A Supplement to E&P Magazine

INTELLIGENT FIELDS

Creating & Managing the Intelligent Field

Controlling the intelligent field

Extending the intelligent field subsea

Subsea communication

Wireless finds new uses offshore

A look into the future

EMERSON™
Process Management

TABLE of CONTENTS

INTELLIGENT FIELDS
A supplement to E&P

Hart Energy Publishing
1616 S. Voss, Suite 1000
Houston, Texas 77057
Tel: +1 (713) 260-6400
Fax: +1 (713) 840-8585
www.hartenergy.com

EDITOR
Judy Maksoud Murray

MANAGER, SPECIAL PROJECTS
Jo Ann Davy

CONTRIBUTING EDITORS
Kelly Gilleland
MJ Selle

ASSISTANT EDITOR
Ashley E. Organ

CORPORATE ART DIRECTOR
Alexa Sanders

SENIOR GRAPHIC DESIGNER
Laura J. Williams

PRODUCTION DIRECTOR
Jo Lynne Pool

For additional copies, contact
Customer Service +1 (713) 260-6442

GROUP PUBLISHER
Russell Laas

DIRECTOR OF
BUSINESS DEVELOPMENT
Eric Roth

Hart Energy Publishing, LP

VICE PRESIDENT, CONSULTING
E. Kristine Klavers

EXECUTIVE VICE PRESIDENT
& CHIEF FINANCIAL OFFICER
Kevin F. Higgins

EXECUTIVE VICE PRESIDENT
Frederick L. Potter

PRESIDENT & CEO
Richard A. Eichler

ON THE COVER
Intelligent Field technologies enable optimal management of the reservoirs and production, giving operators critical data and information.

UNLESS OTHERWISE NOTED
all images courtesy of
Emerson Process Management.

'Predictive Intelligence' *Powers the* FUTURE

As a solutions provider, Emerson helps companies cope with demands of information and technology advances.

It has been said that "the truth is at the source," and nowhere does this axiom ring more true than in oil and gas production. The quality of available information determines the quality of operating decisions, whether related to safety, production performance, reliability, asset health, or cost management. The right information, delivered at the right time, to the right person can enable you to:

- Identify risky operating conditions and provide guidance on how to resolve these critical safety issues
- Provide true real-time operational data to onshore operations centers, thereby reducing the cost and risk of offshore staffing
- Share that data with subject matter experts, regardless of location
- Enable dynamic production optimization – including model predictive control – to ensure repeatable, safe, and profitable operating strategies
- Identify changes in equipment performance to proactively resolve problems and avoid failures
- Remotely monitor real-time asset health for predictive maintenance practices, allowing prioritization and planning of maintenance trips offshore at the best cost and schedule
- Provide specific, targeted information to maintenance personnel on equipment problems, including which tools, parts, and work processes are required to correct problems
- Streamline compliance documentation and reporting.

However, simply applying enterprise management software "above" the operating systems won't help achieve these goals. To make the best possible decisions, high-quality, reliable information from the process source must be available in real time, and delivered quickly, efficiently, and in an easy-to-use manner.

Emerson Process Management's Intelligent Field solutions include the company's state-of-the-art technologies and applications that can ensure data are received in real time and in easy-to-use formats, enabling you to resolve problems in a collaborative environment while achieving optimal and unbroken production.

Wellhead management and more

Operators constantly battle with the dilemma of how to manage reservoirs to deliver the optimal flow, gain the greatest recovery, and obtain the maximum life of the field without overproducing and damaging the reservoirs. Emerson Process Management can help clients gain valuable insight into reservoir performance, receive early warning of possible water breakthroughs, and ultimately control and manage the flow of the production and data through the subsea environment to surface facilities.

Using Intelligent Field technologies, clients can optimally manage each wellhead by monitoring pressure, temperature, and flow inputs, giving the operator critical data and information. This enables better production management and delivery of optimal flow to the process facilities, helping you ensure that unplanned shutdowns do not occur.

Most offshore and onshore operations now use digital intelligence with some predictive capabilities, such as smart valves and measurement devices, and upgraded control systems. With this revolution, however, an additional challenge has developed: As instruments and systems become smarter and generate more information, operators and maintenance personnel become overwhelmed, and data become noise.

The solution must go beyond simple filtering. The ultimate solution is information management designed with specific tasks in mind. At Emerson Process Management, the future of predictive intelligence has arrived.

To discover how predictive intelligence can power your future, visit *www.EmersonProcess.com/IntelligentFields*.

The INTELLIGENT Field Has Arrived

The future is now in oil and gas exploration and production processes.

Walk into any major oil and gas company in Houston, Aberdeen, or Stavanger and you will immediately notice the difference – the difference in how people are using state-of-the-art technology to produce oil and gas more efficiently.

In many of these offices, you will see:

- Real-time data and information displayed on screens on the walls
- Multiple disciplines working together as a single team
- Live "always on" video links from headquarters to the operational locations
- Vendors and service providers supporting operations in real time from remote locations.

This fundamental change in operations support has come about in the last five years and continues to improve oil and gas processes. Dubbed "the quiet revolution" by Statoil chief executive Helge Lund, it is also known as the Field of the Future™, Integrated Operations, i-Field, or Smart Fields, among other names. Emerson Process Management refers to this revolution as the "Intelligent Field."

The availability of good data and information measured in wells, facilities, and pipelines enables better responses to changing conditions. Making these data available to everyone in the organization who can add value allows running core

value-adding processes such as production optimization in a "smarter" way, much faster, and with higher quality.

However, this is not just about the technology; it requires thinking about the way companies are organized to capture the value from having this real-time data and information. Many businesses see this as a technology-enabled *transformation program*, where the company takes a fundamental look at the way people work – from the technician offshore to the commercial analyst back at headquarters. This requires updating core work processes, overcoming employee resistance to changing to a new way of working, and re-aligning organizational structures. This is commonly referred to as the integration of "people, process, technology, and organization" to deliver a *capability* to add value in day-to-day operations.

Having this real-time information at your fingertips allows the company to:

- Maximize production system throughput
- Reduce and recover from unplanned events
- Balance short-term production goals with long-term recovery
- Reduce costs by optimizing maintenance planning
- Maximize the use of scarce resources
- Carry out remote operations and remove people from harm's way.

There clearly is value from doing this. A major oil company recently declared that it has attributed 100 thousand barrels of oil equivalent per day of production to a digital oil field program at a cost of U.S. $3/bbl to $6/bbl. Where else can you buy oil that cheaply?

This supplement will highlight the data and information technologies that enable these exciting changes to the way people work. These technologies are being used to add value in both greenfield and brownfield locations in many companies across the globe.

A major oil company recently declared that it has attributed 100 thousand barrels of oil equivalent per day of production to a digital oil field program at a cost of U.S. $3/bbl to $6/bbl. Where else can you buy oil that cheaply?

This supplement includes articles on:

- The use of "predictive intelligence" across the value chain to realize the future of oil and gas
- The integration of surface and subsurface technology domains
- Electronic marshalling and the resulting savings made on new projects
- The application of wireless technologies to oil and gas
- Human-centered design – the changing way of working.

Many of the real-time data and information technologies that enable the transformation to a truly collaborative way of working are already in place. Although the move to global real-time organizations has only just begun, many companies have embarked on the journey and are already realizing value.

— Tony Edwards, CEO, StepChange Global

Field of the Future is a trademark of BP.

CONTROLLING *the* Intelligent Field

PlantWeb's predictive intelligence capabilities optimize operations in many facilities.

Optimal production is the goal of any processing facility. With slim operating margins and increased global competition, advances in overall performance are highly coveted. Unplanned shutdowns due to equipment failures, higher-than-expected maintenance costs, and lack of experienced personnel can dramatically affect the bottom line.

"The more technology develops, grows, and evolves, the more 'intelligent' information we can get from our facilities," said David Newman, director of Global Oil and Gas at Emerson Process Management. "Instead of sending people out to get the information, we can now – with the right predictive operations – look at it remotely. If the facility can diagnose itself and identify potential problems, and then communicate that information to the right person, the correct solution can be instituted with little or no downtime."

Smart Remote Automation
Extending PlantWeb Into Remote Locations

- Improves **process availability** by using *predictive intelligence*
- Increases **maintenance efficiency and effectiveness**
- Improves **data quality** for reduced custody transfer measurement uncertainty
- Enables companies to increase **throughput**
- Helps **regulatory compliance and reporting**

PlantWeb®

Predictive intelligence is intended to catch problems before a catastrophic failure occurs. A wide range of industries, including the oil and gas industry, use Emerson's PlantWeb™ digital architecture as an early warning system. Using field intelligence to improve performance, PlantWeb can enable at least 2% improvement in overall efficiency and reduce the costs of operations and maintenance; safety, health, and environment; energy and utilities; and waste and rework. Additional savings of up to 30% are possible by reducing risk and startup costs.

"Most equipment can give you hints along the way that there's a problem," Newman said, "but recognizing and reacting to those hints is much easier when using predictive intelligence applications such as those available with PlantWeb. When you don't have the right information, failures can seem catastrophic."

Mechanical equipment failure is the number one cause of availability problems in oil and gas facilities. Pumps, compressors, motors, valves, and instruments are subject to friction, fouling, and normal wear and tear. PlantWeb can monitor these devices and highlight potential problems. For example, if a valve has a maintenance issue that requires investigation, a message to the operator might read, "I/P is starting to plug" or "I/P blocked by grit." PlantWeb can suggest the necessary action such as "Check screen filter, material buildup."

