SPE 112203

Data Access and Integration for Major Capital Projects: A Case Study

Melanie Bell and Jill Fisk, Chevron

This paper was prepared for presentation at the 2008 SPE Intelligent Energy Conference and Exhibition held in Amsterdam, The Netherlands, 25–27 February 2008.

Abstract

It is often perceived that green fields present the ideal opportunity to implement new technology and processes to achieve world class operations via integrated field management. But there are still the challenges of limited recourses, change management and integration into existing operational systems.

This paper will present the results of IT involvement and challenges in 2 different Chevron major capital projects, the BBLT project in Angola and the Gorgon project in Australia. It will look at the construction of current state and future state plans, the prioritization of the project queues, the involvement of local IT support and vendor support, the change management approach for the user community and integration of data within the business value chain and across geographical locations. The project focused on the systems, data management and communications for the operations field teams and the subsurface asset teams.

Data access and integration included well data systems of record, real time drilling data, real time access to time series operational data, especially down hole pressure and temperature and integration of operational data to production allocation, reservoir simulation and well optimization analysis tools.

The project goals were achieved to reduce time and effort in finding and reformatting data, reducing the duplication of data, allowing data access across the globe and enabling better decision making by ensuring that the best data was available for analysis in an appropriate time frame. The data access processes also allowed us to reduce the number of people offshore.

Introduction

Although IT has been a critical component of Major Capital Projects (MCP) and Operations, until recently there has been little formal involvement of IT in the MCP planning process. Much of the IT focus was on supporting the project work via document control and integration of remote offices such as the fabrication sites. Although IT design was done for the Operational phase, it was usually not a dedicated position. Some contact was made with the local IT staffs but this was sporadic and often not updated after the initial design phase. As IT has become a critical component of data access and integration between Operations and Reservoir Management and, as Chevron's MCP have grown, there was the recognition that a more formal IT presence was needed to ensure world class performance for the operational phase of the project. World class performance for data would include reducing time searching for data and reformatting data to load into different analysis tools.

Overview of Chevron and MCP

Chevron is a major global energy company. During 2006, the company produced 2.67 million barrels per day of oil-equivalent from more than 21 different countries around the world. The company is the largest producer of oil and gas in Angola, Kazakhstan and Thailand, and the top crude producer in Indonesia. In Australia, Chevron is the largest leaseholder of undeveloped natural gas resources. The company is a large holder of deepwater acreage in Nigeria, and the No. 1 holder of leases in the Gulf of Mexico, and among the top acreage holders in the Gulf of Mexico's deepwater. As part of the growth philosophy of Chevron, there is a strong exploration process. With exploration success, prospects move into appraisal, design, fabrication and operations. The projects use the Chevron Project Development and Execution Process (CPDEP). From 2002 to present, the number of MCP with a budget over $1 billion has grown from 5 to over 30. These include the Benguela-Belize-Lobito-Tomboco (BBLT) in Block 14; Angola, the Gorgon Project, off the northwest coast of Australia; Agbami in deepwater Nigeria; Tahiti in deepwater Gulf of Mexico; and Sour Gas Injection and Second Generation Plant in Tengiz, Kazakhstan. This case study will discuss the work done for the BBLT and Gorgon projects.

Overview of SASBU, Block 14 and BBLT

The Southern African Business Unit is one of 14 upstream strategic business units and is based in Luanda, Angola. It operates production in Blocks 0 and 14 of Angola and non-operated production in Congo. The Benguela-Belize-Lobito-Tomboco fields, located offshore Angola in 1300-ft of water, are composed of several, deepwater, turbidite-channel complexes of Miocene age (Figure 1). The reservoirs are combination structural, fault, and stratigraphic traps with cumulative STOOIP approaching 1.5 billion barrels.

Discovery of the Benguela and Belize fields was in 1998. Lobito and Tomboco were discovered in 2000. The Benguela-Belize-Lobito-Tomboco (BBLT) project began operations in 2006 and is designed to produce 220,000 barrels of oil per day. At 1,680 feet (512 m), the BBLT drilling and production platform is among the world's tallest man-made structures. The tower also has 3 subsea centers attached (Figure 2). Chevron has a 31% interest in Block 14. Partners for Block 14 include Sonangol, ENI, Total and GALP.

