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Shale Combust, Flow and Treat Options Related to IIoT

Webinar
February 7, 2018
Part 2

IIoT Potential in Shale

- There are currently about 5 billion devices connected to the internet. This figure is expected to increase to around 50 billion by 2020. Amidst this growth, the oil and gas industry is anticipated to witness a global IT investment of more than $48.5 billion by 2020,
- Exploration of greenfield and reengineering strategies for production in brownfields necessitates the digitalization of the assets to effectively use the industrial internet of things. Implementing the right tools across an enterprise data platform can counteract suppressed commodity prices, sustain profitability and reduce OPEX and CAPEX as well as maintain safety and return on investment.
  - The three critical steps for optimized field (re)-engineering and effective use of IIoT are:
  - Access to quality-controlled spatial and temporal data collected from sensors.
  - Automated and semi-automated exploration of the aggregated data to enable data-driven workflows.
  - Domain knowledge and subject matter experts to break down the traditional engineering silos. McIlvaine is taking this a step farther with subject matter ultra experts (SMUE'S) and organized decision systems
- There is a far-reaching IT/OT landscape littered with marketing labels such as artificial intelligence, cognitive computing, deep learning, IIoT, big data, and data-driven analytics. However, the business goals must be the focus. The adoption of these analytical capabilities create digital twins of valuable industrial assets in the form of data-driven models. The only thing slowing down their implementation is the effort required to change mindsets.
- Decision Systems as part of a five step program will help to change mindsets and provide a clear path to maximum utilization of IIoT (discussed in detail at www.mcilvainecompany.com)

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Process Management

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Accenture - Uber for the Field

A new operating model could help drive out inefficiencies in operational decision-making. Drawing a parallel to Uber, Mohanned Saadat of Accenture sees the well as the demand center, like the taxi customer. Multi-skilled technicians, along with high-tech gadgetry (mobility apps, smart glasses and more) are supply points equivalent to drivers. An unmanned, artificial-intelligence (AI) center ("The Brain") is an app that runs diagnostics across wells, directs technicians or vendors to wells, and aggregates ratings feedback on service quality.

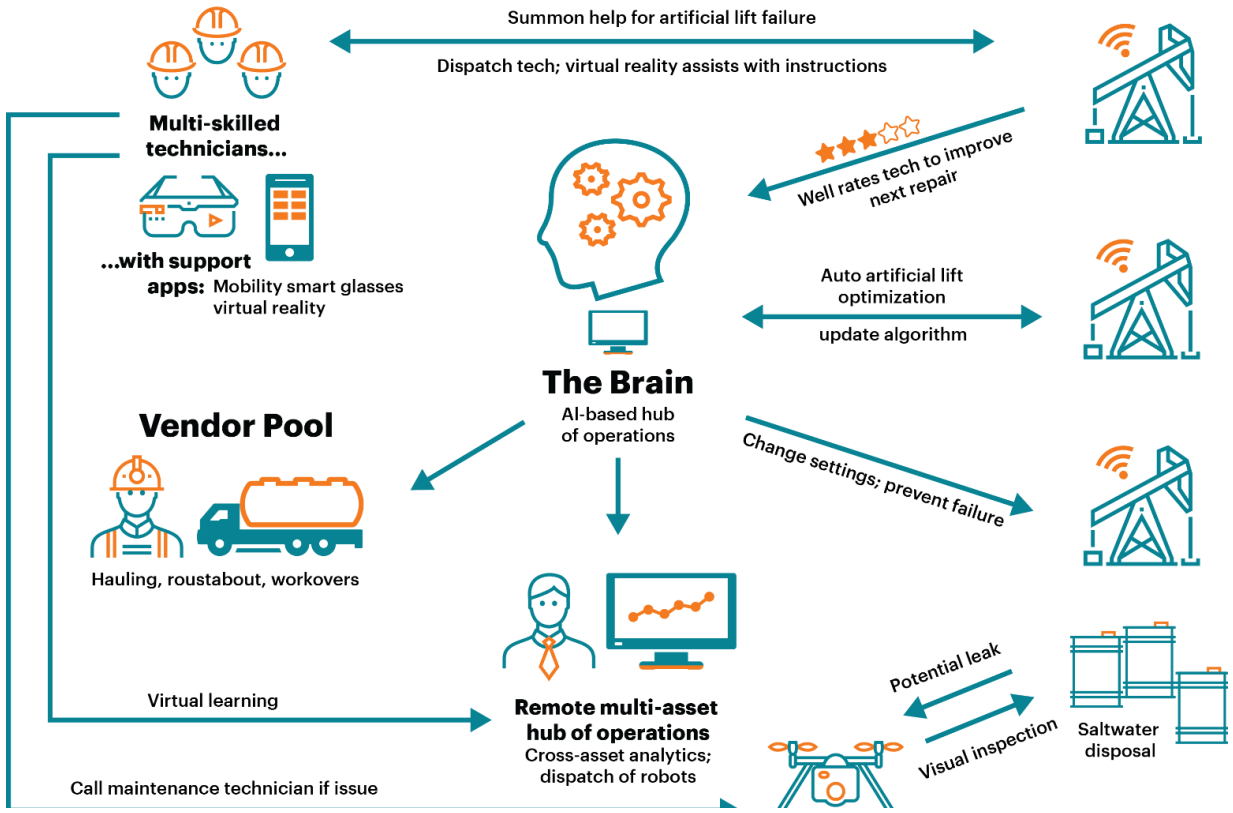
Four key elements in the **Uber for the Field** model shift the focus from "pumpers" visiting wells near-daily to a lean, highly skilled, AI-powered workforce:

Liquid workforce. Multi-skilled technicians (internal or external vendors) are summoned by the Brain to address issues and work plans optimized across activities.

Dynamic analytics. Self-learning, predictive algorithms provide insight and suggest proactive actions for improved performance.

Connected operations. Flexible architecture aggregates data, equipment and sensors for the AI engine, providing continuous linkage and results from geological and geophysical to production.

Smart equipment. Digitally-enabled equipment (e.g., drones to sense methane leaks) assume manual and routine activities.



Rejuvenated Shale Industry will Leverage Digital

- The U.S. shale industry is the ideal candidate to lead the way in IIoT. The business is expanding and the potential benefits are larger than in most other industries.
- Anand Laxshmivarahan of Wipro believes that “while many of the concepts like Predictive analytics for Equipment failure, IIoT (Industrial IoT) enabled OEM Remote Operations Center, or Digital Twins have been discussed for many months (maybe years) now, but the actual adoption of these is still nascent I feel there are two major events happening that will cause an inflection for Digital Manufacturing. These are Shale 2.0 and the Open Process Automation initiative. “I see this as causing an inflection because both if successful will leverage Digital in many ways not seen before.”
- ”The O&G industry is abuzz with Shale 2.0, which is rejuvenation of the Shale industry - its seen as a next phase where most producers from shale oil plays are now able to operate with a lower cost structure.”
- OSIsoft with their PI system of predictive intelligence already has an impressive record in this industry as shown on the following slides.

