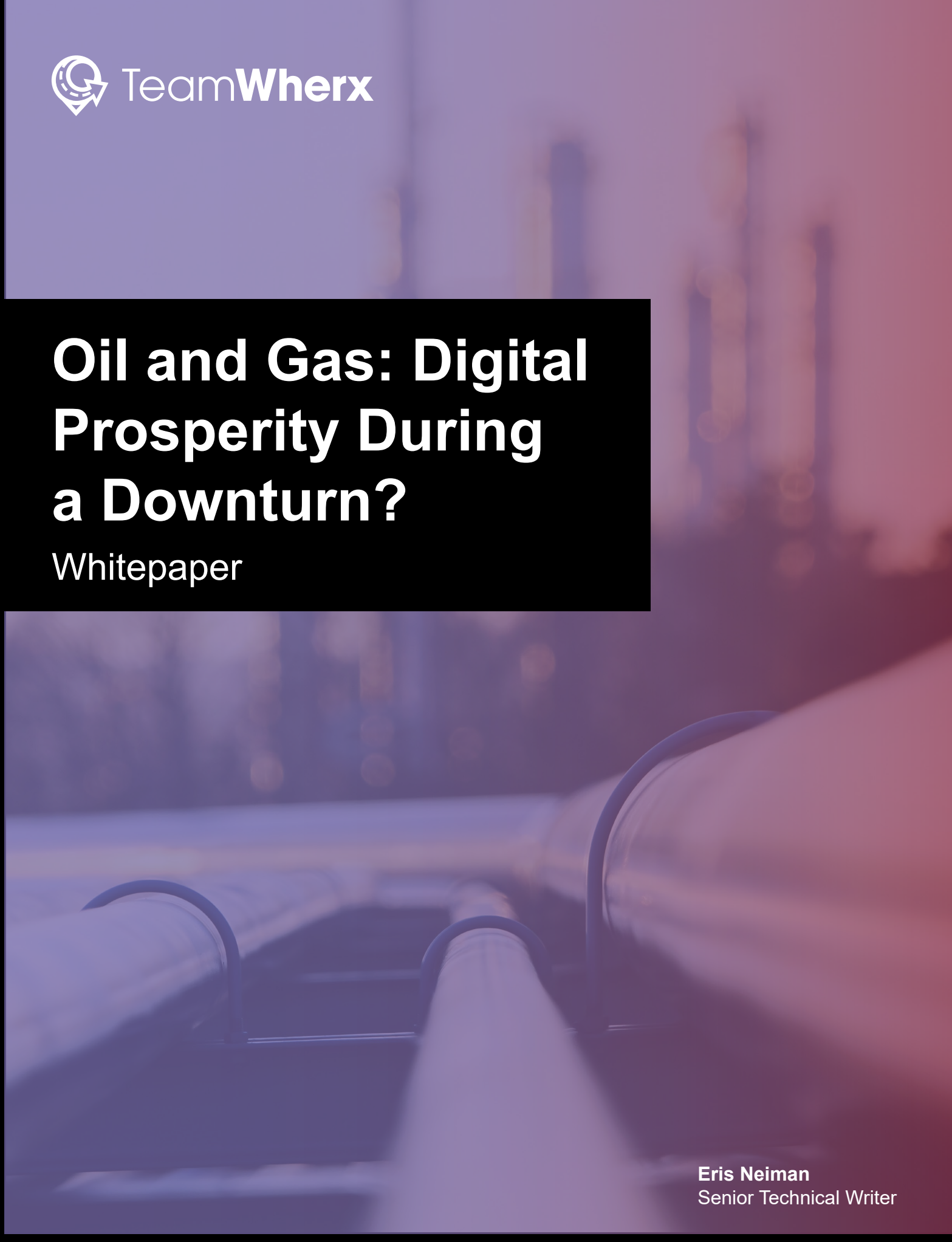
TeamWherx

Oil and Gas: Digital Prosperity During a Downturn?

Whitepaper



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Introduction

The oil and gas industry is a potent global force, generating hundreds of billions and employing millions of workers worldwide. In terms of sheer economic value and production, it ranks eighth in the top 10 industries in the world.[1] Oil and petroleum, one of its by-products, are key ingredients in countless products from medicines to household items to energy sources.

