Engineering Technology Trends Vol 2 Issue 1 2024
DOI: 10.37155/2972-483X-0201-7

Original Research Article

Open Access

Omniscient Pte.Ltd.

Exploration and Practice of Digital Management System in New Energy Construction Units Based on the "Project Portfolio" Model

Lei Zhang*, Feng Li

SPIC International Power Co., Ltd. Shiliquan Power Plant, Zaozhuang City 277103, Shandong Province, China

***Correspondence to:** Lei Zhang, SPIC International Power Co., Ltd. Shiliquan Power Plant, Zaozhuang City 277103, Shandong Province, China; Email: 957237526@qq.com

How to cite: Lei Zhang, Feng Li. Exploration and Practice of Digital Management System in New Energy Construction Units Based on the "Project Portfolio" Model. *Engineering Technology Trends*, 2024; 2(1).
DOI: 10.37155/2972-483X-0201-7

Abstract: In response to the successive initiation of projects in various regions during the "boom period" of new energy construction, a "realistic challenge" has arisen regarding the project management capabilities of construction units. This article discusses how the construction unit has established a digital platform for project management in the field of new energy, creating an efficient management system. It achieves remote and comprehensive integration of system information, contributing to the enhancement of management efficiency.
Keywords: New Energy; Project Management; Organizational Structure

Introduction

SPIC International Power Co., Ltd. Shiliquan Power Plant (hereinafter referred to as "Shiliquan Power Plant") actively implements the "dual-carbon" strategy and invests heavily in the development of new energy projects. In 2022, construction commenced on three photovoltaic power projects, while county-wide distributed, onshore wind power, and hydrogen storage projects entered various stages of construction preparation. Currently, Shiliquan Power Plant has embarked on engineering management through the establishment of a digital platform and the implementation of a digital management system. By leveraging cloud technology and the "project portfolio" management model, it achieves collaborative business operations among project departments, supervisory teams, and construction units' functional positions. Through layered and hierarchical management, seamless information flow, and direct data access, the system assists in high-level decision-making. In the subsequent phases, while providing operational platforms for new projects, the power plant will gradually integrate multi-scenario task management, initiate the digital twinning of the entire project lifecycle, and collaborate with technological innovations to establish a digital ubiquitous interface

for the interaction between power generation and load demand.

1. Implementation Background of the Digital Project Management System in the New Energy "Project Portfolio" Construction

1.1 Following the national strategic direction, exploring and practicing in the fast-flowing currents to meet the needs of central enterprises taking on responsibilities

The "14th Five-Year Plan and 2035 Vision Outline for National Economic and Social Development of the People's Republic of China," General Secretary Xi Jinping's report at the 20th National Congress of the Communist Party of China, and the "Overall Layout Plan for Digital China Construction" issued by the Central Committee of the Communist Party of China and the State Council, all progressively outline the national strategies for dual carbon, building a technology powerhouse, and the path towards digital development. As pivotal players in the national economy, power central enterprises actively implement national strategies, taking a leading role in the processes of achieving carbon peak and neutrality, as well as accelerating digital development to build a digital China, with an unwavering sense of duty.

1.2 Necessity for High-Quality Development during the Energy Revolution Industry Transformation

In alignment with the "14th Five-Year Plan" for the energy industry, State Power Investment Corporation (SPIC) anchors its strategies to seize opportunities, and in accordance with the requirements for achieving high-quality development goals, it has identified "five focal points." Shiliquan Power Plant actively explores management pathways, integrating "accelerating green and low-carbon development" with "intensifying technological innovation." In the implementation of new energy projects, the power plant has set the goal of "accelerating the promotion of digital transformation," synergizing efforts to collectively create growth points for high-quality development[1].

