Paper #2-14

OFFSHORE DATA MANAGEMENT

Prepared by the Offshore Operations Subgroup
of the
Operations & Environment Task Group

On September 15, 2011, The National Petroleum Council (NPC) in approving its report, *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the study's Task Groups and/or Subgroups. These Topic and White Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic and White Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents, but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached paper is one of 57 such working documents used in the study analyses. Also included is a roster of the Subgroup that developed or submitted this paper. Appendix C of the final NPC report provides a complete list of the 57 Topic and White Papers and an abstract for each. The full papers can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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EXECUTIVE SUMMARY

A data management process to collect, secure, distribute, analyze, store, retrieve, and archive information is imperative to improve real time and long-term decision making. The ability to manage data across industry, regulators and other interested groups requires a data management plan. But to date there has been no comprehensive plan that integrates the requirements and operations into a unified data system.

The key elements of progress for improved data management are centered on development and adoption of standards for data organization, formatting and exchange. Even though government regulatory agencies define reporting requirements, development of data standards has been led by non-government organizations. Future effectiveness of data management programs and systems will require closer collaboration among government regulatory agencies and also between the regulators and the non-governmental standards developers.

For US offshore projects, the agencies involved include the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE; eWell System), the US Coast Guard (National Response Center, NRC), the Department of Transportation (Pipeline & Hazardous Materials Safety Administration, PHMSA), the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). Offshore projects in other countries have associated separate data systems, with the most pertinent examples for US interests being those operated by Canada (Canada Nova Scotia Offshore Petroleum Board Data Management Centre, CNSOPB) and the United Kingdom (UK Oil Portal). Indeed, the OK Oil Portal arguably is the best and most successful benchmark for planning data improvements for US projects.

Based upon review of current practices, including US and relevant non-US examples, specific findings about offshore data management include:

- Many of the oil and gas data-management issues identified by the US Department of Energy (DOE) in 2004 remain unresolved and problematical in 2010-2011. The issues are not related solely to lagging deployment of best technologies but also reflect lagging attention to uniform formatting and portability, reliable retention and critical documentation that would make data seamlessly available and usable as long-term resources.

- The multiplicity of US government regulatory agencies involved in setting data reporting requirements has led to inefficiencies both in the ability of industry operators to file reports and in subsequent retrieval of data for use in decisions about practices, permits and environmental impacts.

- US regulatory agencies have not made maximum use of successful data-management examples offered by organizations in Canada and the United Kingdom.

- Development of standards necessary for improvement of data management has been led by non-governmental organizations although progress has lagged in accomplishing adoption and integration into data systems of government regulatory agencies.

INTRODUCTION

Imagine a data management system that not only provides all regulatory agencies with their needs but allows lease operators and other interested organizations to access historical information and lessons learned that would help them make decisions protecting the environment. The more an operator knows about current drilling practices, the more likely they are to use the practices. Although prescriptive practices may help, they cannot ensure that a lesson learned yesterday by one operator can be applied by another operator today. The ability to easily provide data and information and also retrieve the same in a manner that is understood and applicable to an end user's need is a future requirement if we intend to ensure prudent development of our resources.

What is described above actually exists today in the UK and is accessible via the UK Oil Portal (https://www.og.decc.gov.uk/portal.htm). Obviously the regulatory environment in the United States is not the same as in the UK and to create similar functionality in the US will require many regulatory agencies to work toward data management and data transfer standards.

This paper will review the current state of data management and data transfer in the following US offshore regulatory agencies:

- BOEMRE - Bureau of Ocean Energy Management, Regulation and Enforcement Data Center (including Arctic region)
- NRC - National Response Center – United States Coast Guard
- PHMSA - US Department of Transportation Pipeline & Hazardous Materials Safety Administration Data & Statistics
- NOAA – National Oceanic and Atmospheric Administration Data Management
- EPA – United States Environmental Protection Agency Data Standards

It will also review specifics for:

- CNSOPB - Canada Nova Scotia Offshore Petroleum Board Data Management Centre
- UK Oil Portal – United Kingdom Oil Portal
- Energistics, The Energy Standards Resource Centre
- PPDM - Public Petroleum Data Model Association

DESCRIPTION OF TECHNOLOGY: WHY MANAGE DATA?

The amount of data generated through the life cycle of an oil or gas well can be overwhelming if appropriate provisions are not in place.

