

Using Information Intelligence to Improve Projects in the Energy Sector

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IDC ENERGY INSIGHTS OPINION

In the energy industry, successful execution of projects in the design, construction, and operation of plants and facilities is dependent on more than ensuring that schedules and budgets are met. Management of the asset life cycle from planning all the way through to decommissioning requires systems and tools that support a project framework that can leverage information from a multitude of sources to drive decision making, effectively integrate information, and permit collaboration with key partners both externally and internally during all project phases. At the same time, the framework must allow energy companies to meet stringent regulatory requirements.

Information technology (IT) plays a critical role in the execution of capital projects. The ability to leverage essential information at the project and portfolio level becomes knowledge for operators to successfully execute capital projects while mitigating risk, ensuring safety, and maintaining compliance in a resource-constrained environment. IDC Energy Insights believes the following elements are essential to supporting successful execution of capital project management:

- Knowledge management that provides the ability for a system to capture and disseminate information to all participants, all while controlling access of key information to maintain security
- Collaboration that supports the secure exchange and feedback loops between all parties, including external partners, complemented with a policy-based records management and archiving framework
- Integration of information from all stages of the asset life cycle and the ability to identify, capture, and effectively incorporate and leverage information in the asset life cycle

SITUATION OVERVIEW

The energy industry, as a capital-intensive industry, is perpetually involved in multimillion-dollar projects. Major projects involve asset developers, owners, and operators working closely with engineering, design, and construction firms to "get 'er done." The projects could be new transmission and distribution lines, power generation plants, wind or solar farms, sewage treatment plants, oil or gas wells, or retrofitting major physical assets.

Energy Companies Are Continuing to Build Despite the Economy

The most critical driver for investment in capital projects in the energy sector continues to be the unabated global demand for energy. According to the New Policies Scenario published in the International Energy Agency's *World Energy Outlook*, global primary energy demand will rise by over one-third — to 17,197 Mtoe — from now until 2035. Growth in demand calls for \$37 trillion of investment in the world's energy supply infrastructure by 2035. The International Energy Agency estimates that capital expenditures in oil and gas will reach \$19,147 billion by 2035 (see Table 1).

TABLE 1

Worldwide Oil and Gas Industry Capital Spending, 2011–2035 (\$B)

	Oil	Gas	Total
OECD			
Americas	2,100	2,172	4,272
Europe	511	1,019	1,530
Other	92	565	657
Subtotal	2,703	3,756	6,459
Non-OECD			
Asia	963	1,664	2,627
Middle East	1,137	510	1,647
Africa	1,557	1,316	2,873
Latin America	1,971	609	2,580
Other	1,399	1,562	2,961
Subtotal	7,027	5,661	12,688
Worldwide	9,730	9,417	19,147

Source: International Energy Agency (IEA), 2011

More immediately, aging infrastructure and the addition of renewable resources and distributed generation to the power supply are driving investment in transmission and distribution, while the emphasis on clean energy is driving investment in renewables. While nuclear generation is stalled in North America, there is more activity in areas such as Asia/Pacific. There has also been a decline in capital investment in clean energy after government subsidies were cut in several regions, but this has been made up by capital investment in unconventional resources. Table 2 shows U.S. investments for utilities and global investments for clean energy and for oil and gas.

TABLE 2

Capital Investment in Energy

Line of Business	Magnitude of Investment	Investment Drivers	Expected Benefits
Transmission (Utility)	\$13–14 billion expected in 2012 by U.S. investor-owned utilities and transmission companies <i>EEl Annual Property & Plant Capital Investment Survey, December 2012</i>	<ul style="list-style-type: none"> • Connection of renewable resources mandated through renewable portfolio standards • Favorable pricing policies • Aging infrastructure • Pockets of limited capacity • Demand in unserved areas • Competitiveness (exporters of supply) • Reliability regulations 	<ul style="list-style-type: none"> • Enhance reliability • Address congestion • Upgrade voltage • New infrastructure in emerging economies
Distribution (Utility)	\$20 billion expected in 2012 by U.S. investor-owned utilities <i>EEl Annual Property & Plant Capital Investment Survey, December 2012</i>	<ul style="list-style-type: none"> • Availability of federal smart grid funding • Aging infrastructure • Pockets of limited capacity • Demand in unserved areas • Competitiveness (exporters of supply) • Distributed energy resources (future) • Reliability regulations 	<ul style="list-style-type: none"> • Enhance reliability • Increase efficiency (lower line losses) • Quicken outage restoration • Accommodate distributed resources (future)
Traditional Generation (Utility)	\$38 billion (currently under construction in United States, includes hydro), SNL Energy	<ul style="list-style-type: none"> • Replace decommissioned plants • Increase capacity where capacity constrained • Merchant opportunity • Replace uneconomic plants (high emissions, etc.) 	<ul style="list-style-type: none"> • Increase capacity • Increase efficiency of plants • Provide revenue opportunities for merchant plants
Clean Energy	\$108 billion for 2012 (U.S. projects), SNL Energy, 2012	<ul style="list-style-type: none"> • Renewable portfolio standards • Availability of government incentives • Availability of investor funds • Address new markets • Renewable portfolio standards 	<ul style="list-style-type: none"> • Meet regulatory requirements • Decrease dependence on nonlocal resources • Reduce emissions • Increase market share
Environmental Projects	\$3.1 billion for 2012 (U.S. projects), SNL Energy, 2012	<ul style="list-style-type: none"> • Meeting regulatory requirements for mercury, sulfur, GHG 	<ul style="list-style-type: none"> • Reduce emissions

