

A Review of the Open Forum for Intelligent Digital Oil Fields in 2018

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Abstract—A new generation of artificial intelligence is booming around the world and is also having a major impact on the world's petroleum and petrochemical industry. This article introduces the main contents of this conference and the new ideas and new viewpoints of scholars and experts through the annual meeting of the 5th Intelligent Digital Oilfield Open Forum in 2018. The purpose is to provide actions for relevant personnel engaged in and focusing on digital oilfield work and research in China. The guidelines of the iDOF forum are to jointly promote the healthy and rapid development of smart digital oil fields.

Keywords—Informationization, Artificial intelligence, Digital oilfield, Intelligent oilfield

I. INTRODUCTION

The Open Forum for Intelligent Digital Oil Fields (iDOF Forum) was initiated by some petroleum universities in China such as China University of Petroleum (Beijing), China University of Petroleum (East China), Southwest Petroleum University, Xi'an Petroleum University, Northeast Petroleum University, and Yangtze University. Several professors engaged in intelligent digital oilfield research, experts from the China Communications Industry Association, and leading figures in the petroleum system industry are aiming to explore the digitalization, networking, intelligence, and intelligence of oil and gas fields. In order to strengthen the coordinated development of the industry, industry, research and technology of the oil and gas industry, and accelerate the promotion and application of new technologies, new industries, new formats and new models as the core of the new kinetic energy in the oil and gas industry, the iDOF Forum adopts by turns annual meeting system. The first iDOF annual meeting was successfully held in Xi'an Shiyou University in July 2014 [1]. The second iDOF annual meeting was successfully held in Northeast Petroleum University (Daqing City) in July 2015 [2]. The 3rd iDOF Annual Meeting was successfully held in Yangtze University (Wuhan City) in October 2016 [3]. The 4th iDOF Annual Meeting was held in July 2017 at Southwest Petroleum University (Chengdu) [4]. The 5th iDOF Annual Meeting in 2018 was successfully held by the China Communications Industry Association under the guidance of the Oil and Gas Department of the National Energy Administration and the Information Technology and Software Service Department of the Ministry of Industry and Information Technology [5].

The 5th Annual Conference of Intelligent Digital Oilfield Open Forum, with the theme of artificial intelligence leading the intelligent digital oil field, was successfully held on August 18, 2018 at China University of Petroleum-Beijing, from the major oilfields in the country. More than 150 entrepreneurs, experts from the six major petroleum universities, experts in oil and gas field exploration and development service systems, and entrepreneurs who have digitized, networked and intelligently serviced oil and gas fields participated in the forum. Various experts elaborated and shared the field in the field of digital oil fields in recent years. The work and experience carried out discussed and exchanged new technologies and new issues of common interest.

II. IDOF2018 CONFERENCE THEME AND MAIN CONTENT

The theme of the iDOF2018 conference is "Artificial Intelligence Leads the Intelligent Oilfield". The topics of this annual conference include: the introduction and application of artificial intelligence to the oil and gas industry; the construction and application of big data ecosystem in the oil and gas industry; the construction and application of global energy Internet and its energy big data; CPS (Cyber-Physical System) and its practice in the oil and gas industry And application; intelligent software system and its application and integration of oil and gas industry application system; GIS and its practice and application in oil and gas industry; digital reservoir, digital wellbore, intelligent drilling and completion and its visualization practice and application; oil and gas industry production , business and management integration practices and applications.

III. RESEARCH ACHIEVEMENTS OF DIGITAL OIL FIELD IN CHINA PETROLEUM INDUSTRY IN 2018

As the brand column of the Intelligent Digital Oilfield Open Forum, Professor Cheng Guojian gave a detailed account of the international dynamics of the 2018 Intelligent Digital Oilfield. He introduced the generation and characteristics of big data, the rise of artificial intelligence, and the elements of machine learning. He focused on the latest achievements and research directions of international petroleum engineering applications in SPE on 2018. Prof. Cheng given a number of international conferences he followed. Prof. Cheng's explanation brings the latest international information to scientists and entrepreneurs on the oil and gas field, making everyone refreshed.

The most active promoter of the Intelligent Digital Oilfield Open Forum, the deputy director of the Daqing Oilfield Information Center, Wang Quan, sent a carefully crafted video about the application of the large system concept in oil and gas fields, and won the applause [6]. Wang Quan expounded the concept of large system concept, information is the relationship between enterprise's genes, digital oilfield and large system view, pointing out that the future world is dominated by information. From the perspectives of microeconomics, macroeconomics, and new planned economy, it is stated that information is both production data and production relations. "Relationships are more important than entities, and relationships depend on information." The meaning of the large-scale oilfield system is given, and the connotation of digital oilfield informationization should be expanded. The big system is to let the information play the leading role. Everyone is an information worker. Everyone cares about information. Everyone understands information. Everyone develops and uses information, so that information is linked to everyone, every device, every system. Form a large system view.