Oil extraction, processing, shipping, and utilization are spread across three subdivisions of upstream, midstream, and downstream. Upstream includes oil and gas exploration and production. Midstream includes all operations necessary for storing and transporting the materials between extraction and processing. In the final downstream phase, the raw material is converted into consumable forms, such as gasoline and natural gas for heating homes and businesses.[2]

These divisions themselves include countless sub-sector companies like oil rig outposts, transportation and shipping enterprises, natural gas companies, and local gas stations.

Notwithstanding its mammoth presence and global demand, the oil industry has had quite a variable economic history and standing. Dangerous and at times ecologically unsafe, upstream sector operations have been the reason behind global appeals for less hazardous energy solutions. For natural gas, it seems that no other fossil fuel holds the dual role of being part of the solution and problem when it comes to meeting targets ranging from compliance to climate goals.[3]

During the pandemic climate of 2020, however, size and demand failed to protect the industry. Rather, these attributes exposed critical vulnerabilities that have brought the giant to its knees in the months since. Global shutdowns and stay-at-home orders created a surplus of oil supply, causing a worldwide drop in price.

Demand for transportation fuels fell by up to half, and storage tanks filled, forcing refineries to cut rates or stop production altogether. Oil and gas companies experienced the sharpest shock they had ever seen, [which] may also turn out to be the most enduring.[4]

Industry outlook

Despite these truisms, current assessments of the industry's performance are promising. Although global oil demand fell by 25 percent in April of 2020, [it] has rebounded sharply since then, cutting its losses to just eight percent. Looking ahead, 2021 oil demand is expected to recover strongly, but remain lower than pre-COVID-19 levels.[5]

McKinsey & Company forecasts that although economic- and mandates-based investments in renewables will grow significantly, the flexibility afforded by gas-fired power generation will continue to be in demand. Alternative sources of flexibility, such as energy storage — including pumped hydroelectric and utility-scale batteries — and demand aggregation and response, are unable to affordably provide the same reliability as gas-fired plants.[6]

Predictions for oil industry companies depend on whether they can make the bold choices necessary to pivot to the new energy future.[7] Technological advances will play a key role in helping the oil and gas industry weather the current economic downturn. Additionally, oil operations that run cleaner, smarter, safer, and more environmentally conscious will be the tradeoff for effective use of technology.
This white paper outlines how advanced technology and the Internet of Things (IoT) are helping oil and gas companies accelerate digital transformation and navigate current economic waters.

Connecting Smarter

"According to Gartner, by 2025, about 75 percent of all data will need analysis and action in this outer layer of the network."[10]

Cloud Computing

The value of cloud computing has made it a staple in the oil and gas industry. It allows for scalable, customizable expansion in data management and storage. This flexibility allows companies of every sector to find an infrastructure solution that will fit their operations budget.

Increasingly, oil and gas companies are using cloud computing to recoup pandemic losses and insulate themselves from global industry challenges. Ella Benson Easton, oil and gas analyst at GlobalData says, "Cloud adopters will be better placed to swiftly implement new time, energy and cost-saving technologies that will help oil and gas companies adapt to the changing industry."[8]

Also, recent trends in cloud computing further amplify the gains from real-time communication. Edge computing adds faster processing speeds to data collection to help companies further narrow the gap between action, notification and reaction. In edge processing, select data is housed in the outer, more available levels (edge) of the network to speed access and facilitate better decision-making.

Edge computing brings computation and data storage closer to the devices where it's being gathered, rather than relying on a central location that can be thousands of miles away. This is done so that data, especially real-time data, does not suffer latency issues that can affect an application's performance.[9] According to Gartner, by 2025, about 75 percent of all data will need analysis and action in this outer layer of the network.[10]

Another option within cloud computing is analytics. Analytics examines data within a cloud provider's storage. This is accomplished with separate tools that can quickly measure, forecast, group, and cluster data.

Oil and gas companies can use this powerful technology to drive specific business goals. For example, midstream sector refineries monitor pressures within storage tanks using sensors with manufacturer-set schedules for replacement and maintenance. Analyzing this data in the cloud can drive condition-based maintenance, saving man-hours and reducing costs.

Connecting Faster

Internet of Things

The amount of data generated globally is staggering. By 2025, the number of IoT-connected devices is forecasted to be at 75 billion.[11]

Oil and gas has no shortage of IoT-produced data — a single drilling rig can generate up to 10 terabytes of data every day. Even more is gathered by equipment sensors that monitor volume levels, flow rates, vibration, temperatures, and functional statuses along an entire operational chain. Data collection from field personnel with mobile devices also adds to the continual flow of operational data.

