EFFICIENT PRODUCTION REAL TIME DATA.
ACHIEVING OPERATIONAL EXCELLENCE IN THE CONNECTED ENTERPRISE

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Abstract

Operational Excellence seems an elusive goal for Oil and Gas operating companies. Growing mounds of data, equipment reliability issues and overwhelmed operations personnel create risks that may prevent equipment from running as designed, ultimately standing in the way of achieving desired production goals. The presentation will address how to reduce production downtime risks caused by complex graphics, excessively enthusiastic alarming strategies and lack of live data for subject matter experts in the organization. It will also be presented approaches to deploy affordable subject matter oversight through carrying automation concepts to cloud computing. In addition, it will be highlighted some example projects and share our experience.

Introduction

When it comes to Overall Equipment Effectiveness (OEE), oil and gas producers have historically lagged behind world-class operations by about 10 or more points.[1] OEE is a measure of how effective equipment performs its function and depends on a number of factors, including efficiency, availability and throughput. Of these factors, availability seems to impact the oil and gas industry score the most, largely because of unplanned downtime.

Improving or even maintaining OEE performance will only become more difficult as companies employ increasingly complex extraction methods. For example, more advanced systems used on the ocean floor and to capture diffuse hydrocarbons from tight geological formations can require operators to interface with more than 200,000 tags of data and resulting alarms.

A growing skills gap is further complicating matters. Oil and gas companies' older and often most-experienced workers are moving toward retirement. And qualified talent is increasingly hard to come by. Oil and gas executives have listed skills shortages as the number one or two barrier to growth in three of the last four years.[2]

Additionally, the legacy systems in place today are largely unconnected. This denies companies from one of the most important elements for managing complex operations and improving OEE: their own information.

Connected, information-enabled operations can provide a new wealth of operational information to help companies better understand and optimize their operations. They also support the creation of more collaborative environments, where remotely located experts can drive real-time decisions and trained operators can apply those decisions.

Moving to The Connected Enterprise

The Connected Enterprise connects people, processes and technology, enabling the creation of digital oilfields, pipelines and refineries. It also allows companies to access and monitor assets in real time, and convert disparate oilfield data into streams of actionable information.

Leading oil and gas companies already are using these capabilities to capture the full value of their asset data, improve collaboration, accelerate production and more.

Building a Connected Enterprise requires converging information technology (IT) systems with operations technology (OT) systems into a unified network architecture. It also requires the use of integrated control and information solutions, such as by embedding smart devices in wellheads, on compressors and pump stations, and within refineries.

Improving System Interactions

Traditional control approaches involve a large data network that runs at whatever speed the system server can handle. In order to create applied automation systems that address the requirements, oil and gas companies must consider how the process systems and subsystems interact. They then must determine the response times required to contain catastrophic events or temporarily control hysteresis within the affected system or subsystem.

Designing an automation system for optimal operational efficiency requires several considerations, including:

- Total loop response times to achieve effective system and subsystem control
- Graphics strategies to simplify operator interactions
- Alarming strategies to help operations personnel see only what they need to know and act upon
- Controller sizing and utilization rates to maintain desired loop response
- Network design to avoid bottlenecks and permit controller interaction irrespective of server speed
- Selection of a technology horizon to create a secure environment for operations
- Treatment of subsystems as peers, and avoidance of stacking systems

An automation-system project's front-end engineering and design (FEED) phase requires careful consideration of how systems interact.

Traditional control systems on a given unit are often loaded to the point that optimal response times within a unit approach 500 ms. The controllers are then connected on a network that can only work at the speed of the network's server. This response time is typically in the two- to five-second range.

Using a water treatment sub process as an example, if the unit takes a temporary surge in water, the other systems need to throttle back relatively quickly. But communicating the challenge across the automation system can take longer than the 200ms time slot of the water challenge propagating upstream on the vessel. This leads to downtime on the vessel because the end-to-end loop response time is hindered by the speed of network, which is controlled by the server.