The operator is notified when operations are affected. This feature is especially useful if operations are in a remote location and the operator is thousands of miles away. "An engineer in Houston can see how a plant in Africa is performing without making a day-long journey," Newman said.

Maintenance savings

Maintenance is another area that has experienced significant cost reductions and productivity enhancements. "One study found that 86% of maintenance is either reactive (too late) or preventive (unnecessary)," Newman said. "Best practice is 40%, with a shift to predictive/proactive maintenance."

Many facilities in North America and Europe have already made significant cuts to their maintenance staff such that safe operation has become a concern. PlantWeb helps make the most of available staff by improving productivity. "Sixty-three percent of maintenance work orders resulted in no value-added work," Newman said.

Remote diagnostics help alleviate unneeded trips to the field. As many as 35% of these trips are for routine checks, 28% are for non-existing problems, 20% are for calibration shifts, 6% are for "zero off," 6% for plugged lines, and 4% are actually failed instruments. "That's mostly ghost chasing – going out to the field and checking things that were working," Newman said. "With PlantWeb, you can send someone out there when work is actually needed, not just as a matter of routine.

"You also can see savings in relation to your scheduled maintenance costs," he said. "There may be nothing wrong with the unit that is due to be replaced – it's working fine – but it's been there a year and the schedule says it's time for a change. Using PlantWeb will give you the warning needed ahead of when the unit needs to actually be replaced. By using PlantWeb, you can save on spare parts and recalibration costs. These are all OPEX [operational expenditure] costs that can save on the overall efficiency of the facility."

Offshore maintenance presents unique challenges. For example, performing maintenance on subsea equipment requires time to organize a subsea intervention with a support vessel. "Unfortunately, you can't just send an operator out to fix something on subsea equipment the same way you can on topsides equipment," Newman said.

Since subsea maintenance is much more costly than topside maintenance, knowing when a piece of equipment needs repair before a failure shuts down production is a huge advantage. "Being able to safely delay maintenance and defer the cost also can be an advantage while reducing the risk of lost production," said Newman.

Decreasing human intervention

PlantWeb customers report reductions of 20% to 40% of control loops in manual control, and improved optimization of 80% of control loops that have demonstrated excessive process variability. "When facilities are new, loops are tuned for the 'perfect' plant," Newman said. "As conditions change and loops don't perform properly for the changing conditions, the operators start moving loops to manual to 'line out,' to stabilize, and to compensate for the variability that has entered the process. Additionally, we found that many loops were never properly tuned to begin with, and were still set up with default tuning parameters."

As a result, many advanced process control (APC) benefits are being missed. Because APC sits on top of regulatory control, as the conditions change and manual intervention takes place, many operators turn off the APC because it depends on feeding set points to a well-tuned regulatory control system.

Enhancements Enable Industry Change

Emerson Process Management's DeltaV S-series platform is designed to streamline engineering practices and enhance PlantWeb's project and operations performance. One game-changing feature of the DeltaV S-series platform is electronic marshalling.

"When a project is designed, the I/O count has to be decided very early in the project," said David Newman, director, global oil and gas, Emerson Process Management. "Very often, that leaves marginal room for error. If, later in the construction phase, we have a major change to the process and I/O count, it would sometimes require a redesign of the system, incorporating significant cost increases and time delays to the project.

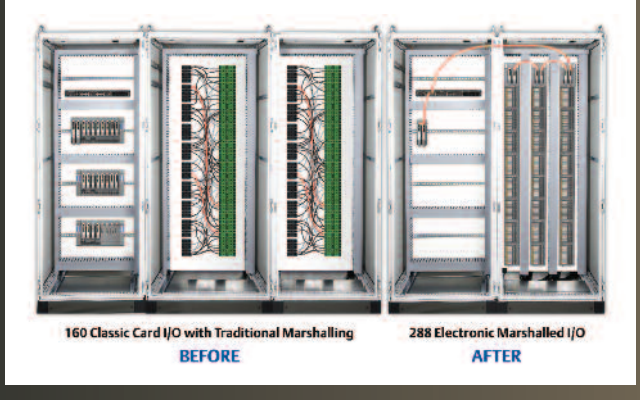
"As part of our 'I/O on Demand' approach, electronic marshalling brings I/O wherever and whenever a user needs it. The clients decide what type of I/O they want, when, and where they want the I/O – whether for late project changes, during startup, during operation," Newman said. "They also can decide where they want the I/O – in a control or marshalling room or in the field. They can also add channels on a channel-by-channel basis, noting that any channel can be consumed by any controller."

Project implementation savings

Electronic marshalling saves significant project man-hours, and makes late design changes easy to accommodate. System engineers can reallocate I/O on a channel-by-channel basis, simplifying system design and delivering project execution savings. For example, for an average platform of 5,000 I/O, a cost reduction of 58,000 man-hours is anticipated.

"When you consider the amount of time and cost in logistics in transporting and housing personnel offshore who are completing upgrades," said Newman, "the use of electronic marshalling will significantly reduce the time of the upgrade, and ultimately, the costs, and it will also improve the risk factors in safety and the potential of lost production during these critical upgrade periods."

Emerson developed electronic marshalling in response to customer needs. "They want their facilities to be easy to wire and operate," Newman said. "Electronic marshalling is a step in the right direction."



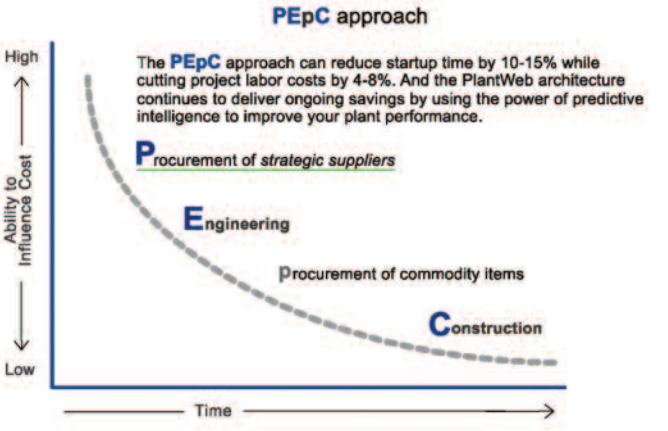
Networked, not centralized

The PlantWeb system is networked. It does not depend on a distributed control system (DCS). "PlantWeb is designed around the fact that there's intelligence everywhere," Newman said. "Integrating that intelligence and getting the right information to the right person is what's important today."

Emerson was a leader in developing FOUNDATION™ fieldbus (FF), a key technology in PlantWeb architecture. Emerson devices, systems, and software work together to deliver the benefits of digital, two-way communication using this technology.

Emerson's Smart Wireless technology uses the IEC 62591 (WirelessHART) standard to give operators a flexibility not seen previously, bringing "new eyes" to parts of the facility that were previously out of reach. WirelessHART uses a self-organizing mesh technology that overcomes limitations of "line-of-sight" wireless installations. The network automatically finds the best communication route back to the network gateway (receiver). If a connection is temporarily blocked, signals are rerouted to adjacent wireless devices, which act as transceivers (or repeaters), maintaining connectivity. These redundant data pathways eliminate single points of failure.

The widely supported WirelessHART technology enables users to quickly and easily gain the benefits of wireless technology while maintaining compatibility with existing devices, tools, and systems. A large number of field devices, valve and equipment position monitors, vibration data transmitters, and smart gateways meeting this standard are currently in use throughout the industry.



Smart engineering, smart instrumentation

Emerson has adopted the PEpC approach for project construction in which it partners with a contractor as a strategic supplier during the design, engineering, and procurement process. Using a PEpC instead of an engineering-procurement-construction (EPC) model could produce time savings of 10% to 15%, and cost savings of 4% to 8% compared to the traditional EPC process.

Design and engineering functions are streamlined during this process using Emerson's DeltaV™ digital automation system. Specifically, instrument engineering and configuration time are reduced using DeltaV software's standard function blocks for designing control strategies. Engineers can determine their needs by using a library of pre-engineered control strategies. A single user interface allows configuration of I/O types including 4-20 mA, HART, WirelessHART, and FF.

Space and weight are continuing concerns with offshore projects. PlantWeb and FF allow the control room footprint to be much smaller. Traditional DCS I/O cards consist of digital input, digital output, and analog input cards. The DeltaV system uses a fieldbus I/O card that can accommodate 64 channels, compared to eight channels for traditional cards. DeltaV's native wireless support also reduces the amount of physical wires. Wireless technology eliminates the need and cost for building in spare I/O capacity, and also reduces material and labor costs for installing wire, cable tray, conduit, marshalling cabinets, junction boxes, terminal blocks, and intrinsic safety barriers.

During startup, predictive maintenance software can detect installation errors. For example, the same devices that monitor maintenance issues on rotating equipment can tell operators if there are vibration or lube oil problems. Instrument diagnostics can detect heat or line plugging problems. Valve diagnostics for friction, valve seating force, and air supply problems can also detect incorrect calibration, incorrect valve packing, or air supply issues. To explore how Emerson can help you optimize your production, visit *www.EmersonProcess.com/IntelligentFields*.