Real-time communication through IoT technology provides quantifiable benefits in all three phases of the oil and gas industry:

Petroleum engineers and other upstream operators invest many hours into prospect maturation, or the well planning process. With well construction comprising 40 to 70 percent of all capital spending in the entire sector, accuracy and precision in this area is critical.[12]

Operators can connect multiple IoT sources to improve subsurface planning for well placement and design. Seismic drilling is performed using sensors that upload images to create a digital illustration of a drill site. They can identify underground geohazards, such as overpressured zones, or obstacles such as flood basalts. Real-time data allows engineers to adjust well design safely during the drilling process, saving costs and speeding timeframes from definition to execution.

During extraction, IoT-connected sensors can track early wear of sensitive well parts such as turbine bearings. Actionable information like this refines the supply chain by triggering the timely order of replacement parts.

Environmental Protection Agency (EPA) and Bureau of Land Management (BLM) regulations require that oil companies perform land reclamation, returning land to its original state after oil mining has ceased. In the final reclamation procedures, environmental and mining engineers use sensors to assess soil quality in the areas surrounding a dry hole. Data surrounding this process is critical to compliance reporting, as well as environmental responsibility.

Midstream sector companies can use real-time data on current product levels with remote tank monitoring to be proactive in filling, thereby preventing shortages.

Accessing certain areas of very large cargo ships for product monitoring can be challenging during water transit. Many of these gargantuan vessels use onboard cranes to maneuver cargo. Monitoring sensors installed on the product provide persistent data on non-operational elements like temperature and pressure flow, without physical interaction. On the road, GPS data from satellites and cell towers provide real-time fleet monitoring.

Downstream storage and distribution is optimized by using data to monitor fuel levels inside storage tanks. IoT-connected sensors let operators adequately monitor environmental conditions and ensure compliance with regulations on emissions and waste.[13]

In the back office, a lack of transparency into operations and processes often results in overspending and unused or misused assets. IoT data connects complex inventories with real-time asset management on the field level. This data optimizes back-office efficiency with quality data in reports, inspection forms, and compliance records.

In municipal settings, data from gas line monitoring equipment supports smaller, more efficient utility and gas company crews. In addition, accurate data on gas line location and integrity is critical for supporting safe residential construction.

Connecting Safer

Robotics and Automation

Among its many unique characteristics, the oil and gas industry is at once vital and volatile, putting it squarely under the microscope of concerned citizens and regulatory bodies. A popular government watchdog industry tracker sets the monetary total of violation fines since 2000 for the oil and gas industry at over $45 billion.[14]

In the current eco-conscious and regulatory standards climate, a solid compliance record and reputation of commitment to the environment is imperative. Escalating EPA regulations and standards require operational transparency, as well as tighter controls on production and distribution.

However daunting, navigating the intricacies of compliance is good for business. The ability to address safety issues proactively with solid audit trails secures trust with clients within the value chain.

Robotics and automation can help companies in the oil and gas industry seek and correct risk before it becomes reality. Robotics and process automation not only speed up operations but reduce the manpower requirement, in turn, increasing efficiency and reducing human-induced errors.[15]

Oil present in water bodies is caused by naturally-occurring seepage, or by production-platform spillage. Natural seepage flows at a slower rate over a longer time period. For upstream oil and gas companies, determining the cause of oil present beyond a drilling site is critical to regulatory compliance.

Because it can be difficult to pinpoint the exact cause where there are multiple areas of naturally-occurring seepage, artificial intelligence (AI) robots are used to perform the extensive on-site evaluations.
Working conditions in the midstream sector, though marginally safer than in the upstream, can still carry a degree of risk. Here, robotics and automation solutions also address hazards while increasing workplace safety.

Many opportunities for robotics and automation exist in maintaining pipeline integrity, a central focus within the midstream sector. Autonomous drones perform aerial surveillance for pipelines in remote locations. In the water, unmanned, untethered autonomous surface vehicles (ASV) and underwater vehicles (AUV) also use geofence data to monitor and report real-time conditions of pipelines. This data applied to machine-vision algorithms can quickly assess and determine if an infrastructure repair is needed to the pipeline, without human intervention.