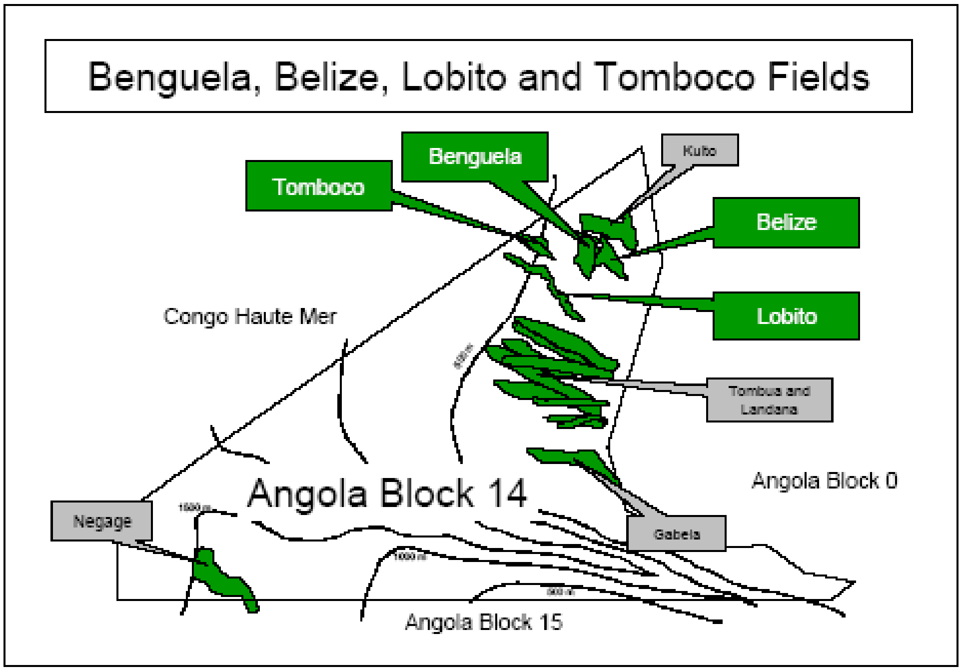

Figure 1: Angola Block 14 and associated fields

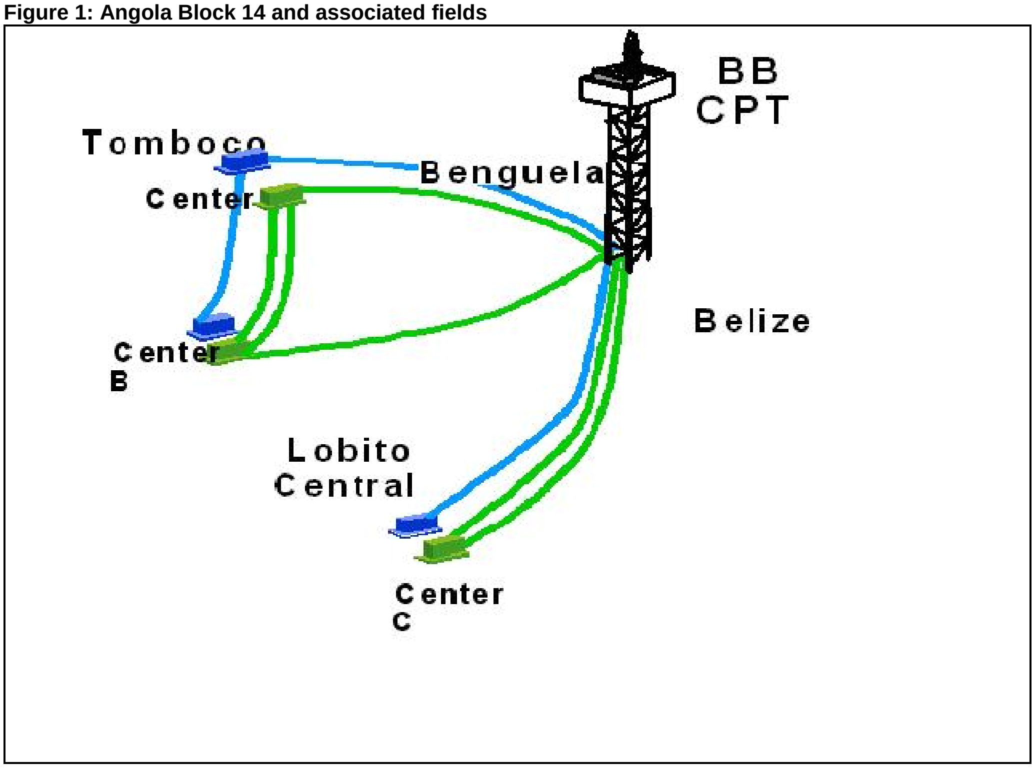

Figure 2: BBLT CPT and subsea centers layout

Overview of ASBU and Gorgon

The Australasia Strategic Business Unit is based in Perth, Australia. It operates production on Barrow and Thevenard Islands, overseas non-operated production on the North West Shelf and the Philippines, operates the Gorgon Project, the Wheatstone Gas Development and has a non-operated interest in the Browse Gas Project. It is an exploration focus area within Chevron. The Gorgon Project off the northwest coast of Australia is one of the largest and most complex projects the company has ever undertaken (Figure 3). In 2006, significant steps were made toward securing environmental regulatory approvals necessary for the development of the Greater Gorgon liquefied natural gas project on Barrow Island, where Chevron has a successful 40-year history of operating Australia's largest onshore crude oil field. In 2007, these efforts transpired into the State and commonwealth government issuing environmental approval for a two-train, 10 million metric tons per year initial LNG development and domestic gas plant on Barrow Island sourcing gas initially from the Jansz and Gorgon fields and subsequently other gas fields within the Greater Gorgon Area. The fields will be developed via sub-sea completions.

