Predicting Oil Well Failures without the Hazardous Area Restrictions of the Past

SIMULARITY & AEGEX CASE STUDY

aegex TECHNOLOGIES

simularity

Using Real-Time Analytics, Downhole Sensor Data, and Hazardous Area Tablets & Sensors to Predict Failures and Confront "Time to Failure" in the Field

Background

Current market conditions in the Oil & Gas industry require greater efficiencies to remain competitive, and uptime is one of the most important KPIs for an organization's sustained viability. When unplanned repairs or equipment replacement occurs, costing the organization two to three times more than planned maintenance and causing unexpected downtime, the inevitable question is, "what can we learn from this so that we can better anticipate in the future?"

In the last decade, due to the hazardous (potentially combustible) nature of Oil & Gas environments that restrict the use of most computing devices, operational data was largely being reported on paper and clipboard, and none of this data was being used for maximum operational benefit. Now, with the integration of intrinsically safe sensors and mobile devices like tablets, organizations are beginning to connect "everything," and use data from all component parts to form a better overall picture of an entire operation. With this insight, companies can use predictive analytics and artificial intelligence (AI) to better predict, plan and respond to anomalies, thus reducing cost and risk and improving overall safety and productivity.

"While automation offers many potential benefits in the upstream value chain of exploration, development, and production, some of the biggest opportunities are in production operations, such as reducing unplanned downtime."

- Digitizing Oil and Gas Production, McKinsey and Company

"Oil and gas companies are faced with intense pressure to deal with low oil prices. Now is a good time to tighten the belt and focus on becoming more efficient and working smarter. The companies that will survive and prosper are the ones that know how to ... apply analytics to improve operations output. If a company does not have operations excellence, they need to get it."

- Chris Niven, IDC Energy Insights Research Director

The Oman Incident:

On December 9, 2015, at 4:56pm local time, a Progressive Cavity Pump (PCP) driven oil well in Oman known as "AV0902" suffered a break in the sucker rod string approximately 4700 feet below the surface.

The unexpected shutdown required a completion workover service and replacement parts amounting to approximately $75,000. Industry average turn around for artificial lift repair is a week which also amounted to another 2,100 barrels of lost production.
(At $40 per barrel = $84,000)

The Solution:

Earlier in the year, AV0902 had been outfitted with an innovative permanent down-hole gauge system from GeoPSI. The gauges had 12 different sensors measuring intake and discharge temperature and pressures, downhole speed, rotor position, twist, downhole vibration, and more.