TABLE 2**Capital Investment in Energy**

Line of Business	Magnitude of Investment	Investment Drivers	Expected Benefits
Oil Drilling and Completion (Upstream Oil and Gas)	\$1.2 trillion for 2013 (global; includes upstream, midstream, and downstream), "Oil and Gas Capital Expenditure Outlook," GlobalData, 2013	<ul style="list-style-type: none"> • Securing access to new reserves • Global energy demand • Address new markets • New/advanced technology • Growth opportunities for energy companies • Higher oil prices 	<ul style="list-style-type: none"> • Increase production • Increase market share • Improve shareholder returns • Meet environmental and safety regulations
Refining (Downstream Oil and Gas)	See above	<ul style="list-style-type: none"> • Locating processing closer to demand • Developing dynamic capabilities to handle diverse feedstock and products 	<ul style="list-style-type: none"> • Reduce cost of transport • Reduce inventory of products that are not in demand
Pipelines and Storage (Midstream Oil and Gas)	See above	<ul style="list-style-type: none"> • Need to add infrastructure to deliver resources from unconventional oil and gas • Electric generation • Address new markets • Aging infrastructure • Proliferation of fuel grades 	<ul style="list-style-type: none"> • Increase energy efficiency • Meet environmental and safety regulations • Increase market share
Mining	\$140 billion in 2012, Accenture, 2012	<ul style="list-style-type: none"> • Meeting demands for new materials • Extending into new markets 	<ul style="list-style-type: none"> • Match supply to demand to reduce production and inventory costs

Source: IDC Energy Insights, 2013

Decommissioning

While countries are still making capital investments in building or retrofitting physical assets, a significant amount of plant decommissioning is occurring around the world. According to the Energy Information Administration, Germany currently generates about a quarter of its electricity from nuclear power yet announced plans to decommission its more than 20 gigawatts of nuclear capacity by 2022. Switzerland generates over a third of its electricity from nuclear sources but has decided to halt development of new facilities. Existing plants will be permitted to operate until the end of their lifetime, effectively phasing out nuclear power in Switzerland by 2034. Japan is planning to decommission any aging reactors older than 40 years to improve safety. Coal plants are also being decommissioned. Nuclear power plants are not the only power generation being decommissioned. Coal-fired generation plants are being decommissioned in North America and Europe.

Joint Ventures Require Improved Control of Information

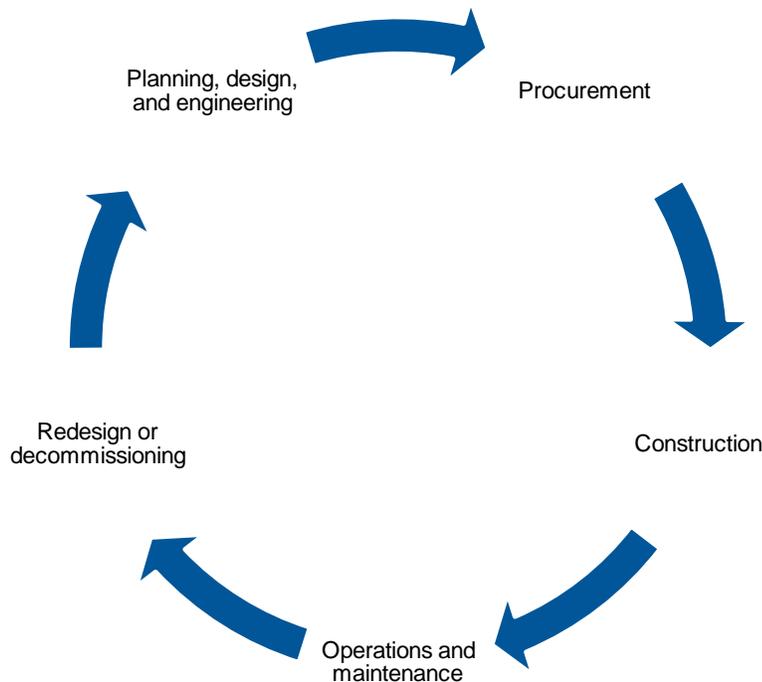
To meet the escalating costs of hydrocarbon extraction and development as well as mitigate the associated risks, oil and gas companies are increasingly reliant upon joint venture agreements. Additionally, as new sources of hydrocarbon are discovered around the globe, access may require a partnership for securing reserves in foreign countries.

