

Geographical information system and remote sensing Technology

serving “digital oilfield” construction

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Abstract: Via induction and sorting for oil field information, we deem that construction content of current digital oilfield shall take Geographical information system and database technology as predominating and expound application of Geographical information system technology and remote sensing Technology on digital oilfield construction.

Keyword: Digital oilfield, Geographical information system, Remote sensing technology

0 Introductions

Along with fast development and use of computer, correlated data and information of oil geology, oil exploration, oil development, oilfield construction are developed to astronomical figures with explosive shape, forming a kind of specific enormous informosome which are not only huge in time span and space span, and very complex in constitutive relationship, but also most are relevant to geographical coordinates and spatial position, which would require us to explore a kind of high efficient, reliable and intuitional technology mode to process, display, query and use oilfield information, which is also urgent demand for “digital oilfield”.

1 Concept of the “digital oilfield “

Digital oilfield has intimate contact with digital earth. Starting from digital earth's signification, the concept of “digital oilfield “ can be defined as “ digital oilfield is a virtual expression of certain oilfield able to collect nature and culture information of the oilfield, people can carry out exploration and mutual act for the virtual body. ”digital oilfield is information infrastructure of oilfield enterprise and basic information platform of enterprise production management. It takes oilfield as research subject and petrolic entire production flow as clue to establish a multi-professional integrated data system of exploration, development, ground construction, storage and transportation, sale as well as business management and others, and carry out a highness mix. On the basis of establishing optimization application for oilfield production and management flow, it uses visualization technology and analog simulation as well as virtual reality and other technology to implement visualization and multidimensional expression, and via intellectualization analytical model, furnishes aid decision making information for enterprise operation and further excavates potential of production and management part to make informatization construction best serve for enterprise production and management, creating a good information support environment for oilfield enterprise development. Digital oilfield is the advanced phase of oilfield informatization, is a brand-new sign of oilfield informatization's reaching networking, numeralization, modelling and scientization, is a macroscopy objective of oilfield informatization, is an important

milestone of oilfield informatization and is also a brilliance banner of oilfield informatization. As it were, digital oilfield is a pronoun of oilfield informatization and automatization and is also a technology means to arm, to promote and reconstruct traditional industry by entirely applying information technology, computer technology, communication technology, automatic control engineering, oil exploration development technique, modern management thoughts, method and technology and others, and to entirely promote production technology ability, managerial abilities and market strain force on decision-making management layer, executive layer and process control layer as well as enterprise inside and outside.

2 Oilfield sorting information and feature

According to whole production operating mode of oilfield enterprise and collection, processing and use of oilfield production information of oilfield enterprise, oilfield information can be divided into 5 main classes: exploration information, oilfield development information, ground construction information, storage and transportation marketing information and operating management information.

2.1 Exploration information

It includes non-quake physical and chemical exploration data, seismic data, well measuring data, well-drilling document, log well data, test oil and test production data, analyses assay document, integrated study outcome document and others.

2.2 Oil-field development information

It includes 4 aspect information of petroleum reservoir engineering, oil production engineering, oilfield monitoring, production management, in which petroleum reservoir engineering information includes oil-field development dynamic data, static data, scheme planning data and others; Oil production engineering information includes production management data, planning scheme data and others of oil production engineering; oilfield monitoring information includes well surveying data, well test data, dynamic monitoring data and others of oil and water well; Production management information includes oil and water well production management data, job execution management data, oilfield monitoring management data, ground gathering management data, development production management data, petroleum reservoir engineering management data, oil production engineering management data and others.

2.3 Ground construction information

It includes surface engineering base data, engineering survey data, surface works static data, surface works dynamic data, investment control and economic evaluation data and others.

2.4 Storage, transportation and marketing information

It includes geo-information of station warehouse, station warehouse production run and process flow information, safe production aid decision making information, fuel station base data, receiving, dispatch and deposit information of product oil, in-house use oil information, client information, market price analytical prediction information of crude oil and product oil and others.

2.5 Operating management information

It includes financial information, assets information, manpower information, material

management information, planning information, quality control information, safety message, environment protection information, business management information, regulation information, public relations information, document information, market development information, scientific and technical information and others.

In collection, storage, processing, transmission and use process, forementioned various data have the following features and requirements:

A. information is multifarious in manifestation, including data form, vectorization data, graph and graph dimension, curve and other various information.

B. information source comes from various aspects. On the whole it is step by step gathered, processed and transferred from bottom to top, but in all levels there are new source data joined.

C. various information are high in sharing requirement. Among departments, among speciality and among system there are cross operating requirements of data, especially in exploring and developing integrative production operating mode, such requirement is more intense.

D. information requirements is of variety. For informational use, varied disciplines and various departments have different requirements, different format and different combination.

E. information maintenance is required to be exact and timely. Along with time change, dynamic information quickly increase termly. Although static information is not changed termly, it also is input new generant data, thus information content also increases.