Consider how one operator addressed this challenge in an offshore operation:

> A complex offshore platform incorporated a safety system, motor control system, and power and energy management system from Rockwell Automation. A large, complex distributed control system (DCS) managed all of these systems. Extensive use of Ethernet also was designed into the system.
>
> The energy management system and the motor control system communicated as peers on an Ethernet network. The safety system featured dedicated inter-processor Ethernet connectivity, and each of these systems leveraged data sharing with the DCS for operational interfacing.
>
> The resulting performance dramatically improved compared to the previous project. Safety system interaction from subsystem to subsystem occurred in less than 50 ms. Interaction between the energy management system and the motor control system also occurred in less than 100 ms. And the end-to-

end response time for a DCS operator to operate a pump, and see a result on the screen, was two seconds or less.

How was this success achieved? During the design phase, a technology horizon beyond what was available at FEED was selected. The networks were carefully planned to optimize performance and network-data optimization during the project-build phase as opposed to during commissioning.

Reducing Operational Risk

Figure 1 demonstrates a traditional HMI approach: put as much information on a screen as possible and provide the same view to operations. Each device shown had the ability to generate two to four alarms, and could drill down for trend information and other point-display data.

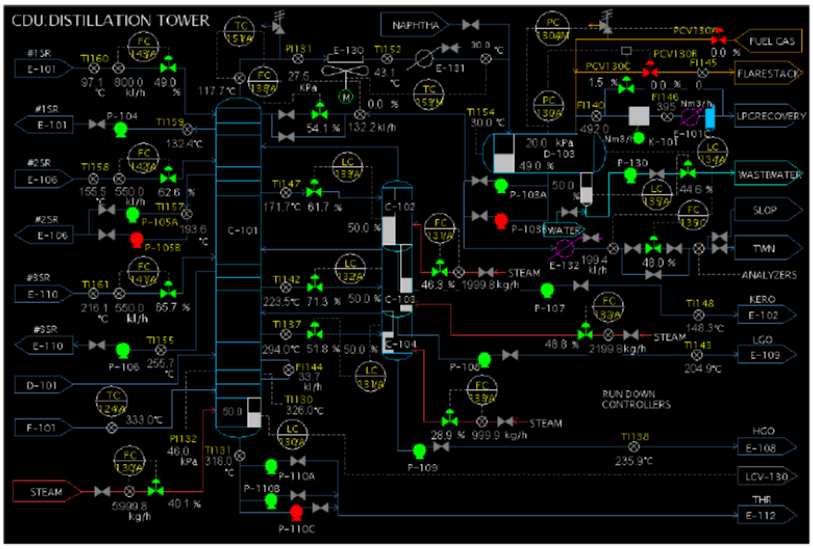

Figure 1. DCS Screen Shot Circa 2000[3]

It's not hard to imagine an operator on the night shift who operated on this screen becoming fatigued and missing an alarm. Additionally, alarm summaries required a separate screen. That screen was often displayed on the wall in the control room, and the volume of alarms also was overwhelming.

Figures 2 and 3 show alternative display approaches. These operator screens were designed to provide information that would help operators be successful in their roles. Multi-dimensional graphics, trends and gauges help quickly demonstrate operational conditions and reduce operator fatigue.