During 2008, government environmental approval is being sought for an initial 3 x 5 mtpa LNG facility within the 300 hectare development envelope that has been approved for Barrow Island. Developing three LNG production trains in parallel significantly improves project economics and addresses mounting industry cost pressures.

The gas fields of the Greater Gorgon Area are located 130 km off Australia's north-west coast 1200 km north of Perth, Western Australia. The fields lie in water depths from 200 m to 1400 m and contain an estimated resource of over 40 Trillion cubic feet - 25% of Australia's total known gas resources.The Gorgon field was discovered in 1980 with the drilling of Gorgon 1 well. The Jansz gas field was discovered during 2000 with the drilling of the Jansz-1 discovery well.

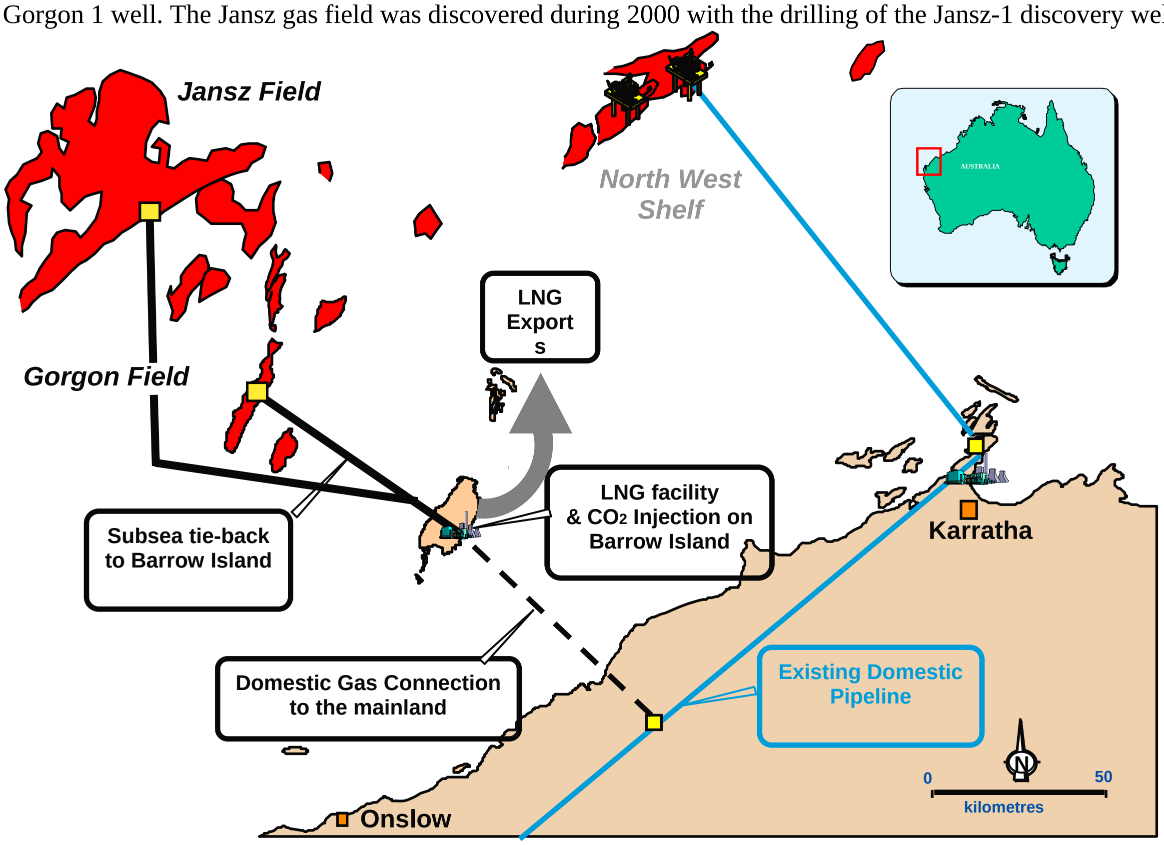

Figure 3: Map of Greater Gorgon fields and proposed development plans

Introduction of IT in MCP

The role of IT in the MCP and Operations has been an evolving one. The iField projects initiative began in the early 2000s but focused mainly on existing fields. In 2003, there was the recognition that a more formal IT presence was needed during the early phases of a MCP. Gorgon formed the MCP Information Management/Information Technology (IM/IT) team, BBLT and Tahiti projects appointed IT/IM coordinators to the projects. Scope for these roles is large. They include both support for the projects – document control, setup and maintenance of remote office sites in fabrication and construction yards, setup and maintenance of IT systems on hook-up and commissioning vessels – as well as ensuring that the operational systems for both the Operations Teams and the Reservoir Management teams will be fit for purpose. This scope of information management, telecommunications, Supervisory Control and Data Acquisition (SCADA) systems, offshore operations and subsurface workflows has to be developed in resources assigned to the IM/IT teams. Subject Matter Experts (SME) for each of these disciplines had to be identified both in the central locations of Houston and San Ramon, where much of the design phases took place, as well as at the operating locations for the projects. There was also effort to understand the best practices from other fields in Chevron as well as industry best practices.

Each IM/IT team also had to prioritize the objective and opportunities for their specific project area. There are a multitude of opportunities to implement but limited resources. The IT assessments went through a current state analysis, which involved extensive interviews with SME across the value chain. Experts were asked what they needed to perform their workflows and what was most important. They were queried about the toolsets they currently used and the tools that were missing from their workflows. Their expectations were gathered for response of systems, real time data access and timelines for workflows. The end results were a series of current and future state diagrams. The entire system was analyzed to understand where the bottlenecks would occur in the system and where additional support might be required (Figures 4-6). From the current state diagrams, a prioritized project list was developed with the result to reach the future state system. The project list included long lead time items and the project milestones such as pre-drill wells, construction targets and first production dates. It also included existing corporate initiatives that would impact the operational phases of the project.

