DIGITAL TRANSFORMATION IN THE DEVELOPMENT STRATEGY OF VIETNAM ELECTRICITY: SOME PROPOSALS ON DIGITAL TRANSFORMATION IN POWER GRID INSPECTION TECHNIQUES

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ABSTRACT:

In the development strategy of Vietnam Electricity (EVN), digital transformation plays a very important role in the development of the electricity industry in Vietnam. The EVN and its member units have implemented digital transformation with high determination and many synchronous solutions. This paper outlined EVN's digital transformation successes in recent times that not only bring direct benefits to EVN and electricity customers but also contribute to building the digital economy in Vietnam. In addition, the paper proposed important ideas for digitally converting power grid inspection techniques, helping EVN complete the digital transformation process in the following years.

Keywords: digital transformation, development strategy, Vietnam Electricity.

1. Introduction

With dynamism and creativity in labor, production and business, over the past many years, Vietnam Electricity has completed the plans assigned by the State and meeting the country's electricity demand. Over the past many years, the Electricity industry has been achieving many outstanding achievements. From a poor and outdated power network system, up to now, the national power system and power network has ranked 3rd in Southeast Asia, 31st in the world (2015) [6]. Furthermore, the Electricity industry have a strong team of human resources with high professional qualifications, rich experience, many initiatives, and the ability to master science and technology, advanced electrical engineering in management and production.

Therefore, this study examines "Digital transformation in the development strategy of Vietnam Electricity - Some proposals on digital transformation in power grid inspection techniques" to make some proposals for digital transformation in power grid inspection techniques, helping to further complete the digital transformation process at EVN with the use of various smart devices in power grid inspection in

areas in different areas, especially in areas with many risks and extreme weather to improve the efficiency of inspection and safe operation of the line.

2. Digital transformation with EVN's development strategy.

The strategy aims to develop Vietnam Electricity into a strong economic group with sustainable, effective and profitable business; serve as the core for Vietnam's Electricity industry to develop rapidly, and take advantage of every opportunity to proactively transform into a digital enterprise.

Digital transformation plays an important role in the 4.0 Industrial Revolution and has important implications for businesses in general and electricity businesses in particular. According to Microsoft (2018), digital transformation is the integration of digital technologies into the operations of organizations to fundamentally change the way they operate, business models and provide new values to customers. It is a change in operating methods, processes, procedures, and culture, based on digital platforms, towards more effective goals.

In fact, businesses under EVN have transformed their business models towards digitalization according to EVN's orientation and development. Most of the group's main activities have been brought to the digital environment to varying degrees. Typically, in technical management and construction investment, EVN has standardized the database on the PMIS technical management system; applying RCM and CBM methods in repair and maintenance management to increase efficiency; applying artificial intelligence (AI) to detect abnormalities in production activities... In addition, the group has created a working environment between investors, consultants and contractors through construction diaries with electronic submission and electronic signature; Applying AI in construction supervision, quality inspection and controlling construction human resources... applying UAV, BIM, 3D technologies in surveying, design, construction management... Technology BIM is considered the "smart brain" of the modern construction industry and is the process of creating and using information models in the design, construction, and operation stages of projects. With BIM, information data will be stored on the cloud system, making it easy to exchange and interact accurately between project participants.[5], [10].

In particular, EVN has promoted bidding work through the electronic system of the Ministry of Planning and Investment. As a result, up to 99% of bidding packages were implemented by EVN online; Applying AI in image analysis to evaluate quality in construction steps; Build a database of material and equipment prices; build project file management folder; Manage procurement of materials and equipment with QR code application from procurement to assembly and installation of materials and equipment...[5], [10].

Comprehensive digital transformation throughout EVN has gradually become a reality as the group is upgrading application software to be able to operate on new infrastructure platforms and smart mobile devices. At the same time, the organization researches new technology platforms such as AI, BigData, IoT, and Blockchain for application in the group's production and business sectors.

3. Implementation results

During the 2021-2022 period, EVN and its units have implemented digital transformation in 5 areas: Internal management, construction investment, production, customer service business, telecommunications and information technology. In September 2022, the results of implementing the digital transformation task for the 2021-2022 period of EVN have reached an average volume of 85.5% and continue to implement the next stages until 2024.[8]

3.1. Digitalization of administration

Currently, 100% of EVN 's member units have applied the Digital - Office system, 100% of reports are circulated electronically, and 100% of managers have been granted digital signatures. EVN has completed the connection between the

digital office system and the national document communication axis and officially used it from 1/1/2020, not using paper documents, connecting with agencies belonging to the Government, ministries and central branches.[8]