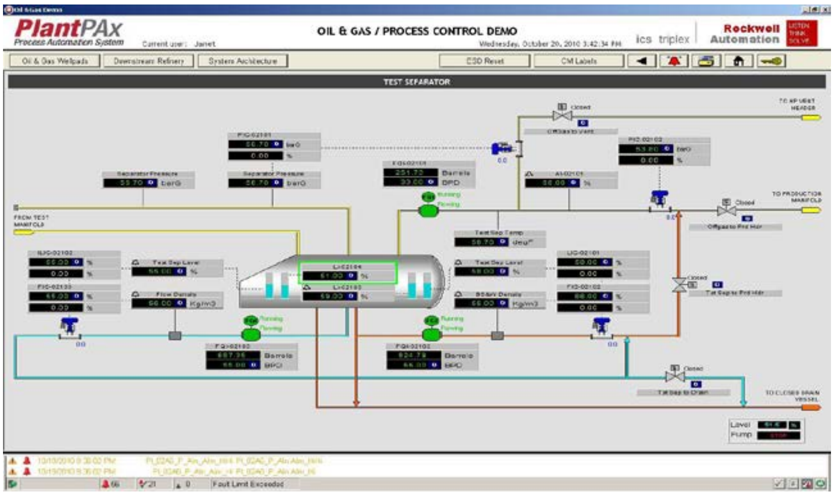

Figure 2. A separator screen with measurement data readily available

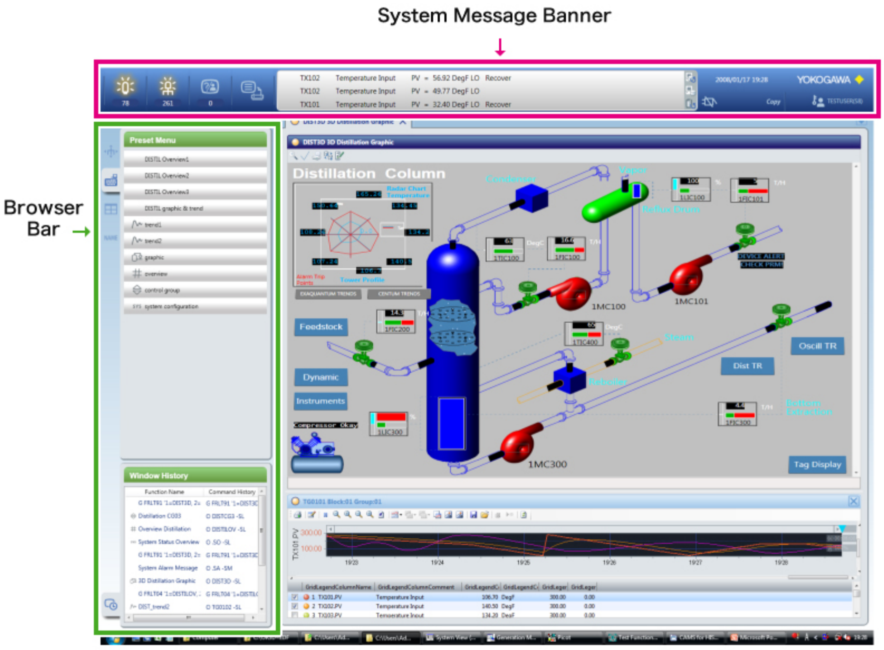

Figure 3. A distillation column displaying critical data readily accessible

Transitioning to Improved Reliability

Traditionally, engineering or maintenance has to build a spreadsheet, hunt down data, manipulate it and sort through it to find a system issue’s root cause. This lost time can lead to increased downtime.

Role-based visualization and reporting, paired with the automation of non-productive work, creates an environment that drives collaboration and improves performance. Additionally, web tools help empower workflow automation and collaboration. For example, simple browser access allows personnel to collaborate using personal computers and mobile devices.

The question is: do oil and gas companies build the technology within their firewalls or take advantage of cloud computing technology? The answer requires a broader view of data usage and data strategies. To achieve reliability and efficiency targets leveraging available data, companies must develop data strategies that address a number of considerations.

For instance, is the data required for collaboration also governed by regulatory or investor expectations? If so, an enterprise should consider holding the data within their corporate structure and investing in infrastructure to store and present it. However, capital budgets and IT resources can limit the ability to build the systems required to achieve the desired collaboration. Purchasing the applications as a cloud-based service can speed up the path to collaboration with a pay-as-you-go model.

Moving to the Cloud

Figure 4 provides a view of the key components of cloud computing. The left side shows the classic model of software installed on enterprise-owned infrastructure, where infrastructure and operating systems are owned. With each subsequent column to the right, less infrastructure is owned by the enterprise.