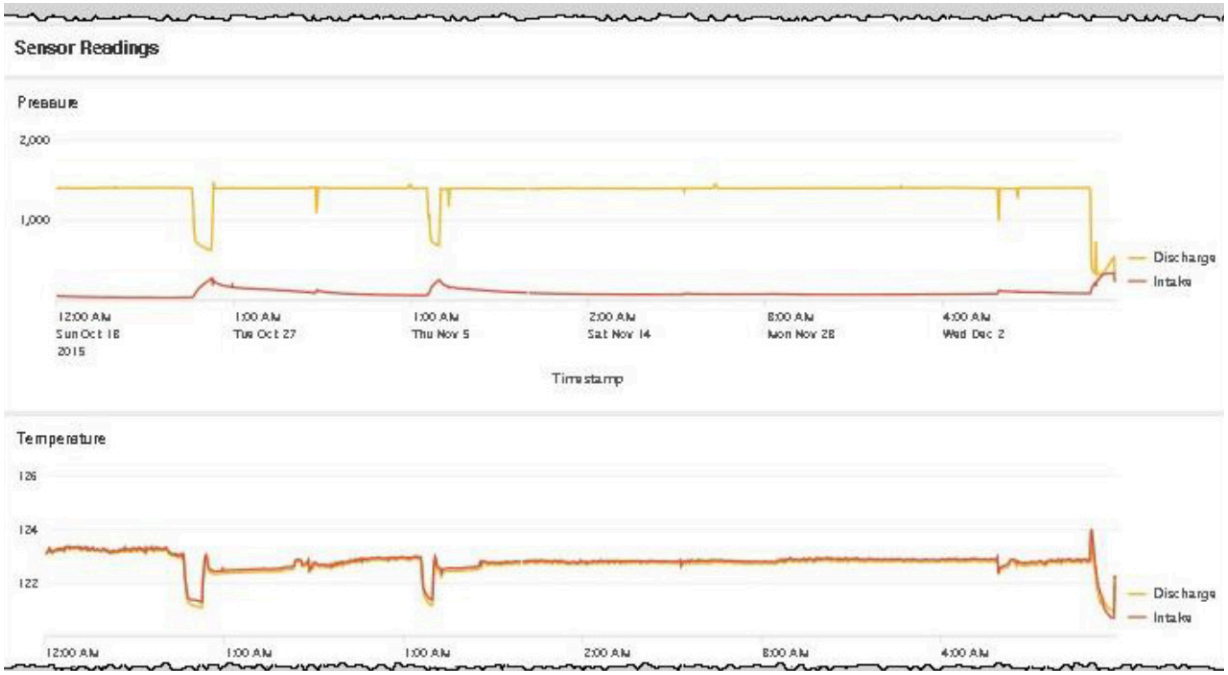
10/7/2015	5:05:00	46.5964	122.99	1405.31	122.954	0	0	1219826	1267396	1	109	151.135	15
10/7/2015	5:06:00	46.6906	122.99	1399.01	122.954	0	0	1219955	1267546	-1	148	151.146	13
10/7/2015	5:07:00	46.6138	123.008	1397.4	122.954	0	0	1220095	1267697	0	147	151.113	21
10/7/2015	5:08:00	46.5804	123.008	1397.55	122.954	0	0.051	1220245	1267849	1	180	151.121	14
10/7/2015	5:09:00	46.3657	123.008	1397.49	122.954	0	0.051	1220391	1267998	3	143	151.121	14
10/7/2015	5:10:00	46.4876	123.008	1396.26	122.954	0.053	0	1220531	1268150	2	125	151.141	13
10/7/2015	5:11:00	46.9764	122.99	1396.45	122.954	0	0	1220683	1268302	-1	180	151.132	15
10/7/2015	5:12:00	46.8255	122.99	1406.34	122.954	0	0	1220826	1268454	0	120	151.108	14
10/7/2015	5:13:00	46.5659	123.008	1398.13	122.936	0	0.051	1220976	1268603	2	112	151.103	16
10/7/2015	5:14:00	46.8589	123.008	1396.24	122.936	0	0	1221114	1268755	1	150	151.134	13
10/7/2015	5:15:00	46.9517	123.008	1396.78	122.93	0	0	1221259	1268907	1	109	151.116	13

The customer wanted to know:

- What caused the failure?
- Could it have been predicted and avoided?
- Were there other things happening deep in the well which still need to be investigated?

Simularity provided the answer. Based in the Silicon Valley area of California, Simularity has developed innovative software that can analyze large volumes of time-series data in real time at the edges of the network. By capturing real time data from multiple sources, the artificial intelligence software can 'learn' what's normal and predict incidents before they happen, including "time to failure" estimates and explanations for its conclusions.

For the AV0902 incident, Simularity's AI, running on an Intel-based server, analyzed the data for each GeoPSI sensor (see below) and learned the complex correlations between the sensor variables.



Aegex Intrinsically Safe Sensors and Tablets:

Additional sensors and tablets could have improved the situation resolution even further.
Specially designed Intel-based hazardous area sensors by Aegex Technologies could have provided additional data that may have helped predict and prevent the failure. Aegex sensors are certified intrinsically safe, meaning they will not cause a spark that could ignite combustible atmospheres present in the well. Had these been in place, they may have also detected changes in seismic vibration, the presence of any gases, and other factors that could only be measured with intrinsically safe equipment that does not pose an explosion risk. Such data, which may not be accessible by traditional sensors and equipment, can provide a more detailed, real-time picture of hazardous area operations that can be utilized to make improvements in processes and overall production.

