# Research on digital transformation and application of key business of power grid planning

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**Abstract.** As the basis for the construction and development of the power grid industry, power grid planning not only affects the development direction of power grid enterprises, but also determines the economic level, social stability and quality of life of urban residents. In the construction and development of the new era, the digital transformation of power grid planning business is an important part of the construction and improvement of the digital power grid system, which will guide the power grid planning business to develop stably in the direction of intelligence, automation and information, actively create a safe and reliable smart grid, and lay a solid foundation for improving the development level of power grid enterprises. Therefore, after understanding the current digital transformation goals and development status of power grid planning business, this paper mainly explores the specific plan for the transformation of power grid planning business of a regional power enterprise according to the structure and transformation requirements of the new power system, and finally explores the practical significance of digital transformation according to the construction effect and development goals, providing a reference for the reform and development of the power industry.

**Keywords:** power grid planning; Key business; Digital transformation; Electric power system; Business form.

## 1. Introduction

As an important stage for the national carbon peak, the 14th Five-Year Plan actively builds a new energy system at this stage, and controls the total amount of energy through precise prevention and control of energy indicators, which can not only improve energy application efficiency, but also meet the development needs of renewable resources. In the context of economic reform and development, by upgrading and optimizing the existing power system, organic and power resources, ensure that the power supply meets the needs of social development. Nowadays, in the face of the development trend of energy reform, the power industry applies advanced technologies such as big data and artificial intelligence to the development of power grid business, changes the traditional power grid business relationship through technical support, and lays a solid foundation for the transformation and development of power grid business. Understanding the new power system architecture and application functions can be seen that it contains a lot of content, in addition to development planning and important factors, but also includes software development, equipment supervision and control modules. Some scholars have proposed in their research that the reason why the new power system has a far-reaching impact is that in its reform and development, new energy

technology is regarded as the main basis, the work process reform is regarded as the development power, and the power supply system is constructed in an all-round digital and intelligent way, which can fundamentally guarantee the safety and rationality of power supply. In addition, the new power system also has the advantages of green environmental protection and economic suitability, which is a technical method to change the traditional operation mode by using digital information. [1.2.3]

According to the current operation of the power grid system, the digital transformation goals of the power grid business are divided into the following points: First, scientifically solve the basic data problems that affect the quality and efficiency of the power grid business. At present, power enterprises will plan their services according to basic data, so improving data quality is an effective means to ensure the safety and specification of power grid planning services. Since the data information obtained by enterprises comes from multiple subjects and multiple systems, the data source is relatively complex, the data amount is relatively large, the technical means is imperfect, and there are restrictions between platforms, so the data loss and application quality have become the main factors hindering the improvement of the quality of power grid planning business. In the digital transformation of power grid business, the smart grid construction and digital grid construction transformation as development opportunities, comprehensive consideration of power grid planning, production, marketing scheduling and other business needs, gradually establish digital collection methods consistent with the development of the new era, and from the development needs of various fields, professions, departments and other aspects of the real implementation of data information sharing application. Finally, an all-directional visualization and controllability digital power grid business system is formed; Second, continue to improve the efficiency of power grid planning business reform. Taking the digital transformation of power grid business as a development opportunity, we should scientifically sort out and effectively regulate the relevant business and management mechanisms of upstream and downstream, comprehensively grasp the business process of power grid enterprises, and reduce repetitive and ineffective work contents after forming a closed-loop management mode, and propose effective measures based on problems, needs and goals, so as to improve the work efficiency and quality of power grid business. In the continuous development of big data technology, the reform of digital power grid business should change the traditional management model and focus on the use of advanced technologies such as artificial intelligence to solve complex problems and core problems; Finally, the technical guidance and service functions of power grid planning business are extended to a larger platform. In the digital transformation and development of power grid business, guide power grid enterprises to build good cooperative relations with government departments, enterprise users and urban residents, establish a safe and smooth information exchange platform, improve the response, speed and processing capacity of business needs, and finally realize the harmonious development of power grid, load and power supply. Therefore, after understanding the contents and objectives of the digital transformation of key business of power grid planning, this paper mainly explores the transformation process and final results of the business implementation of power enterprises in a certain region according to the structure and transformation requirements of the new power system, so as to provide reference for the reform and development of power grid enterprises in the new era. [4.5.6]

# 2. Method

## 2.1 New power system structure

The new power system regards new energy as the main body of operation, realizes the digital transformation and development on the power grid side, and builds the integrated operation mode of source network load and storage on the consumption side. In the working state of the system, the realization of the dual-carbon target is regarded as the main basis, the management level and safety performance of the smart grid are comprehensively upgraded, and the energy is expanded and extended in the aspects of business and industry. Combined with the structural analysis shown in Figure 1 below, it can be seen that it includes two parts: the energy grid system and the system support system. The former will coordinate the relationship between the load and storage of the source network and at the same time, Realize multi-energy coupling and multi-source aggregation and complementation, comprehensively upgrade the functions and technical software of the existing power system, and ensure the secure and rapid supply of energy; In the digital transformation of the power grid, the latter focuses on improving the capabilities of information collection, information transmission, information processing, information application, and security management, and accelerates the upgrading and development of the smart grid.

