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Effective Subsurface Data and Application Support for Optimal Reservoir Exploitation and Development

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Abstract
Integrating skills and technologies in a multi-vendor software environment to reduce reservoir description discrepancies and enhance hydrocarbon productivity is complex. Effective subsurface data and application support is a recommended platform, to guide an asset team in resolving this complexities. Though, data varies in size, format and quality, reliable data must be made easily available to professionals for decision making. This research analyses the dynamics of subsurface tools, analyst value migration, competencies, data policies and routine application support practices required to cumulatively reduce cost, providing better and timely delivery in reservoir description. Approaches are reviewed and tactically outlined to measure data value, current capability and develop performance evaluation checklist for incorporating learns into strategic data support service plan to optimize hydrocarbon reservoir exploration, development and management.
Keywords: Reservoir, data, tools, process, people, compliance, optimization, management

1. Introduction

The benefits of subsurface support are rarely quantified and most likely widely unappreciated by exploration and production (E&P) company. When effectively utilized it reduces communication turns, ambiguity due to data transformation, maintenance cost, analyst work load, and improves efficiency. In addition, it builds trust of information source available in the organization. The objective is to provide viable data that is fit for purpose with high integrity and is obtained in line with organizations policies to support business decision making while providing measures to monitor performance. People, tools, data and processes are the major elements that contribute towards understanding subsurface (CDA and Schlumberger, 2011).

Processes involved in petroleum exploration, exploitation and development generate vast data set which are integrated and analysed to optimally produce hydrocarbon reservoirs. This structured or unstructured data (Garbarini, 2008) must be reliable and made easily available to petro-technical professionals for timely analysis and decision making. Subsurface data has low value density but when combined with other data types and business process, the reservoir domain presents a big data problem (Irving, 2004). Since data interpreted for hydrocarbon reservoir characterization vary in size, formats, period of relevance and quality, it requires competent personnel to manage this data. In optimizing reservoirs, detail interpretations of diverse data set is utilised for accurate reservoir modelling to predict risk and to plan alternate strategies (Kuchuk et al., 2004).

Today most interpretations are dynamic and data are stored, secured and manipulated electronically. Understanding the source, migration path and trapping mechanism of hydrocarbon for further subsurface modelling and development planning of reservoir systems required the use of application software. Software programs provide functionality that could model in 2D, 3D and 4D at precise geometric resolution which depends on the quality of data, processing speed of computer, grid density and allowable computing time. In most large organisations, a team is designated to provide information and data management support services to enable them meet performance objectives.

This study assesses the key essential elements of effective data and application support as a platform to enhance the achievement of desired objectives of an E&P asset team while reducing the lost man-hours for improved productivity.

2. Methodology

The method of study is both primary and secondary. The approach to study is by examining articles, interviewing, use of online surveys tools and evaluating assertions against available evidences on data, people, tools and processes as they are integrated to understand subsurface reservoir heterogeneities for optimal exploitation and development.

3. Challenges

The major challenge is the dynamics change due to continuous need for innovation to achieve business goals. They are rapid change in data formats, applications, operating systems, data management platforms, products and new technologies with more specialized visualization, software and very large data magnitude. Another challenge is the limited number of competent personnel to design procedures that will link data types, implement effective data security and model management.

Irrespective of the challenges, the given mandate of an asset team in E&P is to increase hydrocarbon

production, reserves and develop assets which are achievable by continuous improvement in expertise through trainings that reflects organizations priorities. In addition, support analyst must develop inertia and team responsiveness that embraces changes that make scope and deliverables at any stage of a project, clear. Integrating old and new technologies in updating information available enhances asset team in performance.

4. Determinant Factors

The factors influencing the success and effectiveness of subsurface data and application support for optimal hydrocarbon reservoir exploitation include the quality of data type, people, tools and processes.

4.1 Data Type and Value

Kozman et al. (2008) emphasized on how measuring the value of data, data handling and delivery is important to oil companies. It is necessary to conduct quality assurance on data (Duller, 1995) and like Hawtin (2009) question, if the available data is worth its cost? The way data is classified depends on its use and attributes (Corbin, 2011) and inter-data connectivity is shown in Figure 1.

