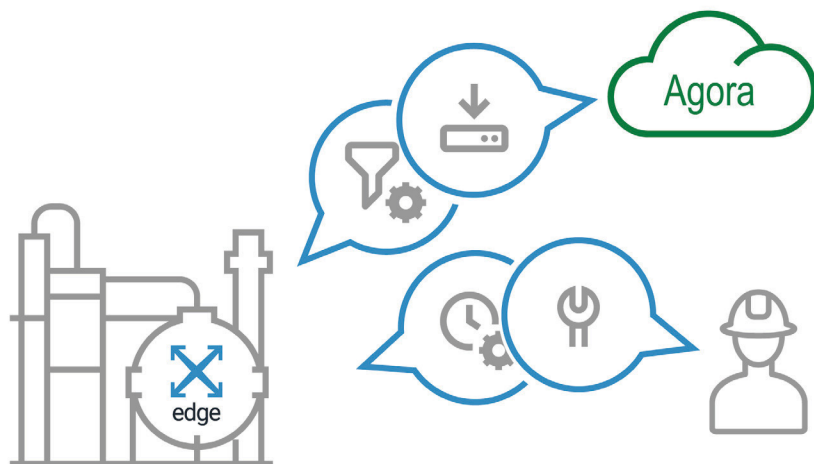
REFERENCES

https://www.mckinsey.com/industries/oil-and-gas/our-insights/why-oil-and-gas-companies-must-act-on-analytics

*30% of production is offshore per:
http://www.oilscams.org/offshore-vs-onshore-oil-drilling

Contact SparkCognition today at info@sparkcognition.com

Crosser Edge Analytics

In Partnership with:

In today's world, where operator's machines, equipment and devices are connected through local ethernet networks; it only makes sense for all relevant data to be aggregated and made available for computing analysis in real-time closer to where it is created.

IoT Edge Analytics – WHEN MACHINES TALK™

Crosser is a real-time analytics, automation and integration engine for streaming data designed to simplify Industrial IoT projects by removing complexity and bring OT, IT and Data Science teams together in one environment. The all-in-one solution helps you to get insights, take actions and build automations and integrations faster and at a lower cost.

1. Connect your IoT devices or other streaming or enterprise data sources
2. Transform, filter, clean and enrich your data
3. Add intelligent logic with event processing, conditions, custom code or ML models
4. Use actions to build workflows with triggers, alerts & notifications
5. Integrate to any Cloud services, storage and BI tools, SaaS Applications or enterprise system

Designed for Industrial and Enterprise IoT and applicable over a wide range of streaming data use cases, including:

- Condition monitoring of assets
- Operational KPI and OEE calculations
- Machine data to Cloud
- Vision based quality inspection
- Factory floor integration
- Machine to machine communication
- Deployment of AI and ML models
- Predictive maintenance
- Advanced automation workflows

Crosser Edge IoT Analytics is agnostic and fully flexible, and available for secure and scalable deployments on the Agora platform.

Agora Platform

Agora is an open, secure, and scalable platform which enables oil and gas industry to connect physical assets to the digital world. E&P operators face constant challenges of choosing the appropriate IIoT provider out of many that are coming from various industries. Agora is solving this challenge by working with multiple IIoT, automation, and instrumentation companies as well as application providers in order to create the biggest ecosystem of oil and gas specific applications in the Agora Marketplace.

Challenges
- Reduce bandwidth
- Collect and compute data from different machines in the field
- Take action on real-time insights and notify engineers/control board

Edge Solution
- All-in-one functionality for collecting and processing streaming data gives full flexibility for different use cases
- Low-code drag'n drop development for faster innovation without the need for software developers
- Full flexibility in data formats, no restrictions, neither in nor out

Benefits
- Get significant cloud, analytics and network connectivity cost savings.
- Edge Analytics allows you to collect more data points without increasing your cost of data.
- Run, autonomy from the cloud, local triggers between machines or PLC's with ultra-low latency.

AgoraInfo@AgoraIoT.com | www.AgoraIoT.com
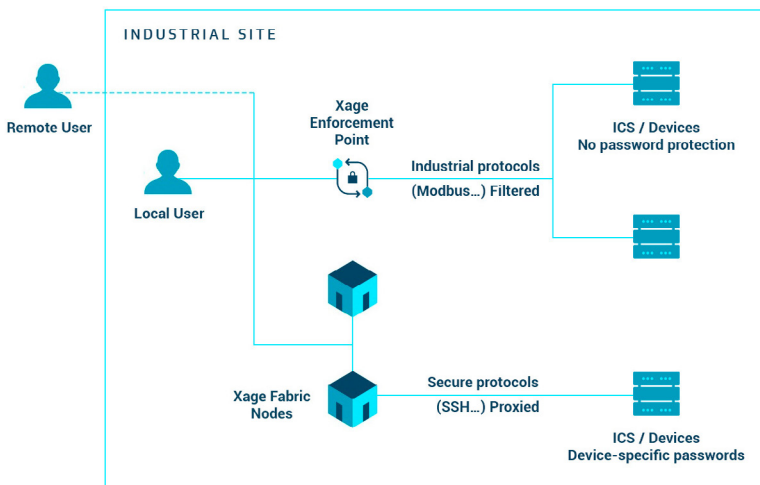
Cybersecurity

Deploy various elements of security for both edge computing as well as transmission and ingestion into a cloud environment.

