



E&P Data Management at Oil India Limited & Its Transforming Landscape to Meet Challenges in an Emerging Scenario

Apurba Das, Arnab Bora, Sudheer Kumar Kurakula, Oil India Limited*

apu@oilindia.in

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Summary

Data is a prime asset for any E&P organization. Management of the data to ensure that geo-technical users get the information they want, when they want it, and in the manner they want it is a critical success factor of an organization. The prevalence of a sound E&P Data management framework can transform the data into a business value creating asset that can potentially propel an organization to the next level of success.

Oil India Limited, the second largest hydrocarbon exploration and production Indian PSU, has a legacy that symbolizes the development and growth of the Indian petroleum industry. From a predominantly North-East India centric organization to an E&P company expanding its wings to a pan-India presence and venturing into overseas assets in the recent years, OIL is emerging thick and fast into a global player.

This paper thrives to delve into the initiatives taken by Oil India Limited, in managing E&P data through its E&P Databank project initiated during 2005. The technical solution, which is based on M/s Halliburton's R2003 product suite, is explained against the dimensions of the application landscape, the database storing various E&P data in OIL's corporate E&P repository, the application access methodology by users and the hardware infrastructure. The paper also brings into perspective the emerging scenario of OIL's expanding operational horizon geographically and how OIL is preparing to re-align its E&P data management from process, people and technology viewpoints to face the new challenges. A special focus is on the adoption of information technology developments by leveraging server and application virtualization & establishing a dual active-active DC/DR topology.

Introduction

Data is the life blood in an upstream E&P company. Organizations are spending millions of dollars generating and collecting data on an ongoing basis. The result is a continuous stream of data from Exploration, Drilling & Production operations. Organizations, that are better prepared to manage the ever growing E&P data stream, can gain significant competitive edge. This is more so true in an era where finding easy oil and gas is increasingly becoming difficult. Decision making demands collaborative approach amongst asset teams. E&P data management has an important role to play in this changing paradigm.

But, what is E&P Data Management? Simply put, it is an endeavor that strives to give E&P users the information they want, when they want it, and in the manner they want it. While it is a simple concept, there is a continuous challenge in executing it. There is the need to deploy the right information technology platform, set processes into place to embrace the requisite change management within an organization.

E&P Data Management at OIL - Backdrop

OIL has been relentless in its search for hydrocarbon since the time crude oil was discovered at Digboi way back in 1889. In 1961, it became a joint venture company between the Indian Government and Burmah Oil Company Limited, UK before becoming a wholly-owned Government of India enterprise in 1981. Today, OIL is a Navratna Company and the second largest national producer of crude oil and natural gas.

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No wonder, OIL is in possession of a significant amount of legacy E&P data from its predominant areas of operations in North-East India. The nature of data are a mix of bulk as well as transactional & are of different varieties such as cultural data, maps, seismic data, well logs, drilling operational data, production related data, technical notes, well commentaries etc. The data existed in various forms such as in paper documents, word/excel files, project back-up files, different tape media etc. The data, both structured & unstructured, were managed by different asset teams working in silos. With the increase in data volume, searching & locating requisite data became an onerous proposition. The result was that the time for actual engineering work began to shrink considerably. All this had an adverse impact in the organization. Moreover, E&P data is priceless & preservation of legacy data assumes significance in light of latest technology developments that has opened up new vista in interpretation of legacy data and adding value to it. OIL Management identified E&P data management as an area of priority and opportunity that needed to be duly addressed sooner rather than later. The impetus by OIL Management led to a new era in OIL's E&P data management - the "E&P Databank Project" got underway.

E&P Databank Project – Approach

E&P Databank Project was awarded to M/s Landmark (now part of M/s Halliburton) to execute a set of deliverables on a turn-key basis. The Project commenced its journey during mid-2005 and continued through the various stages until completion in April '2009. The Project deliverables were split into five phases as outlined below:

- Installation & commissioning of hardware & software;
- Training on all application software modules covering various aspects of the technical solution from system administration, data loading and end user perspective;
- Data Migration of 20% of estimated legacy data; OIL to take a call on the rest 80% post Project completion. Data migration included scanning & digitization of more than 4000 maps, scanning of more than 100000 pages of technical notes, well commentaries etc. before loading into the E&P repository.