> "The sheer volume of upstream information produced by today's digital oilfield environment has prompted oil and gas professionals to call for systems and processes that drive better decision making and job performance," said Ali Ferling, managing director, Worldwide Oil & Gas Industry for Microsoft. "Information overload in the form of siloed, redundant and unstructured data often hinders proactive operations and collaboration." (Rigzone Staff, 2010).

Data management is best described in a Department of Energy (DOE) report in 2004:

> "What constitutes data, how data are collected, who owns the data, how data are organized and stored, how data sets may be re-used, and what ultimately happens to data are significant issues that are surfacing and demanding attention. Old truths have become new challenges, simply because of exponential growth of data and the capability to collect, organize, store, and re-use it for future scientific endeavors. Sharing of data in multi-disciplinary and international collaborations has blurred traditional lines of scientific communication. New issues have arisen as technology enables new kinds of analyses and as numeric data and text data are integrated. End-users of scientific data are demanding better access to more collections and expecting better quality. Information organization and retrieval issues, once considered essential for published research findings, now also apply to data." (OSTI, 2004).

A data management process to collect, secure, distribute, analyze, store, retrieve, and archive information is imperative to improve real time and long-term decision-making. The ability to manage data across industry, regulators and other interested groups requires a data management plan.

HISTORY OF DEVELOPMENT

Basic rig instrumentation has been an integral part of drilling operations since the advent of the petroleum age in the early 20th century. With the introduction of the Geolograph in 1937, time-based analog charts soon became the de-facto record of events and a basic tool for trend analysis and identification of anomalies. In the mid-1970s, there was a gradual shift to capture of information in digital form, as computerized mud-logging units were deployed to drill sites. Digital data acquisition offered greater flexibility in how data were stored, displayed and utilized. Contemporary improvements in telecommunications technology led to possibilities for transmitting the data to other locations and adding value by, for example, aggregating data from various sources, coordinating data analyses, and engaging remotely-located personnel in ways hitherto unfeasible (Booth, 2009).

Most recently the Digital Oil Field (DOF) in the oil and gas industry has gained momentum and has transformed from being a vision to projects that have measurable value. The promise of DOF has motivated many oil and gas operators and service companies to now establish corporate initiatives and associated business programs to develop and deploy DOF solutions (Sankaran et al., 2009).

The Microsoft and Accenture Upstream Oil & Gas Computing Trends Survey 2010, which polled 172 upstream oil and gas professionals within national, international and independent oil companies and service and supply companies worldwide, found that for 44 percent of respondents, the upstream data explosion continues to have a negative effect on their ability to get their work done. Forty-four percent of professionals surveyed reported a difficult and time-consuming search of diverse systems to find information; and data appearing in unstructured forms not easily captured or archived. Forty-three percent of those surveyed reported that data stuck in individual repositories and not easily shared was a common challenge across disciplines, and 35 percent reported too much redundant and/or unnecessary data available (Rigzone Staff, 2010).

DOE identified several issues that remain problematical today (OSTI, 2004):

- Better processes and practices are needed to alleviate the difficulty in obtaining source data.
- The need to manage and preserve data should be explicit considerations in project planning and management.
- Better processes and practices are needed to alleviate the difficulty of obtaining documentation.
- Technology provides new opportunities to address data management issues, but it cannot provide solutions without thoughtful planning and application.
- Data retention (what to archive and for how long) should be addressed discipline by discipline.
- Metadata must be optimized for future retrieval, assimilation, and re-use.
- Data sets need to be referenced in order to be easily located by users
- Retention and re-use of data need to be addressed in the context of emerging needs for long-term management and curation.
- Data, like information, should be widely accessible and available at no cost to the user.

STATUS OF DATA MANAGEMENT

A common issue in data management is that organizations have only recently begun looking at standard data management processes and programs across their own enterprises. It is common that data management was done at a local level with each office defining their process and technology. The end result is many technologies that don't share data. Now those organizations are optimizing their data management across the entire organization either by introducing common technologies and processes or linking the current systems. In the future data management should be considered across all regulatory agencies so that common data and information is easily transferred from the lease operators to the various regulatory organizations and among the regulators. Below we will review where various offshore regulatory authorities are with data management.

A. BOEMRE

Today BOEMRE conducts most business electronically using their eWell permitting and reporting system (MMS, 2007) (Table 1). Lease operators can populate data directly into the eWell system, however some input from operators is received as PDF files and BOEMRE staff must read and manually enter into the eWell data base. The original documents are saved in an electronic data management system.