Deputy Director of the Shengli Oilfield Information Center Duan Hongjie made a report on "Integration of Intelligent Digital Oilfields." The report reviews the development process of oilfield integration. He pointed out that it is necessary to grasp the main contradictions and track cutting-edge technologies, including cloud computing, big data, Internet of Things, mobile Internet, artificial intelligence, blockchain, etc., based on the existing system. Development and improvement. Focus on the exploration, development, production, and operation of the sector, focusing on the information base. He introduced the "New Capability System Architecture of Shengli Oilfield Branch", including five first-class new capabilities such as "Intelligent Exploration and Development Capability, Innovation Driven Development Capability, Value Creation Promoting Capability, Production and Management Integration Capability, Safety and Environmental Protection Productivity". 16 second-class new capabilities. He introduced the key projects of Shengli Oilfield Informationization: (1) Complete the construction of the front-end IoT, and the integrated production operation command has achieved initial results. In order to give full play to the supporting role of production informatization in the construction of oil company system and mechanism, Shengli Oilfield conducted in-depth research and extensive demonstration, and determined the "361" system architecture of PCS system, namely: 3 levels, 6 modules, 1 platform, realized Three levels of linkage, up and down, and layer penetration. (2) The cloud service environment was built and the integrated service capability was significantly enhanced. First, the oilfield enterprise-level integrated service cloud platform was basically completed, which solved the series of problems caused by the dispersion of information applications. The second is to build an oilfield enterprise-level professional software and hardware sharing center to improve the efficiency of resource use. In accordance with the principle of "emphasis on mainstream, feature assistance, centralized integration, and shared application", the three major professional sharing centers of exploration, development and oil production are used to realize the sharing of professional software and hardware cloud services, avoiding repeated investment. (3) Establish an oilfield scientific decision-making system platform and innovative exploration and development decision support model. The exploration has realized visual collaborative decision-making such as research, management and engineering technicians' deployment of time and space wells and scheme optimization. The development has realized the decision-making, operation, tracking and visual interaction application and the whole process management and control; the oil reservoir has realized the integrated control of the reservoir, wellbore and ground. Innovate and apply the "three-line and four-zone" economic operation model, realize the efficiency grading of oilfields, blocks and single wells, classify and implement policies, and guide the development of oilfield benefits. (4) Evaluation of the informationization stage. The goal is to strengthen internal management to reduce costs, improve synergy capabilities to increase revenue, leverage the strength of the overall strength, and cultivate core competitiveness. Finally, he analyzed the twin technology by using the three-dimensional strategy of "man-machine-network" and the six-dimensional intelligence theory, and looked forward to the research and application of key technologies in the new generation of oilfields.

Gao Ruimin, dean of the Shaanxi Yanchang Petroleum Group Research Institute, first appeared on behalf of Yanchang Oilfield to make a keynote report on the intelligent analysis decision-making technology of oil and gas field system information. He introduced the main problems faced by Yanchang Petroleum Oil and Gas Exploration and Development, and proposed the main research ideas of intelligent decision-making: integrating exploration and development data management, GIS navigation, exploration and development professional software, establishing an intelligent decision-making system for oil and gas fields, and integrating and transmitting underground and underground information. Combine static data, engineering and geology, production management and technical research to conduct geological research and reservoir engineering research quickly and efficiently, and provide basis for technical research and production decision-making. Architecture design: Collect various data of oil and gas fields, carry out geological research, reservoir engineering research, ground engineering demonstration, production decision-making and other work on the basis of data analysis and processing, GIS management and navigation and exploration and development professional software collaboration. The functions implemented by the intelligent decision system are introduced. He pointed out the next research direction: 1. Apply AI means, more accurate warning of possible risks, locate problems, and improve the level of system intelligence. 2. Build and apply a more complete Internet of Things, continue to build an intelligent management and control platform covering the entire gas field, and improve production and management

benefits. 3. Provide a more user-friendly system interface, facilitate the quick application of researchers, improve the mobile application of the system, so that managers can work at any time and place.

