ARC WHITE PAPER

By ARC Advisory Group

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Asset Performance Management Overcomes Challenges in the Oil & Gas Industry

Introduction

With the dramatic drop in energy prices in recent years and the resulting pressure on operating companies to maintain profitability, the global oil & gas industry faces unprecedented challenges to reduce costs without increasing risks, especially risks related to safety or unplanned downtime. At the same time, as older, more experienced employees begin to retire and the next generation of workers are just starting to "learn the ropes," the looming skills gap is beginning to hit the industry hard, since much of the uncaptured knowledge remains with those retiring employees.

This white paper draws upon recent ARC research in which we interviewed a representative sampling of asset performance management professionals in upstream oil & gas companies. They identified several specific challenges they face today.

In this cost- and human resource-constrained environment, operating companies in upstream oil & gas struggle to maintain regulatory compliance, ensure employee safety, maintain continuous uptime, and sustain their varied and often far-flung and/or aging production and automation assets. This is particularly problematic for the handful of professionals within each organization responsible for managing, sustaining, and improving asset availability, performance, utilization, and safety. In many cases, same these individuals also have other roles and responsibilities that must be performed in parallel.

Asset performance management (APM) can save companies in the oil & gas industry a significant amount of money by increasing maintenance efficiency and effectiveness, avoiding costly unplanned downtime, minimizing the need for scheduled downtime, and maximizing equipment availability, all while increasing safety. APM also provides a mechanism to reduce regulatory compliance cost and effort and minimize the risk of non-compliance.

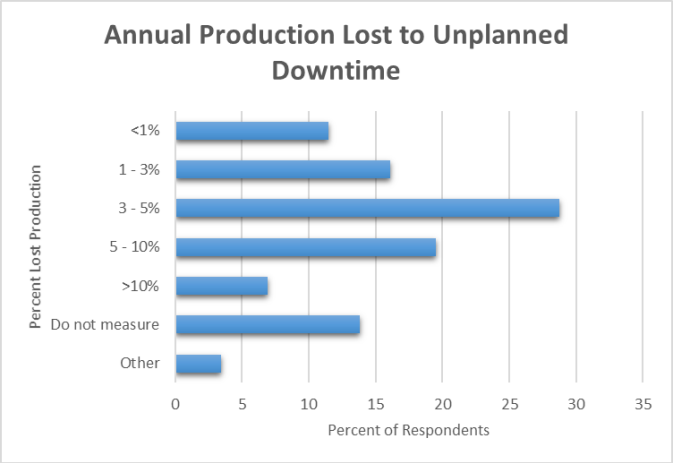
Today, too much time and effort is required to collect, aggregate, condition, and analyze the abundance of available data, much of which often gets lost, rather than converted to meaningful information to manage the business. This is due in part to too many different software solutions, poor integration between them, a lack of openness and standardization, and difficulty creating and maintaining these integrations. Modern APM solutions can alleviate this. A modern approach built on data collection and analysis enables oil & gas companies to develop new techniques that result in greater

efficiencies, improved safety, less unplanned downtime, better yields, less operational risk, and increased production flexibility.

These solutions, based largely on today's increased connectivity, use of open standards, and increasingly more capable platforms for predictive and prescriptive analytics, enable oil & gas companies to move from largely reactive, conventional approaches for managing their critical production and automation assets to today's far more effective proactive and predictive approaches.

Asset Management Challenges in O&G

Upstream oil & gas is an asset-intensive industry in which new wells are drilled and new production assets installed in increasingly remote and/or hostile locations on land, offshore, and even on the seabed. When something goes wrong without advance warning at these remote production sites, the parts and expertise needed to resolve the issues are not necessarily close at hand. This can result in significant and costly production downtime and can potentially create serious safety or environmental issues.



Impact of Unplanned Downtime on Production
(Source: ARC Survey of Senior Executives and Engineering, Operations, and Maintenance Managers in Oil & Gas)

According to a senior manager responsible for maintenance and reliability at an upstream oil & gas business with global operations, "Our company is constantly fighting fires, with maintenance running around replacing equipment left and right, rather than putting long-term asset management plans in place. In general, we're too quick to manage symptoms, rather than performing root cause analysis." ARC's research has found this to be an all too common sentiment.