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WiPro Integrated Agility

- The technology strategy for shale operations should center on the concept of “Integrated Agility”. Multiple and often overlapping point solutions within organizations should be replaced with standardized platforms to reduce complexity, improve data integration and accelerate delivery of new capabilities (such as analytics and reporting). Such platforms may include commercial planning, operational scheduling, drilling and supply chain management applications.
- Agility is a central concept for Shale technology architecture: Traditional enterprise software systems may be over-engineered & too rigid for shale business and may saddle the shale P&L with unnecessary costs. Shale’s technology strategy should embody three essential components of Agility: Flexibility (i.e. ability to pick and choose applications when needed), Speed (i.e. fast deployment of new capabilities) and Cost adjustability (i.e. pay-as-you-go capabilities). This requires a low-frills fit-for-purpose base solution that can be tuned up or down based on market requirements. In an industry where asset ownership changes hands often, hosting the solution components in a cloud-based Software-as-a-Service (SaaS) format will enable pay-as-you-go capabilities as and when needed.
- An enterprise program management office can play a key role in cost effective and efficient delivery of IT services to organizations by driving unified project management approach. A centralized governance approach to IT delivery is recommended to discourage federated development of point solutions in different operating units.

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Shell has Worldwide Enterprise Agreement with OSIsoft

- Shell Information Technology International BV., has entered into an Enterprise Agreement with OSIsoft LLC, a leader in operational intelligence. This agreement allows Shell to deploy PI System software across Shell's global operations which will help Shell streamline IT, conduct advanced analytics and develop new digital services.
- The program will track "tags" or data streams with OSIsoft's PI System and deploy select OSIsoft software across business groups.
- "Data and digital technologies will play an increasingly important role in the oil & gas industry for maximizing capital investments, reducing downtime and helping companies meet their commitments to shareholders and customers," said Martin Otterson, Senior Vice President of Customers Success at OSIsoft.
- Shell currently monitors over 7.5 million instruments with the PI System and conducts approximately 100,000 calculations per minute with data captured and shaped by the systems within select business groups. The PI Systems are also the data engine for 30,000 reports and 40,000 displays daily.
- OSIsoft's offerings help customers remove organizational and purchasing barriers to facilitate companies delivering a data-driven culture for digital transformation.
- OSIsoft also collaborates with customers on training programs and developing use case scenarios getting the most out of their PI System.
- OSIsoft places a premium on creating a unified data infrastructure that provides any authorized employee or partner rapid and comprehensive insight into any device or application at any time. With a data infrastructure, supply chain managers could monitor pricing, shipping, and production in real-time to optimize deliveries and lower costs or analyze long-term traffic patterns at select depots to postpone capital investments.
- "Think of operational data as the Rosetta Stone of digital transformation: that vast store of information holds the key to improving connectivity or developing new products. We've just begun to scratch the surface on what can accomplished," said Otterson. "We help companies to track and analyze more data. They don't have to worry about the number of tags. More data will mean more and better insights."

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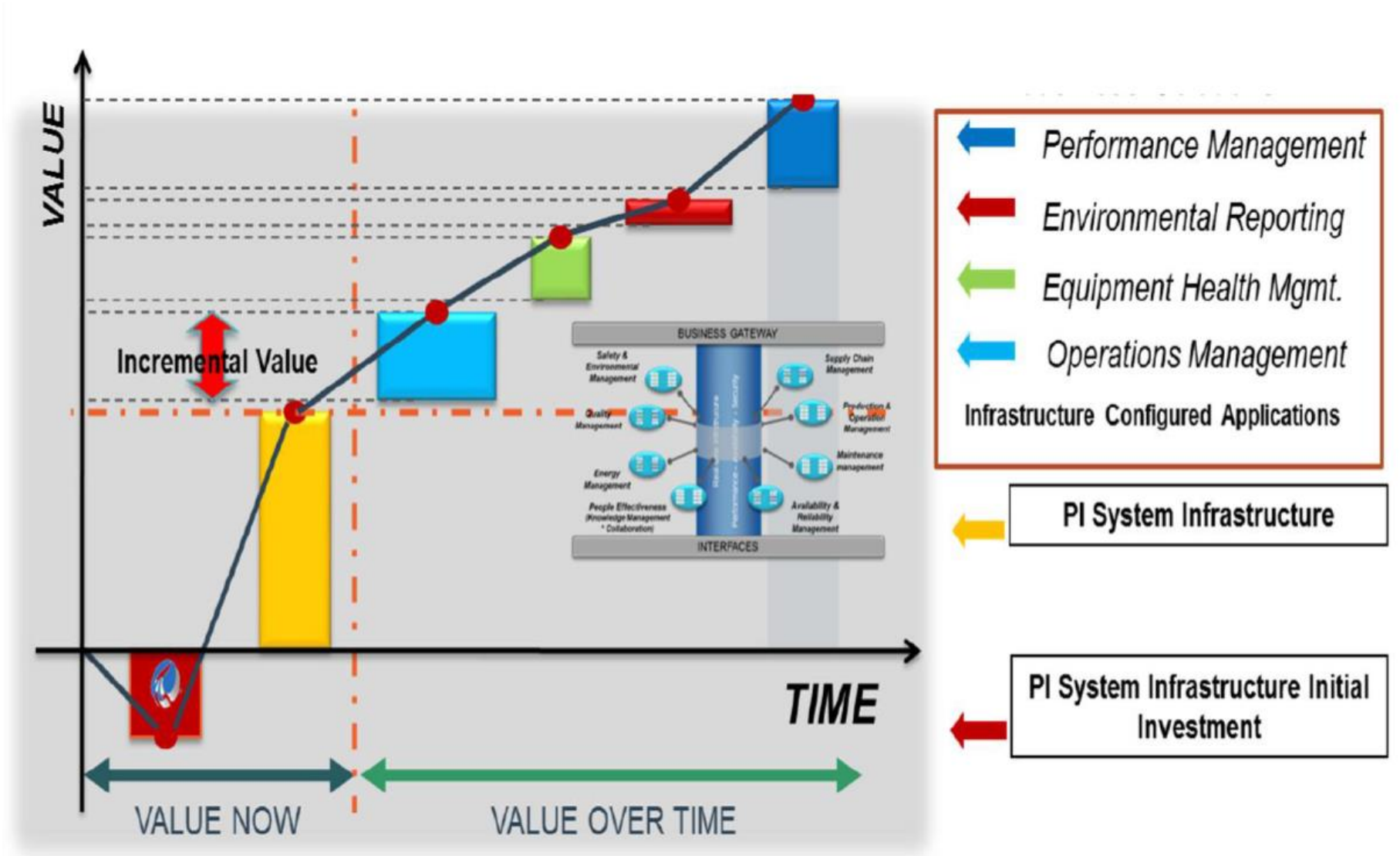
Leverage of PI System as a Strategic Infrastructure



