

# Reducing Risk in Oil and Gas Operations

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## WHITE PAPER

Sponsored by: EMC

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May 2013

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## IDC ENERGY INSIGHTS OPINION

Risk management is an integral part of day-to-day business activities in the energy industry. Oil and gas companies face risks ranging from volatile commodity prices, which are less linked to basic supply and demand but more to global socioeconomic factors, to increased health, safety, and environmental pressures resulting from past and recent major accidents negatively impacting the environment, industry image, and its social lease. However, risks related to asset damage, business interruption, pollution, injuries to people, and damage to properties are intrinsic in normal oil and gas activities. Then there are the additional risks of non-compliance and of major cost overruns for large construction projects so common in today's industry. Consider also the Stuxnet virus and the more recent cyber threats targeting oil and gas companies in the Middle East. These are just a few examples of the serious risks and threats that can impact oil and gas companies. Technology can help mitigate these risks.

## IN THIS WHITE PAPER

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This white paper explores the operational risks faced by oil and gas companies in today's business and regulatory environment, and how the right information technology can help mitigate those risks. Operational risk is experienced at the corporate level, but this paper mainly focuses on what impacts everyday well, pipeline, and plant operations.

## SITUATION OVERVIEW

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### **Unconventional Resources Such as Shale Gas are Making the Industry's Future Even Brighter**

According to the IEA's World Energy Outlook, global energy demand will grow by more than a third over the period to 2035, driven largely by rising living standards in China, India, and the Middle East, which together will account for 60% of that increase. At the same time, unconventional resources are changing the global energy map: the IEA forecast that the United States will overtake Saudi Arabia and Russia as the world's top oil producer by 2017 and become a net exporter of

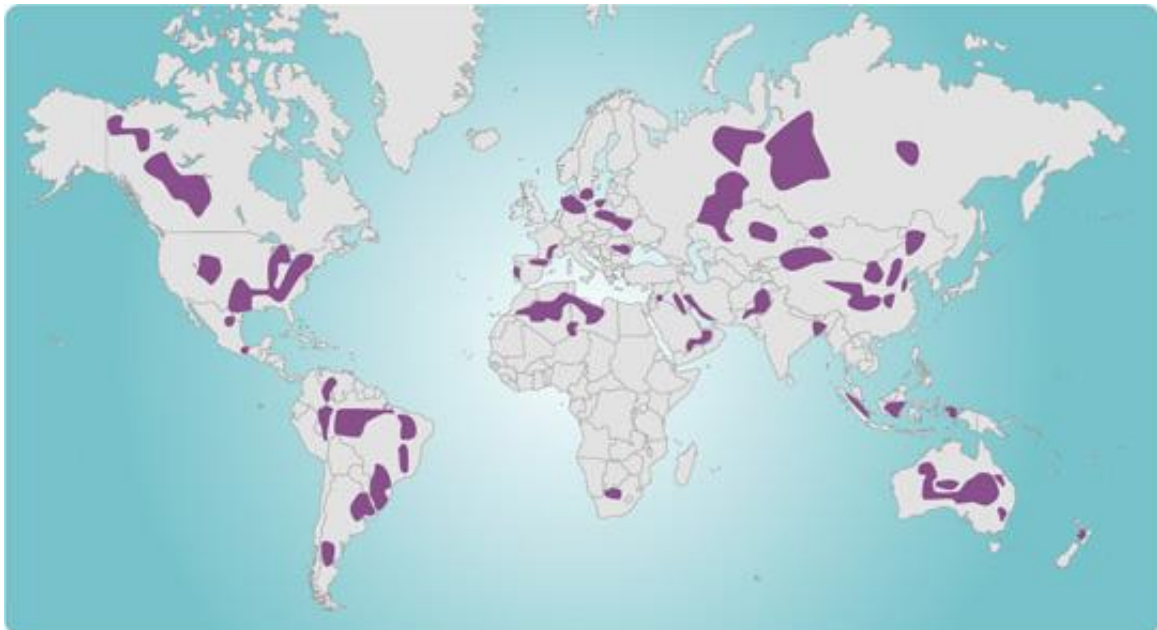
oil by 2030. The U.S. Department of Energy's Energy Information Agency has provided evidence bolstering this conclusion with its finding that crude oil production increased by 790,000 barrels per day (bbl/d) from 2011 to 2012, the largest increase in annual output since the beginning of the U.S.'s commercial crude oil production in 1859. The effect of energy developments in the United States is going to be felt well beyond North America.