Collaboration Centers Are Key to the Intelligent Field

With today's focus on decreasing operational costs for remote offshore platforms, the use of "collaboration centers" can enable companies to solve operational issues with real-time information. Collaboration centers make the best use of scarce resources by creating an operations hub where experts from a variety of disciplines can access information, troubleshoot, monitor, and optimize the oil and gas fields from a single location.

The intelligent field is the perfect collaborative environment for communication, data collection, reporting, monitoring, and information sharing. These physical workspaces are intended to help people make better, more informed decisions in order to take the appropriate actions across the enterprise in real time, and precisely when needed. Opportunities can be prioritized, with the common goal of maintaining optimal and unbroken production.

Innovations in various collaboration technologies are helping companies make the intelligent field a reality. Today's collaboration centers provide a high-tech physical workspace as well as a new way of operating. Access to a complete array of digital, real-time data facilitates the operations process and gives personnel the comfort level to make decisions quickly and intelligently.

Extending the Intelligent Field SUBSEA

Emerson, Roxar combination brings new growth areas to both companies.

The addition of Roxar to the Emerson Process Management family of companies in 2009 brought a new dimension to the exploration and production marketplace. The combination joined automation provider Emerson Process Management – a U.S. $6.5 billion unit within industrial conglomerate Emerson – with Roxar, a $200 million provider of instrumentation, software, and modeling technology.

Like Emerson, Roxar is known for its technology innovation and market leadership. Roxar's metering and monitoring equipment and well-optimization software are strong complements to Emerson's instrumentation products and PlantWeb digital architecture. The resulting technological and solutions synergies open new growth areas for both Emerson and Roxar.

"Subsea is now coming to the upstream," said Steve Sonnenberg, president of Emerson Process Management. "The acquisition has been strategic to extending our solutions to help E&P owners meet the automation challenges of offshore subsea and subsurface. Roxar is the upstream industry's largest provider of subsea instrumentation – a complement to Emerson's instrumentation and valves that power the digital PlantWeb architecture."

Roxar's customer base includes major multinational independents, small independents, and the majority of national oil companies.

"Joining Emerson Process Management leverages our resources for increased customer support and response around the globe," said Gunnar Hviding, president and chief executive officer of Roxar ASA. "Our service business joins an organization where service is a core growth activity and critical to customer satisfaction. Customers will benefit immensely from being able to go to a single company for reservoir to refining solutions."

The move also brings Roxar additional resources and technology expertise that will help accelerate and drive new product development. Roxar's solutions combine real-time data from the company's multiphase flow instruments with predictive geological and engineering models to help operators continuously monitor production, observe and control oil and gas fields from remote locations, process large volumes of vital reservoir data quickly, and use the most up-to-date real-time field information to make critical operational decisions.

"Upstream exploration and production is a very conservative industry," Hviding said. "It can be slow to take up new technologies. This kind of integrated approach is already being used by major oil companies, but the way is open for an industry player to come in and offer a configurable industry solution. With a shared passion and focus on solutions for our customers, together we will be better positioned to serve current and emerging customer needs."

Extending predictive intelligence subsea

The use of predictive intelligence in refining, processing, and other aspects of upstream petroleum production already supplies oil and gas companies with significant business and competitive advantages. Extension of predictive intelligence to subsea and downhole metering and monitoring solutions will deliver immediate benefits to offshore oil and gas operators.

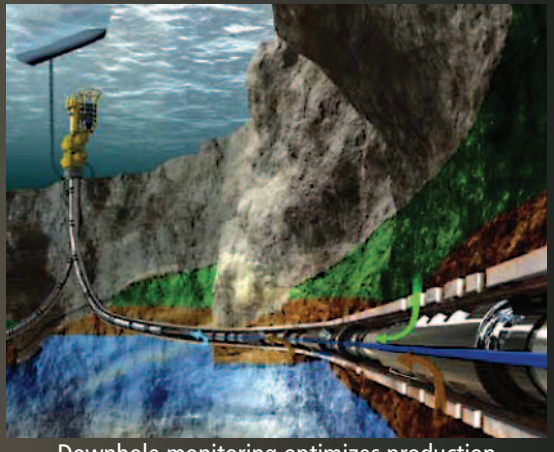
Integrated reservoir-to-transmission solutions provide increased customer support.

Evolving Subsea Technology Brings Advances

With hydrocarbon exploration and production constantly expanding into deeper water and more challenging environments, operators need the best information to determine the most commercially viable, environmentally sound, and safest ways to recover the oil and gas from a reservoir.

Roxar's reservoir optimization capabilities and subsea metering technologies are a key part of Emerson's vision for the future. Roxar's two main product lines – Software Solutions and Flow Measurement – offer the tools operators need to unlock a potential prospect. With its comprehensive line of real-time, in-line multiphase measurement instruments, as well as software for reservoir modeling and simulation, Roxar's knowledge, technology, and services generate continuous information of value to offshore oil and gas operators.

"Reservoir modeling has progressed from using big company mainframe computers to today's very portable technology," said Robert Chelak, Roxar Software Solutions regional services manager, Americas. "I used to carry a big case containing heavy computer equipment with me to the Middle East to work on projects and perform demonstrations. The software was very difficult to run and the scenarios took a long time. Now I use my laptop and can very easily construct complex reservoir models wherever I go."



Downhole monitoring optimizes production and provides critical and timely information on water breakthrough or gas coning.

With these computing changes, Chelak said a greater amount of information is now available for reservoir modeling. "If you go back just a few years ago, there was no way you could load up the amount of data coming from the field into a desktop computer system because the machine power, the memory, and the graphics just couldn't handle the volumes of data. Now that's changed. Plus, they are finding new ways of acquiring data at greater depths, with increased resolution and details.

"Ten years ago we were building models with 30 faults. That took weeks or months to accomplish, and in some cases, it was impossible, depending on the complexity. Now, we're building models with 2,000 faults in a matter of days with very complex scenarios. To go from that scale years ago to the scale and complexity we're at today is just amazing. And we're putting more information and more accuracy into these reservoir models with less effort and time."

This accuracy will enable better well planning and predictions of what the reservoir actually contains. "We're now going into areas that have been difficult to model such as the subsalt areas of Brazil," Chelak said. "We have high-resolution information coming out of the data, and we need to plan very expensive wells carefully to optimize the drilling locations and understand the production potential. Our goal is to build the most accurate reservoir model, characterize it, understand it with multiple scenarios, and plan around it so that when the well is drilled, we understand its capabilities with respect to reality. That is what Roxar technology is all about."

Predictive modeling aids drilling, production process

Predictive modeling also provides valuable information for drilling and production. "I can be at my desk in Houston monitoring the real-time data from the downhole monitors and the tools behind the bit operating out at the rig site in the Gulf of Mexico," Chelak said. "If the predicted path of the well bore is moving past a certain horizon and out of the reservoir, I can monitor this with respect to my reservoir model in my office. If the data from the rig starts to vary from the model, I can run a new model in 10 minutes to have a current representation of reality.

"Five years ago, that would have taken me a week to do. If it appears the well bore is going to come out of the reservoir, I can call the driller on the rig to stop, adjust, and change the trajectory of the well. It's all about having a good model, understanding the model, and updating it as new information comes in real time."

In the same way, full-field modeling can aid the topside facilities in predicting production. "Not only do we need to worry about production coming out of the ground, but we also need to determine what we are going to do with it when we get it to the surface," Chelak said. "Can the facilities handle what we produce? If the facility has only been built to handle so many barrels of oil daily, and we find out the reservoir will produce more, how are we going to handle that increased capacity? If my model indicates what's going to happen, then we need to be able to slow production down or we need to increase the capacity of the production facility."

Preserving the integrity of the reservoir also can be accomplished with predictive reservoir modeling. "In some cases we know where the oil is, but the question is how do we get it out of the ground optimally? In waterflood cases, we can turn on the tap and push water through the reservoir, but if we don't do it right, the water will go in too fast and leave a lot of the oil behind," Chelak said. "However, if we take our time and inject it at a consistent rate and make adjustments, we can simulate how the reservoir is going to act and get the majority of the oil from the reservoir. We build models to understand what's going to happen in the reservoir, and having a good quality model is of immense importance as a planning tool in reservoir management."

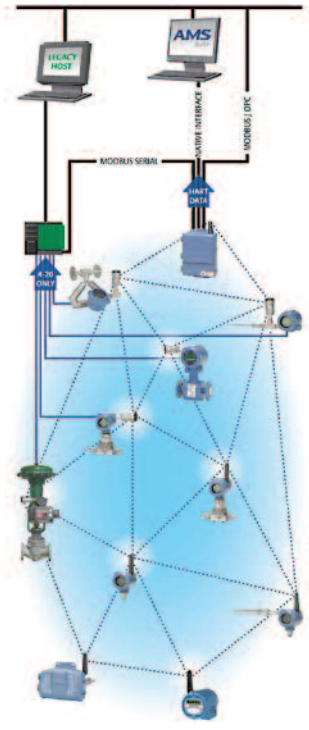
"It's a mistake to think of the subsea and topside facilities as two separate realms," said David Newman, director, Global Oil and Gas, Emerson Process Management. "They are not two separate entities in terms of data. There is a single stream of data that extends from beneath the earth to the ocean surface.