- Customization of the Forms & Reports, wherever required, to conform to OIL specific operational workflow. The total number stood at more than 100.
- Integration between OIL's existing technical systems and the E&P Databank for seamless data flow.

The envisaged benefits were:

- Industry best practices in E&P Data management
- Longevity to legacy data in new digital format
- Significant reduction in data search time
- Concurrent role based multi-user access capability
- Collaboration amongst geo-technical users

E&P Databank Solution Landscape

The solution deploys M/s Landmark's (now part of M/s Halliburton) R2003 product suite. It has a range of products to cater to various data types. Datasets vis-a-vis their management by applications is represented in tabular form below:

Data Types	Loading Appl	Data Access Appl
G&G data	Petrobank MDS	Power Explorer
Well Logs	Recall	Power Explorer
Project Data	Openworks	Web Openworks
Drilling Data	EDM Openwells	iWellfile
Production Data	EDM TOW/cs	iWellfile

The Application Landscape is pictorially presented below in Figure 1.

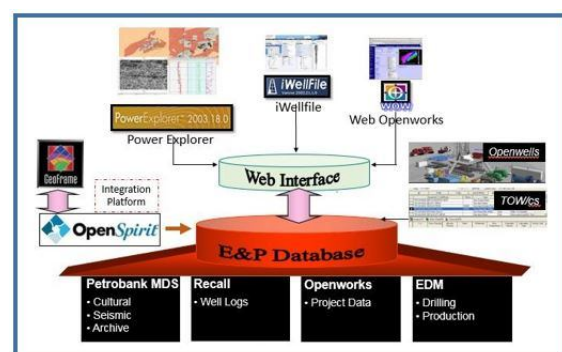


Figure 1 – OIL's E&P Databank Application Portfolio

Petrobank MDS (Master Data Store), TSM (Tivoli Storage Manager) & RECALL incorporated into Petrobank MDS are the central product for G&G

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data. A layered solution of PetroBank MDS is depicted in Fig 2.

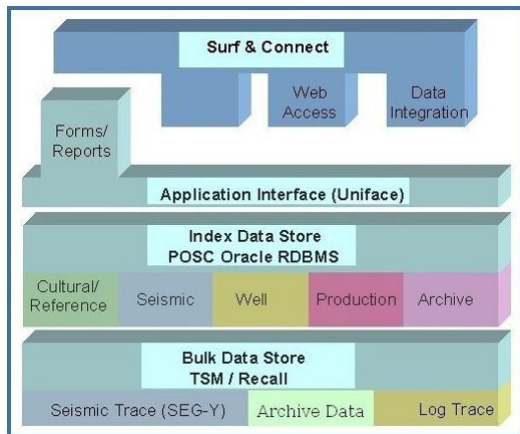


Figure 2 – Layered Solution of Petrobank MDS

Petrobank MDS consists of:

- Bulk data store - It is used to house voluminous data, such as seismic sections and well log traces. Typically it consists of a robotic tape archive plus disk and optical storage devices managed by TSM & RECALL database.

PetroBank uses the following systems for managing bulk data storage:

IBM's Tivoli Storage Manager (TSM) - for storing poststack seismic data, workstation data, and archive objects. The TSM server manages a device pool, which can consist of multiple disk, optical, and tape drives. These devices handle the media on which the actual data is stored.

RECALL Database - for storing well log data. RECALL is a borehole database system developed by Baker Atlas GEOScience. It has been incorporated in PetroBank as the bulk data store for wireline logs and other borehole data.

- Index database - an Oracle database containing less voluminous data and index data, which is used to locate the data in bulk storage. As bulk data is loaded, descriptive information and a pointer to that data are loaded into the index database. This index data enables PetroBank to identify what data is available to a user and to locate and retrieve that data when requested. In addition, the index database stores less voluminous data such as seismic geometry,

velocity data, cultural data, and security and administrative information.

The index database (also referred to as the MDS database) is implemented on Oracle. It is a POSC/PPDM compliant database.