Unconventional plays have led to the emergence of independent producers in North America. According to the Independent Oil Producers Association, independent producers develop 95% of domestic oil and gas wells, produce 68% of domestic oil, and produce 82% of domestic natural gas. The jury is still out on whether the same trend will occur in other regions or whether integrated majors and national oil companies will manage unconventional plays themselves.

Unconventional plays have also sparked the development of new perspectives on accessing resources. In unconventional plays that involve a combination of horizontal drilling and fracking, the line is blurred between drilling and production. Unconventional plays use enhanced oil recovery (EOR) techniques from the beginning, not just when the well needs further stimulation. Experience with unconventional plays has demonstrated how activity at a well relates to the reservoir or field, that is, "frack zones." These discoveries about reservoir structure are also being examined for application to conventional plays.

## FIGURE 1

Major Shale Gas Plays



Source: Total website featuring EIA, 2013

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## **Environment, Health, and Safety**

Human and environment safety and health protection remains the number 1 priority for the oil and gas industry. These companies are used to dealing with stringent EHS regulations across the entire span of their activity, from exploration and production, to pipeline management, down to refinery and marketing. These regulations are not only stringent but also constantly revised to take into consideration technological development and the more extreme conditions in which oil and gas companies operate.

Additionally, recent major accidents — the Deepwater Horizon drilling rig in the Gulf of Mexico in 2010, the Californian San Bruno pipeline explosion in 2010, the Pemex pipeline explosion in 2012, refinery fires and shutdowns like the ones at BP Cherry Point, Chevron Richmond, and Amuay in Venezuela in 2012 — are strong reminders of the importance of being prepared for emergency situations and are constantly influencing the activity of national and international regulators. For instance, new offshore drilling safety requirements have been issues, as well as new pipeline integrity regulations such as the US Pipeline Safety Act. Reinforcement of greenhouse gas (GHG) emission caps is also of concern to refineries.

There are also additional regulations for unconventional oil and gas resources. The technique for extracting gas from shale — hydraulic fracturing or "fracking" — has raised environmental concerns about the water table. In the United States, for instance, companies engaged in fracking are required by federal law to report the composition of fluids that is used in the various stages of extraction. However, most of the regulation of gas shale at this point lies with national, state, and local authorities that differ in their approaches.

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## **WHAT IS DRIVING OPERATIONAL RISKS?**

### **Projects Portfolio: More Complexity, More Projects, and More Risks to Manage**

In the oil and gas industry, managing capital projects, in particular large capital projects, in a global environment is becoming increasingly complex. This is especially the case as large reserves are being depleted and the industry copes by drilling multiple smaller wells to compensate.

Oil and gas companies need to make strategic decisions about which projects should be developed first to ensure their company's best performance. Then there are decisions about equipment resources: When is the best time to reserve a rig? Should the decision be based on getting the best rate even if the rig will not be needed at that exact moment? Or should a firm wait until the exact date for a drilling project is known and risk the equipment not being available, or the threat of higher rental rates? How does an equipment shortage impact planned revenues? Do key decision makers have the ability to review

this information and prioritize projects based on equipment resources? The same resource issues are faced for human capital tied to exploration and production (E&P) projects. Are the appropriate teams in place for a project, or has an unexpected failure at another location impacted the project?

As a result, the project portfolio needs to be dynamically managed as a process, in which the list of projects can be constantly revised, and new projects evaluated, selected, and prioritized based on parameters of importance to the company such as level of risk, expected return on investment, EHS considerations, etc. Existing projects can be accelerated, stopped, or reprioritized, and resources can be allocated and reallocated to the most appropriate active projects as needed.

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### **Operational Complexity**

The oil and gas industry is operating in increasingly remote geographical locations and harsher environmental conditions, with unconventional processes to extract hydrocarbons. Joint collaboration between large producers on risky international exploration and production (E&P) projects is common. Articulated E&P sharing agreements with multiple stakeholders need to be managed. High rates of non-productive time require action, and overall equipment efficiency needs to grow.

Ultimately, companies share the same primary goal of needing to produce hydrocarbon as efficiently and cost effectively as possible. One strategy for achieving this has been the adoption of a "digital oilfield" or "integrated operations" to enhance reservoir recoverability, optimize production, and reduce economic, environment, health, and safety risks. Initially this strategy was only associated with upstream, but companies are increasingly focused on accessing and managing key asset-related data to improve decision making across the entire enterprise from field to refinery.

