



Construction and Empirical Research on Evaluation System for Labor Organization Optimization of Power Supply Enterprises

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Abstract. Driven by new power system construction and digital transformation, labor organization optimization has become an important support for power supply enterprises to realize organizational innovation and productivity improvement. This paper constructs a four-dimensional evaluation framework covering digital empowerment, organizational structure, incentive distribution and talent team, and establishes a complete hierarchical evaluation index system. On the basis of standardized expert scoring and industry public data, Monte Carlo simulation is adopted to carry out empirical analysis on labor organization optimization effect and development potential of enterprises in eastern, central and western regions of China. The empirical results show that eastern enterprises lead in overall optimization level, central enterprises have remarkable growth potential, while western enterprises are restricted by talent reserve and infrastructure conditions. Targeted optimization suggestions are proposed according to regional characteristics, which can provide reference for labor organization reform and high-quality development of power supply enterprises.

Keywords: Power Supply Enterprise; Labor Organization Optimization; Evaluation System; Empirical Research; Regional Difference; Organizational Productivity

1 Introduction

The ongoing construction of new power systems, characterized by high penetration of renewable energy, distributed generation, and complex grid interactions, imposes unprecedented demands on grassroots power supply enterprises. These demands include enhanced operational flexibility, rapid emergency response, and efficient cross-functional collaboration. Concurrently, the proliferation of digital and intelligent technologies-such as cloud computing, big data analytics, and artificial intelligence-is fundamentally reshaping job profiles, skill requirements, and workflow logics within power utilities. Traditional labor organization models, which are hierarchical, function-siloed, and static in task allocation, have proven inadequate to cope with the dynamic and data-intensive environment of modern grid operations. Therefore, labor

organization optimization has become a strategic lever for power supply enterprises to achieve organizational innovation and productivity improvement, driving a transition from management-oriented to empowerment-oriented collaborative modes^[1].

Existing literature on organizational optimization in China's power sector predominantly adopts qualitative approaches, offering descriptive strategies for flattening structures, streamlining processes, or enhancing team integration. While these studies provide valuable managerial insights, they lack systematic quantitative evaluation frameworks that can objectively measure the multidimensional nature of labor organization optimization. Meanwhile, international research has increasingly examined the interplay between technological change and human resource practices in the energy industry, yet few studies have developed comprehensive index systems tailored to the specific institutional and operational contexts of regional power supply enterprises. More importantly, the pronounced disparities in economic development, digital infrastructure, and talent endowments across eastern, central, and western China inevitably lead to divergent optimization paths and outcomes, but this regional dimension remains largely underexplored in existing evaluation models^[2].

Against this backdrop, this paper proposes a novel DOIT four-dimensional evaluation framework encompassing Digital empowerment, Organizational structure, Incentive distribution, and Talent team. The framework is operationalized through a hierarchical index system with weights derived from the Analytic Hierarchy Process and expert consensus. To capture regional heterogeneity, we select representative enterprises from eastern, central, and western regions and employ Monte Carlo simulation to assess both current optimization levels and short-term development potential. This study contributes to the literature by providing a replicable quantitative tool for labor organization assessment, revealing region-specific bottlenecks and growth opportunities, and offering differentiated policy recommendations that align with local conditions. By doing so, we aim to enrich the theoretical and empirical research on power enterprise labor management and support the high-quality development of the industry.

2 Construction of Evaluation Framework for Labor Organization Optimization

Referring to the multi-dimensional evaluation idea of human-machine collaborative operation in power industry^[2], this paper builds a DOIT four-dimensional evaluation framework for labor organization optimization, including digital empowerment (D), organizational structure (O), incentive distribution (I) and talent team (T). The framework and secondary indicators are formulated combining the operational characteristics and labor management demands of China's power supply enterprises, and indicator weights are determined by Analytic Hierarchy Process (AHP) and expert demonstration.

Digital Empowerment (D) reflects the integration level of digital technology and grassroots business. Higher scores mean deeper digital application and stronger emergency response capability. Organizational Structure (O) evaluates organizational flat-

tening, cross-departmental collaboration and terminal business integration, which characterizes the transformation effect from hierarchical segmentation to networked collaborative operation. Incentive Distribution (I) measures the rationality of performance allocation, dynamic resource scheduling and power-responsibility matching, serving as the guarantee for stable organizational operation. Talent Team (T) focuses on compound talent reserve, digital skill proficiency and internal personnel mobility, which is the fundamental support for sustainable organizational development. The four dimensions interact and restrict each other to form an organic whole for comprehensive evaluation.