"As subsea production systems become more complex and move from basic well control to control of subsea production equipment such as separators and pumps, PlantWeb's applicability becomes even more important," Newman said. "For example, well production settings depend on phase separation processing capacity and the properties of the produced fluid, which are typically accomplished and derived topside. With predictive intelligence applied across both the subsea and the facility, a gas slug entering the fluid stream would be detected, communicated, and dealt with from the topside before it negatively impacts production on the topside facilities."

Vincent Vieugue, Roxar Flow Measurement regional manager for the Americas, said, "As quantities and qualities of the produced fluids become known and communicated through a digital network, you have more and better inputs for the production system model. The more rapidly you can update the model, the better its output is."

Further benefits will come from outfitting Roxar technology with Emerson's PlantWeb™ digital architecture and HART Communication Protocol capabilities for condition monitoring and self-diagnostics.

Wireless digital architecture through a self-organizing mesh network.



Robert Chelak, Roxar Software Solutions regional services manager, believes these benefits will give greater impetus to efforts to put digital communication standards in place, analogous to the fieldbus standards used in downstream processing facilities. The most common protocols today are CANbus, Modbus, and TCP/IP.

Today, subsea operators are forced to work with different vendors for the topside control systems and the subsea control modules. Industry experts have estimated that 80% to 90% of control system implementation problems are due to this issue. In one instance, a major operator spent millions of dollars lifting multiple control modules topside once their inability to communicate with the topside controller was discovered. As a result, Newman said many operators are basing their choice of a subsea control provider on the degree of integration the provider can demon-

Using Big-loop, Little-loop Scenarios

Roxar uses a "big-loop, little-loop" approach to reservoir modeling and simulation. Traditional workflows focus on the construction of a geological model. First, a model is built using different geological scenarios of how the reservoir could have been formed millions of years ago. After that, a single geologic model is run through a history-matching exercise.

"We modify the parameters within this 'little loop'," said Robert Chelak, Roxar Software Solutions regional services manager, Americas. "We may have different flow rates, different permeabilities, reservoir factors, etc., in the model that we can adjust to get the flow rates to increase or decrease, depending on what we're seeing, to get a history-match to reality. Our software looks at these different parameters, the statistical variation of those parameters, and then adjusts them with the knowledge given to try to generate a series of probable outcomes with a good history match. We use this process to get the reservoir simulation to match actual production history.

"However, in some cases, our simulation tool will come back and tell us that there is no possible way for you to get a good match because there's something inherently wrong with the geological model. We need go back and alter the original geological model and allow the software to alter these parameters. This is what we call the 'big loop.' In the original geological model, we may have an idea that the channel width of 200 ft [61 m] was appropriate, yet perhaps that isn't correct and we can't get a history match using this scenario. I can allow the software to change that in the big loop to 300 or 400 ft [91 or 122 m], with respect to this uncertainty in this or other parameters in the model. The workflow will then iterate between the big loop and little loop to get a history match quicker than I would if I were running the model on only one simulation model.

"Reservoir simulations deal with models that contain thousands of cells, many wells, and in some cases, more than 20 years of history. If the history match isn't right the first time, it could take a long time to change the parameters and run new cases manually. However, working with the software allows us to make quick automated scenario models, and check them with the simulation tool to see which parameters will make the biggest impact on the simulation, which leads to quicker, and more accurate reservoir models for predictions and planning."

Integrated production system models incorporate real-time and historical data from SCADA and historian solutions into an optimization model. Comparisons of these results with the model's expectations pinpoint anomalies. Combined with analysis and "what-if" scenarios, comparison of real-time results with optimal parameters derived using simulations supports better decision making.

A further advancement capitalizes on the intelligence coming from the well using newer subsea and downhole sensing and metering technologies, allowing the derivation of the key performance indicators that increase recovery and decrease risk.

Measurement Tools Provide Real-time Data

Roxar Flow Measurement products give operators the answers about what is happening subsea right now. "We're taking the real readings of what the models are modeling and show what's actually happening," said Vincent Vieugue, Flow Measurement regional manager, Americas. "How much production do you have? What's the pressure/temperature? Do you have oil, gas, or water coming through? Those are the questions we are able to answer, and operators can compare them to what the models from the software group show. If the model says one thing, but our measurements show something different, the model has to be modified to match what's really happening. By closing the loop with our data, the model for the future will be even better."

Problems become evident when models and measurements do not correspond. "The main focus for operators is to produce as much oil or gas as possible, but they need to do it in a safe manner. By monitoring conditions constantly, if you detect an anomaly such as the temperature or pressure going up or down, it could be an indication that something is going wrong," Vieugue said. "You don't want a pipe to burst or a valve to shut down. That's why you install monitoring devices all the way from the bottom of the well until you export the production from the platform."

Vieugue said operators face increasing challenges. "The environments where we're drilling now are not easy ones. We're in deeper water with deeper wells. High pressure and high temperatures require products with a higher quality. The need for instrumentation also increases – everything escalates. The products we supply are proven technologies. We're way past the time where we have to prove what our products can do. These are field-proven technologies, and operators can clearly see the benefits."

Vieugue believes there are many synergies between Emerson and Roxar. "Emerson products go right in line with technologies Roxar provides subsea," he said. "By having more monitoring devices and by being one company, these devices can work better together and supply even more and better information for the user."

One area where Vieugue sees new opportunities is in Emerson's wireless technology. "We can apply that technology to Roxar products and take the next step in that direction. Is there a possibility that users will suffer from an information overload? That's something the operator needs to think about," Vieugue said. "Measurement devices are becoming smaller and faster, and users need to have a system in place to handle this information. However, the more information you get from your wells, the better models we can provide and the better production you can get from those wells."

strate having with the topside control system provider.

Wireless technology is another important aspect of Emerson's PlantWeb. Already in operation in a variety of downstream facilities, Emerson's Smart Wireless technology is a seamless extension of the wired architecture. Weighing less and having a smaller footprint than a wired installation, wireless technology can deliver significant cost savings, especially on offshore platforms.

"People are very familiar with wireless capabilities in their day-to-day life," Newman said. "From a personal point of view, we have confidence in it, but the oil and gas industry is very conservative, and changes are not quickly or easily embraced. However, our experience has been that once they see the benefits of wireless in the field, and see how reliable it is, they actively embrace the technology, and look for more ways to use it."

Digital architecture signals a step-change

Two important technology trends in upstream oil and gas exploration and production join with the potential for operators to improve recovery, optimize production, and drive operational efficiencies. Many oil and gas companies already benefit from the predictive intelligence capabilities inherent in digital network architectures for instrumentation, valves, and controls. In offshore platform environments, the result is "intelligent" platforms; floating production, storage, and offloading vessels; and related onshore facilities. Subsea and downhole metering technologies – the means to capture well temperature, pressure, and flow data – join integrated production system models to support improved decision making.

The combination of Emerson Process Management and Roxar expertise and capabilities brings these two trends together, providing enhanced insights into automated controls and advanced optimization to bring oil and gas production closer to a closed-loop process.

Immediate benefits include:

- Integration of subsea/subsurface operations with topside facilities, allowing better near real-time modeling
- Insight into actual production, a perennial challenge in oil and gas fields with complex ownership relationships
- A high level of safety and security for employees, reducing travel requirements to offsite locations to perform dangerous tasks.

Value-chain benefits

The value chain benefits of having increased insight (i.e., predictive intelligence) into actual well, reservoir, and field characteristics extend far beyond the offshore platform:

- Reservoir models – based on seismic, intuitive predictions from geoscientists and other exploration technologies – play a major role in determining where wells are placed
- Better production monitoring can deliver an immediate understanding of what is actually being produced
- Knowing what is flowing through the pipelines can help the downstream refineries plan their production and capacity
- Keeping employees and facilities safe from potentially hazardous conditions can result in a flawless health, safety, and environmental record.

To discover how Emerson's Intelligent Field solutions can enhance

SUBSEA *Communication*

Open system architectures are poised to revolutionize subsea controls.

Riding the subway system of any major city, you're likely to hear a multitude of languages. Often, even though people are speaking the same basic language, regional differences can be hard to understand, leading to confusion. The same problem can happen with electronic communication devices. Users have a wide variety of communication protocol choices.

"This has been a source of angst for offshore operators," said David Newman, director, Global Oil and Gas, Emerson Process Management. "They're looking for integrated seabed-to-topside communication and Emerson is working on building that vision."

There has been a recent move toward more open communication structures for the industry. "We have seen a rapid change in mindset in the last five years or so toward open system architectures," said Alistair Birnie, chief executive officer, Subsea UK. "This was driven initially by the IWIS [Intelligent Well Instrumentation Standard] joint industry project [JIP], which has been ongoing for over 11 years."

As the first serious attempt to create an open Ethernet standard based on the point-to-point protocol (PPP), the JIP helped move things along. "Optical communication has taken major strides in recent years, and whilst the PPP standard is still viable, we will see this become obsolete in favor of direct Ethernet connect that is switch-connected subsea and mastered from the surface," Birnie said.

And, while Ethernet has interesting benefits in some areas, Birnie believes it isn't always the best solution. "Another JIP called SIIS [Subsea Instrumentation Interface Standard] uses CANOpen protocol over a four-wire multidrop connection, and is more suited to lower level instruments such as pressure and temperature measurement," he said. "The point is that it is a common, non-proprietary standard that allows open connectivity of any subsea sensor to a control system.

"However, the secret is not just in terms of the open standard – it is about being able to handle and manage the data throughput, and doing so in a network that is robust and deterministic."