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### **Increased Production Flexibility**

Light, sweet crude oils are in short supply, and the less expensive heavy, sour crudes are more plentiful worldwide. However, not all refineries are currently configured to handle the heavier oils. Refiners need conversion capacity for hydro-skimming, cracking, and coking to capitalize on the sour crude discounts. At the same time, stricter fuel standards have forced refineries to retool to be able to accommodate new fuel mix requirements, especially in North America and Europe.

Another challenge lies in having the right crude available based on the demand pattern for products. Refiners must make decisions about whether to buy crude of the quality needed to meet the forecast demand for specific products and put this crude in storage or wait to buy the crude on an as-needed basis. If a company receives the crude on time, the plant must make decisions on how to blend based on the margin for that product. One other aspect is how processing heavy oil impacts emissions at the plant. In response to the changing properties

of crude, refiners are responding with initiatives to increase their flexibility of production and see this as a major competitive advantage.

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### **Shortage of Experts**

A shortage of expert resources is not new to the industry. This problem has existed for several years. Shortages are mainly in the highly technical areas such as geology and geophysics and petroleum engineering. In some geographies there is also a shortage of IT personnel with expertise in some of the more complex information technologies, such as high-performance computing (HPC), used to support analysis of large volumes of scientific and engineering data in exploration and production.

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### **Cyber Security: Expanded Boundaries of Vulnerability**

The industry has always been involved in efforts related to critical infrastructure protection. However, with the progressive digital evolution toward smart oilfields and refineries of the future, IT and OT security has been receiving greater attention. Concerns were originally raised about the security of process systems with the revelation that the highly sophisticated Stuxnet virus is capable of invading process control systems, and potentially disrupting processes by invading control systems on drilling rigs and in the refinery.

More recently the cyber attacks on Saudi Aramco and RasGas were a huge shock for many oil and gas organizations in the Middle East region. The world's largest oil-producing company, Saudi Aramco, was the victim of a significant cyber attack on August 15, 2012. The oil giant announced that 30,000 of its workstations had been infected by a virus. Moreover, on August 27, Qatar's natural gas pumper, RasGas, was hit by a similar attack, resulting in the company being taken offline for a few days. A group of hackers calling themselves the Cutting Sword of Justice claimed responsibility for the attack on Saudi Aramco. They allegedly infected the organization's systems with a replicating malicious software (malware) for political reasons. Some IT analysts credit a virus called Shamoon for both attacks. Both Saudi Aramco and RasGas managed to limit the damage, as the attacks did not affect extraction or processing, but such a bold attack had important repercussions on the IT strategies of oil and gas organizations operating in the Middle East, demanding new projects on risk assessments, new IT security policies, and the adoption of additional security solutions.

In the U.S., the Industrial Control Systems Cyber Emergency Response Team (ICS-CERT) received and responded to 198 cyber incidents in 2012 as reported by asset owners and industry partners. Attacks against the energy sector represented 41 % of the total number of incidents.

## **WHAT DO OIL AND GAS COMPANIES NEED TO HANDLE OPERATIONAL RISKS?**

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### **Access and Visibility: Right Information at the Right Time**

Most oil and gas companies would agree that the most significant challenge for their enterprise is management of information. Oil and gas companies continue to work to be able to create intelligence from the massive amount of technical and business data, both structured and unstructured, that they have collected. The ultimate goal in collecting all this information is to speed time to first oil, reduce risks, and meet compliance requirements with information life-cycle management. Some companies are establishing new information governance structures to harness OT and IT data sources, and IDC Energy Insights expects others to follow. At the same time, information needs to be shared in a secure manner with multiple partners to speed time to oil and lower EHS and economic risks.

Timely access to all relevant information is critical in case action is needed following catastrophic events. In order to reduce response time, oil and gas companies need to ensure immediate distribution of all relevant materials to all interested parties.

Moreover, timely, contextualized, and consistent information is the basis for effectively implementing standard operating procedures, essential to cope with continuous changes in people and teams working on the assets.