At most upstream oil & gas production sites, scheduled maintenance based on the calendar, run times, or number of cycles is routinely performed. To minimize unplanned production interruptions, this routine maintenance is

usually done during planned maintenance outages. Non-critical assets are typically allowed to run to failure.

APM Improves Asset Reliability and Availability, Reduces Cost, and Reduces Operational Risks in the Demanding Oil & Gas Industry

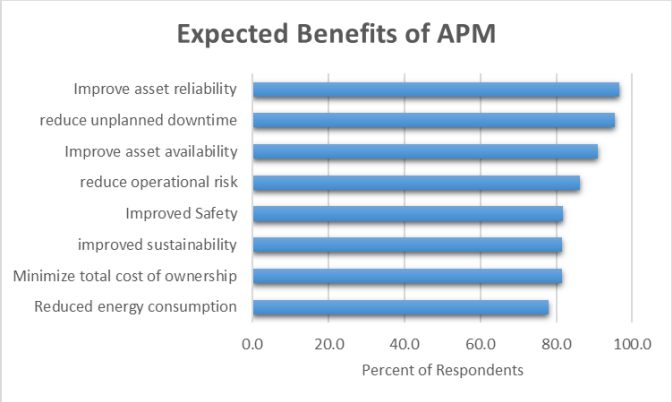
Because different assets have different maintenance requirements and individual sites have different operating, process, and/or environmental conditions, performing routine maintenance this way often leads to unnecessary maintenance being performed – based solely on the calendar or total runtime. Not only does this create unnecessary cost and effort, but as we learned from an operations manager at a pipeline company, "Most of the time, whenever you touch a piece of equipment, you cause two maintenance cycles, one planned, and one unplanned." This problem, created when performing routine maintenance not driven by predictive analytics, often causes more harm than good regarding downtime and costs.

While leading oil & gas companies already monitor much of their large rotating equipment, they don't necessarily employ effective business processes to take advantage of that monitoring. According to that same senior maintenance manager, "We do a lot of monitoring on rotating equipment, but are often reactive rather than proactive when it comes to asset management." This reactive versus proactive response to issues and problems was another common denominator that ARC's research uncovered in the oil & gas industry.

As the senior maintenance manager explained, the problem is not a lack of data or software applications, but too much data without context and too many disparate and segregated applications. "We spend 75 percent of our time manually collecting data, rather than performing value-adding activities. We also see poor integration between many of the available tools, when what we need is an integrated dataset within one larger program or solution." Often, this manual data collection is done hand-written on a clip board and entered into an Excel spreadsheet on a PC, with widespread issues ranging from illegible handwriting to keyboard errors causing decisions to be made based on the wrong data.

Too much time and effort is required to collect, aggregate, validate, and analyze data. This is due in part to too many different software solutions, poor integration between them, a lack of open standards for connectivity, and difficulty creating and maintaining these integrations.

An example of manual data collection and software integration challenges can be found at an upstream operating company in Canada, which requires its people to manually upload asset information to the ERP system. Due to this lack of interoperability, there's often no smooth flow of asset information from project engineering to the owner-operators' operations and maintenance groups. This is a key issue identified in ARC's extensive research in asset performance management (APM) and one that hampers operations and maintenance productivity costs at many oil & gas organizations.



Major Benefits Expected from APM in Oil & Gas
(Source: ARC Survey of Senior Executives and Engineering, Operations, and Maintenance Managers in Oil & Gas)

According to an engineer at a global integrated energy company, "Equipment and machine health will determine availability, so we monitor large rotating equipment proactively. While we would like to use a similar approach for field devices, we struggle with the large number of devices installed and the large amount of data involved."

According to an operations manager at a US-based midstream company, "Moving to 100 percent reliability is astronomically expensive; we're aiming for 99.8 percent, since it's critical that we keep our [single] pipeline full. Predictive maintenance must be performed efficiently, in other words, only focused on critical assets." Oil & gas companies must balance the return on every investment, which sometimes leads to avoiding measuring and monitoring certain assets that are less mission-critical to uptime or safety.