By analyzing oilfield information and feature, it is observed that more than 90% of information for decision making of oilfield are relative to space orientation information. By organizing correlated data and information of all ascertained points within tridimensional space of oilfield, it can form information system containing overground and underground business management and geologic engineering. At the same time it can obtain administrative division, landform, water system, traffic and other standard space geography information to furnish fast and high efficient, exact and punctual geography and spatial information service and can warrant work functional implementation of oilfield enterprise to enhance work efficiency and reduce exploration risk. Thus technology main body of current “digital oilfield” still takes geographic information system (GIS) and database (DBMS) as predominating.

3 Geographic information system technique application in “digital oilfield” construction

Since the 1990's of the 20th century, geographic information system (GIS) platform is universally used in petroleum circles, such as oil exploration, oil-field development, oilfield ground construction and petroleum pipeline. GIS not only breaks through frame of traditional form and menu query, but also uses graphical information enjoyed by humanity and geography query interface natural appeal. Software operating environment and effect obtain identification of enterprise decision layer and geology circle, especially some query by geography space and application function extended to underground geology space entity, give people rouse of finding everything new and fresh. Because geography space inquiry mode is less and easy to be disturbed by

user's logical thinking, GIS platform is also one information resource platform at the same time. Application life cycle of GIS software is far and away longer than other application system or software, which also make GIS receive developer and user's welcome.

Current "digital oilfield" construction mainly includes the following content: (1) basic information: including state fundamental geography, geologic information and oilfield geography spatial information; (2) oilfield enterprise professional database; (3) one GIS product or GIS realization scheme; as shown in Fig. 1. It is observed from the figure that it is the entia of space data and attribute data integrated by fundamental geography, geology and other spatial information and oil field exploration, development, ground construction, storage, transportation, sale and operating management. By using unified management of geographic information system platform, it can carry out the superposition analyses of spatial data and attribute data, realize oilfield informational computer management, fast query search and aid decision making, realize scientization, standardization and automatization of oilfield infrastructure information management, furnish various thematic map timely and exactly, realize simple query, integration query, statistics and other auxiliary management functions and furnish a kind of convenient and fast analytical approach and information support for leader.

For example: by combining oilfield geo-information with oil-field development database, it can form oil-field development manufacturing monitoring system. System can contain various production information data in oilfield production process, such as: spatial data and attribute data of various factories and stations; various spatial data and attribute data of oil, gasses, water well; spatial data and attribute data of fuel transfer, gas transmission, waterline as well as various production data. Aiming at these data, it can develop a variety of functions meeting production need, such as various basic parameter of reflecting various oil-bearing layer positions of oil well, and can carry out simple query and statistics. It can query and maintain well history information and well's fundamental state of oil well in area and can automatically generate pool exploitation actuality graph and build-up pressure distribution graph according to dynamic production data. According to dynamic production data and setting condition, it can select daily servicing measure of oil well (workover, paraffin removal, adjusting parameter, ejecting thimble gasses). According to single well production dynamic data of oil well and selected relevant content, it can generate production dynamic curve. According to production dynamic data of single well and well group and setting condition, it can ascertain output reduction oil well and judge underproduction cause and raise contraposed measure according to correlated condition. Aiming at various pipeline system, it can develop pipeline section analyses, prewarning analyses, bursting tube and closing valve analyses and other functions.

It can develop an electric force management information system of oilfield by integrating numeralization geo information, electric power network composition information, power equipment graph and machine account, equipment operation rule and others. Using abundant geographic information system method describes

electric network operation state to construct one “digital electric network “, with which it can understand various information of electric network in visualization and aid working personnel to carry out business control and decision, thereby carry out effective and scientific management for electric network, enhance quality of management and operating efficiency, reduce operating cost and protect the power distribution reliability.