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### **Data Quality: So Much Still to be Done**

When it comes to information related to assets the issue of data quality hits oil and gas companies. These are typical complaints that IDC Energy Insights collects:

- Asset databases are incomplete
- Documents (including drawings) are not updated
- Information stored in the different company systems are not consistent or integrated
- Information is not available or not properly synchronized on mobile devices
- Data quality is not systematically audited

Poor data quality heavily impacts the decision-making process, increasing the risks of operational mistakes. Oil and gas companies need to carefully tackle this issue to avoid reducing effectiveness of operations. Additionally inconsistent data across systems (typically GIS and EAM/ERP) increases the risk of fines from regulators.

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## **Prevention of Non-Compliance**

With the increasing regulatory pressure, oil and gas companies cannot afford the risk of being non-compliant. More stringent requirements for timely reporting on operations and accidents might be required, as well as risk mitigation plans for critical operations such as drilling. Oil and gas companies need to ensure that vital documents, including approvals for drilling, building, and maintaining wells, are available throughout the enterprise and across enterprise boundaries to minimize risk and ensure regulatory compliance.

EHS systems include a broad set of applications and technologies that cater to the EHS business needs of the oil and gas industry. Primarily, these systems automate the management of structured and unstructured EHS data and facilitate the necessary flow of EHS-related compliance actions, such as inspections and reporting. More sophisticated systems include enterprise operations risk management applications that aid with asset and worker safety. EHS technologies also refer to instrumentation and supporting software that aid with measurement and remediation activities related to ground, water, and atmospheric leaks. GIS and GPS systems, as well as preventive asset management, play an important role in promoting EHS initiatives.

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## **Holistic Approach to Operational and Enterprise Risks**

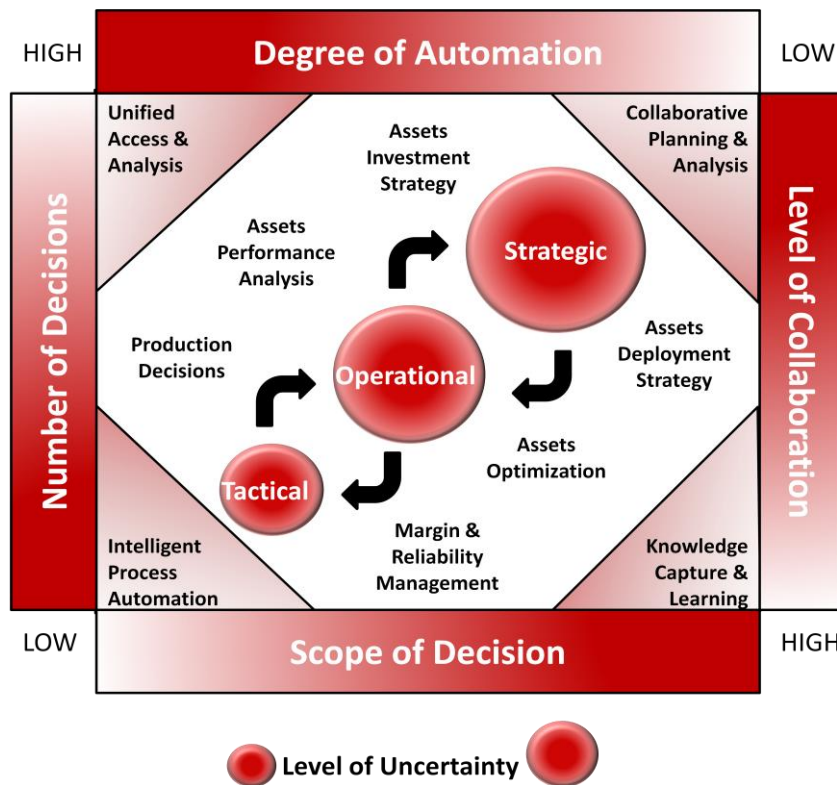
Operational risks are a key component of overall enterprise risk management, and information plays a key role in reducing them. Oil and gas companies, like any other capital-intensive business, need to take strategic, operational, and tactical decisions about their assets, whether they are resources, reserves, wells, plants, or facilities (see Figure 2).

Often there exists a disconnect between the tactical and the strategic levels. The strategists do not have visibility into costs and efficiencies across the portfolio of assets. Also, well/plant-level decisions are made based on the perspective of the individual plant or asset and these decisions may not support the profitability goals set at the corporate level. This disconnect negatively affects companies' ability to handle risks.

