Petroleum Equipment Industry to Digitalization—Taking Jereh Equipment as An Example

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Abstract: The Report on the Work of the Government 2021 voiced that China will strive to develop the Internet in the next few years. It is the fourth year that the industrial Internet has been written in the government report. With the combination of national promotion and social development needs, China's industrial Internet has experienced unprecedented growth in recent years. Based on the case analysis of Jereh's IOT, combining theory and practice, this paper studied the development trend of the petroleum equipment industry's digital transformation and the application scenarios of the Industrial Internet of Things. Through realizing intelligent industrial operations by using the data analysis results obtained by business transformation of machine, computer, and personnel, and based on the application of Internet of Things technology, Jereh’s IOT aims to promote the high integration of enterprise informatization, equipment informatization and operations process informatization, so as to achieve digital and lean industry management.

1. Introduction

1.1. Research Status

With the in-depth development of the new round of information technology revolution, many enterprises reconstruct their core competitiveness through digital transformation to ensure that they can create new advantages in the new round of competition. According to IDC's prediction, there will be 41.6 billion IOT devices in the world by 2025. The Internet of things is the statistical analysis of the data obtained by machines, computers and personnel after using tools to realize intelligent industrial operation. Petroleum, as the foundation of energy industry, shares the characteristics of high equipment value, complex process, long industrial chain and high risk. There are many industry pain points in the work supervision, equipment supervision and safety production. As a listed company with global operation, Yantai Jereh Oil Service Group Co., Ltd. keeps up with the pace of digital transformation, realizes the intercommunication and cooperation of people, equipment and operation through the Internet. It actively promotes the deep integration of artificial intelligence, cloud computing, big data and other technologies with the oil and gas industry, builds enterprise cloud service to create an enterprise cloud service system featuring equipment networking, numerical control, modularization of key processes, accessibility and easy maintenance. The Jereh equipment IOT (Internet of things) under the Jereh service cloud comprehensively improves the digital level construction in the aspects of management configuration, fault early warning, multi-dimensional analysis, comprehensive monitoring, equipment detection and advanced intelligent application of fracturing well site, accelerating the development of intelligent
equipment in petrochemical industry. This project mainly focuses on the topic of digital transformation of Jereh equipment IOT.

![Figure 1 The scale of domestic IoT demand in the industrial field](source)

Compared with foreign countries, China's industrial Internet still has some room for improvement such as the lack of internal supply capacity and application capacity. In view of these problems, China is also increasing support for industrial Internet to promote the high-level development of industrial Internet platform and expand Intelligent Plus. After entering the 5g era, 5g network has provided more innovation power for industrial Internet. From the perspective of enterprise, the overall development level has steadily improved, and the industrial digital penetration rate has increased year by year. To the industrial Internet, the digital transformation of petrochemical industry is promoted by 5g. For example, Hengyi petrochemical, Hengli petrochemical, Yingke petrochemical and other enterprises have begun digital transformation. Through taking intelligent equipment management and control, production collaborative optimization as the breakthrough point, they accelerate the transformation of petrochemical industry to the whole process intelligent direction and lead a new generation of digital technology change.

![Figure 2 Industrial internet scale growth rate](source)

1.2. Innovation and Research Significance of the Project

Through the Internet, the equipment IOT (Internet of things) connects physical devices embedded with intelligent sensors to form a global system. All devices transmit data and communicate with each other through the Internet. Besides, the devices could communicate with applications and services in the cloud so as to improve the comprehensive management efficiency of devices, reduce personnel input for equipment operation and maintenance, and also bring continuous and greater value for the enterprise itself. As a driving force, the digitalization helps to innovate the application scenarios of precise control and execution of data acquisition, and realize the real-time dynamic perception of the whole life cycle of equipment in the platform. Digitalization also optimizes the product architecture of Jereh equipment IOT platform, innovates the interaction mode of industrial equipment, and provides a strong theoretical basis and practical case for the transformation of industrial Internet to digitalization. Based on this research, IOT (Internet of things) implementation of petroleum equipment is of great significance, which is conducive to promoting the equipment management of China's equipment manufacturing industry, especially the supervision of petroleum equipment, reducing the risk of equipment operation, maximizing the use value of equipment and reducing the cost of equipment.
2. Application of the Internet of Things Technology in the Petroleum Equipment Industry

2.1. The Internet of Things energizes the industry
Followed by the mobile Internet, the Internet of things is the biggest economic opportunity featuring three economic characteristics. The first is that all things are connected to the network. The second is its user-centered, and the third is data-driven and data capitalization. From economic characteristics, the scene in fast iteration will become the most important feature of experience economy, and people will more pay attention to personalized social economy. In terms of development trend, products will be replaced by scenes, and the industry will be covered by ecology. The concept of convenience in the industry is becoming more and more vague, which causes that the products must be embedded in the life scene.