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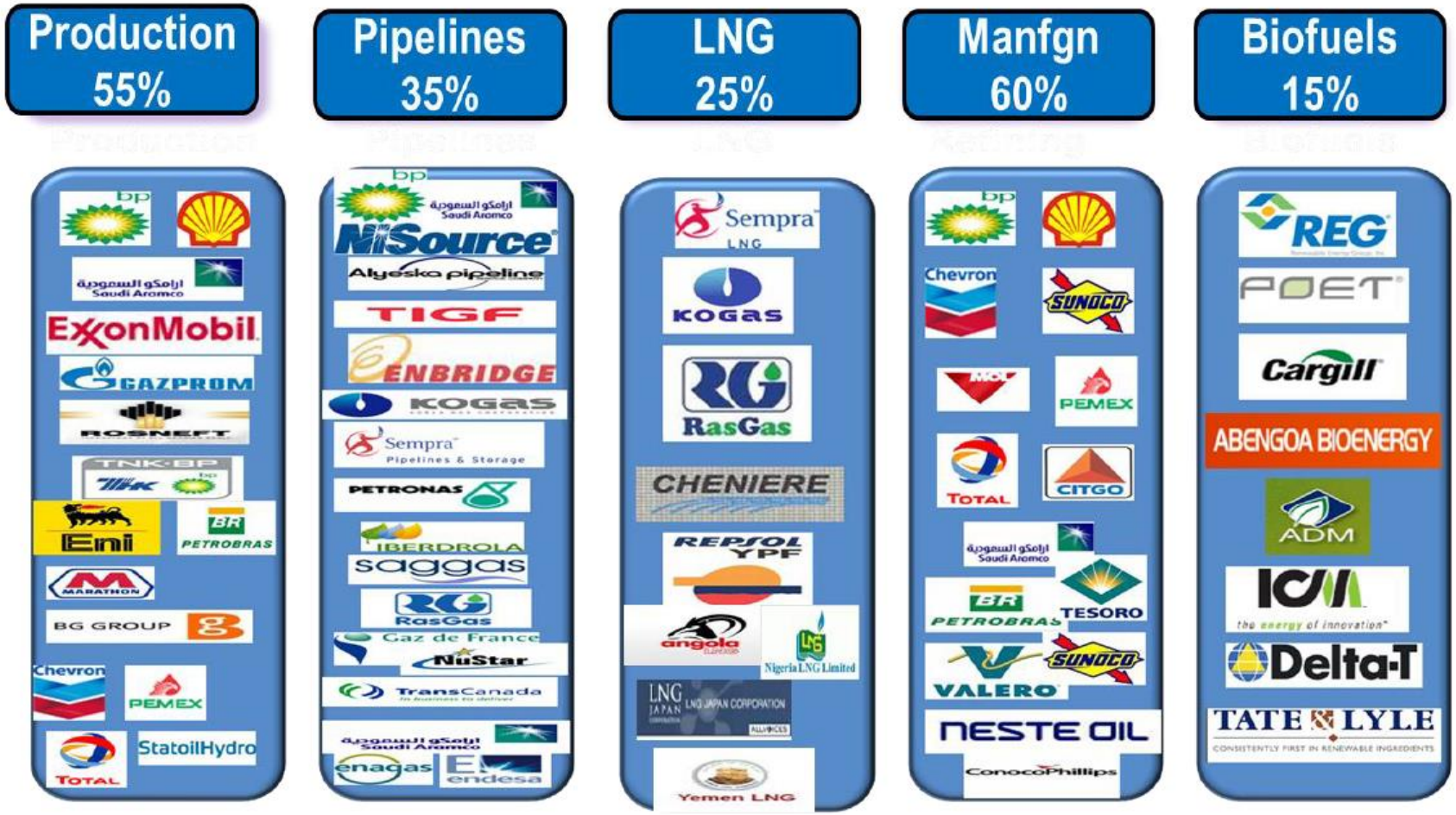
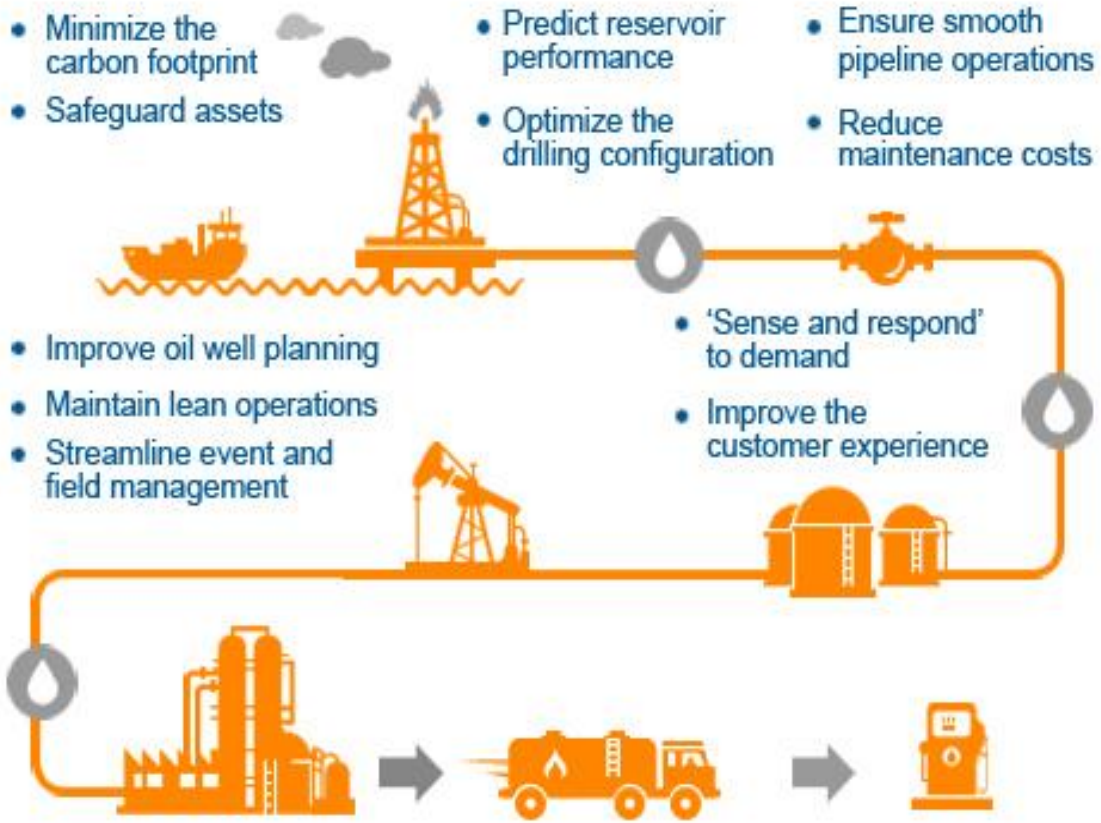
The Standard in O&G - Statement of Value