Technology can help reduce disconnect with analytics and governance, risk, and compliance (GRC) applications, which automate and document processes pertaining to the definition, assessment, and verification of business controls and operational risk at the corporate level. Enterprise GRC software includes financial compliance management, audit management, corporate policy and procedure management, risk management, and continuous enterprise controls monitoring.

**FIGURE 2**

Oil and Gas: Decision Management Model



Source: IDC Energy Insights, 2013

### **Real-Time Monitoring and Predictive Maintenance to Prevent Incident, Failure, or Non-Productive Time**

Refineries have been ahead of upstream in deploying advanced maintenance approaches. However, in the past few years, the upstream industry has adopted many of the same techniques to improve capital asset management. Best-in-class companies use a variety of techniques to reduce maintenance costs, increase uptime, and increase availability. These techniques include:

- **Condition-based monitoring.** Placement of sensors to measure various conditions (temperature, vibration, etc.) to detect situations that may indicate potential equipment failure. The more sophisticated systems have alerting capabilities and are integrated with enterprise asset management applications that can automatically generate inspection or work orders.
- **Predictive maintenance.** Predictive maintenance goes beyond condition-based maintenance in applying advanced analytics to predict potential equipment failures, providing enough notice to procure complex non-commodity replacement equipment. The



algorithms identify a departure from normal operating levels of a piece of equipment rather than comparing performance with expected performance levels for the equipment class.

- **Criticality-based maintenance.** This technique informs decisions on maintenance strategy by identifying which assets are critical to the process and what the process impacts would be if the asset were to fail. Criticality-based maintenance also informs procurement strategy so that inventories, and the costs associated with keeping them, are reduced but not at the expense of increased downtime.
- **Performance center or center of excellence.** The most advanced companies have adopted centers of excellence where engineering staff are able to bring together engineering knowledge for root cause analysis when potential problems are identified. Centers of excellence can also have a view of multiple assets to support decision making and maintenance planning and even suggest future equipment design modifications.

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### **Collaborative Planning, Operations, and Decision Making**

To reduce non-productive time, enhance production, and reduce both economic and EHS risks, oil and gas companies are creating a stronger and more comprehensive connection between field operations staff and remote experts. This connection involves:

- **Collaboration.** The ability for multiple parties to visualize and analyze the same set of data and information from disparate locations.
- **Workflow.** Rationalizing data to make it automatically available to personnel and applications according to role-based need.
- **Access to real-time data.** Surface and subsurface to improve production, often involving sensors.

This is often accomplished through collaboration rooms accessible from multiple locations, both on-rig and off-rig. Visualization can be 3D or 4D and, depending on the data, is most effective with a geospatial overlay.

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### **Cyber Security Policy Design and Execution**

One of the most basic elements to guarantee information security is to have an enterprise information security architecture applied to all the data, systems, processes, and people. It is imperative to be able to track from the business strategy to individual security technologies.

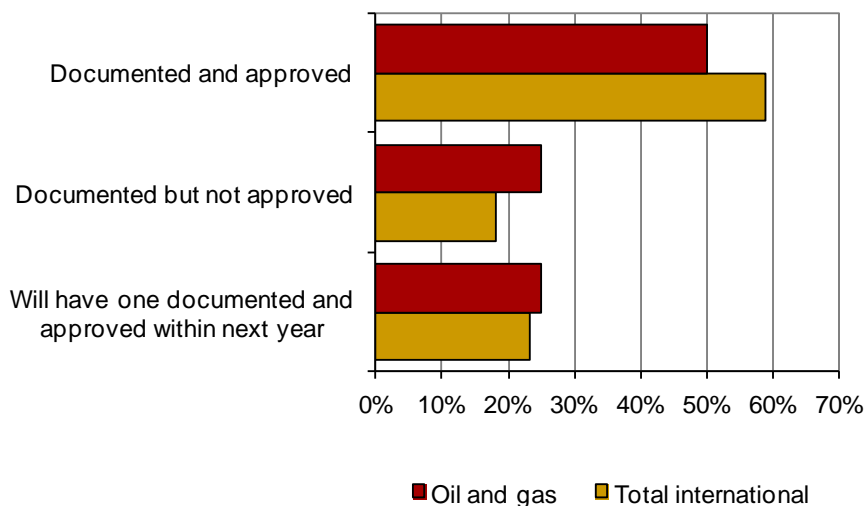
According to IDC Energy Insights' security survey (see Figure 3), only 50% of oil and gas organizations have a documented and approved

information security strategy in place, less than the cross-industry average (58.7%). This is clearly an area of action for the industry, especially considering that 45% of the oil and gas industry respondents do not know how many security events have occurred in the past 12 months, and 50% of them do not know the nature of those events, for example whether those events occurred through applications, devices such as removable storage, smartphones, etc.