Asset-Life Cycle Holds Challenges for Management and IT

IDC Energy Insights describes the life cycle of an asset as a continuous process. It starts with planning, design, and engineering; moves to procurement of services, construction, and operations and maintenance of the asset; and then moves to redesign or decommissioning (see Figure 1).

FIGURE 1

Asset Life-Cycle Management Process



Source: IDC Energy Insights, 2013

While new construction typically makes up the bulk of capital expenditures for energy companies, operations and maintenance of the asset can require capital investment as well as expenditures. The impact of having a prolonged and unplanned shutdown or outage can be significant. For example, one utility has reported that unexpected outages due to failure of aging equipment can cost between \$450,000 and \$700,000 a day depending on the market price of replacement power. When critical equipment fails, the plant must be brought offline, but there is still an obligation to meet load.

Concerns about safety have also led to an increased focus on operation of the asset. Incidents such as the explosion and release of oil from the Macondo drilling operation in the Gulf of Mexico; the explosion of gas pipelines in San Bruno, California; the nuclear power plant disaster in Fukushima, Japan; and a crude oil pipeline rupture in Arkansas, as well as concerns with the environmental and geological impact of gas "fracking," will likely increase regulations and regulatory scrutiny of capital projects. Even without that regulation, companies are expected to pay more attention to processes and documentation for risk mitigation and to defend against liability claims. Investigations of recent accidents have looked at handover of information during shift changes. There has also been a renewed focus on safety with the U.S. Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) rule on Safety and Environmental Management Systems (SEMS), proposed legislation on pipeline integrity, and the desire to maintain and enforce up-to-date standard — and safe — operating procedures (SOPs).

Management Seeks to Reduce Risks

The challenges that management faces in building and operating assets are nothing new. Poor planning and design lead to costly change orders. Poor collaboration between contractors causes project delays and cost overruns. Poor project management can result in resources no being longer available, which in turn produces project delays and cost overruns. Failure to meet regulatory compliance and permitting requirements can lead to project delays and cost overruns. A lapse in following standard operating procedures may result in accidents. Equipment failure can also have safety and environmental impacts and lead to unplanned outages.

IT Tackles Making Information Available, Yet Secure

IT is challenged with providing access to the appropriate documentation to make projects work. The volume of documents (unstructured) and data (structured) to be shared is increasing and needs to be managed by IT. Personnel who need access to information are often not onsite and sometimes are in remote locations with limited bandwidth. With the proliferation of mobility and mobile applications, the expectation is that personnel can get access to the information they need for decision making, wherever they are located.

The increasing dependence on joint ventures requires the control, availability, and distribution of information — an even more critical element for any project. Increasing the number of vendors, suppliers, and energy companies in the process means confidence in the integrity of the documentation throughout the process and ensuring that the most up-to-date document is available. At the same time, much commercial information is confidential, and design and as-built information about critical assets needs to remain secure to protect these assets.

FUTURE OUTLOOK

Information Technology Plays a Key Role in Capital Project Management

The earliest application of information technology to capital projects was with the development of computer-aided drafting (CAD). Since that time, more and more information technology has been introduced to add efficiency to the engineering, procurement, and construction process and, beyond that, to asset life-cycle management.

IDC Energy Insights has developed a capital project maturity model based on our research of best practices at energy companies in improving the on-time and on-budget performance of projects, as well as performance of the asset over its life cycle (see Figure 2). Level 1 denotes an organization with basic capabilities. Level 3 is the highest level of maturity and best practices.