Data and Analytics Help Improve Asset Management in Upstream Oil & Gas

Most oil & gas companies still tend to make decisions based on habitual ways of doing things, tribal knowledge, rules-of-thumb, and the opinions of

in-house experts. This approach has worked well enough until now, but is becoming increasingly risky in today's dynamic, information-driven environment, especially as these in-house experts retire. Without data and analysis, suboptimal performance will likely continue and new options won't become apparent. A modern approach built on data collection and analysis enables companies to develop new techniques that result in greater efficiencies, improved safety, less unplanned downtime, better yields, less operational risk, and increased production flexibility.

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Asset data provides value on multiple levels; both to help ensure uptime and to justify the value of maintenance activities and investments for which senior management often does not have visibility into. One operations manager said, "The daily equipment review is time consuming, but necessary. Our challenge is to ensure that upper management continues to see the value in this." Surely one way to deal with this is to use a common APM solution to collect, analyze, and visualize the data from all the critical assets. With one trusted source of information, the daily equipment review can be quick and effective. And if the system can help predict problems in advance, the meetings can be optimized further.

"Another challenge is that management makes [investment] decisions based on data – but they don't know where the data comes from." A common APM solution that provides a single trusted source of information would solve that problem.

According to a professional we interviewed from the engineering group at an exploration & production (E&P) company with multiple sites around the world, "Everything we do has to either increase productivity or reduce cost. If we don't have the information [we need] readily available, it becomes very costly and cumbersome." No oil & gas company will make any investment that does not increase productivity, reduce costs, or have a short, measurable ROI.

Commented to the senior manager responsible for maintenance and reliability at an upstream oil & gas business with global operations, "Our data is not getting analyzed in all cases. In one example, when the company let go a particular individual, we had no idea what he was responsible for or what

he was doing. When responsibility for data analysis is based on an individual, rather than a program, analysis happens by accident, rather than by a rigorous program." This type of distinction can be critical when looking at the value derived from asset-related data, and is most critical today with the number of senior individuals who are retiring and taking that undocumented knowledge with them.

Cloud Adoption in Upstream Oil & Gas

The reliability consultant at a major global integrated energy company commented, "I think the cloud is coming. I don't think anyone can stay away from it, but they [the IT group] want to be absolutely sure that the data is secure and available." His conjecture was that his company's offshore business unit would be likely to be the first to "go to the cloud."

Oil & gas companies are under increasing pressure to deliver business value from capital investments while ensuring the safety of workers and driving out cost. Information technologies have long played a role in this, but it has become attractive for these companies to consider externalizing their IT infrastructure to cloud service models.

And according to a professional from the engineering group at a global E&P company, "Our IT group has restrictions on cloud use [due to questions about data security], but does allow a private cloud for our asset reliability data."

Oil & gas companies are under increasing pressure to deliver business value from capital investments while ensuring the safety of workers and driving out cost. Information technologies have long played a role in this, but it has become attractive for these companies to consider externalizing their IT infrastructure to cloud service models. With this new paradigm of cloud-based software, the IT service delivery model extends outside the traditional data center located at a plant or corporate facility. Public cloud and hybrid cloud are swiftly moving front and center in reshaping the plans of plant staff, CEOs, and technology providers alike.

Today, the factors that differentiate profitable operations in upstream operations include how rapidly they can adopt technology, improve work processes, eliminate waste, and increase technical agility.

With the cloud, oil & gas companies can accelerate technology deployment and create a business environment that supports agility and rapid deployment. This approach minimizes common support headaches associated with plant software and related IT infrastructure, greatly enhances agility, and offers potentially limitless capability to provide the underlying infrastructure for applications ranging from the well to remote locations on land and offshore, including resource-intensive advanced analytics and operational solutions.

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Security Concerns Linger

Obviously, there are still concerns about the use of cloud technology in upstream oil & gas, even though these systems are often more secure than standalone systems. According to the operations manager at a US-based midstream company, "Big Data is becoming much more cloud-centric. In the past, device data was communicated over two wires via HART for remote monitoring. But how do you centralize the data and make it easily accessible, yet secure for everyone?"

According to another interviewee, "Our IT group believes in the Cloud, but is concerned about hacking. They also appear to shy away from wireless technology." Obviously, cyber- and wireless-security remain a major concern for remote monitoring across the oil & gas industry.