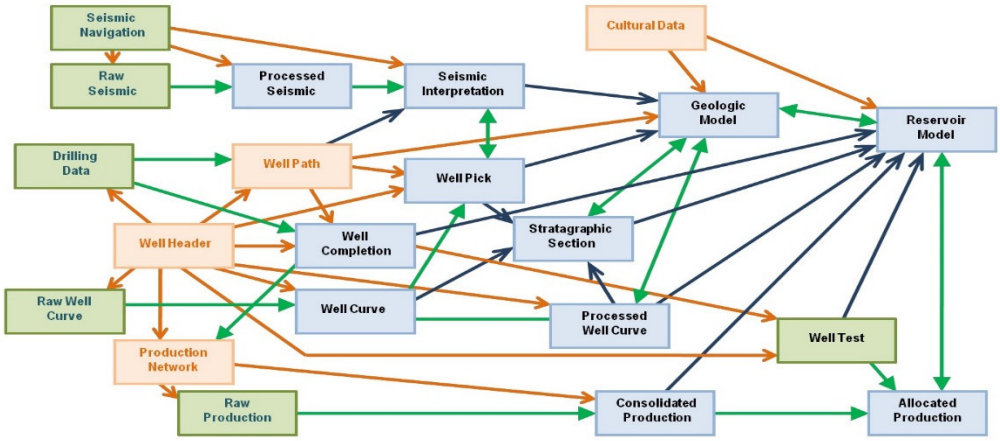

Figure 1: Different category of data used in oil the company (Adopted from Hawtin, 2009)

Well logs, biostratigraphic data, pressure data, core data, seismic data (2-D and 3-D), production data, and fluid data are the commonly used data in reservoir modelling and optimization. Each of this data set is utilized for a specific purpose and its value depends on the business decision which reflects different significance for the stakeholders involved.

To achieve timely decision making by integration of asset data and each data set must be accessible, available and accurate with good quality, consistency, complete and secured. In nature, subsurface data is always incomplete and in many projects 42% to 43% of time is spent on looking for data (Lord, 2013). These have great impact on production time and strategic planning through proper data management can remove or reduce these impacts.

If data is deficient, the geo-model (static and/or dynamic) produced may have little validity. Consequently, it is mandatory to adequately calibrate tools and carry out calibration validation checks before data acquisition and after, results evaluated for quality control to eliminate uncertainties.

4.2 Tools

A wide range of petro-technical tools supplied by many vendors for subsurface reservoir interpretations are available and utilized in hydrocarbon exploration and production today. These tools can be categorized into subsurface data acquisitive, interpretative, quality control, modelling and simulating tools. The workability of the tool utilized depends on the operating system. The most common operating system is LINUX and WINDOWS. Landmark, Geoframe, Eclipse, Geolog, VoxelGeo, Stratimagic, etc., are common tools used in LINUX while Petrel, ArcGIS, Petrosys, Kingdom, Hampson-Rusell, Petra, etc. are common tools associated with WINDOWS. These tools are used for optimal use of data within its lifecycle to better understand uncertainties and risk associated with hydrocarbon exploitation and reservoir development.

They are basically software programs with diverse functionalities that can integrate changing geometries, dimensions, hydrocarbon phases and tested parameters measured periodically to produce results with high geometric resolution. The geometric resolution obtained depends on data quality, data resolution and other parameters which may include grid density, number of cells, the computational power and allowable computing time. Neri (2010) stated how essential it is to integrate software acquisitions an effective data management system.

4.3 Processes

Subsurface data and application support is vital from the data acquisition phase to the management for optimal production of reservoir and this is achieved by systematically planned workflow design which interacts with active databases using multi-software suites to facilitate data interpretation by professions. This structured plan needs to be technical, logical and affordable with safety, health and environmental considerations.

The processes are designed for continuous improvement and computers with high speed processors are utilized with active access platforms and strong internet connection. In reservoir studies, data interpreted are results of macro-, micro- to nano-scale investigations, especially when it involves oil shales. Varying scales and resolution of data parameters reveals different reservoir behaviors and effective data and application support will unmask readily this information that is of great significance to an asset team. It is essential to have processes that integrate data to decrease business risk, increase quality and trust, detect and correct error in data, increases data utilization in workflows in other to achieve expertise (Hawtin et al, 2002).

Today, must data are in digitize but some organizations still have remnants of hardcopy data while in some, both form of data exist. The intricacy in managing physical data is escalated when an organizational system is deficient in standard workflow procedures, skilled manpower and adequate policy for retention and disposal of data. Bamford (2009) stated the need for everybody to embrace digital technology – if it works. Consequently, to achieve competitive advantage, an organization needs to assess and audit stored valuable hardcopy data and convert it to metadata that is stored on secured digital storage devices or cloud.