The following types of data are received electronically by BOEMRE:

- Permits
  - Permit to Drill (APD)
  - Application to Sidetrack (AST)
  - Application to Bypass (ABP)
  - Application for Permit to Modify (APM)
- Reports
  - Rig Move Notification
  - Well Activity Report (WAR)
  - Open Hole Data Report
  - End of Operation Report (EOR)
  - Correction Report

- Directional Surveys
- Incident reports - reportable pollution events, as data with attached documents.
- Well Logs (LAS format)
- Seismic data
- Platform/pipeline flow schematics (AutoCad)
- Environmental studies data are submitted electronically then loaded into the Electronic Document Management System (EDMS) and the Geographic Information System (GIS) system. BOEMRE considers full implementation of EDMS and GIS to be high priorities (BOEMRE, 2011a).
- Share GIS data and platform/rig location information with NOAA.
- Production data - production data as Oil and Gas Operations Reports (OGOR) (BOEMRE, 2011b) for production, sales, and disposition is submitted electronically to the Department of Interior Office of Natural Resources Revenue (ONRR) in Lakewood, CO. Data are then shared with BOEMRE.

Table 1. Attributes of BOEMRE eWell Data System.

BOEMRE eWell	
Advantages	**Challenges**
1. Electronic reporting allows operators to enter data directly into regulatory system, tying up fewer regulatory resources. 2. Greatly reduces the time involved in processing information, reduce the errors incurred during the data input process, and reduce the overall cost of doing business for both the Oil and Gas Industry and the Federal Government. 3. Access to data within a data base allows regulatory groups to perform high level reporting and trending. 4. Incident information is captured for potential retrieval.	1. No industry standard for incident reporting data 2. No defined industry data transfer protocol, although this was considered with the OCS Connect project which has been cancelled. 3. No funds to consider Wellsite Information Transfer Standard Markup Language (WITSML) and Production Markup Language (PRODML) data transmission protocols 4. Operators must pull data from their systems (SAP, Technical databases, etc.) and manually enter into the eWell system. 5. Production data - management of OGOR data is transferred to the Office of Natural Resources Revenue (ONRR) under Rhea Suh, Assistant Secretary for Policy, Management and Budget (PMB) as of October 1, 2010. BOEMRE expects to maintain an avenue of communication with ONRR that allows access this information. 6. Limited regulatory resources and funding for data management activities.

B. National Response Center – United States Coast Guard (USCG)

The National Response Center (NRC) (Table 2) provides information to the USCG's Office of Marine Safety, Security, and Environmental Protection as needed for a variety of reports, studies, or Congressional Inquiries and receives and relays reports of incidents reportable under the Hazardous Materials Transportation Act (NRC, 2010). Additionally the NRC is the single point of contact for reporting all pollution, railroad and suspicious activity incidents reports under the Federal Response System (FRS) which is supported under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Clean Water Act, Clean Air Act, Superfund Amendments and Reauthorization Act (SARA) Title III, and the Oil Pollution Act of 1990. The NRC disseminates telephonic and electronic (fax, email) reports of oil discharges and chemical releases to the cognizant Federal On-Scene Coordinator (FOSC).

The NRC is staffed by USCG personnel who maintain a 24 hour per day, 365 day per year telephone watch. NRC Watch Standers enter incident reports of pollution, railroad and suspicious activity incidents into the Incident Reporting Information System (IRIS) database and immediately relay each report to the pre-designated Federal On-Scene Coordinator (FOSC). The IRIS database was designed and developed by contractors from Space and Naval Warfare Systems Center in Charleston, SC.

The data collected by the NRC are made available to the general public under the Freedom of Information Act (FOIA) and can be queried on-line via their website.

The following types of data are received electronically by the NRC:

- Web enabled incident reporting system. Data required varies by incident type
- Includes incidents for pipelines, platforms, vessels, aircraft and other incident types

Table 2. Attributes of USCG NRC Data System.

USCG National Response Center	
Advantages	**Challenges**
1. Single report source for response to an environmental incident. 2. Ability to search the database 3. Ability to perform a drill or practice entering an incident 4. Statistics available for notifications is captured for potential retrieval.	1. Actual response to the incident is not searchable as there is no regulatory requirement to track the actual response of an incident. 2. Lessons learned are not obvious

C. US Department of Transportation (DOT) Pipeline & Hazardous Materials Safety Administration (PHMSA)

PHMSA's Office of Pipeline Safety collects a variety of information from the pipeline operators under its jurisdiction in accordance with Pipeline Safety Regulation. PHMSA provides both data and some descriptive statistics to the public (PHMSA, 2010).

