Industrial Internet Development Strategies and Innovative Practices for Large Energy Corporation

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Abstract. One major difference between the Industrial Internet and the traditional concept of the Internet of Things is that the Internet of Things advancement route emphasizes "network-centric" communication connections between things, while "things" themselves do not have intelligent features. The Industrial Internet and platforms are built on smart machines, with the ability to interact, anticipate and react quickly from the beginning as terminals, so that networked connections and systems between smart machines can create greater value. This paper focuses on the major strategic issue of industrial Internet construction of large energy enterprises, and proposes strategic thinking to adapt to the new normal of energy enterprise development and promote the overall transformation and development of enterprises. The practical path of digital transformation and development of large energy enterprises is discussed with the example of large energy groups implementing digital development strategies, with a view to providing theoretical reference and practical guidance for the construction of digital transformation and upgrading systems in the energy industry.

Keywords: Industrial Internet, manufacturing, electricity, development strategies.

1. Introduction
The current application of Internet technology is profoundly changing human production and lifestyle, and the digital economy is becoming an important driving force for countries to grow new industries, enhance traditional industries and achieve sustainable growth [1]. The work of network information technology, digital economy, network powerhouse digital enterprise etc [2], has risen to the development strategy of many countries. The Internet, big data, artificial intelligence and other technologies have entered a new stage of deep integration with the real economy. For example, German Industry 4.0, Made in China 2025 both have industrial intelligence as one of their development goals [3].

In recent years, energy enterprises gradually pay attention to the construction of industrial Internet system, the Internet, big data, cloud computing as the key technology for enterprise development. Large energy enterprises through the development of industrial Internet technology, intelligent energy technology, promote the digital transformation of enterprises, leading the development of the energy...
industry [4]. However, one major difference between the Industrial Internet and the traditional concept of IoT is that the IoT route of advancement emphasizes "network-centric" communication connections between things, while the "things" themselves do not have intelligent features. The Industrial Internet and platforms are built on smart machines (smart equipment), with the ability to interact, anticipate and react quickly from the beginning as terminals, so that networked connections and systems between smart machines can create greater value [5].

The purpose of this article is to analyze how large energy enterprises can efficiently build and develop the industrial Internet, propose to adapt to the development path of energy enterprises, and provide the overall digital transformation development strategy of enterprises. In order to provide theoretical reference and practical guidance for the construction of the digital transformation and upgrading system of the energy industry.

2. Opportunities and challenges
Large energy companies are particularly concerned about the development of the industrial Internet. Its development can accelerate the digital industrialization of enterprises. Relying on information technology innovation to drive enterprises, they continue to give birth to new industries, new patterns and new models, and promote new development with new dynamic energy. Enterprises to promote the digitalization of industry, the use of new industrial Internet technology and new applications of traditional industries to carry out a full range of all-round of transformation [6].

2.1. Opportunities
There are three main opportunities for the development of the industrial Internet for large energy enterprises.

First, through the construction of an industrial Internet platform to enhance the quality of the power group's management and control, and strengthen strategic leadership. Through digitization, the Group's three-tier control system is improved, and processes between the vertical headquarters and molecular companies and horizontal functions are integrated, data, wages and hierarchical control are realized. Building a "full-featured integrated work platform" by job and hierarchy. Enhance the Group's strategic control capability, realize strategic closed-loop management, realize transparent control and intelligent decision support for important businesses, especially major projects, and build a data center to support business management. Based on the comprehensive informationization of all functions, the Group has established a shared service center to realize the transformation of the support service process to standardized and intensive.

Secondly, the development of industrial Internet technology will enhance the Group's operational production efficiency and support deeper reform. Build digital-driven and intelligent planning, construction, production, maintenance and marketing capabilities to meet the requirements of large-scale development and specialized operation of new energy sources, guarantee the production of a variety of traditional energy sources and new energy power sources, and meet the operational requirements of the complementarity of traditional and new energy sources. Build an ecosystem of intelligent energy supply and improve the way of collaboration and efficiency within and outside the enterprise. Through digitalization, we promote deeper reform and provide a vehicle for building first-class energy enterprises with institutional processes, tools for executive supervision, the basis for operation and production, innovation of business models, communication platform for enhancing employee communication, richer services, and more convenient operation.