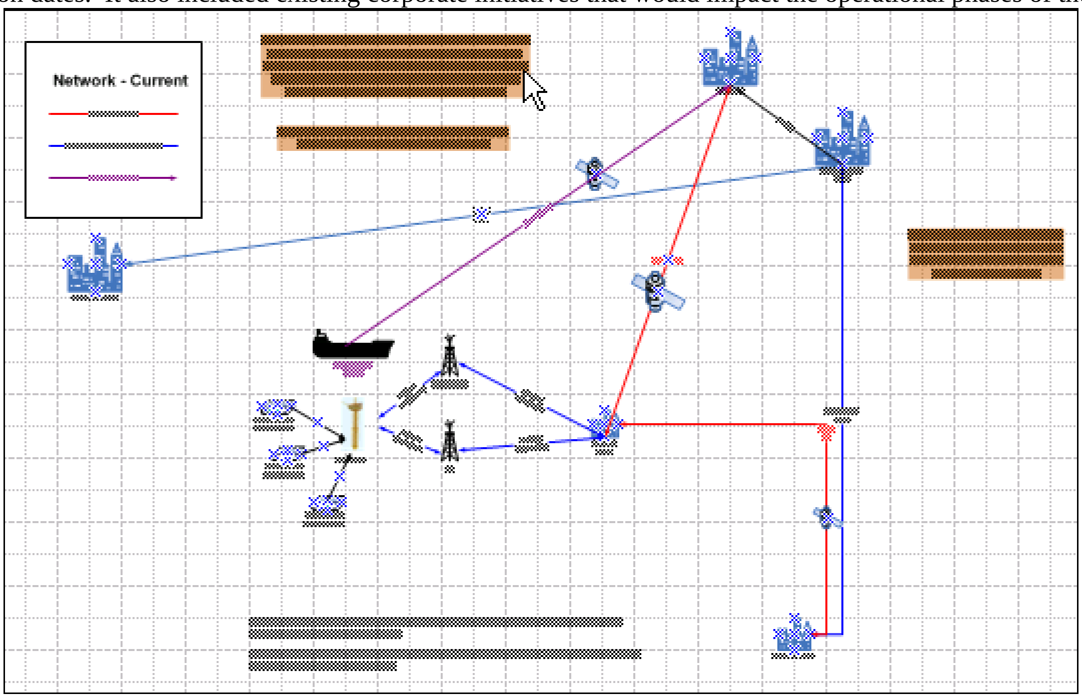

Figure 4: Current State Network diagram for BBLT

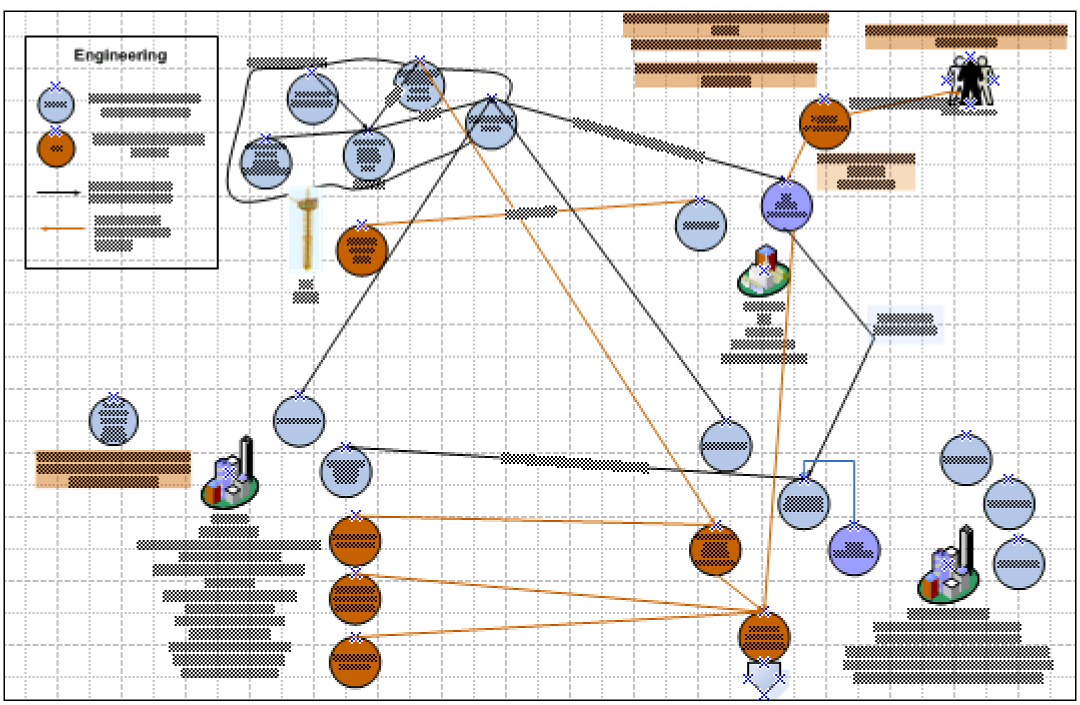

Figure 5: Current State diagram with gaps identified for engineering workflows in BBLT