Hazardous Materials Transportation and Pipeline Accidents are to be reported directly to the 24-hour National Response Center (NRC).

The following types of data are received electronically by the PHMSA:

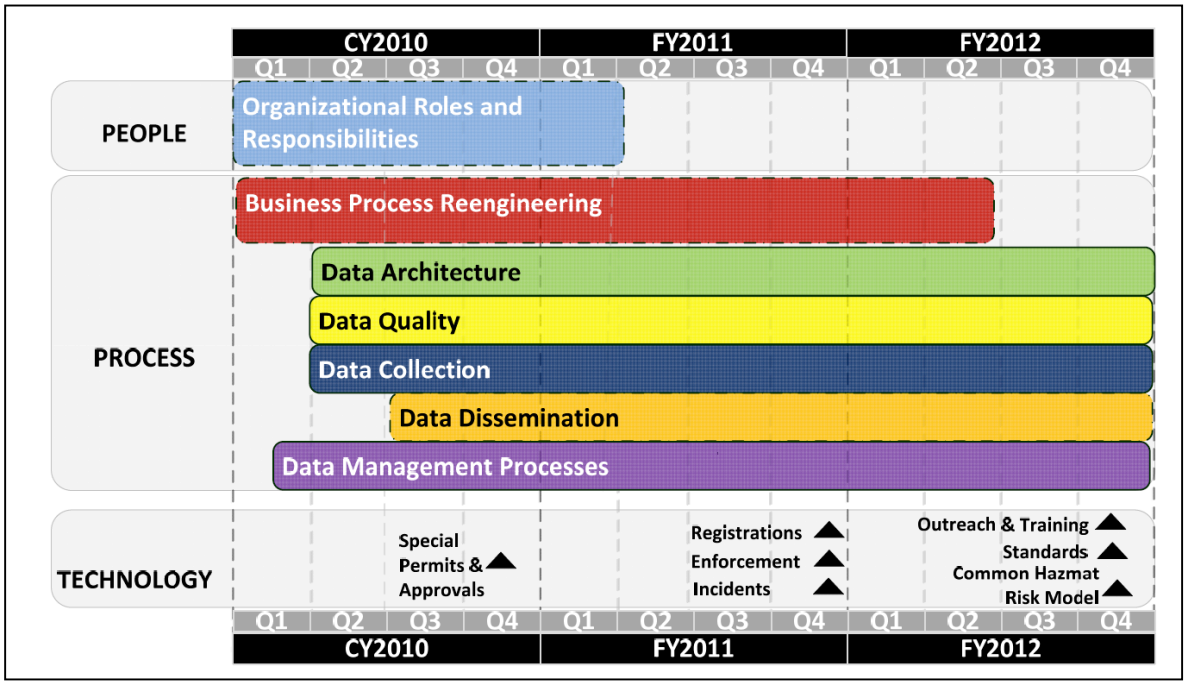
- Reports filed within 30 days of incident – Note that they must be reported within 24 hours to NRS.
- Office of Pipeline Safety (OPS) Online Data Entry (ODES) allows web reporting.

An example of the future is given in PHMSA's 2009 data management roadmap (Fig. 1) where they recognized the need to leverage data to drive program priorities, improve the ability to detect emerging risks and target/focus prevention activities (PHMSA, 2009).

Table 3. Attributes of PHMSA Data System.

DOT Pipeline & Hazardous Materials Safety Administration (PHMSA)	
Advantages	**Challenges**
1. Ability to search for information 2. R&D Information categorized 3. Arctic and Offshore categories 4. Research done by New Jersey Institute of Technology concerning data quality issues include data entry errors, data reporting errors, numerical and logical inconsistencies among data fields, and lack of standard definition for describing failure circumstances. 5. Recent data management roadmap presented in 2009 A. Incorporates people, process, and technology capabilities. B. Designed to enable PHMSA to leverage data to drive program priorities, improve ability to detect emerging risks and target/focus prevention activities is captured for potential retrieval.	1. Need to leverage data to drive program priorities, improve the ability to detect emerging risks and target/focus prevention activities

Figure 1. PHMSA 3-Year Data Management Plan.



D. National Oceanic and Atmospheric Administration (NOAA)

NOAA's long-term (10-year) objective is to integrate data management and delivery to create a more cohesive system (Table 4). This is a lofty goal given NOAA's extraordinarily diverse data programs and observing systems that monitor everything from the ocean floor to the surface of the sun, and involving data types and formats that are just as diverse (NOAA, 2007a, 2007b).