**FIGURE 3**

**Approved and Documented Information Security Strategy in Place**

Q. Do you have an approved and documented information security strategy in place?



Note: Does not include North America.

Source: IDC Energy Insights, Security Survey, 2011

**FUTURE OUTLOOK**

**Five Must-Have IT Capabilities**

The amount of information being produced in the oil and gas industry can only increase. Smart instrumentation, for instance, will continue to pervade operations. At the same time ICT capabilities such as mobility, cloud, and Big Data/analytics offer opportunities to transform the way information is managed, used, and distributed across the company. When it comes to mitigating risk in oil and gas operations, from upstream, midstream, to downstream activities, IDC Energy Insights believes that five capabilities are critical:

- **Enterprisewide management of information and intelligence.** Oil and gas companies design, construct, operate, and maintain large plants and facilities facing increased EHS pressure and growing competition. In order to lower project risks, improve

collaboration, and ensure compliance, companies in the industry need to be able to handle all the information concerning their exploration and ongoing production from every well. They need to be able to review/approve, attribute, and retrieve well file correspondence and other documents that are critical for regulatory and legal compliance. Oil and gas companies need business-critical information to be quickly retrievable. In essence, they need an enterprisewide IT solution (including international branches) capable of managing all structured and unstructured content associated with planning, operating, and maintaining oil wells. That should include the design/construction of well facilities, major modifications, refurbishments, and eventual decommissioning. The same for midstream and downstream activities.

- **Consistent, contextualized, and integrated information, available in mobility.** Having timely, updated, and contextualized information is a prerequisite to be able to make sound decisions and operate effectively and efficiently on assets, reducing the possibilities of mistakes and ultimately mitigating risks. The same goes for data integration. For instance, a single point of asset information related to operations and maintenance across business units and processes ensures that physical asset information is managed, retrievable, and current. It is also important to make this information available in any moment via mobile applications, making the job of field workers more effective and safer, or allowing managers to access information needed to take decisions.
- **Collaboration tools.** Because expertise is required across the globe, the industry has made investments in collaboration technology over the last few years so that experts from different parts of the world can collaborate on engineering, design, and operations. Because of the complexity of drilling and operations, oil and gas teams need high-end 3D visualization and collaboration rooms that allow global teams to access the same data, models, and tools. Aside from the need to bring in experts, exploration and production is supported by many companies – oil field services, drilling and seismic, etc. — as well as partnerships. Detailed descriptions of the events leading up to Macondo give a good example of the number of parties that were involved in operational decision making for this exploratory well, in various parts of the rig, as well as offshore. Collaboration technologies also help speed up decision process in case of incidents or disasters. Additionally, considering the number of parties involved, the geographic spread of these parties, and the amount of data being dealt with, collaboration via cloud-based solutions is a promising option, which also foster standard procedures for all parties and once more reduce risks in operations.
- **Security.** Sharing information across the enterprise and, where needed, with external stakeholders, requires security. Oil and gas companies should invest in information security solutions enabling them to:

- Manage, archive, protect, authenticate, and scale their security systems and video surveillance information more effectively, increasing their capacity to detect, deter, and analyze security events in real time.
- Protect the integrity and confidentiality of information throughout its life cycle — no matter where it moves, who accesses it, or how it is used.
- Build a reliable, efficient, and cost-effective data protection architecture to eliminate tape, improve disaster recovery readiness, and simplify management.
- **Enterprise governance, risk, and compliance.** eGRC is an umbrella term that describes how an organization defines the objectives, policies, and procedures by which it is managed; pursues opportunities while avoiding or managing negative events; and demonstrates adherence to laws, regulations, policies, contractual obligations, and industry standards. Oil and gas companies have been practicing eGRC in a piecemeal fashion for decades, but only recently have they approached eGRC as a holistic strategy for managing risk and compliance across functional domains and the lines of business. In the current atmosphere of global economic stress, heightened regulation, and increasingly complex risks, an eGRC strategy supported by the right technology platform is more important than ever before. The oil and gas industry, especially the upstream segment, has historically struggled to overcome "silos" of segregated data and applications that are not integrated and therefore fail to achieve integrity and do not maximize business value. For example, to be truly effective in helping oil and gas companies manage governance, risk, and compliance, EHS applications must be integrated with a variety of other systems including ERP systems, EAM applications, energy trading and risk management (ETRM) applications, supply chain management applications, and real-time data historians.