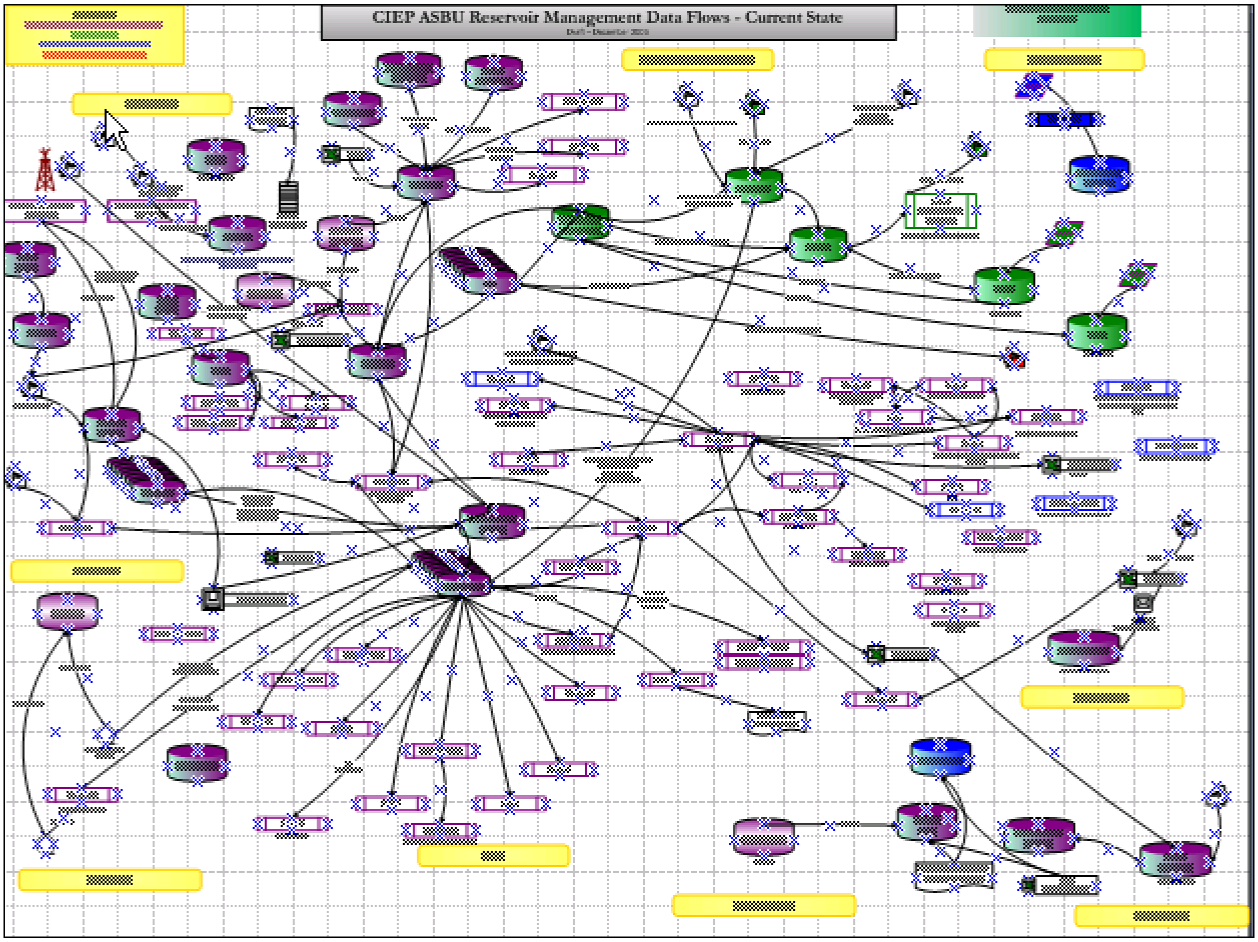

Figure 6: Current state diagram for subsurface workflows in Gorgon

Change management

Since both business units have been in operation for forty plus years, there is a strong history of work processes. But many of the work processes needed to be updated for the new fields and the changing field conditions. The work processes had been developed to work with older wells and many wells that may not have a large amount of production per well. The new fields being developed would introduce a few wells with high rates of production. The value proposition for technology implementation would change.

Real time data access also present some change management challenges. Making field data available to a wider audience causes anxiety for some field operations personnel. Their major concern is security. Since they live and work on the platform, they want to be assured that remote access is read only and that any remote control of the platform is done only under certain strictly defined safety conditions. But they are also concerned about a “Big Brother” approach to their work. Previously they were remote and somewhat autonomous. If the office personnel wanted to know how the field was operating, they had to call up or go to the field location. But with the access to process historians, office personnel can see what is happening real time from anywhere within Chevron locations. Control Room operators concerns of engineers or managers looking over their virtual shoulders had to be addressed. This issue was solved by team building and communications plans. Before operations started, there was a strong effort to make sure the asset team in the office and the operations team in the field knew each other. Face to face business meetings as well as social events helped to develop the networks. The operations teams and the asset teams also jointly developed the communications plans. This developed the processes that defined how the field and subsurface assets teams would handle calls and requests. Calls to the field were limited to the lead geologist and the lead engineer. Communication from the other earth scientist and engineers would be funneled through the lead. The lead earth scientist and engineer would also be the primary contact for well test schedules, drilling queues and other information that the field might need for more efficient operations. Thus the control room operators could be assured that they would not have several different engineers calling through out the day to change a choke setting for the well.

