Automation Vital To Production Phase

By David Newman

STAVANGER, NORWAY–For all the technological developments over the past few years, operators continue to face two significant challenges in their upstream operations: the amount of unstructured data they have to process and the lack of integration across their operations and engineering processes.

Today, an oil or gas field can generate as much as one terabyte of data a day. While exploration and production companies require a complete picture of their reservoirs throughout the production phase to make the best decisions, there is a real danger that the amount of field instrumentation and the hundreds of wells that need to be managed are resulting in an overwhelming amount of data.

The same goes for the lack of integration between different production and engineering processes. Whether it is downhole monitoring of wells and flow rates, reservoir modeling or history matching, or effective management of offshore production installations, some operators lack integrated control over their production strategies.

This data overload and lack of integration often leaves production engineers focusing on data manipulation and integration tasks rather than on the key role of diagnosing a well or reservoir's performance.

So what can be done to meet these challenges?

This requires a new approach to asset management in upstream operations, one that brings the closed-loop automation processes prevalent in downstream operations and other industrial sectors to upstream production.

Achieving this will require integrating instrumentation, production data systems, and software as well as automating day-to-day engineering workflows. In this way, data can be better structured and engineers diverted from trawling through piles of daily operational data.

This approach will lead to a greater use of predictive intelligence and greater integration across upstream production processes, spanning everything from downhole monitoring to reservoir modeling software, and wireless-based smart fields and platforms.

The result will be a more efficient automation of the entire production workflow that will lead to optimized production processes, reduced life cycle costs, and improved operator insight into upstream operations.

It is important to understand the key building blocks of this closed-loop, intelligent process.

Reservoir Monitoring

In the past, reservoir monitoring systems often tended to be commodity-priced and product-driven with a wide variety of pressure, temperature and sand monitoring devices that worked but were not necessarily integrated with other subsea systems.

Today, there is much greater predictive intelligence, automation and integration in reservoir production monitoring. Downhole monitoring systems are deployed in production, injection and observation wells, as well as in conjunction with the instrumentation of highly complex multizone intelligent wells.

As an example, intelligent downhole networks allow operators to install 32 instruments on a single cable, enabling the intelligent network to act as a hub for downhole choke position indicators and third party sensors, and for transmitting power and data. In this way, downhole reservoir monitoring is providing crucial information on not only temperature, pressure and water cut, but also on gas fraction, sand rate and flow velocity.

Reservoir monitoring networks are becoming more intelligent and integrated. A single cable can hold 32 instruments, and the network can provide information not only on temperature, pressure and water cut, but also on gas fraction, sand rate and flow velocity.

Multiphase meters are another case in point. These meters are likely to see increased deployment in subsea operations over the next few years. In fact, a 2006 report by Douglas Westwood and OTM Consulting predicts that by 2015, the number of subsea multiphase meters will increase by 1,000.

In addition to being an effective alternative to well testing, providing critical real-time information on a well's capabilities during production, multiphase meters can significantly impact production optimization and reservoir management across production operations.

When integrated with gauges and other intelligent devices providing pressure and temperature information, the multiphase meter has the potential to become a critical component in measuring flow and production rates, which contributes to real-time decision making. Decisions such as choke settings and artificial lifts, for example, can then be based on all appropriate information.

What we are getting close to describing

is the intelligent well, a well that is equipped with monitoring equipment and can be adjusted–sometimes automatically–to maximize production.

Wireless Instruments

The advent of wireless technologies also is playing a crucial role in automating and adding increased intelligence to production operations. Wireless instrumentation is being utilized in thousands of installations around the world and can deliver 99 percent data reliability.

Smart wireless applications allow operators to increase visibility of their assets and overall operations by adding monitoring points throughout their facilities–at a fraction of the cost of wired instrumentation.