In the last few years, Ethernet-based subsea controls have been introduced in the industry. Still, this has come with a few disappointments, particularly where the network bandwidth is constrained such as when using copper wire connections – still the most common methodology for subsea communications by far.

"The issue is about managing the available bandwidth efficiently, particularly where there are multiple users of the network and where data is fragmented," Birnie said. "Putting IT engineers into a subsea environment has not been a particularly positive experience for some, as they have not understood the need for packet management and optimization, or in network access control, and systems have performed much poorer than expected because of this."

Birnie believes that as development work opens up the bandwidth using Orthogonal Frequency Division modulation techniques used in digital television, and as control engineers learn how to get the best from this technology, the industry will see rapid adoption of open architecture since it can resolve many issues.

"Using Ethernet-based protocols has taken away one level of proprietary protocol access, but it has introduced new differentiators," Birnie said. "Development of subsea controls now hinges on the ability to do packet switching and in having fast routing algorithms to make the networks robust, flexible, and fault tolerant."

Network architecture, like that offered by Emerson, also offers advantages over centralized ones. "Probably the biggest change to the subsea architecture is the ability to connect data sources directly to the umbilical via a switch or router," Birnie said. "This allows much greater flexibility of the subsea control system without loading up the SEM [subsea electronic module] process, and then allows the SEM to use common simple hardware and software, thereby improving its reliability."

The long-term benefit to this is that the user can plug in virtually any industrial network-enabled hardware into the network without having to know very much about what's behind the network.

"This has significant benefits where the subsea system is adapted or extended, using updated or new instruments, and reduces the reliance on bespoke hardware and software, both of which are major obsolescence considerations," Birnie said. "It also allows common tools and software applications to be used via the network, improving productivity and allowing greater freedom without being constrained by proprietary protocols and software."

Another benefit is that a common Ethernet stack – one largely independent of hardware – can be used. "This reduces a considerable element of bespoke interface software – probably the most unreliable

Fiscal/Custody Transfer and Allocation

Getting accurate and timely measurement data from offshore and onshore facilities demands solutions with the flexibility to meet a wide range of applications – from the secure transfer of the measurement data to the reliability of the measurement systems. Emerson is well-positioned to offer a wide range of products, systems, and fully integrated services to ensure precise measurement over time, the highest level of cost-effectiveness, and system reliability while managing the measurement uncertainty.

Whether ultrasonic, turbine, or differential pressure, Emerson's Daniel flow meters are industry standards for oil and gas custody transfer and allocation metering from production to distribution. Daniel ultrasonic meters integrate with PlantWeb's predictive capabilities, providing intelligent meters with advanced diagnostics. Measuring and understanding oil and gas production is critical. Daniel metering systems can predict potential system failures before they happen and sustain key metering equipment throughout its life-cycle, reducing uncertainties and maximizing the return on the investment of clients' metering assets.

As a supplier of flow computers, RTUs, and SCADA systems, Emerson's Remote Automation Solutions inspire confidence that the data are being seamlessly transmitted from the offshore or onshore field to the clients' operating headquarters. Emerson's Micro Motion Coriolis meters were the first to provide direct, accurate, and on-line measurement of mass flow, which is critical for controlling many processes. Since their introduction in the late 1970s, Micro Motion flow and density measurement devices have set the standard for superior measurement technology. Coriolis technology has been expanded to include highly accurate on-line density, temperature, and viscosity measurements for many applications, including custody transfer. Today's products include sensors for measuring hazardous and corrosive materials, high-temperature fluids, and sanitary products, which deliver accurate, reliable, and representative production data for optimal well production and availability.

METCO specialist measurement services focus on ensuring optimum production and throughput measurement and compliance. Audit and consultancy services, field technicians, and office-based engineers assist oil and gas companies in managing their fiscal, allocation, and environmental measurement infrastructure, and meeting their commitments to partners and officials while operating in a compliant and transparent manner.

area of code in any subsea software suite," Birnie said. "It also can eliminate the need for mastering of devices subsea, although the trade-off can be a higher bandwidth requirement on the umbilical, and if there are multiple host devices on the topside suite, this adds to communications overhead. However, by using careful design and efficient data packaging, this issue can be largely negated."

Birnie added that, depending on the network architecture, using routers can allow redirection of data packets on fault, and can allow higher network robustness without having to have a complex communications switching layer in the server processors, again removing code that can cause problems.

New era for subsea systems

Birnie believes the evolution of Ethernet has facilitated a new area of subsea systems that previously was difficult to achieve – that of subsea processing. "By using open Ethernet-based subsea architectures, topside and subsea process controls can merge together seamlessly, making the task of systems integration much easier and reliable," he said.

Another substantial growth area in subsea controls is in being able to deploy data-heavy instrumentation, particularly in areas such as multiphase flow and downhole distributed temperature measurement, both of which can be used for production optimization. "I think we will see future generations of subsea controls with even higher data loading, particularly where either environmental or integrity sensors are routed via a subsea network," Birnie said.

Subsea UK estimates that in five years, the subsea production market will have grown 40% from 2008 levels, which will require even more engineers and even higher levels of sophistication in sensing and data technologies. "With this in mind, we will see an evolution of distributed subsea systems to support plug-and-play type architectures with more of the data integration happening topside and more Ethernet or CAN-connected devices," Birnie said. "As all-electric subsea systems become more accepted and hydraulic components are eliminated, the need for a subsea control module – in its current form – will be eliminated.

"Whilst it can be easier and more effective to recover a complete assembly for repair and maintenance, the absolute need for a centralized module is no longer there," Birnie predicts. "This will change the dynamics of subsea control towards smarter instruments and actuators with minimal subsea controls intelligence. Instead, the smart instrumentation suite will have the power supplies and data routing. This move will allow faster and more reliable system engineering and configuration at less risk to subsea operations."

To find out how open communications can help your operations, visit *www.EmersonProcess.com/IntelligentFields*.

WIRELESS *Finds New Uses* Offshore

As offshore operators look for ways to lower operational expenditure and capital expenditure costs, the possibilities of wireless installations become more attractive. With less weight, a smaller footprint, and enhanced security and reliability, wireless is changing the industry's thought patterns.

"The offshore oil and gas industry is very conservative," said David Newman, director, Global Oil and Gas, Emerson Process Management. "Traditionally, it's been a case of 'not me first' when innovative technology has been proposed, yet once people see the benefits in terms of cost and productivity, they actually end up enhancing that technology."

Wireless technology has moved into people's "comfort zone," according to Newman. "There's a classic photo of a person using one of the first mobile phones. The phone looks like a brick and a car battery was needed to run it. Yet now, we have these tiny phones that have myriad uses and slip into our pockets. In that same way, as decision-makers become more familiar with wireless technology applications offshore, we'll see greater industry acceptance."

In the past several years, wireless monitoring instruments have made their way into remote, hard-to-reach areas on offshore platforms where high construction costs made wired devices uneconomical. Newman acknowledges that traditional cabling will continue to be used in contiguous areas, as well as in safety systems. However, existing facilities are taking greater advantage of wireless benefits, and new construction projects are being built with wireless in mind.

"Reliable, robust wireless technology should be a key component of all capital projects," said Bob Karschnia, vice president, Wireless, Emerson Process Management. "Facilities using wireless realize savings and become smarter through simpler engineering and construction, flexible startup, faster deployment and project completion, and changing automation needs. Further, customers need proof that control with wireless is viable.

"We've responded with real-world Smart Wireless installations using one-second updates, enhanced PID, battery management, and IEC 62591 (WirelessHART®) communications."

Exploring the potential of wireless networks is just beginning.

Emerson's Smart Wireless enhancements are available with its DeltaV™ S-series digital automation system. Full redundancy protects the wireless network from any single point of failure by allowing primary fail-over to ensure that the data are always delivered even if there is a malfunction. Other enhancements include redundant wireless I/O, power and communications, and a redundant Smart Wireless Remote Link. The Remote Link easily links the wireless field network into a DeltaV system.

"When operators are planning for the platforms of the future, they're now thinking about a combination of fieldbus, electronic marshalling, and wireless," Newman said. "And they're finding that wireless can be cost effective, economical, and quickly installed. It's going to prompt a mindset change about the design process with greater awareness of what customers need and what they don't really need."

Evolution of the technology

For years, 4-20 mA analog instrumentation was the industry standard. Beginning in the mid-1990s, the search began for a digital replacement, and FOUNDATION™ fieldbus was developed. It is now widely used throughout the industry, especially for controls.

The first wireless networks were limited by a "line of sight" requirement – a drawback that was especially cumbersome on offshore platforms. Today, Emerson's Smart Wireless solution uses a self-organizing mesh technology that overcomes this obstacle. Self-organizing mesh networks continuously monitor transmissions from a variety of measure-

Industry decision-makers are becoming more comfortable with wireless technology applications.

ment devices that keep track of pressure, temperature, flow, and vibration. The network automatically finds the best communication route back to the network gateway. If a connection is temporarily blocked, signals are rerouted to adjacent wireless devices, and connectivity is maintained. This mesh technology is the basis for the internationally accepted IEC 62591 standard. It enables users to quickly and easily gain the benefits of wireless technology while maintaining compatibility with existing devices, tools, and systems.