% Global Capacity Using The PI System



Inofsys Centers of Excellence

The Infosys Oil and Gas practice addresses emerging business challenges by aligning people with processes and driving operational excellence with technology solutions. The company offers visibility across the enterprise and supply chain so that personnel can access accurate data, collaborate, and take timely and informed decisions.
Centers of Excellence (CoEs) in exploration and production, pipeline management, refining and marketing, energy trading and risk management, geographic information systems, hydrocarbon accounting, and alternative energy drive superior business performance.
INfosys partners with oil and gas companies, oilfield services providers, and Engineering, Procurement and Construction (EPC) enterprises. Experience spans commissioning greenfield projects to transforming onshore and offshore operations at brownfield refineries.



Futura Optimizes Shale Equipment Performance

A customer of Futura is one of the **world's largest designers and manufacturers (OEM) of specialized equipment for the hydrocarbon and heavy engineering industries.** They also provide aftermarket parts and services to their customers. Some of the high-end equipment they provide include Fracturing Pumps, Chemical Additive Units, Acidizing Units, etc.

Cerebra IoT Prognostics/Diagnostics platform ingested signals from a variety of frontline industrial assets in real time like – Acidizing units, Fracking pumps, chemical additive units, blenders, large generators,. The specific signals analyzed include Pressure signals, Oil temperature signals, horsepower signals, rpm signals, discharge pressure signals to: find Anomalies to Potential Fault Modes, predict Failures & Maintenance Requirement, Forecast Spares requirement, and Optimize Asset Performance & Utilization.

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Monitoring and Control

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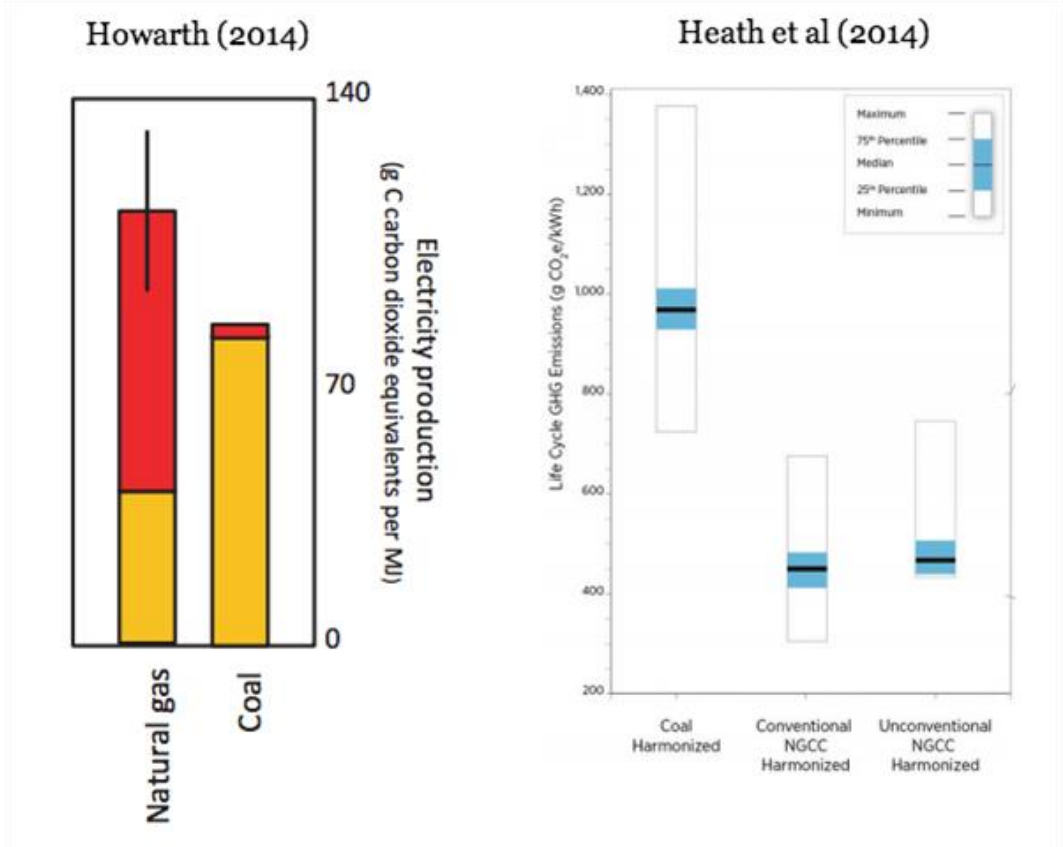
If Gas Leakage is more than 3.2 % CO_2 Emissions Exceed Coal

Two papers examine what the actual climate impact of natural gas is. At first glance they seem to show opposite things. The graph on the left, taken from a paper by Robert Howarth appears to show natural gas electricity generation emissions – the towering left bar – can be much higher than coal's. The second graph, from Heath et al, appears to show the opposite – that coal's generation emissions (on the left) are much higher than those from both conventional and shale gas.

Both papers examine the 'lifecycle emissions' of the fuels: the amount of gas emitted from extraction to combustion. So why is there such a large discrepancy between two papers? In short, it's because Howarth's data includes an estimate of fugitive emissions, while Heath et al's doesn't.

Gas is only cleaner than coal if the leakage rate is below 3.2 per cent, according to one estimate. Some studies now suggest the amount of gas leaking from wells could be as high as nine per cent. But opinions differ on which studies are more reliable.



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Hydraulic Actuator Position Feedback for Control and Shutoff Valves in Shale Applications

Balluff's magnetostrictive linear position sensors are used in servo-hydraulic systems in nearly every industry. The special requirements of hazardous locations in oil & gas extraction, transportation, refining and petrochemical processing require sensing products designed to withstand harsh environmental conditions, while at the same time meeting the certification and agency approval requirements of jurisdictions around the globe.