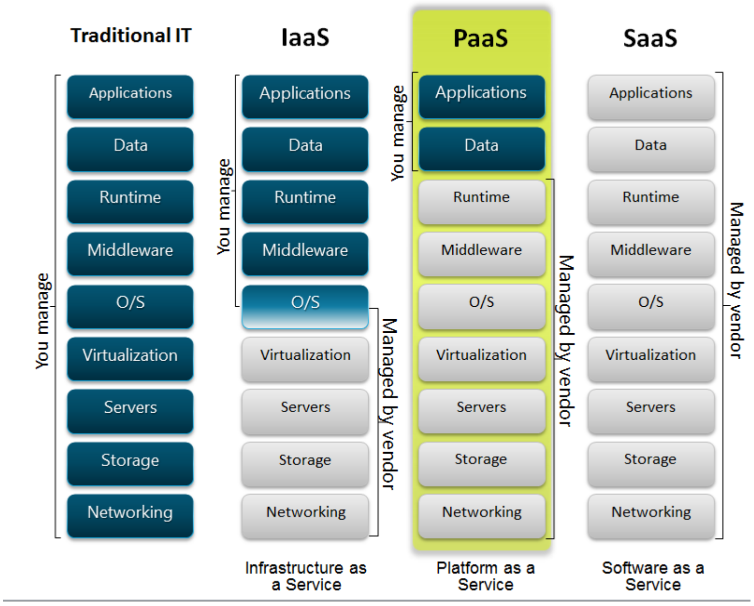

Figure 4. Cloud Computing Taxonomy

Purchasing software as a service enables organizations to move faster into the realm of operational excellence through better utilization of existing data. Purchasing operations management tools as a service avoids using capital budgets and specifically circumvents issues of funding across assets. Services are paid for as they are used with operating budgets.

Utilizing cloud computing to share operating conditional data creates an environment for operational improvement. "Private clouds" leveraging the same technologies can be deployed if an enterprise has considerations that require all of the data to remain within their enterprise, such as regulatory or investor compliance.

Before using data to drive collaboration between disciplines, companies must first develop a data strategy. Some data, such as safety records, testing records and flow records, are regulated and have mandated storage. Other types of data have storage and security requirements. In the case of investor or regulatory data, companies most likely need to hold the data within their structure.

Automating Workflows

Technology helps significantly reduce non-productive operations while presenting the data in a way that drives personnel to focus on areas where they can impact the business to improve efficiencies. Figures 5 and 6 show an example of workflow automation and the resulting dashboard presented to personnel containing role-rich information. This can help improve operator effectiveness.