Table 4. Attributes of NOAA Data System.

NOAA Data System	
Advantages	**Challenges**
1. NOAA currently has three world-class data centers A. National Oceanographic Data Center B. National Climatic Data Center C. National Geophysical Data Center. 2. NOAA currently has a robust, secure information technology infrastructure	1. The volume of data is biggest challenge 2. Data accessibility - ability to access information in real time and from long-term archives at various levels of technical need and ability. 3. Data integration - enabling the merging of data from different observational domains, environments, formats. 4. Metadata - data about data. 5. Data rescue - filling in gaps in the overall data record. For example, data collected prior to the computer age.

NOAA receives data not only from its satellites, but also from other observing systems on ships, planes, buoys, subsurface platforms, and land-based observation stations. All of those data provide the information used to analyze and forecast environmental conditions (NOAA, 2007b). Data received are expected to double in volume every year.

E. US Environmental Protection Agency (EPA)

EPA's Data Standards are managed by the Data Standards Branch (DSB) within the Office of Environmental Information (OEI). DSB works closely with Federal agencies, states, tribes, and other information trading partners to develop data standards (Table 5). By its nature the program is a part of EPA's Enterprise-wide Data Architecture and EPA's Quality Systems. EPA's goal is to provide high quality information delivered in an efficient way to the people who need it (EPA Data Standards).

Table 5. Attributes of EPA Data System.

EPA Data System	
Advantages	**Challenges**
1. Data standards developed by subject matter experts coming to common consensus on how to solve business problems providing: A. Mappings to standards allow comparisons even when data isn't standardized B. Consistent results during data retrieval 2. Data standards can be mapped to other standards 3. EPA offers resources for environmental system developers and architects enabling discovery, understanding, and sharing of environmental data. 4. EPA is currently working on the following with availability planned in 2010: A. Catalog reusable information assets for EPA and its partners B. Allow end users to load metadata (i.e., register) about assets C. Enable end users to load assets not currently tracked in other agency systems D. Harvest metadata from other agency registries and repositories E. Relate services, data assets, and the systems and applications F. Provide a single interface by which users can search for all assets regardless of their type and location	1. The data management standards are EPA specific which do not necessarily translate to other organizations 2. Because EPA has defined standards, data can be mapped to other standards.

F. Canada Nova Scotia Offshore Petroleum Board (CNSOPB)

The Canada Nova Scotia Offshore Petroleum Board (CNSOPB) is establishing a digital Data Management Centre (DMC) (Makrides, 2007).

DMC will manage and distribute the following digital petroleum data:

- Well data (i.e. logs & reports)
- Seismic image files (e.g. TIFF, JPG)
- GIS and production data

In the future, the DMC could be expanded to include: operational, safety, environmental, fisheries data, etc.

Table 6. Attributes of CNSOPB Data System.

CNSOPB Data System	
Advantages	**Challenges**
1. Allows new explorers to rapidly review digital exploration and production data 2. The DMC will also prevent the loss of data, reduce data storage costs and facilitate scientific research by the regulatory Boards, industry, governments, universities etc. 3. The DMC is also intended to act as a "pilot project" in the establishment of a National Data Centre (NDC) for digital petroleum data, which in time may link several regulatory Boards and government departments across Canada	1. Compatibility with US data for adjoining areas (for example, US and Canadian Beaufort Sea in Arctic Ocean).

G. Variations Based on Resource Type and Location

Although data requirements for offshore Gulf of Mexico (GOM) may also apply in other offshore areas, the Arctic has specific data management needs. For Arctic data, the MMS (now BOEMRE) typically required the data resulting from monitoring programs to be submitted on a daily basis (Regg and Kuranel, 1992). Guidelines furnished by the MMS identify the extent and frequency of data collection, and how the data will be reported. Arctic data types include:

- Status of ice conditions
- Ice movements (direction and speed)
- Alert levels
- Forecasts and other meteorological and oceanographic conditions critical to the drilling operation

ENVIRONMENTAL AND ECONOMIC IMPACTS OF DATA MANAGEMENT

A modern and capable data-management system deployed for offshore oil and gas projects has several benefits for environmental stewardship:

- Automated compliance reporting
- Real-time incident reporting
- Historical input for environmental decision making
- Historical input for risk management planning (Prevention, Detection, Mitigation, Recovery)

Because avoidance criteria and acceptance levels for a variety of environmental parameters lean heavily on historical experience to provide a framework for decision-making, the fastest and easiest possible access to relevant historical data offers one of the greatest advantages of robust and resilient data systems. Rather than rely on improvised retrieval of sundry reports or information from possibly wide spans of time or abandoned sources, the best decisions would be enabled by ready access to collective information from a single, well-maintained source.