1.3 Need to Optimize the Enterprise Construction Management Approach and Create High-Quality Projects in New Energy

The dispersed geographical locations and harsh construction conditions of new energy projects, coupled with significant variations in environmental factors such as wind, solar, and storage resources, diverse types of management information, and substantial human resource input, pose considerable challenges. With the nationwide initiation of numerous photovoltaic projects, rising resource prices, and weaker commitment from subcontractors, exacerbated by the unfavorable impacts of the COVID-19 pandemic on construction activities, there is an urgent need to establish an information management platform. Upgrading the digital management system becomes essential to facilitate multi-disciplinary coordination, enhance project management efficiency, and achieve the goals of high-quality project outcomes.

2. Key Practices in Establishing the Digital Engineering Management System for the New Energy "Project Portfolio" Construction

The construction unit, through the establishment of a digital platform, collects, integrates, allocates, and shares data from various projects. It focuses on the analysis of the three major control objectives of engineering construction and key aspects of safety and environmental protection, providing decision-making support. Through the unified operation of the system, it shapes a common "language" for engineering management among all construction collaborators, forming a knowledge base and a methods library for the enterprise. This facilitates remote, comprehensive, multi-process, scientific, integrated, and systematic information integration. The ultimate goal is to create high-quality, innovative, green, efficient, digital, and transparent projects. The implementation involves five key aspects[2].

2.1 Establishing a Sound Organizational Structure for New Energy Project Management

To ensure the comprehensive management of all stages of new energy projects and optimize the allocation of talents throughout the process, the Party Committee has researched and formulated a well-defined organizational structure and system for new energy project management. A total of eight documents have been issued, including three on organizational structure and four for project departments. This initiative effectively streamlines management levels and processes, eliminates management blind spots, and

enhances overall management efficiency.

2.2 Establishing Seamless Core Data Chains

In alignment with the functional division of project management and resource allocation requirements during the construction process, a database has been established with a focus on describing the interconnections. During the early stages, the construction unit coordinates with various functional departments such as project management, material supply, and financial planning to interface with their respective business partners. This collaboration facilitates the comprehensive sharing of information, creating a communication chain to support multi-business cooperation.

2.2.1 Data collection and organization

The project department and supervision team provide real-time data from the construction site, which is then reviewed by on-site management personnel from the construction unit. This data is aggregated into the first layer of the data flow.

Each functional department within the construction unit generates documents and compliance references based on the first layer of data to support their management processes. Relevant information is fed back to the first layer of data and provided to the second layer, where high-level technical experts assess and analyze.

The advanced technical expert group ensures timely awareness of resource conflicts and provides recommendations for high-level decision-making based on their assessments.

2.2.2 Various collaborating stakeholders utilize multiple project management software tools. To ensure a unified integration of information representation, formats such as MS Project output are employed for progress and cost analysis predictions. With the prerequisite of consistently and efficiently allocating task resources, each task-related party chooses a data storage structure based on their project needs. They establish individual folders that provide data support, and management personnel, along with project stakeholders, have access control rights set according to their permissions for accessing project data.

Safety and environmental information are linked to the Safety Surveillance System and the Environmental Soil and Water Conservation Data Collection System. This integration facilitates the generation of formatted reports.

2.2.3 Tailoring the underlying database to the characteristics of each project and function, the lower-level database is configured based on the unique features of each project management function. Information related to progress, quality, cost, safety, environmental protection, and water conservation is submitted in a standardized format across all projects and functions.

2.3 Focusing on the Three Major Control Objectives of Engineering and Integrated Analysis of Safety, Environmental Protection, and Soil and Water Conservation Information

2.3.1 Progress information collection and benchmark analysis

Project progress plans and actual progress for each project are uniformly represented as new Gantt charts and milestone network diagrams. These diagrams elucidate various nodes along critical paths and are shared with relevant business departments and project teams. Stakeholders use network planning to retroactively assess work overlap times and constraint factors. Specific constraints are established for the latest start and finish times for each task within critical paths. If the plans for materials, finance, and early-stage work departments fall behind the work deadlines, the system issues prompts as conflict warning signals. Simultaneously, functional coordination is initiated, and advanced technical experts conduct analyses[3].