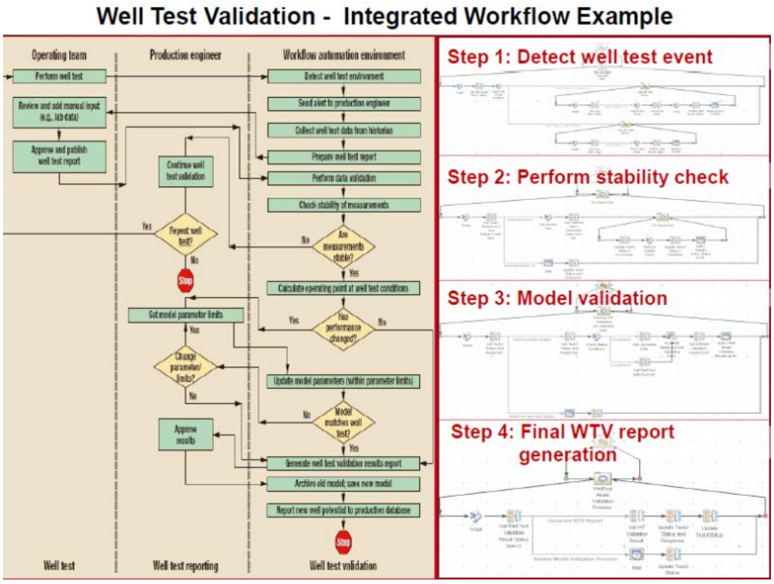

Figure 5. Well test work flow

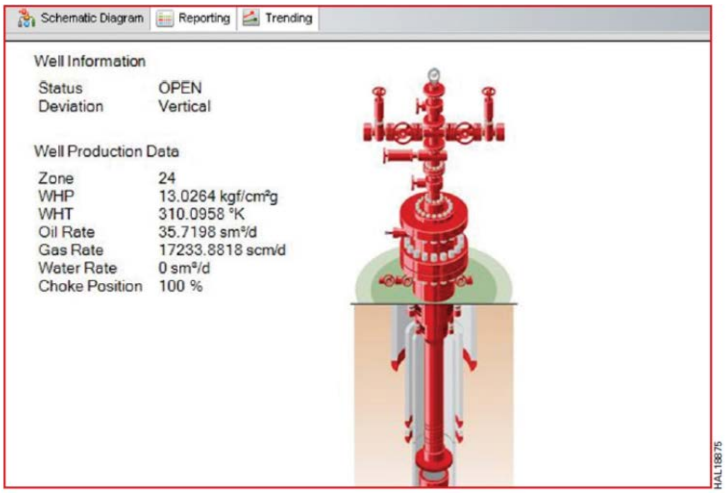

Figure 6. Well data presented to the operator

This is an example of more than 65 workflows automated on a floating production storage and offloading (FPSO) system off the coast of Nigeria. The system's operator claimed significant benefit from implementation of tools to help drive efficiencies. The operator claimed a benefit of 50,000 barrels per day from improved collaboration.[4] In this example, the company invested in infrastructure and application packages. All data remains within the company firewall.

Moving Applications to the Cloud

Automation systems can require both significant capital investments to build and ongoing operating expenses to maintain. In many cases, collaboration is desired, but securing the investment is difficult.

Leveraging cloud computing, applications can be built within the cloud infrastructure and provided as a service. Collaborating in this fashion is possible within constraints of operating budgets using a fund-as-built model. In most cases, the cost of the tools required to gain efficiency benefits are significantly lower than the cost of building traditional systems.

M.G. Bryan, a leading heavy-equipment and machinery supplier to the oil and gas industry, knew it needed a way to remotely monitor and maintain the performance of its $1 million fracking trucks. The Dallas-headquartered company invested in a cloud-based fleet management system designed and implemented by domain experts at Rockwell Automation.

Using mobile technology and the seamless transfer of business information over the Microsoft® Azure™ cloud platform, M.G. Bryan securely pulls data from the cloud to web browsers. The software management system then produces reports and dashboards showing the condition of an individual vehicle's drivetrains and hydraulic fracturing performance.

The system takes the guesswork out of maintenance scheduling, thus preventing unplanned downtime. By using the cloud, M.G. Bryan maintains no infrastructure, and the company can scale the solution from one truck to 4,000 trucks.

Applications and workflow present critical pump information to M.G. Bryan's customers over their existing technology to interact using simple browser technology. The workflows indicate the location of the truck, maintenance conditions, truck operating conditions and fracturing batch campaign data for the given operation. Figures 7 and 8 are examples of these dashboards.

Figure 7. Pump Detail

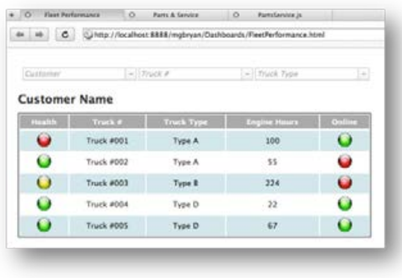

Figure 8. Summary Page

M.G. Bryan’s customers benefited significantly from the solution. In the first 90 days of operation, remote supervision eliminated four unplanned trips to the field. Remote expertise also identified a problem and was able to fix it prior to catastrophic failure of the equipment, thus preventing a major breakdown.

Remote Monitoring

Remote-monitoring technology uses sensors, hardware, software and wireless connections to retrieve important operational information across oilfields and along pipelines. Operators can use information such as daily oil production and pump pressure to continuously monitor current and historical operating conditions, troubleshoot issues, and adjustments to help increase uptime. And they can do all this from workstations that are hundreds or even thousands of miles away from the physical site.

Intelligent medium-voltage drives are an integral part of remote pipeline communications. For example, the drive can use embedded Ethernet connectivity to send a signal to central operations control that a compressor motor is running too high. Operators can then remotely reduce the power. This could potentially prevent dangerous pipeline blowouts, delivering significant operational and safety benefits.

Remote monitoring also can help oil and gas companies address skills-gap issues. Rather than travelling to a site, experts can troubleshoot problems from a central site or even from home. They then can direct onsite personnel to make the necessary fixes.

Conclusion

By moving their operations to The Connected Enterprise, oil and gas companies can access and act on asset information like never before, accelerate high-performance oil and gas production, and improve collaboration.

A number of resources are available to help companies do this. For example, validated reference architectures help expedite the engineering and delivery of oilfield solutions. Training and certification solutions also have been specifically developed for the IT and operations professionals responsible for implementing, operating and supporting networked industrial infrastructures.

References

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