Economic impacts of sophisticated data-management systems include both positive and negative features. Specific attributes include:

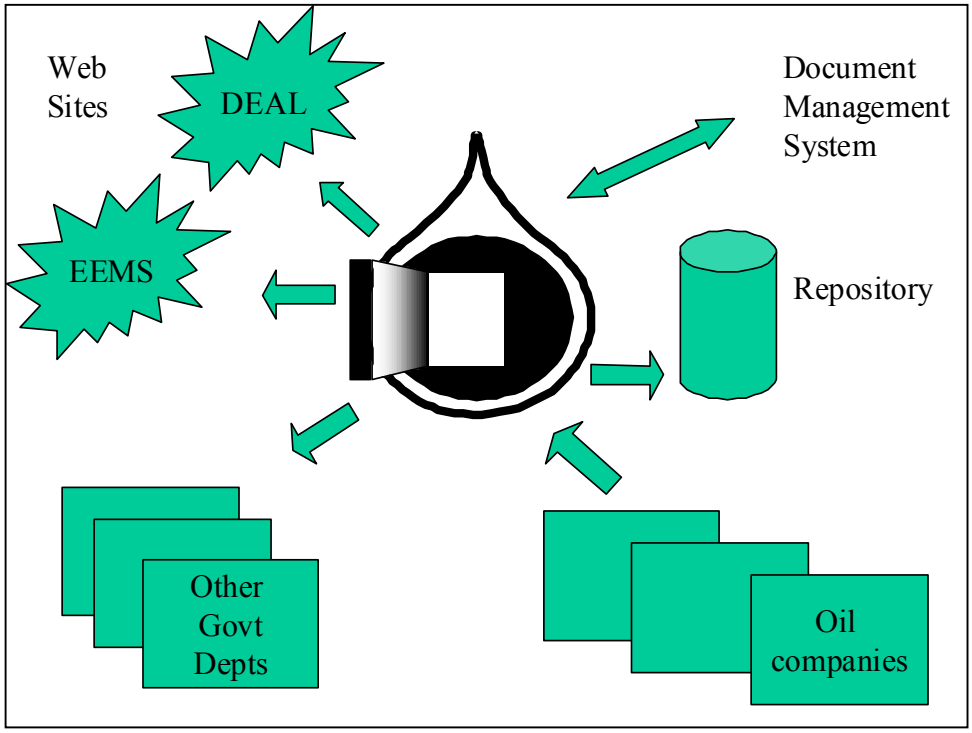
- Positive: Decreased onsite inspectors – operating data delivered in real time to appropriate agency
- Positive: Faster response to critical events – Automatic notification.
- Negative: Short term-cost to move to standards.

During implementation of any new system, there will be short-term costs associated with selection, deployment, testing and validation before the system becomes operational. But the longer-term benefits should be measured as the savings associated with superior delivery of services (i.e., data provision to users or stakeholders) compared with the previous system.

SUCCESS IN THE FIELD: THE UK OIL PORTAL

The UK Oil Portal is probably the most successful data management oil industry system currently in operation. Figure 2 outlines the UK Oil Portal and how it fits into the UK's "virtual" oil database (UK Oil Portal, 2010a, 2010b).

Figure 2. Organization of the UK Oil Portal.



A. Overview

The UK Oil Portal is a regulatory system that handles licensing, license rounds, E&P consents, environmental consents, E&P and environmental returns, reporting, data release and issuing enforcement notices all within one system. The UK is completely paperless in these operations although the system handles paper just as easily. To ensure the legality of the paperless operations, the UK Department of Energy and Climate Change (DECC) worked with the oil industry to develop standards for the use of digital certificates.

The Portal automatically updates two oil industry web sites; the UK offshore oil & gas national database, named DEAL (DEAL, 2011); and the Environmental Emissions Monitoring System (EEMS) (EEMS, 2011). Those updates are achieved via web services.

B. Status

The system has been live since 2001 but the application areas have been introduced progressively. All of the following are undertaken electronically, i.e. paperless.