In addition, Aegex10 Intrinsically Safe Tablets could have been used by personnel onsite or near the hazardous area, providing the ability to receive and view predictive user notifications. The Intel-based Aegex10 operates on Wi-Fi or 4G LTE from any hazardous location around the globe on a unifiedplatform. The 10.1-inch Aegex tablet is lightweight yet rated IP65 rugged for industrial use, and its Windows 10 operating system gives users uniform access to cloud-based apps and services. The tablets are globally certified intrinsically safe for Class I, II, III Division 1, and ATEX/IECEx Zone 1hazardous locations.

With the tablets, personnel could:

- **Open a Skype for Business line to speak and show directly**
- **Record video of the scenario**
- **Use Exchange/Outlook to email photos or other data**
- **Upload information to a cloud-based platform**
- **Reference digital manuals or other pertinent information**
- **Check maintenance records, permits or other relevant data**
- **Complete inspections onsite and upload data in real time**

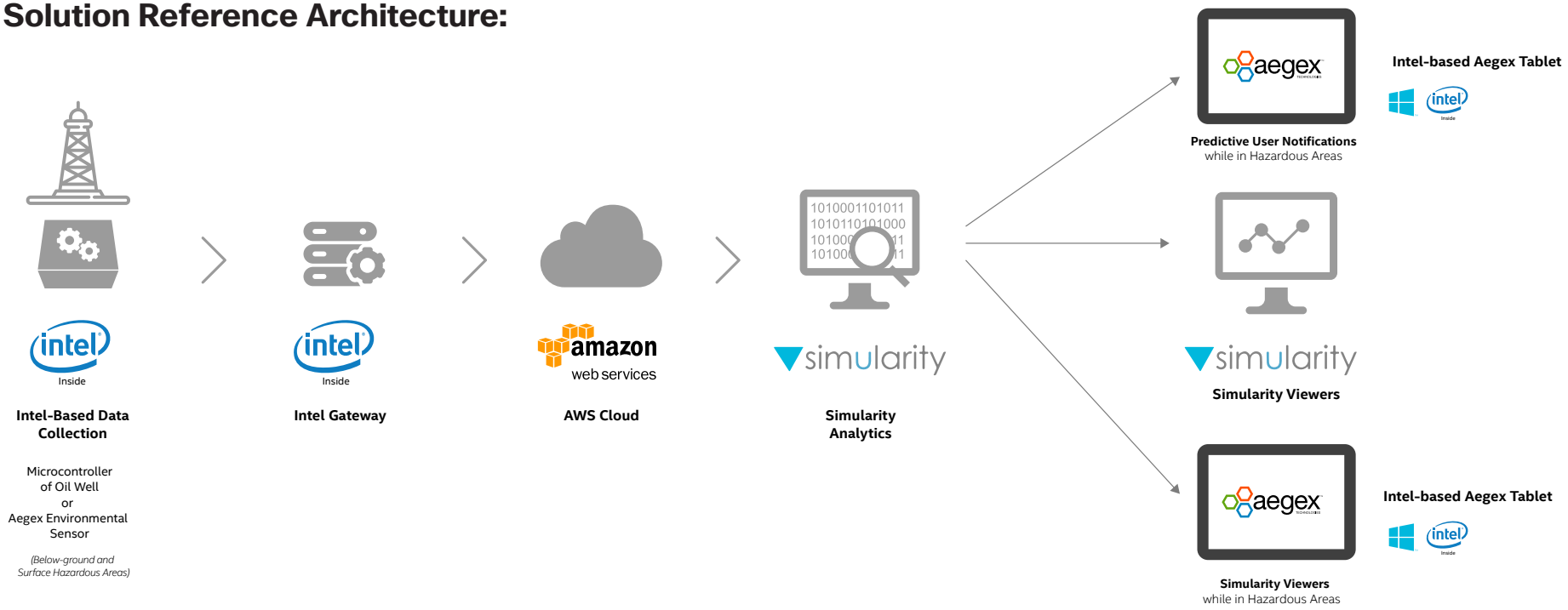
Bringing people with decision-making and problem-solving skills into hazardous areas with the Aegex tablet can help in anomaly response and failure prevention, as they can interact in real time with sensors and other equipment to ensure proper functionality and potentially avert problems.