Within the pipes, smart pigging systems use magnetic flux leakage testing and ultrasonic testing to identify break or leak potential along pipelines such as cracking, erosion, or inconsistencies in thickness.

Other pipe analysis tools create a three-dimensional picture of the entire pipe section, pinpointing blockages, sections of pipeline that have been knocked out of alignment, deformations to the pipeline surface, and more. They are extremely helpful for planning pipeline repairs.[16]

The benefits of automation and robotics in oil and gas are clear, as a McKinsey analysis shows: Deployment of fixed cameras, drones, and subsea robotics could significantly reduce — or even eliminate — the workforce needed to conduct surveillance and inspection of remote assets, and do scaffolding work onboard platforms. Such technologies could decrease the cost of inspection by 35 percent, improve the health and safety of such workers, and cut emissions.[17]

Connecting Efficiently

Manufacturing and Execution Systems

The Manufacturing and Execution Systems (MES) market worldwide is projected to reach $22.9 billion by 2025, driven by rising manufacturing competitiveness in the international arena and the growing reliance on technology to enhance efficiency and outrun competition.[18]

MES has been steadily gaining traction in the oil and gas industry. In fact, applying both the elements of the IoT and IIoT (Industrial Internet of Things) to oil and gas manufacturing is the next step in digital transformation.

MES is combined software and Advanced Process Control systems (APC) designed for streamlining and optimizing manufacturing processes in factories and refineries. MES links the process control systems that directly operate manufacturing equipment (and that capture data such as inventory levels and downtime) with business systems, such as enterprise resource planning (ERP), that track data such as orders, customer interactions and prices.[19]

In the upstream sector, MES real-time data and decision support tools provide access to refinery information to allow quick and timely responses to production issues that can negatively impact efficiency, quality, and regulatory compliance.

“For a refinery to maximize margin, they need to operate reliably, plan robustly, schedule optimally, and execute accurately.” APC is critical to executing the plan’s schedule, producing the desired product at quantity, with the appropriate qualities, while reducing the overall variability.” - Doug McCallum, Director, Industry Mktg, Energy

MES software generally includes management features for documents, inventory, suppliers, quality, supply chains, and more. Although these software features can optimize factory operations in any industry, applications specifically designed for oil and gas are relatively few.

The most effective MES is one that is made to order, and the highly specialized, complex operations of oil and gas are prime candidates for such customization.

A high-level of the creation process begins with defining specific and measurable industry and client requirements. Comparing process gaps with user requirements highlights areas where MES can provide optimization. Digital checks of the validity of all operational processes are made across every sector of production, from initial contact to finished product.

In the concept creation and system-building phases, virtual reality and even simulations can be utilized to mock in-production stages. During the system building phase, the new, optimized digital process instructions are tested. Data gathered at this juncture filters non-optimal processes. In the final stage, the refined outcome matches optimal production with accurate procedures and quality data.

A functional MES is a synergistic, interconnected data hierarchy from the manufacturing production floor to the enterprise level of an organization. The benefits of MES are a smooth integration between these layers, linking higher and lower levels with real-time data. Companies can move assets more easily and manage communication, as well as monitor resources and equipment to identify which ones are slowing down production.[20]

MES technology delivers more efficient data management, improved production execution, and enhanced operational performance, enabling manufacturing entities to quickly transform data into profit.

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Connecting Visually

3D Technology

The 3D technology suite, which includes 3D visualization, animation and printing, is also helping companies in oil and gas reach key performance indicators across sectors.

Safety and Training
The benefits of using 3D animation and virtual reality for training and safety in oil and gas are immeasurable. In critical situations that carry life-threatening risks, workers must be able to respond properly and quickly.

3D technology allows operators to simulate emergencies and safely train workers without physical danger. For example, trainees can respond to a virtual oil leak situation and repeat exercises until mastery is achieved. Virtual reality technology can represent significant cost savings, as no physical equipment or specific location is required.

Additionally, this technology can be used to refine company safety policies and procedures. Corporations can use training metrics and equipment operational specifications to align safety procedures with industry compliance regulations.

Exploration and Planning
3D adds value by reducing costs associated with iterative processes inherent in exploratory drilling. For example, geologists and engineers can use 3D models constructed from real-time data to view realistic representations of oil and gas reserves thousands of feet underground or underwater. This optimizes planning and increases accuracy in prospect maturation.