"With this technology, as you add more devices to the network, the entire network continues to get stronger and stronger with more potential communication paths for each device to use," Newman said. "This is very important when you think about the ever-changing environments your instrumentation faces every day – pumps, motors, and fans cycling on and off, scaffolding being erected and torn down, welders, and a whole host of other things happening all the time. With the network's ability to automatically reroute data, we see data reliabilities of more than 99%, regardless of process environment or application."

Impacting the bottom line

When Smart Wireless technology is used for 25% to 45% of total I/O on both small and large capital projects, significant savings can result. "An Emerson study of an actual offshore platform with about 4,000 I/O proves wireless technology can be broadly used in process applications," Newman said. "It is unnecessary to restrict wireless to those applications where deploying wired instruments would be too expensive or impossible."

Examination of various combinations of wired HART, fieldbus, and wireless devices, and the projected installed costs showed wireless to be cost-effective in comparison with the other communications means. For the platform studied, approximately 17% of signals were economically and reliably transmitted via wireless devices. In this case, installing wireless along with other technologies in the process control system can realize savings of up to 7%, or more than U.S. $1 million. An additional saving is seen in eliminating 800 wired points, which results in weight saving of up to 35 tons, and reduces required deck space of up to 4,556 sq. ft. in cabling, cable trays, junction boxes, and cabinets.

When another study compared wireless to the traditional hardwired 4-20 mA/HART design, the savings were even more significant. "They found 44% of the total points can be wireless, which would result in a savings of 36%," Newman said.

Scalable solutions fit a variety of needs

Emerson's Smart Wireless can be adapted seamlessly to cover anything from a small field network to a full facility complex. "Smart Wireless is neither a top-down nor bottom-up model," Newman said. "You can begin at the plant network level and work down to the field, or at the field network and work up. You can start anywhere based on what your highest priority needs are. You're not required to invest in an expensive wireless infrastructure throughout your facility to try out a simple monitoring application."

Field and facility networks have different technical considerations. Wireless field networks use lower bandwidth for short, high-priority communications. Operating from batteries that last from five to 10 years, the field networks (usually many devices distributed in harsh environments) have low power demands and are secure and reliable.

Emerson offers field devices that monitor pressure, flow, level, temperature, vibration, pH, and position. For facilities, Smart Wireless brings the high bandwidth, flexibility, and expansion capabilities required for business and operational applications. Open standards such as 802.11 (Wi-Fi) are used to provide these solutions. Top applications for facility networks include:

- Field data backhaul
- Mobile workers
- Video
- Safety mustering and asset tracking.

Field data backhaul is the most common wireless application. If a number of wireless field devices are in a remote area of the facility and there is no distributed control system (DCS) rack room, a communications link (or backhaul) is installed to bring the information back to the DCS. The other three applications affect personnel and security. "The business driver for the mobile worker application is worker productivity," Newman said. "Improvements are realized when operations and maintenance workers are able to take the control room console with them or have access to asset management tools or procedures for troubleshooting problems."

Video surveillance is widely implemented as part of facility process safety and security systems. The traditional wired system is costly and takes a long time to deploy. Using wireless networks, video feeds can be delivered to the control room and office buildings with flexibility not possible with a wired solution. "Video has many prac-

tical uses offshore," Newman said. "One operator faced corrosion issues in its FPSO [floating production, storage, and offloading] storage tanks. When they tried to determine how they were going to monitor it, wireless video cameras were the obvious answer. Also, using video conferencing with personnel on the platform has limited the travel and location risks."

Safety mustering and asset tracking improve personnel safety, enhance facility security, and optimize the use of critical assets in a harsh environment. "People's safety is the highest priority," Newman said. "Providing full visibility to people's locations in hazardous areas or mustering stations is extremely critical to an efficient evacuation in case of emergency."

Technology designed with the customer in mind

"'Make it easy to use' was a mantra during our entire product development process," according to Newman. "Customers today do not have the resources or the time to learn new technologies and buy special interfaces and software. Plus, with Smart Wireless, you don't have to run cables to every device, making installation much simpler than for wired networks. In fact, the major attraction of this technology is that you don't have to deal with the complexity of all those wires."

Because the Smart Wireless devices have the same process connections as traditional wired HART devices, existing procedures can be used to complete the installation. Sensors for Smart Wireless can be calibrated using the same configuration tools as for traditional HART devices.

Sophisticated planning and costly site surveys are not necessary for field networks. As long as each device or gateway is within range of at least one other, it can communicate with the network. "Site surveys are a must to define line-of-sight communication paths in traditional point-to-point wireless solutions or those where network reliability is a concern," Newman said. "These surveys can be time-consuming, especially if equipment or other obstacles limit available communication paths."

Adapting legacy systems for wireless use

Emerson Process Management's Smart Wireless THUM™ Adapter helps free up diagnostics and process information from existing HART field instruments that were previously inaccessible in wired legacy system installations. "Most HART instruments have rich diagnostics and process data, yet this valuable information goes unused because older legacy systems are not equipped to receive HART communications," Newman said. "Since it is often too expensive and complicated to access this data through traditional wired means, upgrading transmitters with the THUM Adapter is an easy and cost-effective way to 'see' the valuable diagnostic and process information."

The THUM Adapter is a WirelessHART device that can retrofit onto almost any two- or four-wire HART device without special power requirements to enable wireless transmission of measurement and diagnostic information. Devices with the THUM Adapter operate as components of Emerson's Smart Wireless self-organizing field networks.

As a result, predictive intelligence can be expanded into key areas throughout the facility by:

- Tapping the power of *in-situ* meter verification for magnetic flowmeters and Coriolis meters, enabling significant operational improvements
- Enabling enhanced valve capabilities with in-service valve testing, alert monitoring, and valve position trending
- Remotely managing devices and monitoring health by allowing customers to troubleshoot HART devices from their own desks
- Making any HART device wireless and eliminating the high cost of loop wiring due to remote locations or physical obstructions

Pilot Project Leads to Greater Acceptance

Wiring constraints led to the successful installation of Smart Wireless at Western Europe's largest onshore oil field.

BP wanted to increase the available information, improve worker efficiency, and remove the need for operator rounds at its Wytch Farm oil field in Dorset, UK. Wired transmitters were too expensive due to the wiring infrastructure need, so wireless became the best technology for this application.

The Smart Wireless network installed on one of the well sites included 40 wireless Rosemount® pressure transmitters. Two transmitters were mounted on each wellhead and a single Smart Wireless gateway mounted outside the process area, connected the transmitters to the control system. Data are collated in a PI historian database with the information used for regular maintenance and safety reports.

It took less than eight hours total to complete installation, which included removing the old gauges, replacing them with the Rosemount wireless transmitters, and performing a three-point manual calibration check on every device. All devices were online within 30 minutes.

"The wireless instruments have performed without losing any data since they were installed," Chris Geen, BP manager, said.

Wireless installation made easy. (Image courtesy of BP)

Statoil Gullfaks Platform Sees Increased Production

Emerson Process Management's Smart Wireless network is regarded by one oil company as a viable and necessary solution for its operations in the harsh environment of the Norwegian North Sea.

"We are currently in a process of qualifying wireless as a standard for monitoring," said Anders Røyrøy, production facilities researcher at Statoil's Research Center in Bergen, Norway. "It also is one possible solution in several upcoming projects."

Statoil was occasionally losing flow from the producing wells at its Gullfaks A, B, and C platforms because of a loss of wellhead pressure. Detecting flow loss early enables operators to flow the well through the test separator and thus re-establish flow by reducing pressure. Bringing flow back quickly improves throughput and, over time, significantly increases production.

The loss of flow was difficult to detect since no existing flow-metering devices had been installed within the well pipes. "The installation on Gullfaks would not have been done with traditional instruments due to the installation cost," Røyrøy said. "In order to install such devices, a complete shutdown of production would have been necessary – far too expensive in terms of lost production."

Gullfaks A is used for storage and shipment of stable crude oil. (Photo by Øyvind Hagen, courtesy of Statoil)

Lack of available space complicated the situation. The wellhead was already a crowded area and, for safety reasons, had to be kept as clear as possible. New sensors would have to be connected back to the control room, yet the introduction of additional equipment such as new cabling, cable trays, and junction boxes was not possible.

Another challenge was a time difference between first occurrence of flow loss and first detection of the loss. Platform personnel routinely went to the wellhead – a potentially hazardous area – where they placed their hand on the pipe to feel whether there was a temperature difference between the pipe and ambient. Typically, well fluid is 140°F (60°C), so the pipe feels warm. However, if flow is interrupted, it slowly drops to ambient temperature. Temperature readings were taken only at the start and the end of a shift, so a loss of flow could easily go undetected for long periods of time and production would be lost.

Emerson's solution was to install Rosemount® 648 wireless temperature transmitters to indirectly indicate flow on lines at each of 40 wells on the Gullfaks A, B, and C platforms. The wireless devices transmit data from clamp-on temperature sensors mounted on the surface of the flow pipes.

Personnel have not seen any drop-off in performance. "Because there is daily radio communication within the well area, it is essential that the wireless field network can coexist without any reduction in performance," Røyrøy said. "We have found that Emerson's Smart Wireless mitigates the impact of interference, and the data reliability is 100%."

Emerson's wireless devices transmit readings back to the Smart Wireless Gateway every 30 seconds. This gateway is hardwired into the existing control system, providing operators with the real-time information they need to react quickly to any change in flow. "The operators are not seeing any difference between wired and wireless instruments; they now know when they are starting to lose production from their wells and can prevent that," Røyrøy said.

