

## Application of digitization management technology in Changqing oilfield

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### Abstract

The digital management of the oil field integrates the application of informationization technology and traditional oil and gas production industries, and it is an important method to constantly promote the optimization of the enterprise's management process and innovation of the management modes. According to the structure of "three ends, five systems and three auxiliaries", the established digital management is the modernization management mode of Changqing oilfield, which explored for the development of "three low" oil and gas deposit benefits. It is based on the digital supporting technologies, sets a unified platform of production operation management, production process dispatch and emergency rescue command for production management personnel, providing an efficient and coordinative working environment for decision-making and scientific research.

### Keywords

Changqing oilfield, digital management, economic assessment.

### 1. Introduction

With the rapid development of economic globalization and society informationization, informationization has been an important method of innovation management of energy enterprises, through information construction to improve the comprehensive competitiveness of the enterprises. Many oil companies have listed "digital oilfields" as an important strategic goal for the construction of enterprise's informationization.

### 2. Digital Management Technology Application of Changqing Oilfield

#### 2.1 Organization Structure of Digital Management

Changqing Oilfield mainly carries out the business including the prospecting, exploration, production, gathering and transportation and sales of oil and gas resources in the Ordos Basin. It involves a wide professional fields range and complex business processes, resulting in that it is difficult to manage oil fields. The traditional production organization and management methods have no longer suitable for the current rapid development of oilfields. Changqing oilfield has combined jobs, production process and production safety requirements to establish a digital management construction mode based on the "three ends and five systems".

After studying and analyzing the oilfield production operation management characteristics of the division of 3 terminals, combining with the exploration and development of business processes and the corresponding management requirements, the oil and gas production process management is divided into front, mid and back end. The front-end is based on the center and extends to single-wells and pipelines, covering the process management of oil (gas) and water production from the rockshaft to the station (joint station); the mid-end's center is the pump and extends to the joint station and the pipeline, covering the production of oil and gas well production, production command and dispatch, safety and environmental monitoring, emergency rescue and other production process management; the back-end focuses on oil deposit research, and extends to operations management and

decision-making support, covering the process management of oil and gas deposit exploration, development benefit assessment, development plan deployment, operation and decision-making.

The five systems refer to the front-end production management system, the mid-end production and operation command, safety and environmental monitoring system, the back-end oil and gas deposit management and decision-making support system, Enterprise Resource Planning (ERP) and Management Information System (MIS).

## 2.2 Building Content of Digital Management

### 1)The front-end

The front-end is the basis of digital management. It is the production management system centered on the process control of basic production unit of oil and gas, mainly focuses on the production process control and management of the basic production units such as single well, pipeline and station (base), and provides the mid-end and back-end with data.

#### (1) Well site digital construction

Data collection: real-time collection of oil well load and displacement, 3 phase electric parameter of pumping unit, well site oil pipeline pressure, injection well pressure and flow, injection valve group pressure, 3 parameters of water extraction and water pump for water well.

Data transmission: optical cable, wireless bridge.

Well site monitoring: intelligent video server.

Remote control: start and stop remotely controlled from pumping station, injection well remote deployment, water wells intelligent control.

#### (2) Site digital management

Site data collection: importing crude oil pressure and temperature, storage tank (water tank) level, oil pump (water pump) import and export pressure, loading crude oil pressure and temperature, flammable gas detection in the station.

Through the front-end data collection and the development and application of key technologies, it realizes the production management mode of electronic well patrol, intelligent early warning, dynamic monitoring and remote control, and achieves the goal of ensuring the well site's production and station security of the well site, and creates a good working environment for the operators.

### 2)The mid-end

The mid-end is the key to digital management. It is the production and operation command system and the safety and environmental risk perception system with production command and dispatch, safety and environmental monitoring, and emergency rescue as their core functions.

#### (1) Production and operation command system

Digital production command system of the oil production plant: mainly includes production command and dispatch, safety and environmental monitoring, emergency rescue and other production process management, developing 4 subsystems of dynamic monitoring, achieve "in the same platform, sharing information, multi-level monitoring, and decentralized control".

Digital production command system of the gas production plant: mainly includes production and operation management, gas production engineering subsystem, geological expert subsystem, electronic automatic patrol, remote emergency shutdown. Realize the operation monitoring of the gas field wells, stations, treatment plants and pipelines and other production equipment, and shut down the system if the abnormal emergencies occur.