The features:

- Flameproof/Explosion-proof protection method
- Non-contact, wear-free operation for long service life
- NEC, CEC, ATEX, IEC, and many other international approvals

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Danfoss Components in Fracking Operations

- Designed for harsh industrial environments, the range of MBS pressure transmitters from Danfoss (3000, 4010, 4201, 4500, and 4701 series), which utilize the piezo-resistive sensor technology, are used to control the pump intake, lube oil, and filter pressure on the fracking trucks, as well as the pump suction and discharge lines of the blender trucks and hydrators. MBT temperature sensors (series 3270 and 3560) also monitor the hydraulic reservoir on the blender and fracking trucks, as well as the lube oil and radiator temperature.
- Manufacturers of equipment located on fracking trucks and in the fracking industry are faced with ever-increasing challenges such as high-pressure peaks, liquid hammer, cavitation, high vibration, and mechanical impact in hydraulic systems with changes in low velocity, e.g. fast closing of a valve or pump starts and stops. The piezo-resistive technology found in the Danfoss pressure transmitters used in the fracking industry offers long-term stability on zero point and span, as well as high performance over a wide temperature range. This technology utilizes a silicon diaphragm with diffused piezo-resistive resistors acting as strain gauges, which makes it suitable for applications with pressure peaks in hydraulic applications
- Sauer-Danfoss is a leading supplier of hydraulic systems to key oilfield services equipment, including hydration units, blenders, fracture trucks and, for offshore applications, lift boats. On the hydration units used to premix precision slurry before it enters a blender, a Series 90 130ccm axial piston variable displacement pump and motor handle up to 120 barrels of water a minute. Load-sensing PVG 32 valves and Series 45 pumps then work with low-speed high-torque (LSHT) orbital motors to mix in light chemicals. Eight paddles, each dependent on PVG 32 valves and Series 45 pumps and driven by an OMT 160 orbital motor, aerate the mix to make it homogenous. Critical power Blenders take care of the final preparation of water, chemical and sand slurries that are pumped by fracture trucks into inactive wells at extremely high pressures. Using this advanced technology, oil companies are able to fracture the ground in the well and free up pockets of oil or gas for recovery. Sauer-Danfoss components provide both the blenders and fracture trucks with critical hydraulic power. Sauer-Danfoss systems for blender applications are particularly extensive, including Series 90 180ccm, 100ccm and 55ccm, Series 42 30ccm and Series 45 45ccm pumps; Series 90 130ccm and 100ccm and Series 40 M25 motors; various gear pumps and motors; LSHT orbital motors; multiple-section PVG32 valve stacks and cartridge valves. Fracture trucks benefit from Series 90 pumps and Series 51 bent axis variable displacement motors. In addition, PLUS+1™ technology is now beginning to bring a new era of intelligent control to oilfield service equipment.

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Valve Applications for Emergency Shut Down in Shale Operations

An article by Tom Jeansonne of Emerson–Bettis has been linked in the McIlvaine oil and gas intelligence system. We will be contacting him for updates relative to the regulations, power sources, and technology at the well site and flowlines in gathering processing, and storage developments since this article appeared 4 years ago.

An ESD, PSD or Safety Instrumented System is a set of components, logic solvers and final control elements arranged for the purpose of taking a process to a safe state when predetermined conditions are tripped. These components typically incorporate a spring return actuator to close the valve in the event of an upset. Such a system is important in all flow situations and is especially significant when the field is remote, unmanned or where an external power source is unavailable, undependable or prohibitively expensive. Reliability and prevention are key factors for these systems. The valves and their automation often remain in a static position for extended periods of time, yet they must perform without room for error when required for immediate shutdown or diversion. If these systems did not have this level of dependability, disasters would be much more probable.

Automated Hydraulic ESD at the Choke Valve

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Solar Powered Rotork Actuator Replaces Bleed Gas in Shale Produced Gas System

- Rotork CMA electric control valve actuators delivered an efficient and reliable process control solution and eliminated venting and greenhouse gas emissions in compliance with new environmental protection legislation at remotely sited shale gas installations in the USA.
- Traditionally, spring diaphragm actuators powered by the produced gas have been used, but recent EPA mandates now limit this process to lower fugitive emissions caused by bleed gas. A shale gas company in Louisiana was therefore looking for an affordable and efficient low power solution that could be run by solar panels to replace existing actuation equipment and control a variety of fluids at line pressures up to 413 bar (6000 psig).
- Most shale wells and flow lines are unmanned and located in remote areas that are difficult and expensive to monitor. Skilled technicians must check data and perform manual shutdowns, increasing costs for the time to travel to site, identifying the problem and stopping the flow, which is not cost-effective or practical. Actuators provide an ideal solution to automate valves at the remote wells.
- The key objective was to provide an efficient and reliable process control actuator which could be retrofitted on installed valves to reduce costs and downtime. Rotork's local agent Setpoint Integrated Solutions engineered an interface to enable CML-250 actuators to be easily fitted to installed valves and improve the level of control, without venting gas and with the low power demand required for solar powered operation.
- Designed for quarter-turn, multi-turn and linear valve operation, Rotork CMA actuators perform numerous process control valve, choke valve, metering pump and damper applications demanding precise position control and continuous modulation. Single-phase or DC electrical power is all that is required for simplified installation and control valve actuation. Explosion proof certification to international standards is available for hazardous area applications. Recent developments enable the CMA to be specified with increased functionality encompassing local controls, LCD positional display and programmable fail-to-position performance.

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Butterfly Valves are a Cost Effective Choice for Shale Fugitive Emissions

- Lightweight, compact and effective in a variety of applications, butterfly valves could become the epicenter of development as a low-cost alternative to other valve types. An article in *Valve World* by Mike Brausch & Vijay Malik, Crane ChemPharma & Energy Engineering is linked in the intelligence system The article explores the implications of the rise in shale gas production and intensification of fugitive emissions regulations, and suggests that butterfly valves could provide an efficient, low-cost solution for demanding applications.
- Triple-offset butterfly valves, are commonly recommended for use in chemical, power and refining applications, including shale gas. Specially-designed to shut off in high temperature service where other, resilient-seated valves are not well suited, these butterfly valves offer a compact, low-cost alternative to other valve types

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Bentek Pump Controls

The PumpMaster RTU System provides centralized Remote Monitoring and Control of Portable Pumps in Water Transfer & Frac Water Supply Systems.

Background

Water transfer systems may range from a single pump system to 10+ series pumps for long distance water transfer systems. There is need to monitor and control pumping to insure water supply requirements, prevent overdraw, leak detection, to protect equipment, and insure safe operation.