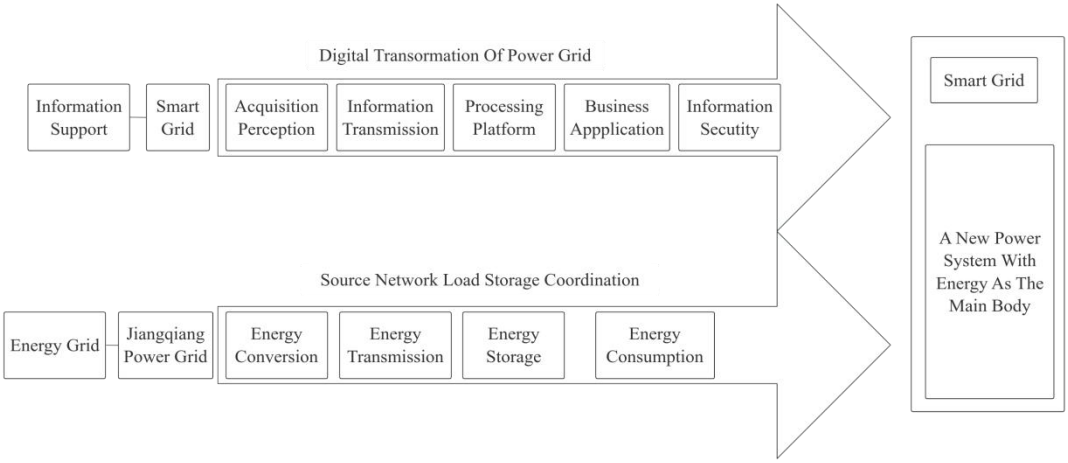


Figure 1 Architecture diagram of the new power system

Based on the above analysis, we can see that this new system structure, with a high proportion of distributed power supply, can provide universal services and big data value-added services, fully meet the needs of power users in the new era, and at the same time, the infrastructure is digitally enabled, effectively docking with the resources of all links of the energy value chain, and truly serve the digital government and smart city. It reflects the mutually beneficial relationship between enterprises and contributes to the foundation for the creation of smart cities and digital economy. [7.8.9]

## 2.2 Transformation Requirements

According to the analysis of the development direction of the new power system, the various businesses of the power grid enterprises should also meet the requirements of digital transformation, and put forward intelligent, restrictive and flexible development countermeasures. From the perspective of long-term development, the digital transformation requirements of key business of

power planning are reflected in the following points: First, under the condition of accessing distributed power supply, energy storage, multiple loads and other elements, it is necessary to ensure the mutual promotion and multiple interaction of new power systems, master and analyze more data information in flexible operation, and finally propose scientific and effective management decisions; Secondly, due to the randomness of distributed power supply, the uniqueness of multiple compliance, and the uncertainty of demand response, the network operation of existing power enterprises is faced with many challenges, and the traditional constraints can no longer meet the demand. Therefore, enterprises should comprehensively consider the constraints such as economy and power quality, and make effective planning and scientific management and control by using a variety of constraints. Thirdly, according to the business needs of flexible planning, when planning and controlling the power system of renewable energy, by adjusting the system framework, upgrading the technical methods, and constantly expanding the basic connotation, etc., the source side can truly allocate sufficient and flexible resources, and the network side can build a flexible support platform to meet the various needs of energy operation in the new era. Finally, the new power system will realize the digital twin construction requirements of the physical power grid, and use three-dimensional simulation technology and VR technology in the whole process from planning, construction to operation, and finally make and implement various decisions under visual conditions.［10.11.12］

## 3. Result analysis

Taking the grid planning business of a regional power enterprise as an example, the manager proposed a three-stage digital transformation architecture and implementation path. From the perspective of application technology, the overall business planning is divided into the following contents: First, all work is carried out based on the time-domain big data; Secondly, the influence of flexible resources such as distributed power supply on the power balance is analyzed comprehensively. Thirdly, the time domain simulation is the basic computing tool needed for management. Finally, in the formulation and selection of schemes, comparative research should be carried out according to the simulation results of big data analysis. Among them, the contents and results of each stage are as follows:「13.14.15」

In the first stage, the enterprise mainly studied the needs of the current digital transformation. According to the industry planning and business needs of the enterprise, and followed the basic principles of comprehensive coverage, hierarchical segmentation and tracing to the root, the business was divided into 5 categories, 18 categories, 68 sub-categories and some special projects.