FIGURE 2

Capital Project Maturity Model

	IT Architecture	Application Integration	Project Portfolio Mgmt	Enterprise Content Mgmt	Business Analytics
Level 3	Service-oriented architecture (SOA)	Business process-level application integration via XML and Web services	Portfolio mgmt across all projects Risk mgmt Project pipeline/funnel mgmt JV mgmt	Enterprise content mgmt Embedded search tools Security and auditing	Real-time visibility into project portfolio through KPIs, alarms, dashboards, and reporting
Level 2	3-tier with Web client	Enterprise application integration via middleware	Portfolio mgmt across some projects HSE mgmt Resource optimization Contract mgmt Change mgmt Procurement mgmt	Indexing and cataloging Version mgmt Workflow Design collaboration	Project/contractor performance tracking
Level 1	2-tier client/server	File transfer or custom point-to-point interfaces	Individual project focus Project planning and scheduling Project budgeting and costing	File/directory based	Project reporting and charting

Source: IDC Energy Insights, 2013

Content Management Is One of the Five Pillars of Capital Project Management

As can be seen in Figure 2, enterprise content management is one of the five major pillars of a comprehensive capital project maturity model. Successful capital project management and execution depends on the sharing of data between developers, owners, venture partners, operators of the physical assets, and third parties at various stages of the process. Much of that data is "unstructured" data in the form of drawings, documents, or other content. In contrast to structured data, which can be found in applications and databases, this "unstructured" content is not formatted for easy transfer between parties through integration or exchanges (see Table 3).

TABLE 3			
Essential Content for Capital Project and Asset Management			
Function	Content Type	Project Participants	Key Capabilities
Planning, Design, and Engineering	<ul style="list-style-type: none"> • CAD drawings • Project specifications • Vendor documentation • P&IDs • HSE plans • Transmittals • Project reporting 	<ul style="list-style-type: none"> • Partners — joint venture partners • Contractors — engineering and design, architecture • Regulators — environmental review boards, permitting authorities, FERC, BOEMRE 	<ul style="list-style-type: none"> • Workflow for design approval • Integration with authoring systems • Collaboration • Audit trail for regulatory approvals • Drawing/CAD management • Transmittal management • Document bulk loading • Scanning/imaging • Business process management
Procurement	<ul style="list-style-type: none"> • Approved designs • Transmittals • Purchase orders • Bill of material • Qualifications • Certifications • Contracts 	<ul style="list-style-type: none"> • Contractors — engineering and design, architecture • Equipment manufacturers 	<ul style="list-style-type: none"> • RFP dissemination and tracking • Contract management • Transmittal management • Collaboration • Records management • Archiving
Construction and Commissioning (drilling and completions for upstream oil and gas)	<ul style="list-style-type: none"> • Approved designs • Transmittals • Inspection documentations • Punch lists • As-built drawings and specifications 	<ul style="list-style-type: none"> • Contractors — engineering and design, architecture, construction contractors and subcontractors • Regulators — local building departments, FERC, OSHA, BOEMRE 	<ul style="list-style-type: none"> • Collaboration • Workflow for change order approval • Transmittal management • Records management • Archiving • Drawing/CAD management • Business process management

TABLE 3			
Essential Content for Capital Project and Asset Management			
Function	Content Type	Project Participants	Key Capabilities
Handover	<ul style="list-style-type: none"> As-built drawings and specifications 	<ul style="list-style-type: none"> Partners — joint venture partners Contractors — engineering and design, architecture 	<ul style="list-style-type: none"> Collaboration Workflow/transmittals for handover acceptance Bulk loading
Operations and Maintenance	<ul style="list-style-type: none"> Operating procedures Exploded views P&IDs As-built, as-operated drawings and specifications Maintenance instructions 	<ul style="list-style-type: none"> Maintenance staff Contractors Management oversight 	<ul style="list-style-type: none"> Integration with maintenance management systems Audit trail for regulatory approvals Collaboration Transmittal management Maintenance optimization/integration Records management Archiving Business process management
Redesign or Decommissioning	<ul style="list-style-type: none"> As-built, as-operated drawings and specifications Exploded views Decommissioning documentation 	<ul style="list-style-type: none"> Regulators Contractors — waste management, construction, engineering and design Equipment manufacturers 	<ul style="list-style-type: none"> Collaboration Workflow for engineering document approval Scanning/imaging

Source: IDC Energy Insights, 2013

Oil and gas companies, utilities, and engineering, procurement, and construction (EPC) companies have their own document repositories. The legal department of most companies tends to "own" these document stores. IDC Energy Insights' research shows that most companies are still relying on EPCs to maintain drawings and documents from the construction phase and then to deliver them to the developer/owner/operator of the asset or facility at best with weekly or quarterly document sharing. Some are still relying on the EPCs to hold drawings and documents to the end of the project, at which point they are delivered to the developer/owner/operator for upload into the document repository.