## CONCLUSIONS

Information technology can help mitigate operational risks. Organizations that understand their risk profile and take concrete action to mitigate risks will be better positioned to be successful in the marketplace. IDC Energy Insights recommends the following to oil and gas companies:

- Consider developing a corporatewide approach to managing information in the plant. Best practices cover use of technology to support operations, business analytics, application integration, EHS compliance, and enterprise content management.
- Work to develop business processes for operations and identify document control workflow for approvals within the organization,

including the transmittal and standard operating procedure (SOP) processes. Determine how often you wish to share documents with vendors, partners, regulators, and others. Work together to develop a coding standard for components/documents to ensure that there is consistent master data management.

- Participate in industry associations and user communities to help arrive at standards for sharing of content and supporting well and plant workflows.
- Look to areas of high vulnerability in your operation such as current processes that still rely on paper files that can potentially be difficult to find and update and may be misfiled or lost and ultimately expose your company to regulatory or internal audit failures.
- Focus on process improvements that will allow more effective creation and sharing of content both inside and outside the firewall. A good area to start would be the transmittal and SOP processes.
- In this time of increased regulatory pressure, look at solutions that optimize the way you manage, share, store, and archive content to comply with environmental, health, and safety regulations.
- Look at deploying information rights management tightly integrated with content management to ensure that only authorized recipients can view, copy, print, or edit confidential information.
- Reassess your customer communications capabilities to ensure timely and personalized correspondence tailored to the delivery requirements of the recipient, including customers and regulatory agencies.
- Take a more holistic approach of your asset information to ensure that drawings, records and other documentation are properly identified, stored, classified, accessible, accurate, and appropriately safeguarded.
- Familiarize yourself with emerging asset management standards such as PAS 55 and ensure that future asset management solutions that are deployed in your company operations adhere to such standards.
- Evaluate solution vendors that have the flexibility to support mobile access of project and plant information, which enables and optimizes access of information wherever it is accessed.
- Consider solutions that provide options to deploy cloud-based solutions and can support projects that require cloud deployments.

## **ABOUT EMC**

The EMC Information Intelligence Group (IIG) delivers enterprise solutions and services for information management that range from compliance to business process in order to provide people with the right information at the right time. IIG technologies can be delivered either on premises or in the cloud and are designed to simplify the complexity of managing and protecting an organization's most valuable asset: information. EMC Documentum for Energy solutions supports capital projects and plant operations in the energy industry to reduce risk and improve compliance. For more information, visit [www.emc.com/DocumentumForEnergy](http://www.emc.com/DocumentumForEnergy).

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## **Challenges and Considerations**

EMC has built a strong offering with Engineering, Plant, and Facilities Management (EPFM) solutions based on experience working with energy companies and specialist systems integrators on a diverse set of projects. Project portfolio management lends itself well to a cloud application where collaboration between owner operations, oilfield service companies, suppliers, and regulators is critical to success. However, it may be difficult to convince the industry of the use of cloud due to security considerations, especially when it comes to critical infrastructure protection for assets such as nuclear power plants. Another seemingly intractable challenge for the energy industry is the handover from engineering, design, and construction to maintenance and operations of a large and complex capital project. EMC will need to convince the industry that EPFM with workflow and asset-connected documentation can serve as a bridge between engineering and design to enterprise asset management and operational applications that are used on a daily basis.

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## **About IDC Energy Insights**

IDC Energy Insights provides research-based advisory and consulting services focused on market and technology developments in the energy and utility industries. Staffed by senior analysts with decades of direct industry experience, IDC Energy Insights covers the energy value chain — upstream, wholesale, delivery, and customer service — providing independent, timely, and relevant analysis focused on key business and technology issues. IDC Energy Insights serves a diverse and growing global client base, including electric, gas, and water utilities; IT vendors; independent power producers; retail energy providers; oil and gas companies; equipment manufacturers; government agencies; financial institutions; and professional services firms. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

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