In addition, engineers can use 3D animation to perform multiple design iterations before final submission. In this way, they can refine their designs while reserving funds for the final product.

Streamlined Organization and Logistics
Oil rig platforms are massive structures designed to support oil extraction underneath the water's surface. Some of these cities at sea measure up to thousands of square feet.

In addition to drilling-related processes, many are also self-contained ecosystems housing a network of services and support staff, sometimes numbering in the hundreds.

Creating virtual models of all the spaces on the platform, with critical data on supplies, personnel, and equipment allows managers to plan operations and manage staff more effectively, and even remotely.

Replacement Parts
Equipment in the oil industry is often intricate, highly sensitive and costly to reproduce. Many components on drilling rigs include multiple parts that must be welded, bolted, or brazed together. A breakdown can create a domino effect impacting schedule, quality, or quantity. In addition, dispatching parts to remote locations can increase the time from incident to recovery.

3D printing of replacement parts can eliminate process interruptions. In some instances, 3D printing can produce single-part fabrications that are superior to their multi-component counterparts.

Connecting the Pieces

Software

Software animates the technology available in the oil and gas industry by connecting processes, equipment, and output.

Countless options for every aspect of production exist even within each sector. There are accounting software, solutions specific to drilling and recovery, asset management solutions, compliance management options, and more. In contrast, larger and more powerful enterprise solutions have feature sets to efficiently manage multiple tasks across sectors.

Enterprise oil and gas solutions are vertical-specific enterprise resource planning systems with highly specific industry features, fully integrated with standard business capabilities such as marketing, accounting, and HR.[21]

Statistics prove that the planning and implementation of it all can be daunting: 87 percent of oil and gas companies have invested in analytics, but 68 percent of those companies are still using homegrown software or no solution at all for asset integrity management. [22]

Choosing the right software means matching business processes with the right feature set. Important options for oil and gas software applications include:

- Online and offline modes
- Customizable price lists
- Training and support
- Inventory management
- Material management
- Job and ticket search
- Signature capture
- Compliance management
- Logistics management
- Project management
- Accounting
- Employee scheduling
- Equipment management
- Maintenance management
- Resource management

Choosing the Right Software

Businesses should approach the selection process with a focus on the broad areas below:

- Zero in on what your function is and what it is not. A succinct definition will help to isolate software needs.
- Take stock of your assets. What kinds of assets do you have, and how many? List vehicles, equipment, and other tangibles that support your operations.
- Zoom in on operational pain points — areas where process flows might be stalled, or where duplication of effort is taking place.
- What are the specific needs of your operation? These answers are critical, as they will help you to sift through the distraction of unnecessary software features. For instance, upstream oil and gas accounting focuses on joint operating agreements and lease acquisitions, while midstream entities focus on the metrics of maintaining product balance and supply.
- Where users will access application data is important to network configuration. In-office versus remote locations will require different infrastructures for access and storage.
- What purpose will the data serve? How the data will be used can dictate reporting requirements. If data will be included in audit trails for regulatory entities, solid reporting capabilities will be necessary.
- Figure in long- and short-term goals. These will drive future functionality requirements for your organization.
- Then, use the specific needs, goals and how your data will be used to create an essential versus a nice-to-have functional requirements list.

Maximize Oil and Gas Operations with TeamWherx™

Changes in the oil and gas industry outlook have taken digital transformation from optional to imperative.

TeamWherx™ can help your company respond with value-adding features, such as Wireless Forms and Mobile Timekeeping. Transform your operations into a modern, connected workforce that makes your IoT data work for you through comprehensive reporting, powerful analytics, and asset management.

Powerful analytics: Assess how your workforce is aligning company policies with powerful data-capturing tools. Alerts, reporting, and GPS location tools can help you fine tune operations from supplies ordering to worker timesheet accuracy.

Interoperability: Actsoft's mobile suite provides seamless communication and integration with varied hardware and software systems. Hardmount monitoring puts fleets on the map, keeping your organization abreast and in control of events in the field. In the office, APIs unlock the power of data for essential operations in other applica**tions.**

Ad-hoc Reports: Monitor patterns in your daily, weekly, and even annual operations with ad-hoc reports and custom reporting on demand. Extract any data entered into your digital forms to create ad-hoc reports, then schedule them to run as needed.