The enterprise's digital production command system: mainly includes the online monitoring of oil and gas production, gathering and transportation, dynamic management of production capacity construction, monitoring of key oil and gas fields, safety and environmental protection, emergency rescue command and comprehensive management of mining areas, realizes the real-time monitoring

and operation of production, the scientific dispatch of the operation team, and the online rescue commend for emergency.

#### (2) Safety and environmental monitoring system

It is based on the real-time data collection, including oilfield safety environmental monitoring, gas field safety environmental monitoring, vehicle GPS safety monitoring system. It realizes the early warning of dangers, emergency stop, video surveillance, emergency vehicle dispatch, information management and other functions. In order to determine the factors to deal with uncertainties, ensure that the major oil and gas facilities are safe and environmental protection goals are under full control. Through the development and application of mid-end production and operation command system and safety and environmental risk perception system, a fast and efficient production management platform has been set up for management personnel.

#### 3)The back-end

The back-end is the core of digital management, including oil and gas deposit management and decision-making support system, Enterprise Resource Planning (ERP) and Management Information System (MIS).

#### (1) Oil and gas deposit management and decision-making support system

The fine description of the oil and gas deposit is the core, covering the exploration, assessment, development, steady production stage of all business. Make full use of the existing hardware and software resources to create the integrated environment combining data flow, workflow and software integration for decision makers and researchers, realize multidisciplinary and collaborative environment that enables data collection automation, business process flow, visualization of results display, and coordination of research and decision-making.

#### (2) ERP (Enterprise Resource Planning)

The information system integrating the business functions of finance, planning, purchasing, sales, production, inventory and other functions emphasizes the regulations, unification and standardization of business processes, and focuses on the highly integrated operation and management information system on people, financial and material information, further shorten the management links and improve the enterprise's management level.

#### (3) Management Information System (MIS)

To standardize the system as the leading purpose, according to the requirements of internal control work of the enterprise, integrate and develop Management Information System, whose core is process management, break the "isolated administration" "information islands", focus on the enterprise resource sharing, integration and interaction, and gradually establish a suitable MIS system of its own standardized management.

### **3. Economic Performance Assessment of Digital Management**

At present, Changqing oilfield has completed the digital construction of 76 complete digital operation areas, 1,200 stations, 35,302 oil wells, 12,010 water injection wells and 500 water source wells, and has built 12,000 sets of video surveillance and more than 200 digital integrated supercharging device. For example, Huachi Oilfield has developed for 27 years. The digital management mode was used to transform, and simplify the process by using a digital integrated supercharging device; the 3-level distribution mode was optimized to a one-and-a-half distribution mode, management stations has reduced from 19 to 8, well station implementation of electronic patrol and other technologies has achieved none-human patrol, and the employees have reduced from 724 to 510.

The greatest benefit of digital management of oilfields is to save human resources and reduce operation costs. Changqing oilfield has started the digital management technology research in Sulige gas field in 2007, and invested RMB 32,000 Yuan/ well on the average single-well digital construction in the oilfield. The amount of Changqing oilfield million tons wells is 1375, and the total amount of million tons investment is:

Million tons of digital construction average investment = average single-well digital construction investment  $\times$  million tons of well = RMB 32,000 Yuan/ well  $\times$  1375 = RMB 44 million Yuan.

Through the application of digital management technology, the average employee has dropped from 1,800 persons/ 1 million tons to 1,000 persons/ 1 million tons, saving an average of 1 million tons of employees of 800 people and labor costs:

Labor-saving costs = average million tons of labor saving  $\times$  average labor costs = 800 people  $\times$  80,000 = RMB 64 million Yuan.

Average million tons saves the cost = labor saving costs - million tons average investment in digital construction = 6400-4400 = RMB 20 million Yuan.

#### 4. Conclusions and Cognitions

Apply digital integrated technology and intelligent control technology to the oilfield production and operation management. Through collecting, processing and intelligently analyzing the production process data, realize the automatic and remote intelligent control of equipment, make the production operation mode more scientific and standardized, and greatly increase the safety management level. According to the production process, to establish the labor organization structure, make the production process and management processes are unified, reduce the management levels, avoid cross-management and make the management flattening; based on the new type of production organization model whose core is "electronic patrol, manual patrol, center duty and emergency linkage", create a centralized and coordinated operations environment for technologic and maintenance personnel; digitized management frees employees from the working environment of desert and the Loess Plateau, reduces the labor's intensity of first-line workers and improves the production and living conditions, which is the largest "livelihood project" of the enterprise.

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