Third, to promote the continuous innovation and development of enterprises and promote high-quality development by enhancing the innovation capacity of the industrial Internet. As the driving force of enterprise innovation and development, the in-depth application of digitalization and information technology will bring unprecedented innovation capability to enterprises, and bring new possibilities for innovation models and services by focusing on building and gradually precipitating the basic capability of industrial Internet technology innovation at the group level. At the same time, digital and intelligent means as a new medium for the future energy value chain from production to
service, will bring a pioneering role for the future industrial layout planning and expansion of enterprises.

2.2. Challenges
Large energy companies are asset-intensive, equipment-intensive, capital-intensive, technology-intensive and talent-intensive. Corporate assets are characterized by long life cycles and high values. How to use industrial Internet technology to achieve the goal of digital transformation of energy enterprises is fraught with challenges.

One is that there are certain technical risks associated with digitalization, investment and return, business model is still unclear, and the introduction of relevant policies is lagging. For example, there is a rapid trend towards digitalization and emerging technologies are constantly being created. However, the development of digital technology needs to be strengthened in terms of application promotion, breaking down software ecological barriers and increasing financial investment. To address the characteristics of small, scattered and weak industrial software enterprises, provide relevant policy support, reorganize and merge software departments of state-owned enterprises, form large industrial software enterprises, solve the problems of enterprise industrial software related to more confidential, relatively independent R & D use, sharing difficulties, weak R & D capability, interface is not uniform, high intellectual property risk.

The second is the need to strengthen the pilot demonstration management, experience needs to be summarized and disseminated, timely application for intellectual property rights, the development of standards, and summarize the results; we should make efforts to do a good job of resource coordination, production, supply and demand docking, the depth of the binding of interests and other work. Leverage market technology advantages and promote the overall development of the digital industry based on the actual use of industry software and development priorities.

Third, data management is a more difficult issue, data sensitivity is important, data standardization, algorithm model development, core chips, visualization technology is a card-neck link; at the same time, strengthen open software, cloud computing, big data, artificial intelligence new generation of information technology and software integration and fusion application[7]. Do a good job of the industry, academia and research system under the cloud architecture. Industrial scenarios, manufacturing needs-oriented, state maintenance, scientific decision-making.

Fourthly, there is the issue of network security, the use of a large number of new information technologies to manage the boundary is blurred; information security is very risky and in practice it is slow to spread. Strengthen the application of cybersecurity information technology such as dynamic awareness, whitelisting, etc., with clear management responsibilities. Important assets and equipment should pay attention to the research and application of industrial control and protection systems to prevent the occurrence of network information security incidents from the source.

Fifthly, there is a lack of composite talents, who have to have both a background in electricity and familiarity with other professions such as computers, mathematics, statistics, analytical diagnosis and so on. Emphasis is placed on the cultivation of IT and OT integration talents and team building. The company actively cooperates with high-level universities and research institutes to conduct research and training courses on artificial intelligence projects, so as to form a talent scale effect as soon as possible, and continue to strengthen the deep integration with economic, equipment control, telecommunications networks and other related fields.

3. Key Tasks for Industrial Internet Development
With the continuous emergence of industrial Internet technology, rapid and innovative digital application scenarios will become the key to the success of enterprise industrial Internet construction, and these are dependent on data-centric intensive, professional digital foundation capabilities, which are data capabilities, perception capabilities, network security and guarantee capabilities, organizational personnel capabilities. Enterprises should collaboratively build the four major industrial Internet
capabilities in accordance with the new architecture, and initially realize the digital transformation of enterprises.

3.1. Data capacity
Data is the foundation of all kinds of industrial Internet technology and technological innovation; therefore, enterprises need to establish a unified data governance system, centralized construction and hierarchical application of enterprise data architecture, in order to form digital assets, safeguard data governance, achieve data sharing, innovative data application. Specifically, the Group should manage the generated data in four dimensions: strategic planning, organizational responsibilities, institutional processes, and management performance, including the management of data quality, management of data standards, management of data architecture, management of master data, management of data security, and management of the data life cycle. Ensure that data can deliver value through comprehensive data management in multiple dimensions [8].

3.2. Perceptual capacity
The rich and comprehensive data that can reflect the internal and external operation and production status of an enterprise in a timely manner relies on the ability to perceive the real-time status of key elements such as electricity load, power generation equipment, station environment, operation and logistics through the industrial Internet. Therefore, through the construction of the Energy Internet of Things, combined with the application of big data and artificial intelligence, can effectively improve the refinement of production capacity, optimize production control and operation [9].