Change management was not limited to the asset teams and operations. IT and other support staff also needed to be involved with the changes and plans. Local IT staff would need to support any new technologies that were deployed. They needed to be aware of the new systems coming in and how that might impact load on the systems and interaction with current operations. IT staff also had to be trained to support new technology that was part of the project. Due to the increase in workload, a staff position was created to deal with the moves, add, changes specific to the setup of the project for operations.

Communication to all stakeholders is vital to success and was assisted by co-location with the teams for whom work is being done. Other successful communication methods were monthly updates on status and progress via email to all the stakeholders, semi-annual presentations to management stakeholders on direction. Informal “lunch and learns” were setup to explain to other groups in the business unit what work was going on and why it was being done. For the users of the system, just in time training was setup to allow maximum retention of knowledge.

Technology choices

Before any integration project can begin, the fundamentals must be addressed. Data quality is an important issue that should be resolved before any integration program can be successful. Data must be consistent between the different data stores, complete with in the data stores, and as accurate as the business requires. One hundred percent accuracy of all data is not a realistic goal. But for key business data, a tolerance for accuracy must be determined by the business and implemented as part of the data loading and data management procedures. Effective methods of synchronizing data between different data stores also need to be established. Data will quickly diverge if left alone. This may include setting up unique identifiers that will allow data sources to identify same data with different primary keys and naming standards. The unique identifiers are traditionally as part of the data managers and by back office integration tools and not by the primary user groups. Finally clear roles and responsibilities need to be defined for data owners – those who sign off on the accuracy of data and define the data priorities – and data custodians – those who load, manage and control the data and data sources. The synchronization process must also establish which data stores will become the Systems of Record (SOR). The SOR will be the data store where data first enters the system and will be the source for all other systems or data stores that need that data.