Summary and Recommendations

By helping prevent asset-related safety or environmental incidents, APM helps oil & gas companies avoid both related monetary fines and even more costly long-term damage to a company's reputation. In this manner, APM can help increase the company's attractiveness as a potential supplier, partner, employer, and investment opportunity. It can also often make it easier for an operating company to obtain insurance, and thus lower its annual

insurance premiums. According to a facilities engineer at an upstream energy company with operations in several countries, "APM provides a clear and defensible case for [obtaining] insurance and enables companies to manage this on a global basis."

Operating companies can expect to reap huge benefits from APM. But at the same time, implementing APM typically requires significant time and effort as new work processes are developed, enabling technology is put in place, and employees are trained and adapt to a new way of looking after their instrumentation, systems, pumps, motors, compressors, turbines and other equipment assets. Until recently, these systems have often been difficult to justify up front, but an investment in asset performance management can often provide a rapid ROI, especially with modern APM solutions.

Effective asset performance management, supported by the appropriate IIoT-enabled sensing, data collection, data aggregation, and analytics technologies and solutions, can provide oil & gas companies with that information.

Based on the growing body of actual use cases, ARC believes that IIoT-enabled predictive solutions for asset performance management can provide significant business value for owner-operators in the oil & gas industry.

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When well integrated into the larger automation and information environment with reliable, secure communications, today's APM solutions can help companies take advantage of opportunities in shale oil and gas, ultra-deep water, subsea, and other "unconventional" upstream applications. In addition, a wide variety of midstream and downstream applications can also benefit from securely integrating APM data with a variety of plant and enterprise applications.

As previously mentioned, these APM solutions, based largely on today's increased connectivity and increasingly more capable platform for predictive and prescriptive analytics, enable oil & gas companies to move from largely reactive, conventional approaches for managing their critical production and automation assets to today's far more effective proactive approaches.

These are designed to maximize asset availability, performance, and utilization to help improve overall business, environmental, and safety performance across the upstream oil & gas industry.

Based on the challenges identified in this research, an effective APM solution should be both modular and scalable, as well as able to:

- Help users create and maintain an intelligent asset strategy based on equipment criticality and actual condition
- Ingest, validate, and manage large volumes of data
- Support use of advanced analytics to help predict critical equipment failures in time to prevent unplanned downtime or abnormal conditions
- Be built as a native cloud application; but deployed as a private cloud if this is more appropriate
- Support robust security

GE has assembled a comprehensive set of APM capabilities for the Oil & Gas industry based on the requirements identified in this paper. To learn more about GE's APM solutions powered by Predix, GE's operating system for the Industrial Internet, contact GE Oil & Gas at: http://info.geoilandgas.com/APM_Upstream.html

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Acronym Reference: For a complete list of industry acronyms, please refer to www.arcweb.com/research/pages/industry-terms-and-abbreviations.aspx

API	Application Program Interface
APM	Asset Performance Management
B2B	Business-to-Business
BPM	Business Process Management
CAGR	Compound Annual Growth Rate
CAS	Collaborative Automation System
CMM	Collaborative Management Model
CPG	Consumer Packaged Goods
CPM	Collaborative Production Management
CRM	Customer Relationship Management
DCS	Distributed Control System
EAM	Enterprise Asset Management
ERP	Enterprise Resource Planning
HMI	Human Machine Interface
IOp	Interoperability
IT	Information Technology
MIS	Management Information System
OpX	Operational Excellence
PAS	Process Automation System
PLC	Programmable Logic Controller
PLM	Product Lifecycle Management
PdM	Predictive Maintenance
RFID	Radio Frequency Identification
ROA	Return on Assets
RPM	Real-time Performance Management
SCM	Supply Chain Management
WMS	Warehouse Management System

Founded in 1986, ARC Advisory Group is the leading technology research and advisory firm for industry and infrastructure. ARC stands apart due to our in-depth coverage of both information technologies (IT) and operational technologies (OT) and associated business trends.

ARC analysts and consultants have the industry knowledge and the first-hand experience to help our clients find the best answers to the complex business issues facing organizations today. We provide technology supplier clients with strategic market research, and help end user clients develop appropriate adoption strategies and evaluate and select the best technology solutions for their needs.

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