Goefencing and GPS: Prevent equipment theft and enhance accountability. Use GPS Tracking to see the pinpointed locations of fleet vehicles and equipment trailers around the clock, as well as engineers during working hours.

Wireless Forms: Reduce paper costs and delays. Wireless Forms lets you create digital maintenance forms, frack tank inspection sheets, and safety checklists.

Form Workflows: Create solid compliance and regulations audit trails with Form Workflows. Team members can share actions and edit details on forms that require approvals and/or signatures. A single form can route to as many users as necessary for completion.

Footnotes

1. BISWorld. Global Biggest Industries by Revenue in 2021. https://www.ibisworld.com/global/industry-trends/biggest-industries-by-revenue/
2. April 5, 2017. “Upstream? Midstream? Downstream? What’s the Difference?” https://energyhq.com/2017/04/upstream-midstream-downstream-whats-the-difference/
3. Covid-19 Dents Demand for Gas and Undermines its Role as a Bridge Fuel in the Energy Transition —https://www.spglobal.com/en/research-insights/featured/covid-19-dents-demand-for-gas-and-undermines-its-role-as-a-bridge-fuel-in-the-energy-transition
4. September 3, 2020. “Downstream oil and gas amid COVID-19: Succeeding in a changed market” https://www.mckinsey.com/industries/oil-and-gas/our-insights/downstream-oil-and-gas-amid-covid-19-succeeding-in-a-changed-market
5. Deloitte 2021 oil and gas industry outlook. “Exploring oil and gas trends and impact of COVID-19” https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/oil-and-gas-industry-outlook.html
6. January 6, 2020. “The future of natural gas in North America”— https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-future-of-natural-gas-in-north-america
7. Deloitte 2021 oil and gas industry outlook. “Exploring oil and gas trends and impact of COVID-19” https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/oil-and-gas-industry-outlook.html
8. August 4, 2020. “Strategic adoption of cloud computing can alleviate oil and gas industry challenges” - https://www.petro-online.com/news/fuel-for-thought/13/global-data/strategic-adoption-of-cloud-computing-can-alleviate-oil-and-gas-industry-challenges/52890
9. November 13, 2019. “What is edge computing and why it matters” - https://www.networkworld.com/article/3224893/what-is-edge-computing-and-how-it-s-changing-the-network.html
10. October 3, 2018. “What Edge Computing Means for Infrastructure and Operations Leaders”- https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders/
11. January 28, 2021. “How Much Data is Created Every Day?”- https://seedscientific.com/how-much-data-is-created-every-day/
12. May 26, 2020. “Five Opportunities for Greater ROI From IoT Upstream Energy” -https://cdn2.hubspot.net/hubfs/2563250/Whitepapers/Speedcast_IoTforEnergy_whitepaper_v2%205.26.2020-1.pdf
13. November 15, 2018. “How the Internet of Things is Powering the Oil and Gas Industry” https://blog.particle.io/oil-and-gas/
14. Good Jobs First Violation Tracker Oil and Gas - https://violationtracker.goodjobsfirst.org/industry/oil%20and%20gas
15. Startus Insights – Top 10 Oil & Gas Industry Trends & Innovations in 2021 - https://www.startus-insights.com/innovators-guide/top-10-oil-gas-industry-trends-innovations-in-2021/
16. Pipe Tek AU – Intelligent Pigging Services - https://www.pipetek.com.au/pigs/intelligent-pigging
17. November 6, 2020. “How tapping connectivity in oil and gas can fuel higher performance” - https://www.mckinsey.com/industries/oil-and-gas/our-insights/how-tapping-connectivity-in-oil-and-gas-can-fuel-higher-performance
18. April 2021. Market Impact Survey: Global Manufacturing Execution Systems (MES) Industry https://www.reportlinker.com/p03101178/Global-Manufacturing-Execution-Systems-MES-Industry.html
19. Cognizant Glossary of Terms – Manufacturing Execution System - https://www.cognizant.com/glossary/manufacturing-execution-system
20. An Expert’s View – Best Practices in MES Implementations - https://www.engusa.com/en/posts/best-practices-in-mes-implementations
21. https://www.trustradius.com/oil-and-gas
22. WEBINAR: Mechanical Integrity in the Era of Analytics - https://www.oilandgasiq.com/digital-transformation/webinars/mechanical-integrity-in-the-era-of-analytics