Zhao Hui, a young professor and doctoral supervisor at the School of Petroleum Engineering at Yangtze University, released their latest research report on data-driven reservoir identification and optimization. He analyzed the research background and significance of data-driven research, introduced the data-driven model based on material balance, and analyzed the data-driven dynamic optimization principle of injection and production and the results achieved. He proposed to build integrated optimization, develop intelligent optimization decision-making platform, and dock the oilfield database. The bottom layer module is embedded in the oilfield database, and the back-end is calculated by the data center to realize the injection-production structure, the well-well position, the process measures, and the adjustment timing integration simulation decision; the real use of the data for intelligent decision-making, and the development of the traditional oilfield to the emerging oilfield .

Dr. Cao Jing shared her research findings: the Smart Software System. She analyzed the pain points of the traditional software system and introduced four aspects of the wisdom principle of the smart software system: data-centered, micro-program-based development mode, multi-mode distributed computing platform, and large platform and micro-program. Software development architecture. It analyzes several aspects of the SDPI overall architecture of the intelligent software system: SAAS level, DAAS level, PAAS level, IAAS level. The core technologies of the intelligent software system are expounded: data planning technology MODP, data modeling technology MODM, distributed multi-modal computing platform DTOS, information physical system CPS, micro-programming technology MP, database technology DB. Finally, the application scenarios and application cases of the smart software system are shared.

Professor Li Chunsheng, the founder of the Intelligent Digital Oilfield Open Forum and the Dean of the School of Computer and Information Technology of Northeast Petroleum University, shared his latest research results: a three-mining business skill training system based on virtual tutors. He focused on the construction of the tertiary oil recovery tracking business skills training model, the design of the tertiary oil recovery tracking business skills training system, the implementation of the business skills training system and the application effect analysis. This achievement has attracted the attention of the participants.

Dr. Sun Xudong of Sinopec has benefited from the Harness Oil and Gas Big Data with Analytics combined with his practical experience in a variety of work in the petroleum industry over the years.

IV. APPLICATION OF INTERNET OF THINGS TECHNOLOGY, BLOCKCHAIN TECHNOLOGY, MACHINE LEARNING AND OTHER TECHNOLOGIES IN CHINA'S PETROLEUM INDUSTRY

Wang Hongliang of Zhongke Aowei Technology Co., Ltd. introduced "Industrial Internet of Things WIA-PA Technology and Industry Application". He introduced the technical background and technical characteristics of the Industrial Internet of Things WIA-PA, and listed application cases in oilfield, petrochemical, military and other industries. Industrial Internet of Things WIA-PA technology realizes ubiquitous sensing and heterogeneous network (perceived network + high-speed network) has been successfully applied in important industries such as petroleum and chemical industry and achieved breakthrough results. Combining MES and ERP for enterprise intelligence and digitization, Refinement provides powerful technical support and provides data support for enterprises to realize highly intelligent applications such as big data and cloud computing in the future. It is pointed out that the Industrial Internet of Things WIA-PA technology will bring greater benefits to enterprises.

Shen Longbin, an expert at Sinopec Geophysical Corporation, shared his latest research report: The Application of Blockchain Technology in Digital Oilfields [7]. He first introduced the blockchain technology and characteristics, discussed several applications of blockchain digital oilfields, and finally explained the difficulties and obstacles in the development of blockchain.

As the leader of China's configuration software, Beijing Yakong Technology, Xu Haihai, manager of the petroleum industry, explained the comprehensive information system solutions for the production management of the Asian Control Software and its oil production plant. The architecture and function design based on the KingFusion platform are shared, and the application highlights and application development of the comprehensive information of production management are displayed.

Li Dawei, from the Institute of Global Oil and Gas Resources and Exploration Planning of China Petroleum Exploration and Development Research Institute, gave a detailed introduction to how to explore and develop oil and gas in the field. He analyzed the application of machine learning in various fields, and pointed out that machine learning can be widely used in oil and gas exploration, development, transportation, refining, engineering construction and so on. The oil and gas exploration and development data contains great value, and is valuable. Valuable assets, assets, and unlimited business contain unlimited business opportunities, which need to be tapped and utilized. Mature algorithms and functional examples of machine learning need to be comprehensively utilized. Learn and use the latest relevant technologies (cloud computing, fog calculation, edge calculation, blockchain, etc.) in a timely manner. The focus should be on developing algorithms and software platforms for the oil industry's data and needs. Professionals such as professionals + IT+ applied mathematics are required to work together.