■ Efficiently gathering data from multivariable devices.

Looking toward the future

Planning for future technological advances can pay off now. "In anticipating the life-cycle needs of an upcoming project, one customer made the decision to put in 300 points of wireless from the beginning," Newman said. "They wanted the wireless infrastructure in place to give them the flexibility and nimbleness to address things that they can not anticipate right now."

Because wireless requires minimal engineering, less well-defined areas can be specified for wireless later in the project without reworking all of the conduit and electrical work. The long-term operational benefits come from the fact that the hurdle for incremental measurements to improve facility performance is much lower.

"The next step for offshore newbuilds is to go with wireless," Newman said. "Think of all the weight and cost of cable going in on an offshore platform. Those are tremendous issues and wireless can help solve those problems. People say, 'Why should I put wireless in? I still have to run a cable anyways.' It's a fair comment, and yes, at this time, you do have to do that for controls. But when you get things like electronic marshalling in the field, then you don't have to run that multicore cable anymore."

Newman said there are companies that, by 2015, will have offshore platforms that are 70% wireless. He noted that wireless installations have become an accepted part of offshore facilities within the last three years. "Widespread use of wireless isn't going to happen overnight, but as the technology brings proven results in terms of costs and productivity, the industry will see a culture change."

To explore how Emerson's Smart Wireless solutions can enhance

A Look *into the* FUTURE

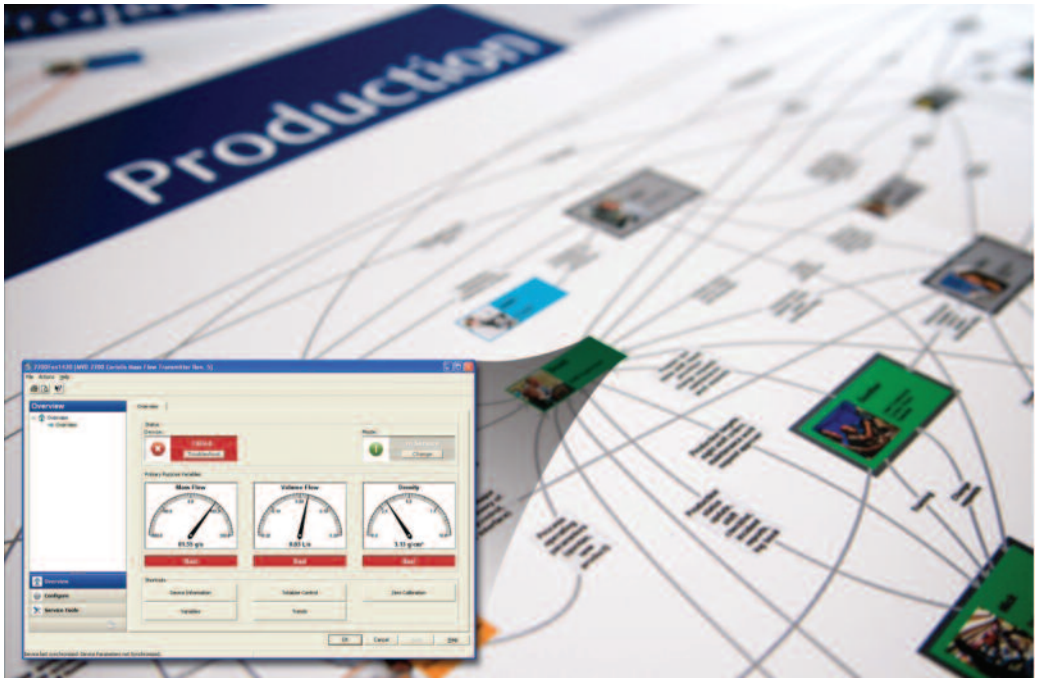
Predictive intelligence will increasingly affect how people work.

While no one can accurately predict what tomorrow's digital oil field will look like, several experts shared their vision for the oil and gas industry within the next 10 years.

The UK's National Subsea Research Institute foresees autonomous subsea fields as one of the future technological challenges facing the subsea industry. Yet Emerson's David Newman, director, Global Oil and Gas, believes that hurdle will be overcome within the next 10 years, and processing that now takes place topside will be relocated to the seabed. "All the processing today that you have on the platform – the compressors, separators, and boosters – will be sitting on the seabed," Newman said. "We'll be taking technology that's currently in use topside, 'marinizing' [adapting the technology for marine use] it, and moving it subsea. We'll have buoys on the surface that send and receive data from an onshore control center and, possibly, a loading buoy where a tanker will come to the site, load up, and go."

Newman also believes that autonomous underwater drones (AUVs) that can perform simple functions will be used. "They'll be able to have a look and see what's happening subsea, and will be able to adjust or gather data. This sort of technology is continuously evolving and growing."

Alistair Birnie, chief executive officer, Subsea UK, an industry group that is the focal point for the British subsea industry, concurs. "Subsea, overall, has the greatest potential for predictive intelligent technology," Birnie said. "At the forefront of this is the massive innovation in autonomous underwater vehicles that can now think for themselves and work out what to do based on what they see, and change their missions based on higher level objectives set by the pre-mission configure.



Human Centered Design: Process tasks made easy.

"We also have an opportunity to use technologies that have been applied to topside processes, and we can expect to see, in time, autonomous production optimization technologies being deployed. However, reservoir mechanics also would come into the skill set required to close the loop, so it will be a while before we see this level of integration."

With exploration technology such as 4-D seismic becoming better refined, reservoir optimization technology is also an area where operators are seeking more answers. Current recovery rates in the North Sea's Norwegian sector are averaging 45%, compared to 30% globally, but Statoil is targeting 70% ultimate recovery rates from its offshore fields. Integrated Operations (IO) are seen as a way to increase recovery and improve uptime.

"Higher resolution is being seen with 4-D seismic. In order to build a more correct model, we have to understand the reservoir better," said Robert Chelak of Emerson's Roxar division. "Uncertainty is the big thing we have to deal with, but advanced reservoir optimization technology is being delivered to expand our understanding and people are embracing it."

He looks forward to combining Roxar software and subsea capabilities with Emerson's topside process control management. "Emerson saw Roxar technology and software solutions as a good way to expand their own technology. There are a lot of good ideas and innovations under consideration so that operators can optimize their reservoirs in smarter and quicker ways," Chelak said.

Additional instrumentation opportunities will become available as more complex projects require involvement from several different partners. "In less than five years – and as processing moves to the seabed – we'll see technology focus on such items as subsea compressors, separators, and boosting, as well as temperature and pressure measurement," Newman said. "Also, there will be advances in subsea separator and compressor control, subsea storage tank level and radar measurement, and subsea wireless."

Beyond the 10-year time-frame, instrumentation will take on the challenges of control buoy data gathering systems and communications, and the previously mentioned AUV control, according to Newman.

Technology changes the way people work

Intelligent Field technology not only brings changes that speed up the amount and quality of information available to operators, it also will change the way people work. Companies that integrate advances in information and communication technology and processes with workforce-related solutions will be on the cutting edge of the industry's "quiet revolution."

"The movement to use real-time data and information technology is changing the way we work," said Tony Edwards, chief executive officer, StepChange Global, a leader in the application of digital oilfields and integrated operations. "However, you cannot regard technological changes as strictly IT projects. If you treat them as such, this transformation doesn't go very well. Technology is an enabler, but it should enable changes to our way of working."

Edwards noted that connecting people to real-time information brings basic alterations to an organization by:

- Speeding up work process
- Providing data and information that crosses traditional historical boundaries
- Enabling moves to geographically remote locations
- Allowing teams with different backgrounds to collaborate on the same assets.

"One of the drivers for these changes includes the fact that many companies have moved out of the heartland of oil and gas production – the Gulf of Mexico, North Sea, or Alaska – into more remote geographic areas," Edwards said. "As a result, there's a lot of geographic dislocation and separation from traditional areas." Also, with offshore projects moving to greater depths and more remote locations, these technologically challenging areas may not have the same infrastructure available.

"Finally, the demographics of our industry have changed. Fifty percent of our personnel are due to retire within the next 10 years,

Technology Serving People

In 2009 Emerson formed the Human Centered Design Institute to make process control easier to use.

Following more than five years of customer work-practice analysis, new product development re-engineering, and organizational training, the goal of the institute is simple: make products that are not only reliable, compatible, and cost-effective, but also bring about a significant improvement in ease-of-use and work force productivity.

"Process control technologies have come a long way in the past 40 years," Peter Zornio, chief strategic officer at Emerson, said, "but the industry has invested almost exclusively in feature and technology enhancement instead of designing around how people actually use this technology. We believe it is time technology began serving people, instead of the other way around."

The primary goal of Emerson's Human Centered Design Institute is to ensure that user work practices and improved task completion (usability or work force productivity) are at the heart of every new product that Emerson introduces.

"There is a demographic paradox facing the industry," Zornio said. "In mature markets, knowledgeable workers are retiring. In emerging markets, finding knowledgeable and skilled workers is very difficult. By putting increased emphasis on ease of use, we can meet this demographic challenge head-on and simply make it easier to extract value from technology investments."