- Running license rounds
- Issue of exploration and development licenses
- Issue of seismic permits
- Issue of drilling permits.
- Issue of production consents, such as production and flaring.
- Issue of pipeline permits
- Monitor of well operations – workovers, abandonments etc.
- Monitor oil and gas production
- Monitor of field operations, annual field reports etc
- Issue of environmental permits for wells, seismic operations, pipelines
- Monitor environmental incidents, oil spills etc.
- Manage decommissioning process for platforms and pipelines
- Update other sites with meta data such as well numbers

The Portal is linked to the E&P bulk data held in UK's National Data Repository (DEAL). Data is available to users who are entitled to see the data. Environmental data are available. Production data are available after three months. The UK has a website, DEAL, which indexes a considerable amount of data. DEAL is intended to provide a single, unified view of all United Kingdom Continental Shelf (UKCS) license data. Table 7 compares the pros and cons of the total system.

Table 7. Attributes of the UK Oil Portal.

UK Oil Portal Data System	
Advantages	**Challenges**
1. Everything is handled in one system. 2. This reduces possibility of inconsistencies. 3. Monitoring returns can be compared electronically with permits issued. 4. Government can build up good working relations with oil company stakeholders. A. The Portal has allowed the UK to hold regular user groups with industry who feed back ideas, problems etc. which has proven to be very positive.	1. Funding 2. There are no globally accepted standards for regulatory data A. Much of the data management standard is UK specific. 3. Longevity of data – can we access in future what we have stored today? This is relevant for Microsoft Word, Excel; as well as Extensible Markup Language (XML).

INNOVATION AND FUTURE USE

Standards are the most realistic way to pull the unlimited incompatible data formats together in a useable virtual data base of the future. In general, standards provide more flexibility with off-the-shelf applications and the allow integration with legacy systems.

A. Current Research

One of the greatest barriers to exchanging data is the need to have common mapping of data elements and two different organizations have led standardization efforts. Energistics is a global consortium that facilitates the development, management and adoption of data exchange standards for the upstream oil and gas industry. Public Petroleum Data Model Association (PPDM) is a not-for-profit organization that develops and maintains data model standards for the Resource Industry (PPDMA, 2010). Table 8 compares and contrasts the advantages offered by those two alternative approaches.

Table 8. Advantages Offered in Respective Data Standards.

Data Standards	
Energistics	**PPDM**
1. Allow energy companies to leverage their investment in highly instrumented fields to enable new capabilities for automation and optimization. 2. Reduce the cost of information exchange between software within an operating company and between operating companies, partners, contractors, and regulatory authorities. 3. Reduce the cost of replacing or substituting software to benefit from improved functionality. 4. Faster implementation of new technology with new tools quickly integrated into the global data exchange	1. Eliminates the need to develop, evolve and maintain individual internal data models 2. Reduces take-up time for new software applications, 3. Lower systems costs to update and maintain duplicate information, 4. Improves the quality, quantity and timeliness of information, 5. Effective business processes through clarification of data ownership, 6. Reduces risk through improved reliability with clear, concise data definitions, 7. Minimize data transfer between software applications or multiple databases

B. Barriers and Opportunities

Several challenges currently affect the potential success of data standards:

- Operator competitive advantage derived from knowledge of data.
- Data explosion continues to exceed human absorption abilities
- Loss of knowledge workers
- Data input is currently an additional task where the operators manually pulls data from their systems and inputs it into regulatory systems

C. Key Elements of Future Data Management

The Microsoft and Accenture Upstream Oil & Gas Computing Trends Survey 2010 found fifty-seven percent of respondents stated that more extensive upstream IT standards and a service-oriented architecture approach hold the most value for providing enhanced computing, while thirty percent surveyed reported that cloud computing and social media hold the most value for enhanced computing (Rigzone Staff, 2010).

When issues and opportunities for advancement are considered, the following list of key elements emerges:

- Standardized data management across upstream
  - Industry alignment among data providers – common data interchange
  - Open standards and interfaces
  - Regulatory alignment
  - Data mining of all available data
- Standardizes data delivery protocols
  - WITSML and PRODML
- Easy to use graphical tools
- Easy to use data security & distribution tools
- Service oriented architecture
- Cloud Computing – Will the collective intelligence of the oil industry be here?
- Social Media
- Active management of lessons learned built into processes and refreshed as the process and technologies changes.
- Intelligent agents to filter, interpret and focus data toward specific individuals or regulatory agencies
- High bandwidth connectivity – from Fiber Optic to ? [next emerging technology]
- Workflow approach
  - Package workflows
- Management of change (MOC)
  - New breed of workers
  - Expert advisor centers
- Move from independent regulatory silo functional approach to cross functional approach
- Real Time data centers
- Automated drilling process
- NDR National Data Repository

D. Recommendations for Years 2030-2050

The Microsoft and Accenture Upstream Oil & Gas Computing Trends Survey 2010 served to identify key near-term issues in data management. But longer-term goals, which might require several decades to accomplish, must also be considered.