5g technology is the most cutting-edge technology of mobile communication in the new era. With the maturity of 5g, it can be competent for the Internet industrial scene of high reliability, low delay and anti-interference. 5g plus industrial Internet further enriches the connotation and extension of the new infrastructure, spawns the application of digital innovation and new mode of industrial interaction, and effectively leads a new generation of technological change, all of which provides a new impetus to the digital development of petroleum equipment industry. In the process of transformation to digitalization, the demand for integration and collaboration between various elements has increased significantly, and the complexity and uncertainty of technology development has increased substantially. The application of 5g technology helps to accelerate the digitalization and intelligent transformation of industrial enterprises, and promote the formation of a new model. The two demands complement each other and drive each other.
2.2. The development trend of the Internet of Things in the petroleum equipment industry

The Internet of things of petroleum equipment is a branch of the Internet of things system, which uses various online and real-time measurement sensing devices, such as instruments installed in oil and gas wells, operation pipelines, storage and transportation equipment, etc. From the field application, the Internet of things in oil, big data and intelligent analysis are inseparable as a whole. Through oil Internet of things, big data of equipment operation in this field can be obtained in real time. In the future, the Internet of things of petroleum equipment industry will realize industrial transformation and upgrading through professional collaborative transformation, and the platform global configuration realizes the optimal allocation of resources in the group and even the industry. Combined with the above factors, we can analyze the functional development trend of domestic petroleum equipment IOT platform in the future;

1. The production equipment of oil and gas industry is dangerous. In the operation of the equipment, if there are abnormal high temperature, high pressure and leakage of the equipment in the retest, it will cause fire or explosion accidents, causing casualties. In the past, enterprise intelligence regularly sent people to repair and inspect the equipment, which consumed a lot of working time. In the future, under the background of industrial Internet of things, the real-time intelligent analysis of operation equipment can realize the early warning and alarm of the corrosion degree and leakage of special equipment and pipelines;

2. In the past, most of the oil and gas leakage accidents were not discovered because of the initial small problems until they developed into a big one. Before that, the monitoring of dangerous sites and accident-prone sites was not systematic and the supervision was not strict, which led to great disasters. In the future, all operation scenarios can be networked, real-time video analysis can realize the alarm of original leakage, smoke and fire in dangerous sites;

3. Achieve the transformation from manual inspection to intelligent inspection, and the real-time video analysis is used to intervene and alarm some violations of rules and regulations of personnel in dangerous areas. By using sensors, augmented reality eyes, UAVs, intelligent robots and other tools, the real-time, accuracy and visibility of inspection are greatly improved, and the inspection efficiency is improved;

4. From the collaborative transformation of enterprises to enterprises, the early warning and alarm information is actively pushed to the personal terminal or intelligent mobile terminal of relevant personnel;

5. After decades of development, China's oil and gas industry has accumulated a lot of process technology, practical experience and expert knowledge, but most of them are fragmented and unsystematic. Affected by the space and technology at that time, a lot of knowledge is scattered around the industry without high-quality industrial chain. Under the background of industrial Internet of things, the platform will automatically collect the behavior data of operators, and the working status of the
equipment is recorded in the database for retrieval;
6. Enable multiple users log online at the same time to achieve the supervision and management of the scene;
7. Evaluate and analyze the safety level of key dangerous sites at any time.

3. Research on application scenario design of Jereh equipment

In the new round of Internet of things infrastructure construction, Jereh IOT will realize the digital level of comprehensive monitoring, remote operation and maintenance, intelligent equipment control, supply chain management, energy saving and consumption reduction in the global scope of Jereh equipment business. Typical application scenarios and practices are extended through the needs of specific scenarios to analyze interactive scenario, enrich equipment monitoring scenarios, optimize product remote operation and maintenance work, remind the equipment of alarm, troubleshooting, maintenance, repair or dispatch workers, analyze equipment health and optimize other functions. Pain points such as equipment safety, operation safety, environmental protection of the oil and gas industry are deemed as the starting point of platform construction.