3.2. Digitalization of the construction investment sector

EVN and its member units have applied electronic construction log books, electronic acceptance minutes and electronic project document management, etc. for thousands of projects, and at the same time applied digital signatures, electronic project records, etc. electromagnetic project diary, completing testing and deploying AI in image analysis and construction supervision and applying new technologies such as 3D, UAV, BIM from design survey to project implementation. In particular, EVN is one of the pioneers in implementing online bidding, highly appreciated by the Ministry of Planning and Investment.[8]

3.3. Digitalization of the manufacturing sector

EVN has completed updating 97.3% of operating electrical equipment data at factories and transmission lines from 110kV to 500kV. In repairing, maintaining and exploiting equipment effectively, the EVN has applied advanced repair methods such as RCM (reliability-based maintenance) for factories and CBM (condition-based maintenance conditions) for the power grid. In particular, successfully tested the application of AI in image analysis, identifying 20 equipment objects on the line to serve operational monitoring and detecting abnormal conditions of transmission lines.[8]

3.4. Digitalization of business and customer service

Digital transformation in EVN is bringing maximum convenience to electricity customers. EVN has installed 21.1 million electronic meters, reaching 70.9% of the total number of meters on the grid, which is an important basis for collecting and exploiting data to serve customers. EVN has also provided 100% online electricity services; multi-channel, multi-platform connection in the digital environment, helping electricity customers to register for services and connect with the Electricity industry anytime, anywhere, 24/7.[8]

In particular, the group has built the EVNCONNECT ecosystem, connecting with platforms: National Public Service Portal, electronic invoice system of the General Department of Taxation, National population database, digital platform of Thai Nguyen ID and Hue-S provinces; Connect to banks, e-wallets, Mobile Money, public administrative centers and public service portals of other provinces and cities.

In addition, EVN is also constantly improving telecommunications infrastructure capacity, applying digital technology platforms in exploiting and deploying information technology services; enhance the maximum exploitation of shared services and data to accelerate the process of building and implementing digital transformation programs in EVN.

4. Some proposals for digital transformation in power grid technical inspection from Asian countries

Proposals in digital transformation have been applied by many countries in many scenarios, providing direction for EVN in applying digital transformation in power grid technical inspection.

The traditional operating mode of power grid devices will be changed in the future. A comprehensive and around-the-clock automatic inspection regime is essential - helping to ensure the full operation and efficiency of transmission centers, extending the life of grid equipment, and ensuring supply security electricity for the entire system.

4.1. Method 1: Intelligent line inspection

Although UAVs are deployed in some areas for on-site operations, they are controlled manually, and UAVs cannot be used in no-fly zones and in extreme weather conditions. To improve inspection efficiency and risk inspection accuracy, and ensure safe line operation and reliable power supply, we need to deploy deploy smarter and richer inspection methods and faster and more reliable communication networks.

Table 1. Application of various edge/device collection devices in intelligent line inspection

Core Collection Device	Objective
UAV	Determine the distance between the line and the obstacle in real time through infrared thermal imaging/3D modeling
Radar + PTZ dome camera	Radar: Utilize millimeter wave technology with high precision and strong anti- jamming capability to realize all-weather, high resolution, and multi-target recognition for dynamic intruding objects. PTZ dome camera: Proactively takes snapshots and monitors and tracks the area coordinates detected by the radar.
Non-electrical quantity integrated sensor	Line running status: temperature, movement, etc. Route safety risks: icing, bird's nest, tree barrier, etc.

Key technology application 1: space-air-terrestrial integration + edge intelligence, making inspection intelligent.

1. Ground side and space: Various end-to-end collection devices, such as UAVs, radar dome cameras, and non-electrical sensors, complement each other to comprehensively sense and monitor intrusions on the tower foundation and abnormalities when operating the power grid.

2. Air side: The remote sensing capabilities of LEO satellites achieve comprehensive coverage and all-weather high-precision monitoring in real-time , complementing UAV inspection which is restricted by region and climate. Satellite remote sensing and technology technology will play an extremely important role in making quick decisions to overcome major disasters caused by extreme weather.

3. Edge intelligence: To meet timely and accurate requirements in monitoring, processing, analyzing data and the ability to react quickly to any abnormalities that occur as well as make appropriate decisions, based on cloud-based training and edge execution will be deployed as the standard mode of smart line testing in the future - relying on the powerful computing power of the cloud to achieve learning and modeling modeling of massive unstructured image data and structured running monitoring data are realized and enable edge and device through remote deployment.

Technology-based diagnosis will replace differential judgment based on personal experience. It will support and accurately judge exceptions and automatically generate alarms, improve grid inspection efficiency and ensure tower base security and power supply reliability.