The project department utilizes the information system to promptly understand the resource allocation provided by the construction unit, such as payment progress and the supply of materials. In the event of incompatible guarantee plans or unforeseen circumstances, the project department communicates promptly with survey and design, construction, supervision, and other units to make adjustments or optimize the project schedule and resources.

2.3.2 Quality information collection and benchmark analysis

Considering the complexity of the quality formation process, each project department and functional department provide the database with comprehensive data covering decisions, design, materials, machinery, processes, technical measures, management systems,

and natural conditions, starting from the early stages of the project.

Cloud-shared data and process monitoring are integrated into the construction unit's quality inspection system, actively accepting oversight and inspections from government quality supervision agencies. The supervisory team records and releases daily construction situations comprehensively based on the 4M1E five quality control elements, providing all functional departments of the construction unit with insights into the quality formation process, serving as the basis for addressing contractual issues. The engineering department compiles control and acceptance data, regularly publishes Pareto charts and cause-and-effect analysis diagrams, and feeds the analysis results back to all relevant parties. Relevant stakeholders then formulate and submit countermeasure plans based on the feedback.

2.3.3 Investment and financing, as well as cost control information collection and benchmark analysis

Key data related to investment, financing, and cost management from various stakeholders are published based on the WEB structure defined by the system. Data users conduct comprehensive assessments by comparing visual progress and the actual consumption of resources. The joint measurement process of supervision and contractors involves uploading site pictures and documents within 48 hours.

Using the investment plan and payment progress as references, a curve chart is generated to analyze discrepancies. Data is sourced from the financial data module, and after confirmation by the engineering department, partial and cumulative investment discrepancies are analyzed. Targeted measures are then taken to rectify any discrepancies. If discrepancies exceed the set threshold or if there are common issues across multiple projects, advanced technical experts are engaged for in-depth analysis. Reporting is done to high-level decision-makers to resolve cross-functional conflicts.

2.3.4 Integration of storage and reporting for safety, environmental protection, and water conservation information

Recognizing the crucial importance of safety baselines and environmental protection redlines, an integrated approach is taken for the storage and reporting of safety, environmental protection, and water conservation information. Utilizing cloud databases and real-time systems linked to on-site surveillance and environmental water conservation monitoring, formatted reports are generated in the safety management module. These reports are then submitted to the construction unit to provide information on safety and environmental protection. Daily special management reports are compiled, incorporating safety, environmental protection, and water conservation monitoring data along with visual materials. These reports are made available for remote real-time access, serving as a reference for management decision-making.

2.4 Process Streamlining and Optimization

In response to identified collaborative stakeholder needs, project management data is consolidated into cloud-based storage, facilitating information integration to achieve:

2.4.1 Establishment of a rapid interaction response mechanism

Regular communication on original material supply, fund planning, contract management, and boundary condition follow-ups, which were previously discussed during weekly meetings, has transitioned into a combination of online and offline information exchange. This facilitates timely communication, rapid response, and the establishment of countermeasures[4].

2.4.2 Establishment of element retrieval functionality

Survey and design, supervision, construction, environmental protection, water conservation, comprehensive land use, safety assessment and filing, material supply, financial planning, and progress, among other factors, are integrated to enable efficient retrieval and utilization of heterogeneous information through effective information integration.

2.4.3 Direct decision-making and feedback

Middle and upper management can promptly be informed about changes in policies, environmental factors, and on-site conditions across different locations. This enables the adjustment of resource allocation and the direct provision of feedback or issuance of instructions with a single click. Issues requiring resolution at the grassroots level can

efficiently reach decision-making process nodes, thereby improving overall decision-making efficiency.

2.4.4 Autonomous analysis and forewarning

In the course of project advancement, if incompatible elements among various functional aspects arise, the integrated information system can autonomously provide alerts to relevant stakeholders.