![Cloud function architecture of the Internet of Things](https://csdn.net)

**Figure 6** Cloud function architecture of the Internet of Things  
*Source: CSDN*

### 3.1. Typical application scenarios and Implementation

The first is the detection and management of equipment management status. According to the screening conditions such as region, well site, drilling crew, equipment model and leasing conditions, it conduct reasonable management of regional equipment. Besides, the usage time of different equipment is also divided by grade color service life according to the different colors of the current equipment operation status. Through the sensor and fault code, the platform will enter the equipment fault alarm. Through the digital twin modeling of physical equipment geometry, historical operation data and real-time detection results, the remote control of equipment maintenance, adding accessories and condition evaluation is realized.

![Jereh IOT part of the page](https://csdn.net)

**Figure 7** Jereh IOT part of the page
The second is the promotion of general configuration system, equipment operation and comprehensive management ability. Jereh Equipment has a 3500 Mu manufacturing industrial park with an annual production capacity of more than 900 sets. It has successfully developed 15 kinds of heavy equipment, such as turbine fracturing truck, 7000 meter drilling rig and super large intelligent coiled tubing equipment. With a huge user base, its products are distributed in more than 60 countries and regions around the world, as well as its the equipment. After users log in to the IOT system of Jereh equipment, they first need to carry out configuration company management, customer management, regional management, approval process management, and then configure the drilling crew management. The next is to configure the corresponding equipment type management, model management, statistical parameter management, etc. After configuration, the home page would show all tenants statistics in equipment, well sites, leasing and drilling crew, as well as the GIS distribution of well sites.

The third is the equipment maintenance. When the equipment was damaged and needed to be replaced urgently, the maintenance personnel could log into the system to enter the maintenance record center, and fill in the maintenance application of the corresponding equipment, including the basic information of the equipment, whether to use accessories, whether to select the approval process, and whether to dispatch workers. After submitting for approval, the approval process starts to flow internally with corresponding maintenance record. If the approval is rejected by the leader, the submitted maintenance record will be deleted. After the final pass, the user will be prompted. Under urgent scene situation, the maintenance personnel could also repair the equipment first and then, supplement the maintenance records after logging IOT.

The forth is the equipment leasing business. When Jereh needs to rent a certain equipment, the user will log in and enter the equipment leasing business page to edit the equipment leasing information and submit the application. If approved, the status of the equipment can be automatically changed to leased. If rejected, the device will automatically return to the pool list. Users who apply for equipment rental can enter the page of My Application to see if the rental is successful. Another case is that if a customer has finished using an equipment which has been leased before, Jereh can log in to the system, enter the allocation page and transfer the equipment to customer B.

4. Research Results of Jereh Equipment IOT Design

The digital transformation of oil and gas industry is essentially the deep integration of information technology engineering and industrial manufacturing technology. The goal of building Jereh equipment Internet of things is to realize the comprehensive improvement and high-quality development of the industry. We must conform to the general trend, promote the technological revolution and mechanism revolution of new energy by means of digital intelligence, and achieve innovation driven and ensure energy security by the deep integration of information technology and industrial technology.

The petroleum equipment industry should put the protection of ecological resources in a prominent position, and solve the pain points of superposition of hazard sources and pollution sources in the equipment operation site by informatization and intelligence. As regard to a series of pain points, Jereh equipment IOT (Internet of things) has made functional configuration in the following aspects: firstly, it promotes independent innovation, highlight demand orientation and carry out and key and common technology research and development for related core technology issues in the development of petroleum equipment industry so as to promote the breakthrough and industrialization adaptation of core software and hardware. Secondly, the supply chain module is optimized in the platform to ensure the supply of downstream enterprises of products, and realize the optimization of the whole process, rational utilization of resources and value optimization of petrochemical supply chain. The third is to improve the ability of intelligent operation and assistant decision-making in the Internet of things; Fourth, improve the safety management ability, focus on the research and development and promotion of state monitoring, remote accident diagnosis and predictive maintenance solutions for key refining and chemical plants; Fifth, improve the comprehensive management ability of energy and equipment. Only by improving the accuracy and timeliness of the system in these aspects can the management of the whole process be improved.
The industrial Internet continues to cooperate with the outside world and actively lay out industrial digitalization with an open mind. In the future, under the joint efforts of the whole society, the industrial Internet will surely in more rapid development and promote the economic and social digital transformation and high-quality industrial development.

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