Emerson's DeltaV™ S-series digital automation system hardware and more than 50 new field Device Dashboards are the first applications of this philosophy of human-centered design (HCD). Customers and engineering contractors can have unprecedented flexibility in I/O engineering thanks to electronic marshalling. Hard-wiring each device as a unique connection from field to controller, and every contact in between, is eliminated. This means less engineering up front and fewer change orders later in the project.

Also, by focusing on the repetitive tasks operators and maintenance staff perform and how they interface with field devices, Emerson was able to overhaul its Device Dashboard. "We evaluated device interfaces across the industry and found a common problem," Zornio said. "Routine steps – which operators and maintenance personnel perform frequently – were cumbersome, confusing, and illogically laid out. It's an endemic problem in the industry. Based on user input, we believe the changes we've made to the Device Dashboard will improve speed and accuracy of confidently performing these tasks."

This innovative approach likely will impact design costs and time. "We observed that customer project engineering and design processes across the industry put too much emphasis on locking down designs very early in the project, often before the process design was complete," Zornio noted. "Not only does this increase FEED [front-end engineering and design] and detailed design cost and time, but it also exposes the project to increased labor and potentially significant change-order costs during construction. Additionally, the existing wiring processes were time consuming and laborious."

Partnering with Carnegie Mellon University, a recognized leader in human interface and interaction with technology, Emerson began incubating the HCD process during the early days of its Smart Wireless designs. "The products Emerson will introduce based on this and ongoing research will make a profound difference in how people accomplish their tasks," Duane Toavs, director of Emerson's Human Centered Design Institute, said.

taking 80% of the knowledge with them. The historical model of staffing up a project is no longer feasible. You can't pick up 300 people and take them to a remote location anymore. They don't want to go there."

With the upcoming shortage of skilled manpower resources and the so-called "gray shift change" occurring in the energy industry, the utilization of technology is important, but it's how we use it that's more relevant. Moving to multidisciplinary work teams can bring sustainable value-added capability to the process.

"Many companies have production optimization teams that include the reservoir people, the petroleum engineers, operations and facilities engineers, and the commercial people," Edwards said. "Having the information flow allows functions to be moved anywhere around your company or even external to your company. It enables a lot of options in the way you do things."

However, companies need to update their processes. "You need to address the people-change aspect of it. For example, if you have engineers who have worked one particular way for 20 years and now you're asking them to work in a very different way, how do you overcome that resistance to change? You have to make innovations in the organization, the way people work, and the organizational processes."

Luckily, much of today's intelligent field technology enables operators to accomplish remote tasks they couldn't do previously. "Many of the technologies we need are already developed and are being integrated in the industry including high bandwidth communication, low cost of data storage, video-based technology, and sensor technology," Edwards said.

Looking beyond technological applications used strictly in the oil and gas industry also can be beneficial. "The oil and gas industry is pretty risk aversive," Edwards said. "Many times there will be a 'no new technology' statement for a project, yet that is a barrier to taking lessons from areas closely related to us. What's been learned in a refinery can be used here. For instance, Emerson's FOUNDATION™ fieldbus technology is absolutely routine in refineries, yet in the upstream oil and gas

industry, you routinely hear that this type of technology is 'not proven.'

"If you look at many platform and facilities' designs, they're still based on early 1980s or 1990s technology. However, we're finding that many brownfield projects are incorporating needed technological changes more quickly than greenfield projects."

Both Edwards and Birnie agree that one significant challenge facing the industry today is the lack of personnel familiar with both digital IT technologies and the needs of the industry. "Data management is a big and hot topic in the industry," Edwards said. "Assuring good quality data and incubating new functions can be a challenge. Finding dedicated data managers or digital engineers – someone who understands not only the engineering, but also the data and IT sides of a project – can be difficult. Engineers have to know what kind of data they want. The digital oil field can help capture the 'brain drain' that's occurring in the industry."

"In recent years, there has been a growing skills shortage, not just in development of controls technologies, but also in delivering projects," Birnie added. "The use of IT technologies helps change the skill set in some areas, particularly where the data systems are more complex, and this has certainly improved the software delivery process.

"However, subsea control is about understanding the entire subsea system and its behavior, including its interaction with the extended production process. These attributes make it a much tougher challenge to develop the broad competency needed to engineer subsea systems solutions, particularly as the growth in subsea in recent years has been immense – 20% per year.

"When we can get to the point where subsea controls become a logical extension of topside facilities controls, then we will start to make some significant progress," Birnie said. "I think we are starting to win on this front, but there are still too few competent systems engineers around."

Birnie believes Emerson is well positioned for the growth in the subsea industry. "Considering Emerson as a whole, they have a wide portfolio of topside control and data acquisition capability, and this can be extended to subsea through the use of open data architecture," he said. "As the market grows and systems become more open, we will see an increased drive toward integrated topside and subsea systems, with the aim of reducing the hardware complexity and increasing the flexibility of the overall process control."

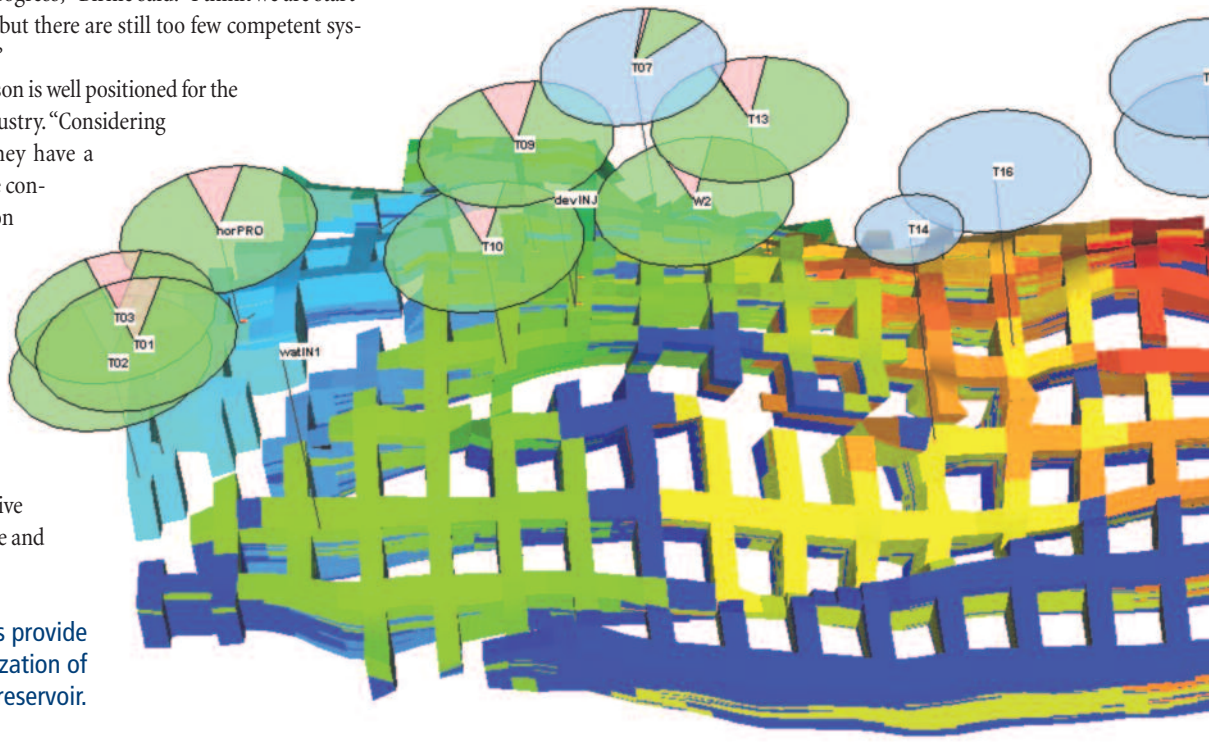
According to Birnie, Emerson's acquisition of Roxar is conducive to new subsea advances. "Having now a subsea sensor capability such as Roxar, integration between subsea instrumentation can be tightly managed using common topside and subsea software, and in some cases, common hardware, to create a flexible and robust solution that is seamless between subsea and topside environments.

"Emerson also has the strength, through its portfolio of capabilities, to manage the evolution of automation and control for the future – a challenge that is becoming increasingly difficult through the increased complexity and short life cycle of commercially available components. Combined with the buying power of Emerson, this will lead to stability of product lines and proven solutions that should improve the availability of systems for the future," Birnie said.

The pace of development of Intelligent Field technologies continues to accelerate as operators push into deeper, more remote environments while trying to cope with a growing shortage of people who understand and can solve the challenges they face.

"The future for the subsea sector is very bright indeed, with both a continued strong growth in the market and a growing desire for higher levels of instrumentation and redundancy, particularly in ultra-deep water," Birnie said. "With this growth, we will see a rapid change toward control and automation companies, such as Emerson, participating in this market. We will see from this new ideas being brought to bear, changing the way we think about subsea controls forever."

To see the vision of your technology future today, visit *www.EmersonProcess.com/IntelligentFields*.



Intelligent Fields provide greater visualization of your reservoir.


EMERSON™
Process Management

The Pathway to Your Intelligent Field is Just a Click Away

Discover how Emerson's Intelligent Field solution can help you improve your remote operations, enhance safety, optimize production, achieve overall cost effectiveness, and extend asset reliability and utilization. Contact us to learn how we can strategically enhance your operational excellence.

To start on your path to becoming an intelligent field, visit:
www.EmersonProcess.com/IntelligentFields

EMERSON.
Process Management