Through fast access, application, and control of smart devices, it is possible to realize the transformation of OT and IT data, precipitation, and the docking ability of multiple-use awareness layer. The whole process is divided into four steps, the first step is the IOT terminal parameter management, the second step is the industrial Internet terminal access, the third step is the protocol and data conversion, the fourth step is data acquisition and terminal control.

There are three types of typical application scenarios for perceptual abilities. The first category is equipment failure warning, which can be sensed by sensors, and then the relevant information is passed to the diagnostic analysis module, through which failure warning is carried out. The second category is operational optimization, which allows the simulation of processes through models, dynamic optimization through data, feature prediction and parameter verification. The third type is equipment condition overhaul, which can be combined with equipment overhaul history and family defects through intelligent terminals, intelligent robots, and equipment measurement points to carry out equipment deterioration analysis, and at the same time carry out equipment condition overhaul at the right time. Effective application of industrial Internet technologies for the three types of scenarios is the key to success.

3.3. Cyber security capabilities
Enterprises to promote the industrial Internet means that the management and production of enterprises rely more and more closely on network information technology, network security has become the basis for the healthy development of enterprises, safe production. Therefore, power generation enterprises should build a secure big data analysis platform based on a sound and systematic network security foundation, discover network threats that cannot be covered by traditional defense software through machine learning and combined with network-wide threat intelligence, trace the attack means and provide timely and actionable solutions.

The basic features of a big data-based network security system are visible, knowable, manageable, controllable, traceable and early warning. It is divided into three layers, from the bottom up, which are cybersecurity foundation layer, cybersecurity insight layer and cybersecurity management. A sound and systematic network security foundation should have basic network security management capabilities, a sound network security system norm, effective protection of organizations and personnel network security, and network security incident response capabilities. At the same time,
infrastructure security, such as host security, network security, physical and environmental security, should also be ensured. Application security, terminal security, data security and disaster preparedness and business continuity management capabilities should also be safeguarded. The cybersecurity insight layer should leverage digital technologies to build capabilities such as threat analysis, risk prediction, and traceability analysis. The cybersecurity management should build a cybersecurity situational awareness platform with capabilities such as cyber posture assessment, cyber threat assessment and cyber posture prediction.

A sound cybersecurity situational awareness should have application security, data security, terminal security, infrastructure security awareness, and should have pre-audit and post-inspection functions to ensure enterprise cybersecurity through three lines of defense. Pre-emptive control at the first line of defense, with security management, security technology, security organization capabilities. Control in the event of a second line of defense to ensure the safe operation of the system. Ex post facto control on the third line of defense with emergency recovery capability.

3.4. Organizational human capacity
The implementation of industrial Internet innovation and development ultimately needs to rely on personnel organization as the core to promote, digitalization requires personnel organization capabilities are different from information technology, therefore, the company's IT department needs to cultivate new capabilities in terms of organization and skills to match with digital needs.

The digital organization of the future should have three "new" organizations, namely, "new" organizations, "new" thinking and "new" skills. Build new organizations that enable future IT to meet the increased content, scale and complexity of work. Therefore, IT departments need to have a matching organizational structure and scale, and at the same time, to transform the talent level from the traditional pyramid type to a diamond type that can provide quality services, complement and optimize the talent intelligence structure, while at the same time, the concept and thinking of digitalization is embedded in the cultural DNA of the department. Cultivate new thinking, adapt employees to new ways of writing internally and externally, have a more open mind and market-centered awareness, and understand working with a fast iterative, sprint-win model. Develop new skills, add experts with digital skills to the team and lead the digital transformation from a technical standpoint.

4. Digital innovation case- power generation monitoring, diagnosis and service platform
In order to achieve the goal of building a world-class energy enterprise, large energy enterprises promote management innovation, business model innovation and scientific and technological innovation by carrying out industrial Internet intelligent power generation monitoring, diagnosis and service platform construction [5]. By deploying two monitoring and diagnostic technologies based on mechanical and mathematical models, the platform provides remote intelligent monitoring and diagnostic services for multiple power plant equipment, builds a new business model of industrial knowledge reuse and knowledge promotion services, takes the lead in establishing the first data monitoring and diagnostic center in the industry, implements organizational management model changes, breaks the original production and operation management model of power plants, and cultivates a group of digital and industrialized composite talents.