Results:

Above is a chart of Simularity's Predictive Failure Signature for the sensor data preceding the failure. After a period of normal operations, two significant alerts appear 45 and 33 days in advance of the failure. Had the customer known beforehand that this failure was looming (Alert 2), things would have been different:

- The downhole artificial lift system could have been re-programmed to operate differently to avoid stressful situations that can cause sucker rod string failure.
- The meantime between failure could have been extended improving the operating expenditure of the Oman production field.
- Artificial lift repair and workover costs could have been planned more effectively to reduce lost production.
- Aegex Intrinsically Safe Tablets could have been deployed to reduce employee and management stress and lower the chance of on-site mistakes.
- Real-time feedback and field modifications could have been invaluable.
- Simple digital communications could have avoided additional on-site complications.
- Onsite access to engineering diagrams and specifications could have proven invaluable.
- Aegex Intrinsically Safe Sensors could have been deployed to detect surface temperatures, vibrations, and gases, providing additional enhanced, real-time data relative to the potential failure.
- Additional sensor stimuli could have been available, leading to better on-site employee awareness and additional safety measures.
- Simularity AI could have potentially determined other possible, or predicted the failure even further in advance with data from Aegex sensors outside the down-hole system.
- Additional Hazardous Area sensors could have been deployed to better predict other anomalies that not only impact potential failures, but increase risk to personnel and assets.

Solution Reference Architecture:



"Our AI was designed to predict incidents by looking at large volumes of real time sensor data – the kind of data that is generated by the Internet of Things. We are excited to work with the Oil and Gas industry in helping our clients realize significant savings through applying our AI to achieve production efficiency and reduce maintenance costs. Aegex sensors and tablets are a great fit for companies looking to improve safety and reduce costs."

- Liz Derr, CEO, Simularity

Conclusion:

Had Simularity's AI been in place, monitoring the sensor data in real time, the artificial lift system could have lasted longer and repair turnaround could have been quicker. This is particularly true when having the extra capability to capture data in the surface area Hazardous Locations, leading to additional key data for analysis.

Had Aegex intrinsically safe sensors and Aegex intrinsically safe tablets been utilized, not only would additional crucial data have been accessible onsite, but anomalies could have been addressed more quickly and efficiently. Failures may have even been averted completely with real -time information from the most crucial areas of the operation.

Companies already deploying IoT are gaining significant competitive advantage in both knowledge and operational costs over slower adopters. With predictive analytics and AI that is accessible anywhere in a hazardous location via intrinsically safe sensors and mobile devices, actionable data from a comprehensive Internet of Things can help transform Oil & Gas organizations into Industry 4.0 operations.

"The ability to view all areas of a hazardous location operation in real time with intrinsically safe sensors, combined with the means to instruct personnel to address any problems on the spot via a safe mobile device, makes troubleshooting and issue resolution much simpler and quicker. Aegex solutions are a great complement to Simularity's AI, and together, they can truly help prevent catastophes."

- Thomas P. Ventulett, CEO Aegex Technologies

Contact Aegex or **Extronics** to **learn more.**

About Extronics:

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A Silicon Valley based software company that focuses on artificial intelligence, embedded software, and predictive analytics for the industrial Internet of Things. Simularity's software
runs on Intel-based servers, gateways, and microcontrollers
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About Aegex: A technology engineering and design company that provides intrinsically safe Industrial Internet of Things (IIoT) and mobile solutions for hazardous industries. Our globally certified intrinsically safe Windows 10 tablet, sensors and partner monitoring systems, form an IoT platform that manages big data to improve efficiency, safety and productivity in hazardous industrial environments in oil & gas, chemical, pharmaceutical, utilities, public safety, defense and other industries with potentially explosive atmospheres.

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