Key technology application 2: developing a private power network for reliable communication

Power grid lines have different data transmission characteristics due to different geographical locations, voltage levels, and transmission distances. Therefore, for remote areas without signal coverage, optical communication technology based on MS-OTN or OPGW should be used to ensure communication transmission at distances of over 1000km. For medium and long distance transmission lines, microwave technology with high reliability, strong anti-interference ability, and high light availability can be used. For low voltage lines, cameras can be connected in wireless daisy chain mode for lightweight deployment due to short communication distance. Building a dedicated power network based on actual local conditions helps eliminate signal blind spots and improve data transmission efficiency.

In addition, businesses need to deploy solutions to protect multipath transmission and the ability to buffer and resume data at the edge. Data transmission should be implemented to ensure data continuity and consistency during path transitions.

Key technology application 3: achieving harmonized communication and sensing for next generation communication

By 2030, with the maturity of 5.5G/F5.5G/6G/F6G technologies, access networks will integrate communication, sensing and computing capabilities. Key technologies such as sub-millisecond latency, centimeter-level positioning, millimeter-level imaging, and fiber-based precision sensing are applied to implement communication convergence and open up a new channel for real-time interaction between the physical world and digital space.

In the future, the application of new, high-bandwidth edge/device acquisition devices with high real-time performance, as well as highly reliable communication networks that meet power requirements can solve the problem, efficiently solve grid line inspection and achieve intelligent remote inspection.

4.2. Method 2: Improve digital conversion of intelligent substation

Substations are the power transmission center and play essential roles to the power grid system. Currently, the substation management boards mainly use cameras at fixed monitoring locations. There are dead spots in patrol inspection and high-risk manual operations need to be performed to supplement substation management. In addition, businesses often use the preventive maintenance method of planned maintenance, which is still applied to substation equipment, leading to shortened service life and frequent equipment replacement. .

Future intelligent substations will need to rely on more powerful and flexible sensors as well as more advanced fault prediction models to achieve automated operation and management, improving efficiency. positive results of equipment maintenance, extending equipment life and eliminating unplanned downtime.

Key technology application 1: Use the combined power of cloud devices to build a digital team. In the future, smart substations will be unattended. The inspection task will be performed by various robots inside and outside the substation, such as UAVs, wheeled robots, rail-mounted robots, and cameras at key points, which will help in comprehensive inspection area, improving the efficiency of inspection. With the support of these technologies, smart robots can complete tasks such as collecting, filtering, storing, analyzing and mining data, diagnosing security risks and device exceptions in real time substation, send corresponding alarms, identify the area, location and cause of faults, and complete automatic assignment of inspection, maintenance and troubleshooting tasks.

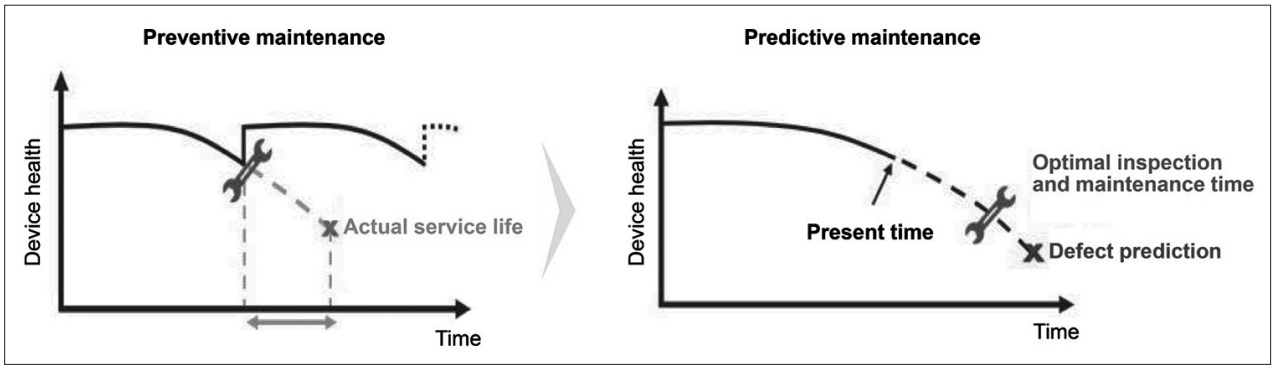
Besides, the offline computing capabilities of the devices need to be improved to ensure that the devices can perform intelligent checks of substations when they are offline, further ensuring power security .

Key technology application 2: Applying advanced intelligence technology for predictive maintenance and extending the life of substation equipment

Currently, the maintenance of substation equipment is based on maintenance plans, so mathematical prediction models based on historical inspection and maintenance records cannot reflect status changes and trends operation of the device.

In the future, there is a need to explore more advanced AI technologies and related technologies such as graph computing, advanced analytics, and unsupervised learning that can be used to perform deep learning of the elements. Various related elements, including historical equipment failure records, test records, and operational behavior model states and mechanisms, to build complex equipment failure diagnostic and prediction models than. In addition to comprehensive assessment and condition analysis of the current operating status of the equipment, based on multi-dimensional influence factor simulation, a more accurate prediction of possible equipment failure risks is provided in the future and their causes, the optimal time for manual intervention is determined and the corresponding inspection and maintenance solutions as well as material requirements are

Figure 1: From preventive to predictive maintenance



Source:

provided. This creates favorable conditions for preparation and advance training for operations staff in the enterprise.