Cloud storage offers greater operational efficiency and higher resource utilization. Measures to prevent loss must be put in place by making multiple copies or use of an encrypted cloud storage gateway that is equipped with flexibility, auto-tracking and de-duplication features. Irani et al. (2014) described data pre-processing ways to handle missing values and discretization with approaches to improve signal to noise ratio and other selective features.

Data management procedures that can systematically handle data backlog, voluminous data (Old, new and on-going acquisitions) and data migrations needs to be active. This procedure varies with data type and server or storage facility utilized and its processes are strengthened when incorporated as a policy that prioritizes data integrity.

Acquiring and working with highly sensitive tools and applications requires understanding their needs for optimal performance. These requirements vary for installation, upgrade and maintenance. Consequently, they is need have an in-house procedure or policy to administer approval and controls on tool and application acquisition, license issuance, maintenance and access control. Support service provide this changes that are gradual or sudden and every organization needs to enhance staff capacity, create innovative channels, increase enlightenment and synergize creative ideas towards achieving their visions.

4.4 People

Support service personnel must be focused and mentally stable with clearly defined objectives based on each task ahead. Ability to learn fast and adapt to changes in technologies is an effective aptitude needed in reservoir management. In addition, being accountable, multi-tasking and good interpersonal skills are welcomed attribute when this career path is chosen. At every level of expertise, a data and application support analyst should be able to implement and develop internal controls that are bound by policies and well documented procedures.

5. Survey results evaluation

The survey showed varying individual suggestions on the degree of relevance of data and application support to optimal hydrocarbon reservoir exploitation and development, and the response differ with years of experience, present job role, geographic location and industrial segment. Generally, the ratio of job role which require data and application support those that do not are 4:1.

Data, tools, people and processes have strong impact on the workflow for reservoir optimization. This survey shows tools and people to have the highest effect as shown in Figure 2.

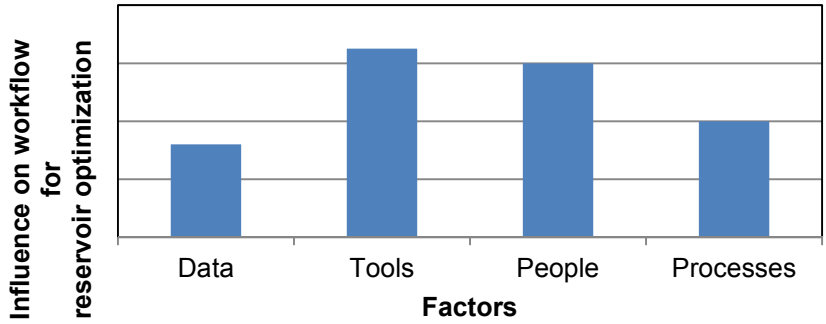

Figure 2: Impact of factors on effective workflow for reservoir optimization.

People are more complex to manage than tools and people with the right skill set are desired for data and application support services. This survey reveals that adaptability and interpersonal skills are of highest priority and relevance to this job role (Figure 3). This is accompanied by self-motivation, multitasking, diligence and accountability.

Figure 3: Skill relevance in effective data and application support for optimal reservoir exploitation and development.

6. Conclusion

The evolving nature of information technology our yesterday's strength is most likely a future weakness, if it fails to understand the pattern of value migration in reservoir management. The ability to develop and recognize competencies to address evolving nature of subsurface tools is essential in achieving effective subsurface support for optimal reservoir exploitation and development. The fundamental element for successful subsurface investigation is reliable data.

The strength of information and data support service quality must improve consistently with innovativeness to eliminate barriers in analyzing and identifying hydrocarbon reservoir uncertainties that guide business decisions making. It is recommended that organizations in the petroleum E&P sector should embrace more digital technologies that are workable and fit for purpose. In addition, develop or adapt policies that encourage training of data and application support personnel who are mandated to implement routine evaluation on data category, effectiveness, storage, security, risk, access control and compliance towards achieving total system accountability and continuous improvement.

The application of standard quality control, quality assurance and audit procedures can be used to ensure data accuracy, integrity and accessibility for reservoir management in accordance with internal organization policies and binding external business regulations.

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