2.5 Opening an Intervention Window for Audit and Supervision Management

Strengthening both pre- and mid-process supervision involves accessing the engineering department's database through a shared platform to monitor the legality and compliance of bidding and tendering. By remotely reviewing on-site permits, a comprehensive understanding of the situation is obtained before the final approval of project quantities. Real-time supervision is employed to verify the accuracy of surveys, optimize designs, review drawings, and disclose design details, allowing for a clear focus on audit points during project completion and settlement.

3. Implementation Results

3.1 Achieving Lean Control throughout the Project Lifecycle

Utilizing the digital management system for precise control has led to lean project management, ensuring that investments do not exceed the budget, quality remains within control limits, and achieving a 100% completion rate according to the schedule.

For Project 1, digital analysis of personnel and fund allocation, coupled with increased pressure for equipment delivery, resulted in a 10% advancement in the delivery quantity of photovoltaic components compared to the original plan.

Project 2, through digital analysis and consolidation of technical and commercial indicators, accelerated negotiations and locked in prices. Within 20 days, seven contracts for major equipment supplies were signed, saving equipment investments by 2.37 million yuan.

In Project 3, digital monitoring of quality, permits, and concealed engineering acceptance allowed for controlled management of critical quality milestones. Optimization of process connections led to the completion of the main equipment and prefabricated foundation construction for the booster station in 25 days, saving 5 days on the critical path.

3.2 Management Upgrade Driving Technological Advancement

Achieving an organic integration of low-carbon development and technological innovation, the digital management system for new energy project construction has evolved into a "comprehensive analysis software" patented technology.

The Safety Surveillance System has been upgraded, expanding its functions from safety supervision to a comprehensive and scenario-based surveillance system. In the later stages, it will incorporate digital twinning for operational management during the operational phase.

3.3 Seamless Information Flow, Direct Data Access, and Enhanced Decision-Making Efficiency

Consistency in data sources across departments has reduced data deformation and information value decay. Common issues and urgent problems across all projects are highlighted for prioritized resolution. Senior management can access foundational data comprehensively, shorten information transmission pathways, and enhance the core value of decision-making and management[5].

3.4 Implementation of Digitalization, Facilitating the Creation of High-Quality Projects

The information management platform has enabled searchable and traceable data management, providing audit and supervision departments with interfaces for effective oversight. The visualization of information analysis enhances the efficiency of various professional management processes, contributing to the achievement of six major goals for high-quality projects: quality, innovation, environmental friendliness, profitability, digitalization, and integrity.

4. Conclusion

Tenli Quan Power Plant is anchoring its strategies to the opportunities presented in the 14th Five-Year Plan, making high-quality development its top priority and dedicating efforts to new energy construction. Management innovation has been employed to stimulate vitality and enhance the driving force for corporate development. The operation of this digital management system serves as a successful demonstration, offering innovative management tools

to enhance efficiency for the construction unit.

References

[1] Ouyang, Xianglong. "Research on the Construction of Informationized BIM Platform for Project Management of New Energy EPC." Engineering Technology Research, 2019, 4(21): 157-158.

[2] Zhang, Yaxi. "Research on Project Group Management of Large-scale Engineering Construction Based on BIM Technology Application." Urban Architecture, 2020, 17(18): 180-182.

[3] Zhang, Yonggao, Qiu Xinglong, Fang Hualiang. "Distribution Network Planning Model Based on Internet Technology for Source-Load Interaction." Electrical Measurement and Instrumentation: 1-10 [Published online on 2023-03-12].

[4] Tian, Hao, Liu Wenyin, Wang Fangyu, Wang Weizhou, Yao Wei. "Multi-Objective Optimization Method for Peak Load Shifting Based on Source-Load Interaction and Load Participation." Power Grid and Clean Energy, 2018, 34(11): 32-38.