Identity and Access Management

Agora

Identity management and access control enforcement for OT field devices, users, and apps

In Partnership with:

xage
S E C U R I T Y

Today, industrial operators are experiencing transformational change focused on autonomous data-driven, machine-to-machine IoT cooperation. The network-layer isolation security methods of the past are insufficient, exposing vulnerable systems to the risk of cyber-attack. Current security solutions provide limited visibility and security control over maintenance operations and industrial processes. As organizations and processes change, the only way to update credentials across the field may be to manually change them one-by- one. This creates an impossibly difficult and expensive task for operators, leaving systems vulnerable to cyber-attacks. Plus, misused credentials could result in financial and reputational loss.

Xage Security™ Identity and Access Management Solution

Xage's Identity and Access Management (IAM) services are delivered either wholly on-site, or via the cloud with additional on-site enforcement. They remain robust even if the network is breached, and cover a comprehensive array of IoT, SCADA, PLC, RTU and HMI systems together with the latest control and monitoring applications.

The Xage Security Fabric delivers a tamper-proof fabric that validates and controls every interaction, securing systems and data while protecting and simplifying digital transformation, Xage protects data and all equipment, delivering Zero Trust access, identity management, single sign-on, multi-factor authentication (MFA) and immutable data with in-field enforcement across the operation.

Xage delivers role-based access control services using a decentralized architecture, enabling uninterrupted service delivery over intermittent network connections without a central point of failure. The Xage Security Fabric uses consensus-based security techniques to ensure data confidentiality, enforce access restrictions and self-heal even if part of the network is compromised so the larger the deployment, the more secure the system becomes.

Agora Platform

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Challenges

- Varied systems & access methods
- Lost, stolen, and shared credentials
- Systems with fixed or no credentials
- Temporary access needs
- Internal & external staff turnover
- Multiple cyber management tools
- Diverse and insecure protocols
- Native control app requirements
- Operational data silos
- OT, IT &, cloud integration needs
- Limited visibility and control

Edge Solution

- Xage Fabric on Agora IoT platform
- Central access management
- Distributed in-field access control
- Single sign-on for ICS, IoT and legacy
- Support for Active Directory, LDAP
- Certificate & key management services

Benefits

- Site wide and Remote IAM
- Single Sign-On with Role-based Access Control and MFA
- Secure access to any asset from any location
- Access Control policies in fabric
- On-site, IT, cloud, or remote

Active Cyber Risk Management

Agora

The first purpose-built data lake for security

In Partnership with:

Oil and gas enterprises operate 24x7 across literally every corner of the world. These enterprises leverage a broad range of devices– including IoT, portable handhelds, and laptops – that may not have on-board security. Together, these factors make the Oil & Gas security exposure surface one of the highest for any industry. Yet, legacy security stacks are optimized for defending a datacenter's perimeter not a distributed and diverse environment.

Edge to cloud security with Agora and Prismo

Prismo Transaction Graph is integrated into Agora to provide an extra layer of edge to cloud security tailored for Oil and Gas environments. Prismo is the first distributed, federated data lake purpose-built for security at enterprise scale, providing Active Cyber Risk Management and enabling enterprises to protect IT infrastructure and applications while simplifying the security stack and reducing costs. Prismo builds a transactional view of entity activity, exposing security blind spots, minimizing attack surface, and detecting active threats in real-time without false positives.

Features include:

- Eliminate blind spots with a singular transactional view of the enterprise

- Enable 24x7 monitoring consistent with Oil & Gas operations

- Create proactive intent policies that prevent exposures

- Block cyber threats at trigger to give security teams breathing room

- Mitigate cyber threats efficiently, often with a single click

- Integrate with Oil & Gas systems and SOCs via Open APIs

Agora Platform

Agora is an open, secure, and scalable platform which enables oil and gas industry to connect physical assets to the digital world. E&P operators face constant challenges of choosing the appropriate IIoT provider out of many that are coming from various industries. Agora is solving this challenge by working with multiple IIoT, automation, and instrumentation companies as well as application providers in order to create the biggest ecosystem of oil and gas specific applications in the Agora Marketplace.

Challenges

- Distributed operations
- Multitude of devices supported
- Devices without on-board security

Edge Solution

- Prismo Transaction Graph installed on Agora edge IoT platform
- Agora device security

Benefits

- Fits seamlessly into Oil & Gas 24x7 operations
- Secure IoT devices
- Prevent exposures proactively
- Mitigate threats efficiently
- Integrate fully with IT and Security systems