Each technology integration plan will be unique for the asset needs and business unit capabilities. The interview process, current state and gap analysis should help to define what the priorities are for a given asset. Project schedules will be defined by the priorities and the amount of lead time the project needs for implementation before first production.

Real time drilling data integrated the LWD and MWD into the geologic and geophysical interpretation projects. This allows the assets to effectively know where the drilling program is against the geologic interpretation, pick coring points and geosteer the directional wells. It also takes the burden of loading LWD data off the data management support and frees their time for more value added tasks. The loading tool is a 24/7 application that takes the data from the drilling vendors website and loads to the interpretation projects. The earth scientist does not have to wait for the drilling engineer on the rig to send out the information via email or anonymous ftp, as had happened in the past. The drilling vendor’s website is accessible via id and password so it can be accessed from home, the office or anywhere around the world. This proved very effective for a geographically distributed asset group where members are interested in the status of the well.

The integration of SCADA or Distributed Control Systems (DCS) data into the asset environment is a complex issue that requires adequate pre-planning. Security concerns must be addressed to ensure that the field installation cannot be controlled by outside users. The process historians are used to connect to both the process control network and the business network. The process historians need to be designed to capture both the operational needs and the asset needs. Operations may only need to trend data for a few months but the asset will want data for the life of the field for some key tags. These tags need to be identified and setup in a separate but synchronized process historian. The separate historian can either be onshore or in the asset office. Due to limited space offshore, having a full life of field process historian should be avoided unless operations have a need for it. Tag development also needs to be evaluated. Most SCADA/DCS systems are setup by operations and for operations. The aggregate set of tags needed for the petroleum engineers could be different from what is needed by Operations. Early involvement with the instrumentation teams will ensure that the system has enough capacity and that the needed tags are in the system from first production dates. Once the necessary data is in the process historian, it can be used by engineers around the world and delivered to other systems. Production data, pressure, temperature, well tests, and downtime tags are delivered to the production allocation and production history system. After the allocation is run daily, the production allocation system uses this data and other data to automatically generate the daily morning report. Morning report excel spreadsheets were eliminated as was the need to email them to the interested parties. A web tool was developed to display the daily morning reports. Since they are generated on request, there is not storage of these reports. The production allocation system also feed data to the well surveillance tool. Using materialized views of the database, the well surveillance database was updated on a nightly basis with the new data. The most complicated integration was the production data with the well test analysis and well production optimization tools. Much of the raw data from the process historians needs to be cleaned up. The down hole pressure and temperature gauges will go down from time to time and instruments drift off calibration over time. We decided to use an outside integrator to scrub the data (remove spikes, zeros readings and correct drift) and load that data in the well test analysis tool. The overall system greatly reduced the amount of data reformatting and entry into various analysis tools (Figure 7).