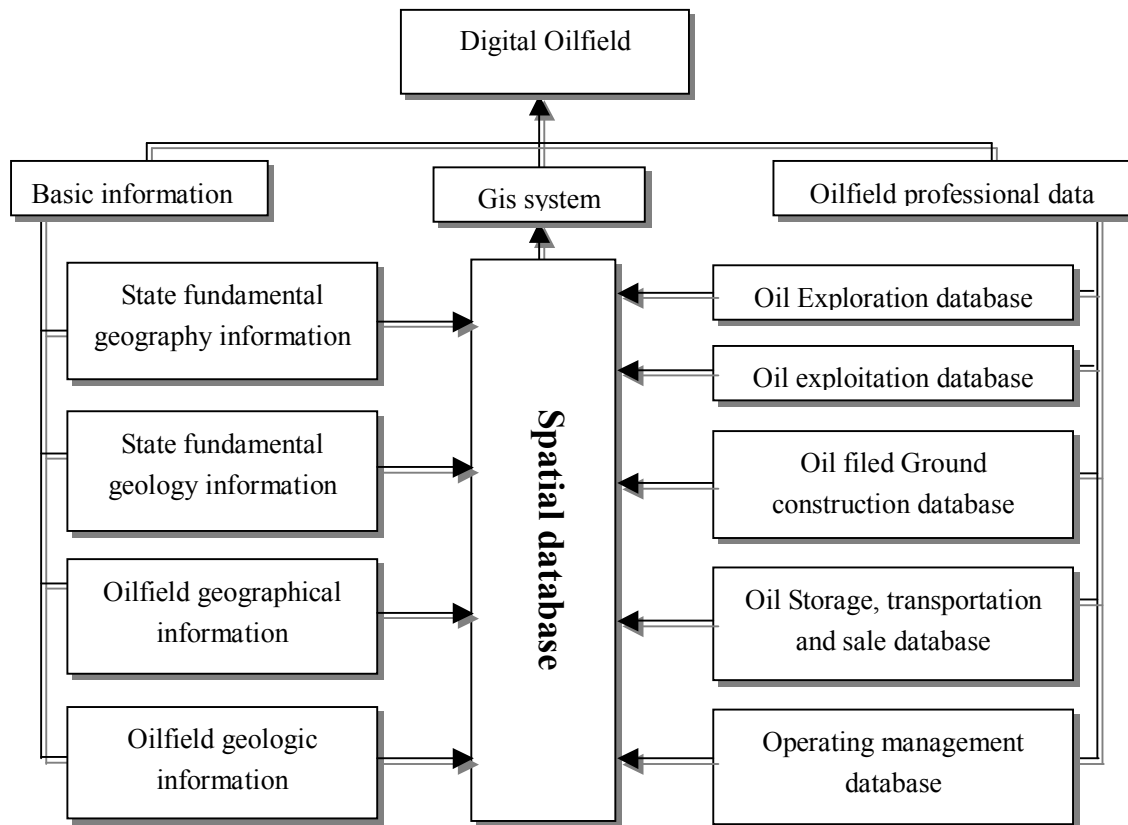


Fig. 1 geographic information system action in digital oilfield

4 Remote sensing technique application in “digital oilfield” construction

1) Oil and gas resources exploration

As one high and new technology, remote sensing can carry out regional tectonics framework analyses, research and explain out favorable structure and play a support role for basin oil and gas exploration, especially remote sensing technique and has the original location for flat ground surface structural identification, It can furnish important reference gist for oil and gas exploration and succeed in forecast exploration target area by the integrated application research for oil gas remote sensing information in E Er Duo Si basin and other loess altiplano regions.

2) Remote sensing engineering geology siting

In engineering application research area, using remote sensing technique can carry out a siting of long fuel transfer gas pipe. By carrying out research of topographical relief, structure and engineering geology for oil gas pipeline corridor, it can carry out the

maintenance of topographic maps along the line and a siting by integrative remote sensing.

3) Marine pollution monitoring

It is feasible to use satellite remote sensing technique for monitoring ocean oil pollution can exert its wide range, real-time, synchronizing and continuous monitoring features and exerts a biggest action with the least investment. By filming a thermal picture of ground and sea surface using infrared scanner (using wave band of 7.5 ~ 14 μ m) in daylight and nighttime, it can effectively monitor an offshore oil pollution. Using infrared scanner can measure a difference value of radiation temperature and reveal an offshore oil pollution and distribution state. Heavy oil film radiation temperature and watery radiation temperature of difference calculated on thermal picture is higher than difference of thin layer oil film and watery radiation temperature, by which it can distinguish thickness of sealevel oil film.

4) Hydrocarbon micro seepage detection

Using high spectra data can directly detect hydrocarbon micro seepage leak. Combined with comprehensive analysis for ground spectral test, multivariate remote sensing and physical-chemical prospecting drill well document, it can carry out direct oil and gas exploration research.

5) High resolution satellite remote sensing application

The appearance of high resolution satellite remote sensing enables people to observe the ground surface detail change at the lesser space scale and to carry out the large scale remote sensing drawing as well as to monitor human activities' impact for environment, which possesses the extensive application prospects. It can mainly be applied to large-scale cartography, oilfield surface works planning, tridimensional map and other aspects.

5 Epilogues

Aerospace remote sensing technology is a high-tech of comprehensive application. It possesses high speed, real-time and other features of information acquisition and processing; at the same time it can possess high precision and quantification of application, etc. Geographic information system technology combines spatial position of object in real world with relevant attribute organically to meet user's management for spatial information and to carry out a variety of aid decision-making by means of specific spatial analysis function and visualization expression.

Along with the propulsion of oilfield informatization constructional, these two technologies will certainly play an important role in the construction process of “ digital oilfield “.

Reference:

Zhang Yongsheng, 2000. Remote sensing image information system, Science

Publishing House.

Chen Shupeng and others, 2000. Geographic information system, an introduction, Science Publishing House, Beijing.

Wu Lun, Liu Yu, Ma Xiujun, Wei Zhongya, Tian Yuan, 2002. Method and application of geographic information system principle, Science Publishing House.

Wang Quan, 2003. Digital oilfield mode and development strategy research of Taching Oilfield Ltd, Tianjin University master thesis.