Collaboration, Workflow, Access, and Accountability
Reduce Risks and Costs

This section highlights the best practice capabilities and expected business value associated with content management.

1. **Collaboration.** Ability for multiple parties to collaborate via drawings while controlling versioning and approvals. Level 2 organizations have version management and design collaboration, typically the ability to mark up PDFs or other documents. Level 3 organizations use electronic document rooms or engineering collaboration software. Secure role-based access and secure file synchronization and sharing are a "must" for maintaining the confidentiality of data.

Expected business value: Reduce length and cost of design process

2. **Request for proposal (RFP) dissemination and tracking.** Ability for developer/owner/operator to quickly disseminate drawings and specifications, as well as subsequent updates, via email or other electronic means to potential suppliers during the RFP process.

Expected business value: Reduce length and cost of RFP process

3. **Ease of access to asset documentation.** Ability to quickly access current documents and drawings associated with an asset, especially in the field using mobile devices. Tools include search, auto-numbering, and versioning. This capability is especially helpful in the operations and maintenance stage of the asset life cycle as improved access to exploded views, process designs, drawings, equipment specification, and job history can aid in diagnosing conditions and speed ordering of replacements. Designs become as-built drawings and documentation, which, when modified during operations, become as-operated drawings and documentation. Access is typically linked through integration between enterprise content management (ECM), enterprise asset management (EAM), project management (PM), contract management (CM), materials management (MM), enterprise resource planning (ERP), and environmental health and safety (EH&S).

Expected business value: Reduce nonproductive time (construction or drilling) and wrench time (operations and maintenance)

4. **Workflow for approvals.** Ability to control how information progresses within the enterprise and to external partners. Workflows can ensure that critical information is made available to the appropriate parties for approval and that the process is efficient. Formalized workflows support the accountability for completion of tasks.

Expected business value: Increase productivity, improve the accountability of individuals for task completion, and drive consistency across multiple projects

5. **Audit trail for regulatory documentation.** Ability to provide a description of the activities covered during a compliance audit. Identify noncompliance to ensure safety and environmental requirements.

Expected business value: Meet compliance requirements and take a proactive approach to ensuring safety

6. **SOP management.** Central repository and business processes for the creation, management, updating, and sharing of SOPs for all operational practices within a plant or facility.

Expected business value: Reduce operating costs and production delays while improving safety conditions and compliance

CONCLUSIONS

Recommendations for Energy Companies

By leveraging an application that permits access to all information associated with a capital project, an enterprise can increase productivity and security and mitigate risks. IDC Energy Insights has the following recommendations for energy companies:

- Consider developing a corporatewide approach to managing capital projects from planning to completion. Best practice covers use of technology to support portfolio management, business analytics, application integration, and enterprise content management.
- Work to develop the business process for construction, and identify engineering document control workflow for approvals within the organization. Determine how often you wish to share documents with project partners. The EPC and owner/developer/operator can work together to develop a coding standard for components/documents to ensure consistent master data management.
- Participate in industry associations and user communities to help arrive at standards for sharing of content and supporting workflow.
- Involve the operations and maintenance team early on to ensure that handover is understood and relevant to operations and maintenance.
- Look to areas of high vulnerability in your operation like current processes that still rely on paper files that can potentially be difficult to find and update and may be misfiled or lost.
- Focus on process improvements that will allow more effective sharing of project content both inside and outside the firewall. A good place to start would be the transmittal process.

- In this time of increased regulatory oversight, look at solutions that will optimize the way you manage, share, and archive content to comply with environmental, health, and safety regulations.
- Ensure that the solutions selected are accessible via mobile device. This will streamline content-centric processes.
- Evaluate options to improve project ROI and provide added flexibility in opex/capex allocation by deploying private and public cloud-based solutions.
- Ensure that the solutions selected provide an open architecture that can be easily integrated with other business applications.
- Look for solutions that include industry best practice configurations, as well as tools and templates that minimize the time and expense required to set up new projects.

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-premise 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 support capital projects and plant operations in the energy industry to reduce risk and improve compliance. For more information, visit www.emc.com/documentumforenergy.

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 owners, operators, 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.

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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