The spatial data store supports graphical display of data in GIS enabled 'PowerExplorer' to be explained in subsequent section of this paper. It is actually a collection of shape files generated from data stored in the index database. Shape files can be generated for cultural data (blocks, leases, etc.), wells, and seismic geometry data (navigation data)

- MDS application interface - the PetroBank API
- User interface - MDS forms & reports and Surf & Connect Standard and Web Editions of PowerExplorer.

PowerExplorer is a Web based data management tool with advanced capabilities to browse and manage spatial and tabular E&P data. It leverages an open-access generic framework, extended by vendor-neutral data connect modules to integrate data from the master data store, project data store and corporate solutions. A few snapshots of data extracted through PowerExplorer are shown in figure 3:

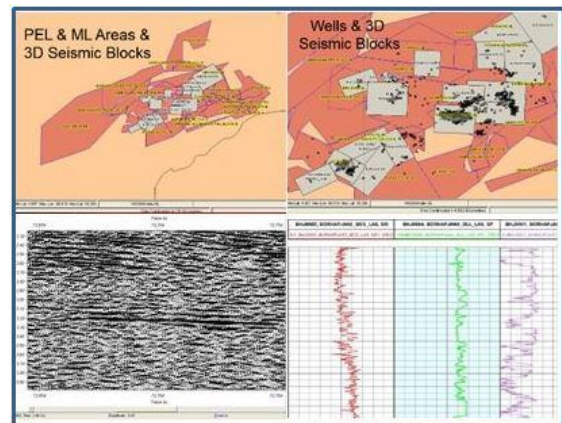


Figure 3 Snapshots from PowerExplorer

OpenWells, is a fully comprehensive well drilling operations reporting, communications, data analysis, and corporate data management system integrated into the Engineer's Data Model (EDM) platform. OpenWells provides drilling, completions, and well servicing information within a single application.

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TOW/cs is designed to provide enterprise-wide collection, storage and analysis of production data. TOW/cs is an integrated suite of applications used for:

- Field data capture
- Production management and optimization
- Production accounting
- Daily and monthly operations reporting
- Regulatory reporting

iWellfile is a browser based application for managers/ end users to view data entered through Openwells & TOW/cs. It provides a dashboard view whereby the progress of operations can be monitored against targets and thus facilitates decision making to keep intended progress on track.

One of the important deliverables of the E&P Databank Project was to achieve integration between E&P Databank & OIL's existing engineering applications. As part of this, the product 'Openspirit', an energetics integration platform, was deployed by M/s Landmark. Openspirit has its own server & client component. The client Openspirit application opens a tunnel with the Openspirit Server to transfer attribute level data such as seismic horizons, faults from client applications and store them project wise in Openworks database. End users can use application Web Openworks to view the data.

Solution Architecture

The solution deploys a 3-tier architecture, viz.

1. **Client Tier:** Client machines - workstations and PC's attached to Local Area Network (LAN). Run Client Application software or X emulation software against the Application/Database server tier.
2. **Application Server Tier:** Servers that run server side Landmark applications and Oracle servers. Connects to external disk storage via Storage Area Network (SAN) and most of the peripheral tape devices.
3. **Data Source Tier:** SAN connected disk array that store and serve the data to applications. It contain database files, project file directories, MDS stored data, Tivoli Storage Manager (TSM) volumes. This tier also includes local storage resources directly available for the application server tier (application servers).

All the three tiers communicate seamlessly so that data based on user's request is presented to them transparently. The architecture driving the entire landscape is depicted below in figure 4:

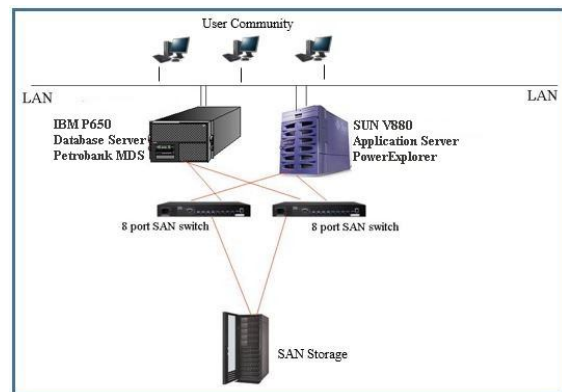


Figure 4 - E & P Databank R2003 H/W Infrastructure

Hardware Components

The servers hosting the applications & databases include an IBM p650 series server & a SUN server SUNFIRE V880. The storage is SAN-based with dual redundant controller. The IBM p650 is a RISC server with AIX 5.2 OS & hosts applications Petrobank MDS & the FlexIm license server. SUNFIRE V880 is a SUN Sparc based server hosting applications PowerExplorer, Openworks & Openspirit. The Oracle instances for Petrobank MDS & PowerExplorer are hosted on in IBM p650 & the Oracle instances for Openworks & EDM (Engineers Desktop Model) are hosted on SUNFIRE V880. The storage is driven by SAN enabled IBM TotalStorage DS 4400 system with dual redundant controller and having 2x EXP700 expansion units with 20x74GB fiber optics connected disks. System includes 2x2GB 8 port IBM SAN switches for server connection. Servers are redundantly connected to both switches.

Client desktops are Intel Pentium4 based and run EDM/TOW clients directly via OpenWells/EDT client interface, OpenWorks clients via Exceed, PetroBank MDS /Recall loading via Exceed X-term emulation software.

Expanding Exploration Horizon of OIL

As producing fields in the North-East India are maturing, squeezing hydrocarbon from beneath the

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mother earth is becoming that much more difficult. From an era when OIL was sitting pretty on 2D seismic data, we had to move on to 3D/ 4D Seismic data, 3D 3C seismic etc. OIL management also realised the compelling need to expand its operations to a pan-India presence and venture into overseas assets. The recent years have seen OIL taking significant strides in this direction. There has been a spur in exploration activities through acreage expansion, joint ventures & acquisition of assets. The current operational spread of OIL is depicted in figure 5 below:



Figure 5 – OIL's operational spread

The rapid expansion drive by OIL has resulted in newer sets of E&P data pouring in at a fast pace. Earlier, data was primarily from North-East India operations; however, now, data is coming from operations globally & other parts of India. Accordingly, OIL is required to re-align its E&P data management strategy to meet the challenges posed by the emerging scenario. A parallel inevitable development on technology front meant that the existing solution of R2003 needs to be upgraded to a newer paradigm of R5000 on a Linux platform leveraging the power of server and application virtualization.

In the face of a transforming scenario, OIL has taken a fresh look at the E&P data management approach while taking care to protect the investment already done so far. Going forward, the Organisation has embarked upon an E&P data management approach by addressing the three dimensions of people, process & technology in the manner enumerated below:

People: Loading of data into the E&P repository is a routine activity guided by standard application procedures. With the volume of data growing rapidly,

OIL plans to adopt a 'Managed Services Model' by outsourcing the activity of data loading to a third party thereby freeing up its internal human resources so that they can focus on the core activity of data analysis & interpretation.

Process: All E&P data generated from areas other than North-East India operations would be managed by a newly formed group CEMG (Center for Exploration & Monitoring Group) at Noida. CEMG Office would be the custodian of all such data. Data from North-East will continue to be managed by OIL's Field Headquarter at Duliajan in Assam.

Technology: the existing E&P DC (Data Center) is already due for technology upgrade from R2003 to the new platform of R5000. The new version of R5000 necessitates a complete revamp of the hardware platform. Along with this mandatory upgrade of IT hardware & software infrastructure at the E&P DC, a second E&P DC at Noida will be commissioned in an active-active DC/ DR (Disaster Recovery) mode for dual centric data loading. Each site shall load the data under its purview at respective E&P repository. However, the same set of network version licenses will be shared by both the sites. This will ensure a significant saving in costs while optimally using network bandwidth over WAN. The two individual E&P Data Centers will act as primary site for respective data loading activity; however, they will also complement each other as Disaster Recovery site too. The data at the two sites will sync periodically to ensure data consistency and availability in the event of a disaster in either site. Disaster Recovery is a noteworthy aspect that was missing with the existing set-up. The new set-up at each site will make extensive use of server virtualization using VMWare vSphere Enterprise software. Multiple physical servers will be combined to provide a virtual platform where multiple virtual Linux (RHEL 5) and Windows (Server 2012) machines will be created. The Linux platform will be used for installing Petrobank Explorer, Openworks, Team Workspace & Power Explorer whereas the Windows server 2012 machines will be used for another layer of Application virtualization of Citrix Xenapp so that users can connect to EDT suite of applications from their desktops. The desktops will simply have a light Citrix client. The vMotion feature of VMWare vSphere technology will be configured

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for online migration of virtual machines from one physical server to the other physical server online and

would be transparent to the users. This ensures continued availability.