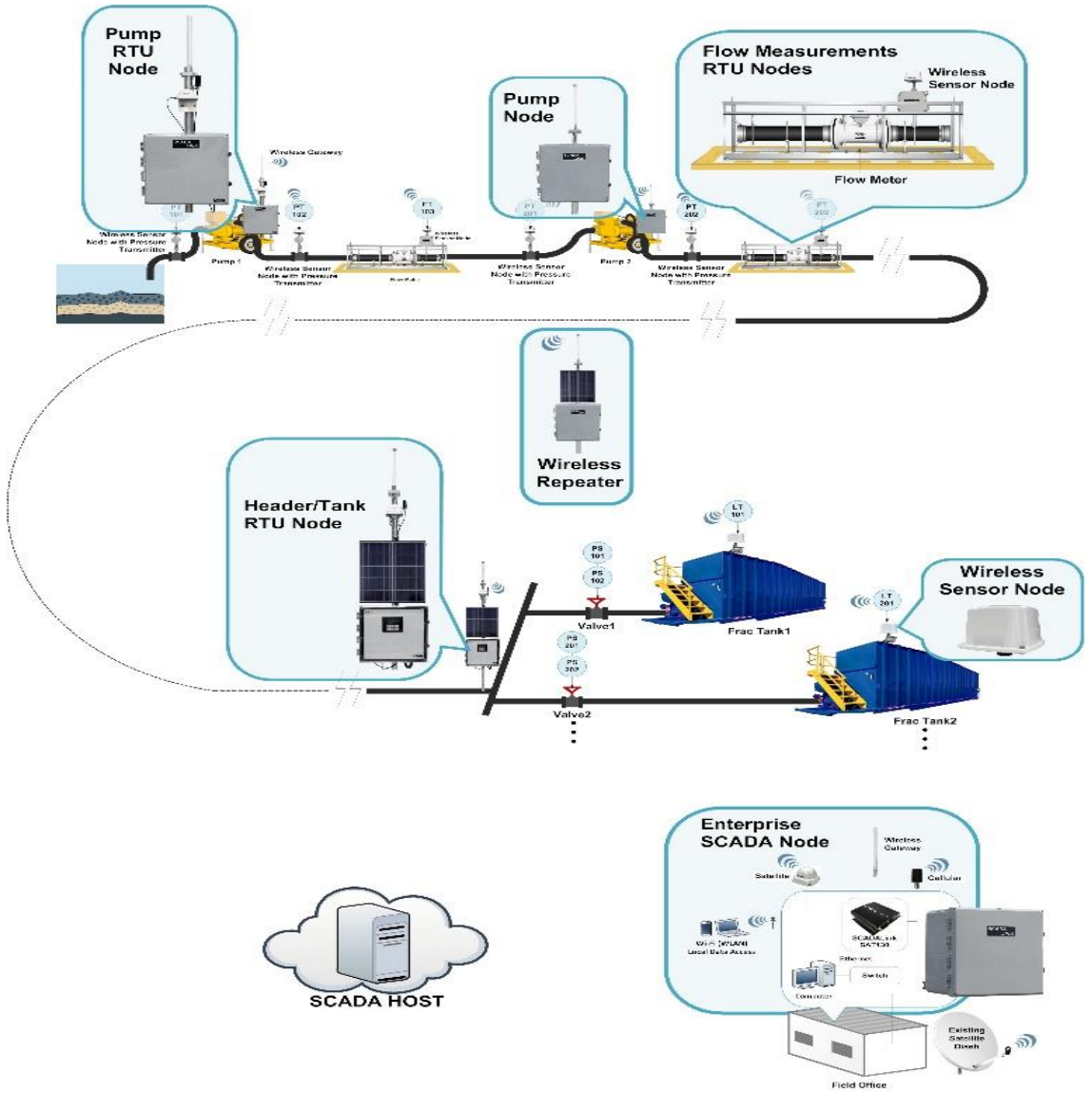
The PumpMaster Systems is comprised of a network of RTUs at each pump communicating via a wireless networks supported by a central Monitor Node. PumpMaster allows remote monitoring and control of the pumping system from any location.

PumpMaster Systems consists of the following:

- Pump RTU Nodes
- Header/Tank RTU Nodes
- Flow Measurements RTU Nodes
- Wireless Sensor Nodes
- Field SCADA Host Node
- Enterprise SCADA Node

PumpMaster has the following features:

- Long Distance Wireless Network Connectivity – Private Radio, Cellular, & Satellite Communications
- Wireless Sensors
- Flexible Architecture



Emerson Asset Management and Predictive Measurement Including the Analyzers and Controls

From precision measurement to asset management, Emerson solutions reduce risk, increase reliability, and improve operational performance with best-in-class technologies and services.

APPLICATIONS							
Cementing	Artificial Lift Optimization	Instrument & Utility Gas Supply	Burner Management System Interface	Burner Management System Interface	Tank Blanketing	Fiscal Measurement
Chemical Additives	Production Measurement & Control	Net Oil Calculations	Fuel Control	Pilot Control	Tank Bottoms	Gas Gathering
Drilling Fluids	Well Monitoring	Pressure, Level, Flow Control	Pilot Control		Tank Monitoring	Proving
Hydraulic Fracturing	Chemical Injection	Production Measurement	Pressure, Level, Flow Control		Truck Loading	Pressure Control
Mud Pumping	Emergency Shutdown	Separator & Well Test Optimization	Production Measurement		Vapor Recovery	
Water Management	Flow Assurance	Sand Accumulation Detection	Heater Treater Optimization		Tank Inventory & Accounting	
Well Placement	Production Planning & Forecasting	Production Test Manifold	Sand Accumulation Detection		LACT Pump Operations	