For example, Emerson is working with the Netherlands' largest gas producer, Nederlandse Aardolie Maatschappij B.V (NAM), to deploy its wireless sensors on NAM's well testing systems. These test system containers are connected to the wellhead to identify problems such as drops in the well's capacity. The wireless sensors provide the necessary connectivity between the sensor in the field and the base station, transmitting the required operator information on differential pressure and temperature.

Nederlandse Aardolie Maatschappij B.V is using wireless sensors to measure differential pressure and temperature as part of a mobile wellhead test system. Wireless systems are enabling companies to automate more processes.

Following the successful introduction of this wireless technology, NAM has identified a new opportunity to use a wireless pH transmitter to test the acidity of the oil being extracted. Unlike the test strips currently used, the wireless sensors will provide continuous, online measurements, enabling NAM to automate measurements.

Predictive Software

Predictive software, such as programs for reservoir modeling and history matching, also has a crucial role to play in bringing increased intelligence and automation to reservoir production.

A modeling package released this year, for example, comes with an automated intelligent workflow based on single-step modeling. Interpreted horizons are modeled first, followed by isochore controlled horizons, which add detail to the larger scale framework. Changes to the controlling picks then can generate an automatic rollout of the changes to all affected parts of the model.

Automation also is playing a crucial role in history matching, the act of closely reproducing the past behavior of a reservoir. Computer-assisted history matching allows the engineer to focus on understanding the reservoir mechanisms and their relative impact on production behavior. Through such history matching tools, match modifiers are updated intelligently, parameter sensitivity is analyzed automatically, and runs are even submitted when engineers are away from their desks. Because the software interacts with the engineer, engineering judgment still can be applied to interpret and reconcile information. The result is that the production engineer can seamlessly perform a range of complex history matches and simulations easily and efficiently.

However, perhaps the most important step in developing greater automation in production is the closer alignment between hardware and reservoir management software, and the subsequent incorporation of dynamic data into reservoir models.

Today, well data change on a daily, hourly, and even minute-by-minute basis, especially in an active field. These changes can significantly impact the reservoir model. Production data also change rapidly, which can change the simulation model and provide history matching opportunities. Real-time data from the field, such as pressure, temperature and flow rates, also can be used to update the model and quantify structural and reservoir property uncertainties in real time.

The result is a rapid model updating workflow running on a continuous basis as new production data are gathered, ensuring the most correct model always is available for making important decisions about the reservoir.

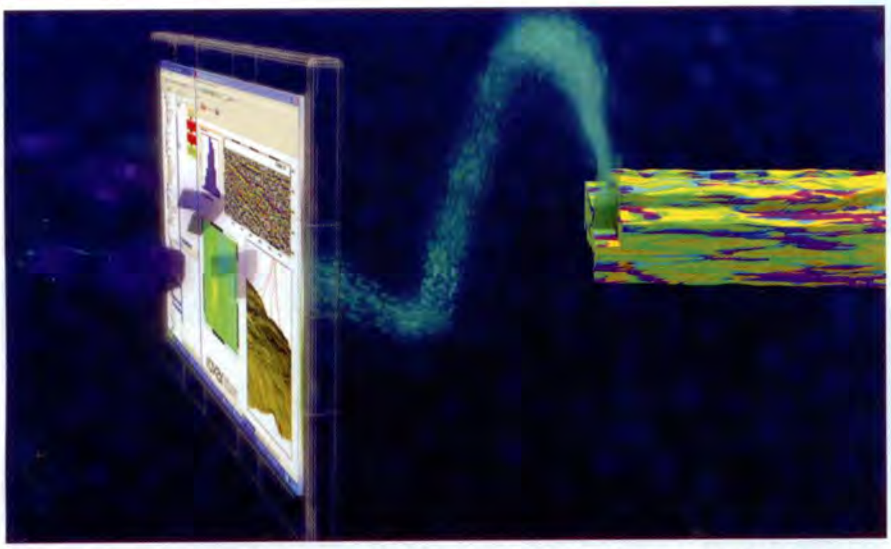
Through a combination of real-time data from instrumentation with predictive models from software, instrumentation companies can help operators monitor production continuously, process large volumes of vital reservoir data quickly, interpret the data rigorously, and automate as many routine engineering processes as possible. This is what we describe as a closed loop, intelligent and integrated process.