The proposed architecture is shown in figure 6.

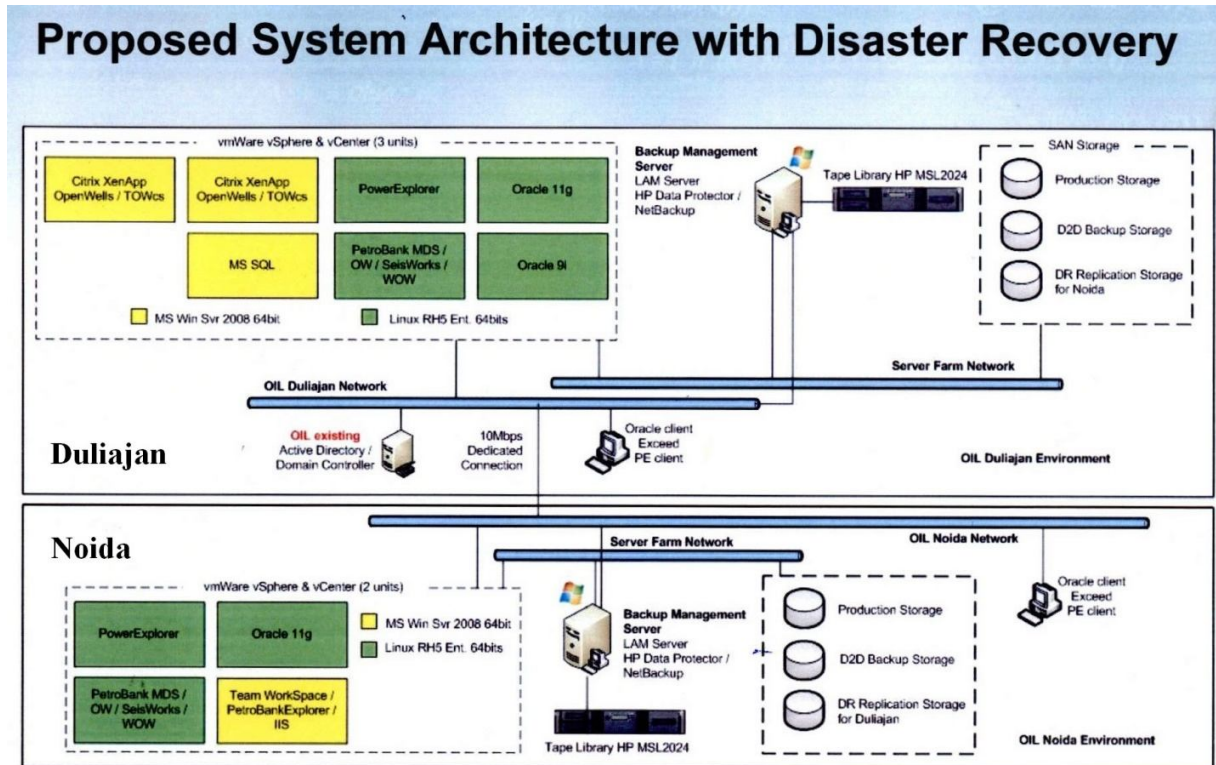


Figure 6 – Active-Active DC/ DR Set-up

Conclusions

OIL's E&P data management endeavors started its journey in the right earnest a decade ago. There have been challenges along the way. However, we are staring at exciting times ahead as emerging scenario has given OIL the opportunity to make use of the experiences gained so far to re-align E&P data management approach by leveraging power of information technology and setting processes to enable user community to derive maximum benefit. The Organisation as a whole stands to gain significantly from this.

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