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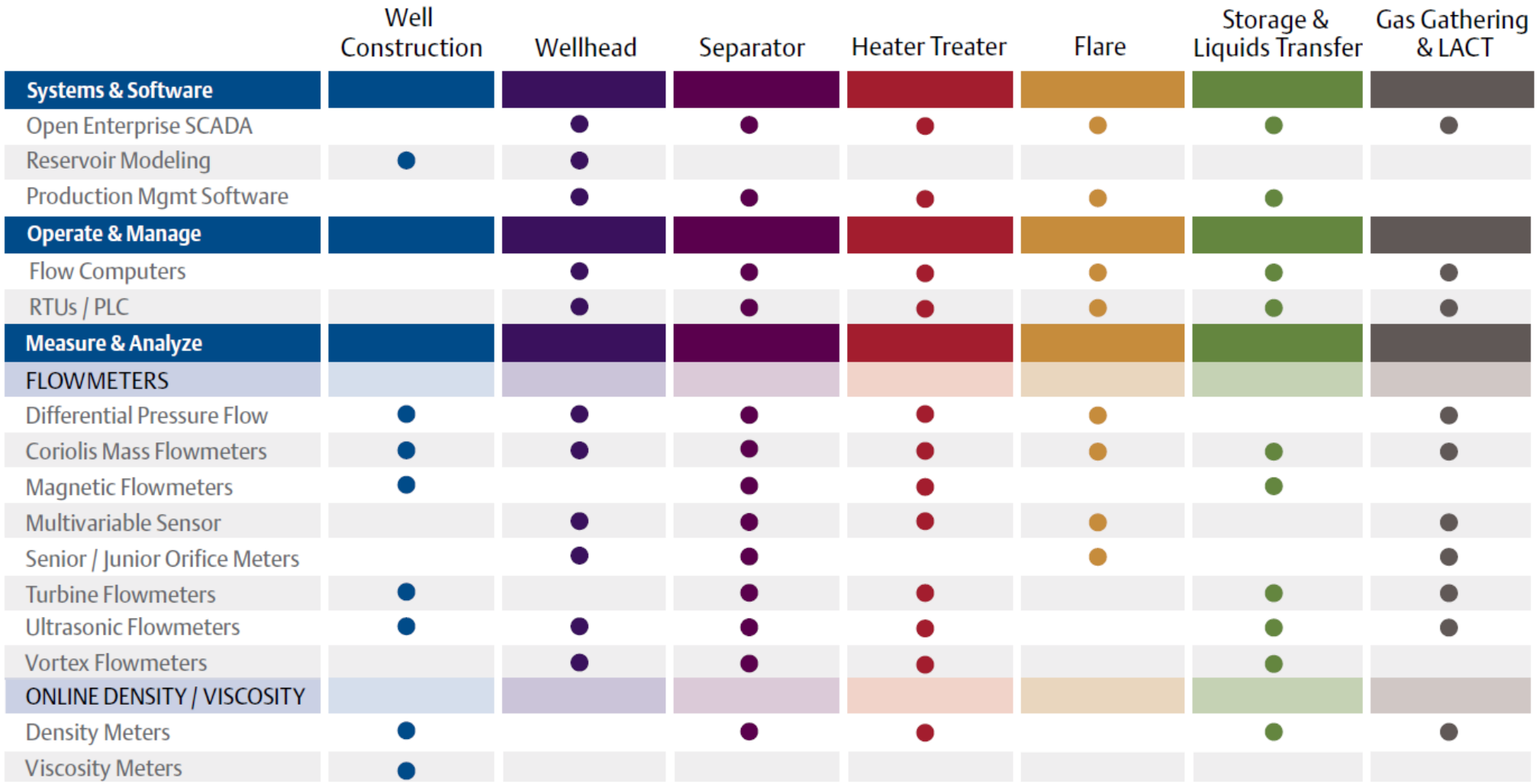
Emerson Controls and Instruments for Shale

Extensive instrumentation is needed at every point in the shale oil and gas extraction process



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Emerson Instruments for Shale

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Emerson Provides Solution for Emergency Shut Down with Gas Containing H_2S in Eagle Ford

A large midstream pipeline company recently installed a pipeline that will eventually be flowing produced natural gas that contains hydrogen sulfide (H_2S). The pipeline is routed under a major South Texas Interstate highway in the Eagle Ford. This highway is busy with a lot of interstate commerce transportation.

The company needed rapid closing valves on each side of the highway for emergency shutdown in the event of a gas leak or line break. In the event of an emergency, the pipeline company also did not want to send personnel to the valves because of the time it could take to react and to eliminate their exposure to the possible lethal gas

It was important that the actuator would be able to close the valves locally on site using hydraulic power or a manual hand pump, remotely from gas control and/or automatically by responding to pressure sensors on the pipeline. The control system had to monitor the pipeline pressure, react if line break conditions were detected, and signal the actuator to close the line valves.

Normally, a gas/hydraulic actuator would be used and powered with the pipeline gas. However, that was not possible in this instance because of the H_2S content. To complicate matters further, this is a desolate site, so there was no utility electric power available. Electric motor actuators were not selected because a sizable reserve power source would be required to assure speed of operation and reliability.

SOLUTION: POWER SOURCE A battery-powered electrohydraulic system was chosen to provide hydraulic power. A charged accumulator provides the power to achieve the speed requirement and for additional stroke capability. Batteries are kept adequately charged by a bank of solar panels aimed at the South Texas sun.

SOLUTION: ACTUATOR A rotary vane type actuator was selected because the hydraulic actuator can operate the valve smoothly and the hydraulic fluid will protect the internal components from the harsh South Texas environment.

A hand pump was included for manual operation backup if the power fails.

Linebreak detection was provided by the Emerson LG 2300 linebreak detection system, which constantly monitors line pressure. This allows the customer to determine normal pressure variations and compensate settings before arming for automatic closure.

The system will then alarm or close the line valve when the rate of drop, low- and/or high-pressure set points are exceeded. It also alarms if the accumulator head pressure is too low for adequate reserve power.

For added reliability, the linebreak detection system has a power system separate from the electrohydraulic power unit. The pipeline company also added communication that allows valve position visibility at the gas control site in another state.

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Pumps and Trucks

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Preliminary Listing of Pumps, Engines, Transmissions and Trailers

Pumps	Engines	Transmissions	Trailers
B&G	MTU Detroit Diesel	Allison	Loadcraft
Dragon Products	Cummins	Caterpillar	Industrial Diesel
FMC	Caterpillar	Twin Disk	Troxel Manufacturing
Frac Tech	Others	Others	
Gardner Denver			
Haliburton			
Industrial Diesel			
NOV			
Pro Source			
Weir SPM			
Others			

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Several examples are detailed in the following slides.

New Approach to Reduce Frac Sand Costs

Dragon Products is a manufacturer of mission critical products serving the energy and industrial industries. Based in the United States, and family owned and operated for more than 50 years, the Dragon supplies “severe duty engineered” equipment for a broad range of applications including well servicing, bulk storage, liquid and solids hauling and a variety of pumping and mud solutions. Their equipment portfolio includes tanks and trailers; roll off equipment; pumps and stimulation equipment; mobile workover rigs; and surface production equipment.

The new roll-off frac sand hauling system manufactured by Dragon Products offers an alternative to delivery from the standard pneumatic trailer. Dragon’s Roll-Off Sand Pod reduces costly wait times at well sites by reducing long lines, and demurrage pay. “Our sand pods are now available and we have begun customer demonstrations,” according to Dragon Sales Manager Gary Lidiak. “The ability to pre-stage sand near the well-site means it’s ready for ‘last mile delivery’ at a moment’s notice.”

The historical frac sand hauling system relies on rail cars and over-the-road (OTR) trucking companies to transport loads of frac sand to well-sites. Each frac job requires multiple stages worth of sand to begin the process. OTR drivers are paid hourly simply to wait their turn to offload sand which is a costly delay to the process.

Using new Dragon roll-off sand pods instead means qualified oilfield drivers can stage sand quickly. The pods can then offload when needed to blender hoppers via pneumatic air, blowing aloft, or a gravity-based system—the same options offered by current methods. This results in significant savings in transport and delivery costs, as pods can be dropped 24/7 without waiting and the trailer redeployed to pick up the next load.