Table 9 summarizes future goals that are expected to drive progress on data-management systems and processes but which might also require efforts at the decadal timescales.

Table 9. Data Management Goals for Years 2030-2050.

Data Management Goals	
2030	**2050**
1. Regulators and industry should agree on basic data management standards A. Define regulatory data types and metadata. B. Align data management policy among all regulators C. Standards for reporting, permitting, etc. 2. Regulators and industry should agree on basic data transfer standards A. All regulatory reporting requirements are automated and in real time via a single data transmission standard. B. Paperless reporting to all regulatory agencies. 3. Develop a cross industry Data Management Roadmap similar to PHMSA's roadmap 4. Provide research incentives for oil field data management of the future to include real time historical data mining and automated decision making.	1. Virtual Worldwide Data Repository of all data and reports populated in real time with minimum operator redundant input. 2. Automatic drilling controlled with input from intelligent data mining of lessons learned and best practices to avoid environmental impacts.

FINDINGS

Vast amounts of data related to offshore oil and gas development projects are spread among multiple data systems operated by different government agencies. For US offshore projects, the agencies involved include the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE; eWell System), the US Coast Guard (National Response Center, NRC), the Department of Transportation (Pipeline & Hazardous Materials Safety Administration, PHMSA), the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA). But those various data systems were developed with different objectives and standards, levy multiple and sometimes repetitive requirements on industry project operators and do not readily share data with each other.

Offshore projects in other countries have associated separate data systems, with the most pertinent examples for US interests being those operated by Canada (Canada Nova Scotia Offshore Petroleum Board Data Management Centre, CNSOPB) and the United Kingdom (UK Oil Portal). Indeed, the OK Oil Portal arguably is the best and most successful benchmark for planning data improvements for US projects.

The key elements of progress for improved data management are centered on development and adoption of standards for data organization, formatting and exchange. Even though government regulatory agencies define reporting requirements, development of data standards has been led by non-government organizations. Future effectiveness of data management programs and systems will require closer collaboration among government regulatory agencies and also between the regulators and the non-governmental standards developers.

Specific findings are:

- Many of the oil and gas data-management issues identified by the US Department of Energy (DOE) in 2004 remain unresolved and problematical in 2010-2011. The issues are not related solely to lagging deployment of best technologies but also reflect lagging attention to uniform formatting and portability, reliable retention and critical documentation that would make data seamlessly available and usable as long-term resources.

- The multiplicity of US government regulatory agencies involved in setting data reporting requirements has led to inefficiencies both in the ability of industry operators to file reports and in subsequent retrieval of data for use in decisions about practices, permits and environmental impacts.

- US regulatory agencies have not made maximum use of successful data-management examples offered by organizations in Canada and the United Kingdom.

- Development of standards necessary for improvement of data management has been led by non-governmental organizations although progress has lagged in accomplishing adoption and integration into data systems of government regulatory agencies.

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APPENDICES

A. Appendix 1: Glossary

BOEMRE. US Bureau of Ocean Energy Management, Regulation and Enforcement. As of June 2010, BOEMRE was created to succeed the former Minerals Management Service (MMS). BOEMRE itself was divided into two different agencies (BOEM and BSEE) in January 2011.

DOF. Digital Oil Field.

DOT. US Department of Transportation.

EPA. US Environmental Protection Agency.

GOM. Gulf of Mexico.

MMS. US Minerals Management Service (MMS). As of June 2010, it was replaced by the BOEMRE.

NOAA. US National Oceanic and Atmospheric Administration.

NRC. National Response Center. A functional unit of the US Coast Guard.

PHMSA. Pipeline & Hazardous Materials Safety Administration. A functional unit of the US Department of Transportation.

OCS. Outer Continental Shelf. By physiographic definition the continental shelf is the expanse of seafloor between the shoreline and the break in slope at the continental margin that defines the continental slope and the more distant benthic regions of the ocean bottom. The continental shelf varies in width and depth. For US regulatory purposes, the OCS is defined as “an offshore area in the United States that begins where state ownership of mineral rights ends and ends where international treaties dictate”. The OCS includes both shallow and deepwater developments.

USCG. US Coast Guard.