Robots and AI technology can be integrated to comprehensively monitor substation security and equipment running status, and perform fault diagnosis and send alerts. Above all, advanced AI technologies support predictive maintenance, building intelligent brains and implementing rapid sensing, decision-making, and response to substation equipment failures.

5. Conclusion

During the digital transformation process, EVN has had many challenges: The management information system is not highly integrated and interconnected; Data mining utilities are not yet centralized and do not really meet the Group's high demands; The latest technology related to Industrial Revolution 4.0 (artificial intelligence, Big Data, cloud technology, etc.) has only been applied to a limited extent or is in the process of research and application... Besides, Human resource qualifications are not uniform, in particular, human resources that can meet new technology requirements are limited, especially platform technologies such as: IoT, Bigdata, AI, Cloud, mobile, BI, etc. However, it is too late. The process of implementing digital transformation, especially digital transformation in power grid inspection techniques, is still being prioritized. Through this article, we see that the use of smart devices varies in power grid inspection in different areas. Currently, in electricity enterprises, identifying and responding to errors is still passive and planned preventive maintenance inspections are applied to inspect and maintain equipment in general. Therefore, the main proposed directions for breakthrough changes in the coming time are as follows:

- Improve smart equipment inspection rate: Apply smart equipment to inspect all power grid lines and substations.

- Improve communication efficiency: Achieve full private network coverage, reduce transmission latency to milliseconds and eliminate signal coverage gaps.

- Improved autonomy: Build and develop applications of computing power and algorithms, improve the timeliness of exception diagnosis and response, and enhance local caching and capabilities data transmission can continue.

- Improve AI coverage: Enhance AI training to improve the accuracy of identifying abnormalities of various power grid devices and reduce false alarm reporting rate and detection rate miss. Explore advanced AI applications (e.g., graph computing) and improve predictive maintenance rates for substation equipment.

In addition, EVN needs to train the enterprise's human resources in skills and professional knowledge related to digital transformation. Digital transformation requires the workforce and leaders of businesses to adapt and operate according to the new model, acquiring skills and specialized

knowledge that will be effective when implementing digital transformation. Therefore, businesses need to train and equip employees with necessary skills, creative capacity and the ability to quickly adapt to a constantly changing technological environment.

Finally, EVN needs to allocate financial resources to focus on investing in appropriate technology

Enterprises need to apply digital technology to gradually connect existing systems into an information system throughout from production to management operations in the enterprise; build a common database throughout the enterprise; Invest in research and development (R&D) to create changes in products and services and constantly upgrade current systems; Apply new digital technology to ensure information security and network security for data of the entire enterprise.

Although technology platforms serving digital transformation are becoming increasingly popular, choosing a platform suitable for the scale and resources of the business must ensure that it meets the following criteria: optimal, Modern, up-to-date with trends and has features that truly suit the specifics of the business, meeting actual requirements during operation. In addition, businesses need to pay attention to security policies and tools to protect business secrets, customer information and prevent risks in business operations ■

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Received date: April 12, 2024
Reviewed date: April 17, 2024
Accepted date: April 29, 2024

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CHUYỂN ĐỔI SỐ TRONG CHIẾN LƯỢC PHÁT TRIỂN CỦA TẬP ĐOÀN ĐIỆN LỰC VIỆT NAM: MỘT SỐ ĐỀ XUẤT VỀ CHUYỂN ĐỔI SỐ KỸ THUẬT KIỂM TRA LƯỚI ĐIỆN

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TÓM TẮT:

Trong chiến lược phát triển của Tập đoàn Điện lực Việt Nam (EVN), chuyển đổi số được xác định đóng vai trò quan trọng trong sự phát triển của ngành điện Việt Nam. EVN và các đơn vị thành viên đã triển khai chuyển đổi số với quyết tâm cao và nhiều giải pháp đồng bộ. Bài viết này trình bày tóm tắt những thành công trong quá trình chuyển đổi số của EVN. Những thành công này không chỉ mang lại lợi ích trực tiếp cho EVN và khách hàng sử dụng điện mà còn góp phần xây dựng nền kinh tế số tại Việt Nam. Bên cạnh đó, bài viết cũng đề xuất một số ý kiến về việc chuyển đổi số kỹ thuật kiểm tra lưới điện nhằm giúp EVN hoàn thiện quá trình chuyển đổi số trong những năm tiếp theo.

Từ khoá: chuyển đổi số, chiến lược phát triển, Tập đoàn Điện lực Việt Nam.