In the second phase, the enterprise focused on the digital transformation path of the key business of grid planning. According to the current development status of the enterprise, the technical level and management level of the planning business are discussed from the three aspects of informatization, digitalization and intelligence, and the corresponding transformation and development path is clearly defined. On the one hand, from the technical perspective, it includes grid diagnosis and analysis, composite prediction, power supply planning, electrical calculation, etc. The specific path is shown in Table 1 below:

Table 1 Analysis of digital transformation based on technology

| category | status | informatization | digitization | Intelligence (goal) |
|---|---|---|---|---|
| Power grid diagnosis and analysis | Power grid diagnosis of | Automatic identification | Diagnosis and analysis of | Full-time domain, big |

| | | | | |
|---|---|---|---|---|
| | extreme working conditions and equipment operation data | and diagnosis of problems, the relationship between problems and equipment geographic information | power grid with multi-operating conditions and big data | data, intelligent power grid diagnosis and early warning |
| Load forecasting | Annual Spatial Conventional Load Forecasting | Automatic space load forecasting | Multi-intelligent spatial load forecasting | Full-time, self-learning load forecasting |
| Power planning | The power supply plan | Scheme formulation of auxiliary access system | Power planning of automatic collection | Proactive power planning |
| Electrical calculation | Simple network computing | Electrical simulation of automatic parameter extraction | Electrical simulation of multi-time and automatic parameter extraction | Full-time domain simulation calculation of distribution network |

On the other hand, from the perspective of management, it includes digital management, connection with government planning, planning cycle, planning orientation, etc. The specific path is shown in Table 2 below:

Table 2 Analysis of digital transformation based on management level

| category | status | informatization | digitization | Intelligence (goal) |
|---|---|---|---|---|
| Data management | Limited data usage | Data center gathers internal data. | External digital convergence, data management | data asset management |
| Linking up with government planning | Irregular inclusion in municipal planning | Promote cooperation between government and enterprises | Two-way big data sharing | Closely linked with government planning |
| Planning cycle | Periodic programming | Periodic online programming | Big data support planning | Real-time intelligent planning |
| Planning orientation | Demand oriented passive planning | Multi-objective constrained programming | Planning of Multi-domain Big Data Sharing | Guide the active planning of demand |

Combined with the results of the two aspects of the transformation path, the transformation plan proposed according to the detailed content can ensure that the pace of business transformation is more secure and stable. Taking power grid diagnosis as an example, after comprehensively considering the development status, the transformation contents and main objectives are defined from the directions of informatization, digitalization and intelligence. The specific results are shown in Table 3 below:

Table 3 Transformation contents of power grid diagnosis

| status | informatization | digitization | Intelligence (goal) |
|---|---|---|---|
| 1.Typical daily maximum load moment; 2. Based on equipment operation data+Current power grid ledger for power grid diagnosis. | 1. Associated with geographic information system to realize the management and display of diagnosis problems and graphs; 2. Establish a closed-loop correlation mechanism of problem-project-effectiveness evaluation. | 1. Introduce meteorological, land and resources, municipal and other external data; 2. Based on the big data analysis technology, the power grid diagnosis and analysis under the scene are carried out; 3. Intelligent equipment health status, realizing multi-dimensional and differentiated evaluation. | 1.Using deep learning model, the state prediction model is generated, and the running state of equipment is predicted in full time domain; 2. Real-time analysis and early warning in full-time domain, holographic image display and identification. |

Taking planning orientation as an example, after understanding the current development situation of power grid enterprises, we also start from the directions of informatization, digitalization and intelligence, and finally obtain the transformation results as shown in Table 4 below:

Table 4 Contents of planning-oriented transformation

| status | informatization | digitization | Intelligence (goal) |
|---|---|---|---|
| 1. Meet the new load demand: 2. Demand determines the construction. | 1.Based on the goal of dual-carbon development and the requirements of energy internet construction, expand the planning boundary to energy and environmental protection; 2. Power grid | 1.Build an energy big data center to realize the monitoring of energy consumption in the whole region, industries and users; 2. Realize carbon emission monitoring and footprint tracking. | Intelligent analysis tools are introduced to realize the fusion analysis of power, energy and carbon emission data, explore the deep reasons and realize the fusion planning. |

| | | | |
|---|---|---|---|
| | planning technology covers the planning technical requirements after boundary expansion. | | |

In the third stage, we have mastered the relevant objectives and transformation paths, and on this basis, we build a digital project with informatization, digitalization and intelligence as the core, and get feedback needs through construction and application, and finally support the digital transformation of key businesses. From the perspective of overall construction and development, this transformation model can realize the asset-based management of all data, all decisions are made using big data analysis and artificial intelligence algorithm application analysis, and the development needs are guided according to business planning, and the final income obtained by the enterprise can increase by about 10% to 20%. It can be seen that under the background of the reform and development of the new power system, the key business of power grid enterprises should realize the digital transformation, and on the basis of integrating and optimizing the information system, the rational use of new basic means should be made to improve the technical capabilities of hardware and software, improve the internal management and operation mode of enterprises, and guide the high-quality and efficient development of power enterprises.

## Conclusion

To sum up, although there are many research topics on digital transformation at home and abroad, scholars from various countries have realized the practical significance of the construction and development of new power systems, and have clarified the main goals and fundamental needs of the digital transformation of key business of power grid planning, but there are still many problems in practical development. Therefore, in order to better achieve the dual-carbon goal, the key business of power grid enterprises should continue to use advanced technical means, gradually optimize and adjust the energy structure, and finally ensure that the construction benefits of power grid enterprises are maximized on the basis of reasonable distribution of energy resources.

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