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Gardner Denver offers Five Different Pump Models

GD-3000

The GD-3000 is claimed to be the most powerful well-stimulation and fracturing pump on the market while also being one of the lightest pumps in this class. Its high pressure and flow rate make it a highly demanded pump. The GD-3000 has a maximum pressure rating of 22,000 PSI with a maximum flow of 1,375 GPM and weighs 18,550 lbs.

GD-2500

This pump was designed to work in harsh environments like the Barnett Shale. The GD-2500 is one of our most popular pumps because it can reach a flow capacity of 2,044 GPM with a pressure rating of 17,800 PSI. The pump combines the heavy-duty power end with upgraded valve-over-valve or Y-style fluid ends for ultimate durability.

GD-2250T

The GD-2250T is the result of upgrading the HD-2250 pump. This triplex pump offers new fluid end and power end technologies designed to extend the life. The middle-weight pump weighs 12,650 lbs. with a high maximum pressure rate of 21,500 PSI and maximum flow of 1,319 GPM.

GD-1600

The GD-1600 is our lightest and smallest stimulation pump weighing in at 8,000 lbs. It's lightweight and small footprint is ideal for truck mounted units such as body loads and trailers. The pump offers stud fluid end configurations for easy removal and maintenance. With a maximum pressure of 18,100 PSI and flow of 1,135 GPM, the GD-1600 is the right pump for smaller jobs.

C-2500

This quintuplex pump was originally designed for stimulation service in the Barnett Shale. With a maximum pressure of 20,000 PSI and flow of 2,523 GPM, the pump weight is 18,800 lbs. Patented, stem-guided valve designs extend the service life. The C-2500 is designed with 12 inch chamber spacing which means it shares common components with triplex 2250 pumps. This allows customers to streamline their aftermarket inventory.

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EPIX is Weir, Rolls Royce Joint Venture

- EPIX is a joint venture between Weir Oil & Gas and Rolls-Royce Power Systems subsidiary MTU, industry leaders in the design, development and distribution of well service pumps and heavy-duty industrial power systems based on diesel and gas engines. EPIX harnesses the expertise of its founding companies to answer an industry need for greater operational efficiency in harsher environments and the demands placed on equipment in continuous operations. Headquartered in Houston, Texas, EPIX synchronizes performance through integrated systems and service designed specifically for oil and gas projects.
- The EPIX system features an MTU FracPack, (Series 4000 engine combined with ZF 8 TX gear box) coupled with the SPM® QEM 3000 hydraulic fracturing pump. ZF Friedrichshafen Group, a key supplier to the EPIX solution, developed the ZF 8 TX transmission to work seamlessly with the engine and pump as a true fully integrated system.
- In addition to offering the first completely integrated system for fracking, EPIX is also committed to delivering a warranty and service promise for the life of its products. All components are designed to work together mechanically to deliver more operating hours per unit. By allowing operators to align maintenance schedules and warranties across the entire power system, downtime is reduced and significant efficiencies are achieved.
- Future enhancements for the first system include integrated monitoring controls which will provide intelligence for predictive and preventative maintenance.
- Weir’s global service network will manage all aspects of maintenance and service for EPIX, bringing together the vast technical expertise of Weir, MTU and their partners for a seamless, one-stop customer experience.

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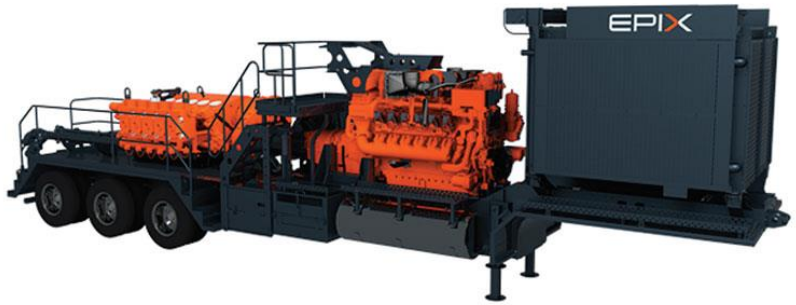
EPIX System

The system incorporates a powerful engine matched with a lightweight transmission, which drives the hydraulic fracturing pump. The result is one system that provides seamless operation with streamlined service through one company

The industry's first high-hp frac pump is designed for continuous-duty pressure pumping operations at a sustained 275,000-pound rod load, 24 hours per day, seven days per week. The pump incorporates a new dual-line optimized lubrication system, which regulates pressure and flow for each component, and onboard filtration to filter contaminants. The largest frac pump bearing in the industry evenly distributes stress on critical components, and the addition of an engineered skid and patent-pending improvements to the frame increase rigidity to resist cracking from increased rod loads and 24-hour operation. Fluid end technology lowers cross-bore stress by 30 percent or more, which can double the life of conventional fluid ends, and the use of corrosion-resistant stainless steel can deliver up to five times the fluid-end life.

This new pump was validated through extensive in-house testing as well as field testing in harsh, real-world conditions. The traditional frac pump development process typically tests around 1 million cycles at full-rod load. Completing a 13-million-cycle endurance test in-house, the new frac pump is designed to deliver durability, cost-efficiency, long-term performance and life span.

The pump recently logged more than 1,000 hours of field time in harsh conditions in the Duvernay and Montney formations in the Western Canada Sedimentary Basin. A scheduled inspection after the first 1,000 hours showed no sign of the typical wear seen in previous generation pumps, such as worn bearing gears, leaking seals or hoses, or broken bolts, to name a few. The pump is projected to meet 6,000 hours before any major overhaul, leading to the estimated reduction in total cost of ownership by 17 percent. The pump will return to the field for a minimum of 5,000 hours of additional testing.



Throughout the duration of the field testing, the pump experienced a maximum flow rate of 11.3 barrels per minute (1.8 cubic meters per minute [m3/m]) and a maximum pressure rate of 12,000 psi (not concurrent). The typical flow rate was 8.2 barrels per minute (1.3 m3/m), while typical pressure was 9,000 psi. During testing, the frac pump power system was situated behind a typical 2,500 bhp drive train and the pump used 100 percent of the available power and torque output.

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U.S. IIoT Opportunities in Oil and Gas

	2016	2017	2018	2019	2020	2021	2022
Guide	1962.52	2092.33	2230.96	2474.19	2740.19	3030.95	3356.23
Control	4151.03	4425.59	4718.81	5182.97	5688.58	6239.19	6856.24
Measure-Liquids	844.48	900.33	959.99	1054.42	1157.28	1269.29	1394.82
Measure -Air & Gases	844.48	900.33	959.99	1054.42	1157.28	1269.29	1394.82
Measure-Free Flowing Powders	187.33	199.72	212.95	233.9	256.72	281.57	309.41

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