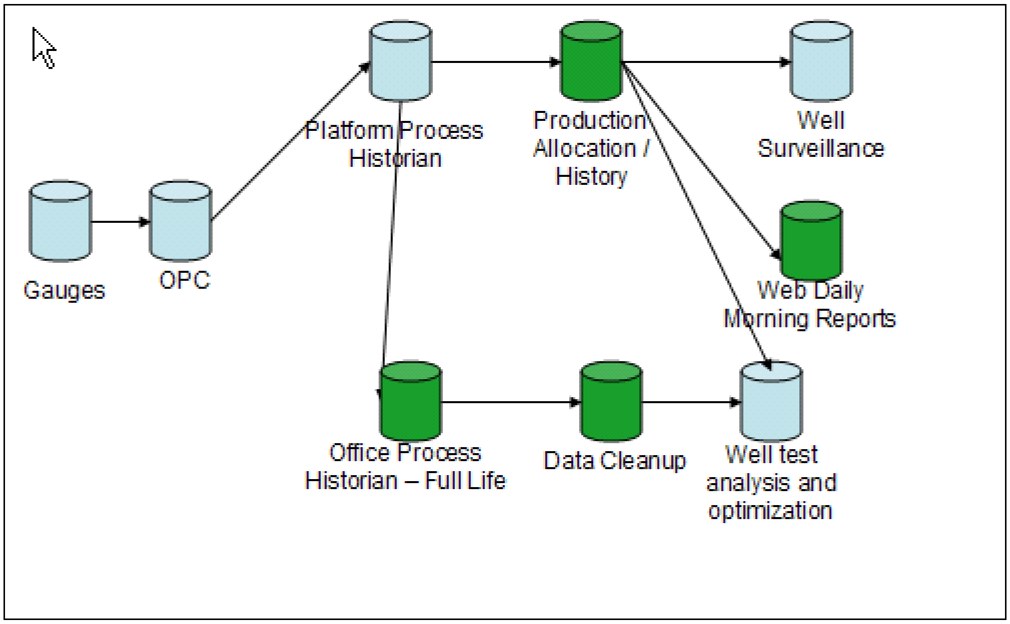

Figure 7: Schematic of integrated data flow for engineering workflow

It is also critical to ensure that the unstructured data that resides in documents is easy to find on the business network. With engineers and earth scientists in multiple locations, sharing a single repository for business and technical documents such as word, PowerPoint and excel was not performant. Access for documents was too slow. Instead, a common directory structure was developed and implemented in the locations where the users would be. The directory structure was based on the business functions in the assets (reservoir engineering, geology, asset management plans, etc) with input from the users. They police the structure and add new folders using a consensus process. After the new directory structure was in place, all of the old folder and files were identified and moved into the new structure. Old folders and files were image archived and deleted from the system.

Challenges

Challenges for implementing integration projects goes beyond change management concerns. One of the key challenges is lack of qualified resources. An ideal candidate for an integration project will have business understanding of field operations, petroleum engineering, drilling and earth science workflows and procedures and an IT understanding of telecommunications, process control network, business computers infrastructure and technical computing infrastructure. As well, an understanding of best practices within the company and in industry is a critical component. There are few people that have this broad range of skills. Solutions for bridging these resource gaps is to have clear understanding of the technical subject matter experts in each area that have the time to devote to the projects. Another solution is to bring resources on early and develop learning plans to bridge some of the gaps. Site visits to other field operations and office areas to develop networks and best practices is important. It is still not clear as to the best way to transfer this knowledge from one asset to another. Documentation, if written, seems to be accessed infrequently. Face to face handover is effective but travel and time constraints often limit the amount of time resources can spend together. Knowledge networks via asynchronous email or portals has been suggested but never successfully implemented. Annual or semi-annual workshops have also been suggested but not yet tried, mainly due to lack of resource to setup and implement.

Logistics can also be a challenge. Schedules for other technology implementation projects and major capital projects are ever changing. Project schedules both slip and accelerate. Contingency or fall back plans should be developed for critical components that may not meet scheduled deployments. People resources can also be an issue. With global resources, visa and travel plans need to have some flexibility in the planning to cover a window of time for testing, installation and deployment of technology solutions. Contract negotiations and setup with new vendors can take quite a bit of time to agree to terms and conditions.

Conclusions

The implementation of dedicated IT/IM resources to prepare MCP for first production has proved to be successful. After the initial implementations, other assets and MCP have recognized the value and added staff to their projects to focus on these areas of data access and data integration. There has also been uptake of the technologies by other assets within the business units. A central team is being developed to allow projects to allocate IM/IT resources when needed. The central team is recruiting from a wide range of IT experience such that the expertise can be utilized by a wider range of projects. IM/IT resources are being involved at early stages of project design to provide the least amount of rework in later stages. Early involvement and planning also allows projects to consider technologies that are still in development but may be commercial when the field is operational.

Dissemination of best practice and tactical implementation plans is still slow and ad-hoc. There has been some information shared at internal company conferences but these tend to be high level concepts and not the in depth information that people need.

Acknowledgments

The work presented above has had support and input for many individuals and teams. The authors was like to thank: The BBLT asset team, especially – Bill Higgs, Mark Moon, John Fryters, James Swain, John Moore, Fred Brownlee, Pradeep Kumar, Shanhong Song, Sanae Kelly, Dharmen Shah; The BBLT Operations team, especially – Bobby Fisher, Rick Bullock, Bret Fowlkes, Twila Moore, Torres Ambrosio, Frank Kiteculo, Tony DaSilva, Chris Scott, Armando Duda: The SASBU IT teams, especially – Tom Bell, Santos Vieira, Louisa Reid, Adrian Goulding, Paula Fernandes, Dinah Silva, Augusto Xavier, Jim Gano, Steve Duis, Rick McKillip, Phil Vrankovich, Jade Evans, Gert Geldenhuys, Pedro Borges, Predo Casaco, Zeca Manuel, Frank Staten: The Gorgon asset team especially – Roger Bartlett, Bill Robinson, Kemal Anbarci, Seb Leigh, Dal Falcone, Louisa Jack, Chris Vaughan, Craig Richards, Fiona Koelmeyer, Daniel Chia, Randy Gurton, Kevin Scott, Ana Villella, Ken Richards; The ASBU IT teams especially – Sirikarn Narongsirikul, Ray Smelley, Martin Kirk, Tim Ballinger, Paul Sheppey, Tim Lightfoot, and Wayne Skeggs.