As an important pillar of the national energy revolution and industrial revolution strategy, the power generation industry is characterized by long life cycle and high value of its assets, and asset control capacity and management quality are particularly important. However, there is a lack of unified and efficient digital and intelligent analysis and management tools for the full life-cycle evaluation, operational reliability and economic improvement of the fleet assets. The project builds a monitoring and diagnostic platform based on artificial intelligence technology by using two basic platforms of cloud computing, big data and three general technology systems of machine learning, pattern recognition and human-computer interaction, and integrates two complementary monitoring and diagnostic technology principles to improve the relevance, universality and stability of monitoring
and diagnostics, and realize the intelligent early warning of field equipment and the intercommunication of information data.

Creating new business models for innovative knowledge services. With the continuous upgrading of digitalization and information technology innovation applications in the power generation industry, the existing decentralized operation model, matrixed organizational structure is increasingly difficult to adapt to remote monitoring and diagnosis, cloud computing, the Internet of Things emerging information technology as the core of innovative applications. Enterprises should pay attention to the establishment of a business model applicable to industrial knowledge reuse and knowledge services, build an exponential organization, realize the deep participation of site personnel in monitoring and diagnosis work, improve the effectiveness of monitoring and diagnosis, realize the whole system, the whole process of organizational management innovation. Through business model innovation, the company achieves management optimization, operation optimization and equipment management optimization, supports production and management decisions, improves market-oriented management, and builds a value assessment system with business operating conditions.

Explore new paths for digital transformation in the power sector. In the context of the continuous development of the new generation of information technology, the digital transformation of the power generation industry needs to explore new paths. The organizational system, system, management system and value system summarized in the case study have important exemplary significance and can promote the industry transformation and upgrading to create business value and social benefits. The establishment of data monitoring and diagnostic center, central power plant exponential organization and interactive management model, predictive diagnostic case value assessment system, all lay the foundation for monitoring and diagnostic business operation and value realization, and make strong exploration for the digital transformation of the power industry.

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References
[1] P. Goel, A. Datta and M.S. Mannan, “Industrial alarm systems: Challenges and opportunities,” Journal of Loss Prevention in the Process Industries, vol. 50, 2017.
[2] C. Sanin, H. Zhang, I. Shafiq, M.M. Waris, C.S.D. Oliveira and E.J.F.G.C.S. Szczerbicki, “Experience based knowledge representation for Internet of Things and Cyber Physical Systems with case studies,” vol. 92, no. MAR., 2019, pp. 604-616.
[3] Wei, Congying, Xu, Jian, Liao, Siyang, Yuanzhang, Jiang and Yibo, “A bi-level scheduling model for virtual power plants with aggregated thermostatically controlled loads and renewable energy,” Appl Energ, 2018.
[4] X.L. Chen, P.H. Wang, Y.S. Hao and M. Zhao, “Evidential KNN-Based Condition Monitoring and Early Warning Method with Applications in Power Plant,” Neurocomputing, 2018.
[5] Y. Yang, Y. Yang, X. Li, X. Li, Z. Yang, Z. Yang, Q. Wei, Q. Wei, N. Wang and N. Wang, “The Application of Cyber Physical System for Thermal Power Plants: Data-Driven Modeling,” Energies, vol. 11, no. 4, 2018.
[6] G.J. Gong, Y. Sun, M.M. Cai, R.Z. Wu and L.R. Tang, “Research of network architecture and implementing scheme for the internet of things towards the smart grid,” Power System Protection & Control, vol. 39, no. 20, 2011, pp. 52-58.
[7] M.H. Eldefrawy, N. Pereira and M.J.I.Io.T.J. Gidlund, “Key Distribution Protocol for Industrial Internet of Things Without Implicit Certificates,” vol. 6, no. 1, 2019, pp. 906-917.
[8] P. Goel, A. Datta and M.S. Mannan, “Application of Big Data analytics in process safety and risk management,” Proc. 2017 IEEE International Conference on Big Data (Big Data), 2017.
[9] A. Singh S. Garg K. Kaur S Batra N. Kumar and K.-K.R.J.I.T.o.I.I. Choo “Fuzzy-Folded Bloom Filter-as-a-Service for Big Data Storage in the Cloud,” vol. 15, no. 4, 2019, pp. 2338-2348.