Abstract

As high-value data assets, exploration and production data are usually managed and operated by organizations or institutions, such as National Petroleum Data Bank, NDR (National Data Repository) and neutral companies. Meanwhile, national energy management departments and oil companies pay great attention to the E&P data. With the rapid development of information technology, many new challenges have been brought to the traditional operation management of E&P as well as data management and its application. According to Gartner’s research, digital innovation has been rising as a strategic business priority in the oil and gas industry, which is a critical pathway to deliver efficiency and has now become a distinguishing hallmark of industry leaders. Facing the tide of digital innovation and intelligent application, we propose the enterprise IT architecture of "Digitalization + Platform + Intelligence" to improve the traditional NDR data management and application model, to promote innovative transformation of upstream business operation and management, to advance the digitalization and intelligence of traditional oil enterprises by establishing integrated data management and cloud sharing application environment.

1 Introduction

Facing the challenges of rapid IT development, along with the exploration practice for many years, BGP iDOField team researched and developed a new data management platform and an open application environment based on cloud architecture. It can be used to upgrade the existing exploration and development data management and application service environment of oil companies, creating a more open cloud application ecological environment, which is able to support the intelligent application construction such as big data analysis, cognitive computing and so on.

Values created from this open platform can be summarized in four aspects:

1. Data Interconnection: support the data Logic Unification of the whole Service chain in the Upstream, Interconnection and Interoperability.
2. Technical interoperability: provide open, unified technical standards and integrated framework.

2 Solutions

Integrated data management and application environment solutions for exploration and production with IaaS / PaaS / SaaS three-layer cloud architecture (see figure 1).

Since infrastructure cloud service (IaaS) is provided by cloud data center, our solutions mainly focus on enterprise level platform cloud service (PaaS), data cloud service (DaaS) and sharing application cloud service (SaaS) construction.

2.1 PaaS Platform

The platform cloud service (PaaS) is based on container + scheduling and orchestration, microservice framework and continuous delivery pipeline (DevOps) to build an enterprise level application development, operation and maintenance platform, and embed common middleware services, big data analysis and professional services engine to support stable operation of exploration and production business applications, and support agile response to business environment, business applications and process optimization (see figure 2).
The enterprise private cloud platform based on PaaS architecture has the following advantages:

- All cloudization applications are more stable, efficient and flexible;
- Providing a cloud development environment and data services for application development, developers only need to focus on business logic, which has more efficient application development;
- With unified, visual cloud platform operation and maintenance mechanism, system maintenance is much easier;
- Prompt response to users’ demand;

2.2 DaaS Platform

In the platform cloud service, EPBank as an integrated data management product for exploration and production is based on EPDM which is the data standard of CNPC (China National Petroleum Corporation) Exploration and Production, and which builds an integrated data management and service engine (DaaS) for exploration and production business with the technical framework of open data lake, to implement multi-source data governance, heterogeneous data integration and knowledge enrichment, meanwhile supporting efficient data query and big data analysis applications (see figure 3).

DaaS data standard conforms to EPDMX and China petroleum exploration and production data exchange standard as well. The standard package business data is divided into data sets according to application granularity as the unified standard of data incepted, data management and data application. The data conforms to the standard is shown in figure 4.

Data service bus is constructed according to OData standard. Based on the two dimensions of master data and data set type, the data authority are managed and controlled at different levels to ensure the data security.

2.3 SaaS Platform

With PaaS platform, the application scenarios such as field operation, production, comprehensive research, operational management and decision-making can be rapidly established for oil and gas companies. Meanwhile, open application integration service is provided through sharing application cloud service (SaaS). (see figure 5).
The platform based on IoT is able to realize the technical service of drilling engineering and the monitoring and management of oil and gas production, and support the early warning analysis and process optimization based on big data.

For the staffs engaged in exploration, development and production management, it’s able to provide business process and production dynamic management, achieve the whole process of refined management of exploration, evaluation of projects and production operations, and support remote production command and dispatch.
With shared model (data, achievement, process) as the core and integrated application software, the collaborative working environment for geophysics, geology, reservoir and engineering researchers and the collaborative application scenario for decision-making are created respectively (see figure 8).

![Collaborative research and decision-making](image)

Figure 8 Collaborative research and decision-making

Based on the shared data service standard and application access framework of cloud platform, the open application ecology of exploration and development is created to realize the cooperation of oilfield company and IT company (see figure 9).

![Prospects: Platform support open ecology](image)

Figure 9 Prospects: Platform support open ecology

3 Case Studies
On the basis of EPBank products, BGP has accomplished unified management of exploration and production data of 16 oilfield companies of CNPC. At present, with the integrated data management and application environment solutions for exploration and development, CNPC upstream business sharing platform is being built by BGP, which supports collaborative research and application environment construction. In the near future, production management, operational management and decision-making application will be fully supported.

4 Conclusions
CNPC’s IT construction has experienced stages of development from centralization to integration and then to sharing. With cloud architecture and internet of things (IoT), big data analysis and artificial intelligence, BGP’s integrated data management and application environment construction solution can effectively support the digitalization and intelligentization transformation of oil and gas companies.

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