Wu Haoda, project manager of China University of Petroleum-Beijing, explained the research progress of oil well multiphase flow online measurement technology based on data fusion. He briefly describes the development status of multiphase flow measurement, introduces the data fusion technology of oil well multiphase flow measurement, discusses model-based data fusion, information theory-based data fusion, based on wavelet transform and multi-scale estimation. The

online twinning model of oil well phase separation rate is analyzed. Then, the experimental results of oil well multiphase flow online measuring device are illustrated. The oil well multiphase flow online measuring device and its application are presented. The multi-phase flow measurement is difficult, and the special oil field has complicated working conditions. The existing metering technology cannot achieve high-precision measurement of the phase fraction of crude oil. Multi-sensor data fusion technology can make more innovations from the perspective of data on the basis of existing measurement technology, thereby improving the phase separation measurement accuracy of multi-phase flow in oil wells. The research team used multi-sensor data fusion technology, adopted the measurement method based on differential pressure method and radio frequency method, built a multi-phase flow measurement digital twinning model for oil wells, formed multi-phase flow measurement products, and achieved certain results.

Lin Daoyuan, deputy general manager of Beijing Jiahe Unlimited Technology Co., Ltd., explained in detail the big data composition and intelligent breakthrough of smart oil fields. He analyzed the evolution from enterprise informatization to information technology enterprises, and used the IT experience of China's banking industry to analyze the advanced manufacturing informatization. He proposed the Lin's enterprise architecture methodology and the new model of Lin's enterprise architecture. He gave the smart oilfield. The top-level design and integrated solution analyzed the professional intelligence to business intelligence application system, and finally pointed out the seven directions of the oilfield intelligent breakthrough.

Chen Yan, a young associate professor at Southwest Petroleum University, shared the application of blockchain application scenarios and implementation methods in the context of big data. She analyzed the nature of blockchain technology, the relationship between blockchain and big data, and finally pointed out the application scenario of blockchain. Her team's research results in recent years have been novel and have attracted wide attention from delegates.

Dr. Zhao Yanhong from Beijing Jinghong Xiangyun Technology Co., Ltd. shared the application practice of big data technology in the field of road traffic and oilfield exploration and development. She introduced the company's core technologies and major products. The company's products include: Hadoop/Spark Universal Big Data Cloud Platform, Big Data Migration and Big Data Management Platform, MyDM Data Mining Platform, Jinghong Xiangyun Geological Analysis Big Data Platform, Jinghong Xiangyun Sedimentary Microphase Analysis Big Data Platform, Mining Oil well condition diagnosis big data analysis platform, logging big data analysis platform, casing damage big data analysis platform, road traffic big data platform, community security big data platform.

Manager Ma Hongguang of Xinhua Group III gave the intelligent oilfield IoT solution. He introduced the Oasis Platform 2.0, highlighting the application functions and application effects, and introduced the advantages of Xinhua III in 2018.

V. SUMMARY

The forum brought together experts, scholars and technical backbones active in the petroleum and petrochemical industry. They summarized and shared new technologies, new industries, new formats and new models in the petroleum and petrochemical industry. The work carried out in this forum will definitely have a certain impact on promoting the promotion and application of new kinetic energy in the oil and gas industry. Five experts in the field of intelligent digital oil field, led by Dr. Sun Xudong, invited Dr. Duan Hongjie, deputy director of Shengli Oilfield Information Center, Shen Longbin, expert of Sinopec Geophysical Corporation, Li Chunsheng, professor of Northeast Petroleum University, Cheng Guojian, professor of Xi'an Petroleum University, and Yan Ying, associate professor of Southwest Petroleum University. He has launched a heated discussion on the application of big data and artificial intelligence in the construction of intelligent digital oilfields, focusing on the technical hotspots and technical bottlenecks in the petroleum and petrochemical industry, giving solutions to the problems, and pointing out new research ideas for difficult breakthroughs.

The newly established Intelligent Digital Oilfield University Dean's Summit Dialogue was presided over by Professor Li Chunsheng of Northeast Petroleum University, Professor Li Hongqi of China University of Petroleum, Cheng Guojian, professor of Xi'an Petroleum University, Yan Ying, associate professor of Southwest Petroleum University, and He Yuming, professor of Yangtze University. The location, special conditions and employment opportunities of the university are introduced, and their different research directions and teaching practices are introduced. The presidential high-level dialogue can point the way to the future life of the students who are in the middle of the lost oil university, which will also promote the cultivation and docking of talents in universities and industries, and help the university's education reform and talent cultivation.

ICT can be well integrated with the oil and gas field business to better serve the development of oil and gas fields. The smart solution and good products of the intelligent digital oil field can also serve the intelligent manufacturing of discrete industries. In line with China's new generation of intelligent manufacturing development strategy, the intelligent digital oil field needs to be further developed. The Intelligent Digital Oilfield Open Forum will continue to play a unique platform function, which will certainly promote the further development of industry, academia and research.

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