A Streamlined Workflow

An effective software-based workflow also can play a key role in bringing greater intelligence and automation to upstream production.

Such a workflow is vital as a repository for experience and knowledge, as a way to disseminate best practices across widespread teams, and as a tool for structuring data and alleviating the problems of data overload. A strong, information technology-based workflow also ensures a high degree of quality control by coordinating inputs and outputs, ensuring transparency and accountability, and streamlining job sequences.

It is with this in mind that companies have developed a specialized Windows-based field monitoring system that enables operators to watch their fields remotely.



Software for reservoir modeling and other tasks is key to bringing increased intelligence and automation to reservoir production.

Real-time data now can be accessed directly at the desktop through a graphical user interface.

The software's rapid retrieval and display capabilities enable the user to quickly visualize data and identify trends, patterns or areas of interest for further analysis. In this way, it meets operator demand for an integrated and intelligent reservoir monitoring and asset management system, where the economic impact and risk of reservoir management decisions can be fully assessed.

Offshore Production

It also is important that the intelligent closed-loop automation process extends from the reservoir to the pipeline.

The measurement and control systems that manage pipeline installations and the processing, storing and offloading of oil and gas are a vital link in the production process. With that in mind, a digital automation architecture was developed to integrate offshore production operations and help ensure optimum process control and automated production.

The architecture leverages digital intelligence, including diagnostics, to enable users to predict and prevent problems before they affect the process. It connects measurement and control devices with control and maintenance systems through open communication standards. This enables greater information access and accountability on both process and equipment, making it easier to improve production and keep operations running smoothly. And the architecture's new technologies, such as wireless, help ensure uptime is increased, performance optimized, and maintenance costs reduced.

This technology has been applied to Total's Akpo FPSO vessel offshore Nigeria. The technology's developer worked with Akpo on the development, installation, configuration, testing, and commissioning of the systems controlling the vessel topsides, hull, subsea and radar tank gauging.

The result was a network of intelligent transmitters, valves, and assets that will deliver continuous process and equipment health information to personnel running and maintaining the FPSO. Predictive diagnostics will enable these personnel to engage in proactive maintenance, which will increase uptime and production by addressing issues before they become problems.

A smart wireless network is being used on Statoil's Grane platform to remotely monitor wellheads and heat exchangers, and to generate vital production-based information. Twenty-two wireless pressure transmitters have been mounted on the wellhead to measure annular pressure, and 12 similar devices are monitoring the inlet pressure and pressure drop over the heat exchanger.

Wireless tools also are monitoring production processes on Statoil's Gullfaks Field in the northern part of the Norwegian North Sea. Here, the smart wireless network is automating flow monitoring to increase production. Wireless devices are transmitting real-time temperature data that indirectly monitor flow, allowing a quick reaction to any loss of well pressure and maximizing throughput from the well.

In contrast with once-a-shift manual recordings, the wireless devices on the Gullfaks Field now transmit readings every 30 seconds to the smart wireless gateway. The gateway is hard-wired into the control system, providing operators with the real-time information they need to react quickly to any change in flow.

To date, Statoil has implemented additional smart wireless devices on Platforms A, B and C in the Gullfaks Field, bringing the total to 90 wireless transmitters covering all production flowlines. The result is the predictive intelligence and production information so vital to today's operator.

While this article has covered many elements of the reservoir management and production process, there is one clear message: that there is a greater place for integration, intelligence and automation in production operations.

Whether it involves wireless platforms, predictive reservoir software, or continuous downhole monitoring, effective process control and asset management is all about taking greater control over the production process. By doing so, operators can boost engineers' productivity, reduce uncertainty, and make better operational decisions. ❐

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