3 Construction of Evaluation Index System

Based on the DOIT framework, the analytic hierarchy process (AHP) is used to decompose secondary indicators, and all indicators are standardized within 0-10 points. The comprehensive score calculation formula is:

$$Y = \omega_D D + \omega_O O + \omega_I I + \omega_T T$$

where ω_D , ω_O , ω_I , ω_T represent the weight of each dimension, and the sum of all weights is 1. The detailed index system and weight distribution are shown in Table 1.

Table 1. Three-level Evaluation Index System and Weight of Labor Organization Optimization

Primary Dimension (Weight)	Secondary Indicators	Indicator Interpretation
Digital Empowerment D (0.30)	Business Digitization Rate	Proportion of daily business processed by digital platform
	Intelligent Equipment Coverage	Popularization degree of intelligent operation and maintenance equipment
	Fault Intelligent Disposal Efficiency	Response speed of digital system to grid faults
Organizational Structure O (0.25)	Organizational Flatness Level	Compression of management levels and team integration
	Cross-department Collaboration Efficiency	Operation efficiency across professional departments
	Terminal Business Integration Degree	Implementation effect of integrated services
Incentive Distribution I (0.25)	Performance Distribution Fairness	Rationality of differentiated performance distribution
	Dynamic Resource Allocation Capability	Flexible deployment of human resources

Primary Dimension (Weight)	Secondary Indicators	Indicator Interpretation
Talent Team T (0.20)	Power and Responsibility Matching Degree	Rationality of team authority and job responsibilities
	Proportion of Compound Talents	Ratio of employees with cross-post service capabilities
	Digital Skill Mastery Rate	Staff proficiency of intelligent opera- tion tools
	Personnel Mobility Frequen- cy	Normal flow of internal talents

4 Empirical Analysis

4.1 Data Source and Standardized Scoring Process

This research selects 15 typical prefecture-level power supply enterprises, with 5 samples from each of eastern, central and western regions. Samples are selected strictly in accordance with China's official regional division standards, covering typical urban and rural power supply enterprises. Objective operational data are derived from annual public reports issued by China Electricity Council and provincial power grid enterprises [2]. A total of 12 experts including grid managers, human resource specialists and digital engineers are invited to score qualitative indicators.

AHP is adopted to calculate index weights, with the consistency ratio $CR=0.028<0.1$, which passes the consistency test. To ensure result reproducibility, unified scoring anchor criteria for 0, 5 and 10 points are defined for all indicators. Scores satisfying $|x - \bar{x}| \geq 2SD$ are eliminated as outliers, and the arithmetic mean of valid scores is taken as the original score. Min-max normalization is adopted to unify all scores within 0–10 points. The Kendall's W coefficient of expert scoring is above 0.8, indicating high consistency. Monte Carlo simulation takes regional index scores as input to analyze the short-term optimization potential of each region, and the potential level is divided according to simulation output range.

4.2 Evaluation Results and Analysis

Eastern enterprises own sound digital infrastructure and abundant professional talents, with all indicators maintaining a relatively high level. Affected by saturated existing operation modes, its short-term growth space is limited. Central enterprises develop steadily with balanced indicators, presenting obvious late-development advantages and sufficient room for improvement. Western regions are constrained by geographical conditions and insufficient talent reserve, leading to relatively low performance in digital empowerment and talent team construction^[4]. The overall optimization level

presents an obvious echelon distribution from eastern to western regions in China. As Shown in table 2.

Table 2. Evaluation Scores of Labor Organization Optimization in Three Regions (0-10 points)

Region	D Score	O Score	I Score	T Score	Comprehensive Score	Optimization Level	Short-term Potential
Eastern	8.26	7.85	7.92	8.10	8.05	High	Medium-high
Central	6.72	6.58	6.65	6.43	6.60	Medium	High
Western	5.13	5.41	5.86	4.92	5.32	Low-medium	Medium

Note: Short-term potential is divided into three levels: High, Medium-high and Medium, classified according to Monte Carlo simulation results.

Digital and intelligent tools have been widely applied to optimize daily business workflows across the power industry^[3]. Reasonable human resource allocation also helps to improve the overall operational efficiency of power enterprises^[5]. Digital transformation is also proven to reshape organizational structure and optimize internal collaboration mechanisms^[1].

In this evaluation system, relevant indicators measure the completeness of standardized management systems rather than inherent operational risks of power grid business. Strict industry supervision defines the operation boundary of grassroots organizations, while the evaluation score reflects the construction level of labor organization. The two concepts are independent and compatible under the power industry safety specifications.

5 Conclusion

5.1 Main Conclusion

First, the constructed four-dimensional evaluation framework and hierarchical index system can effectively quantify the optimization level of labor organizations of power supply enterprises. The standardized data processing and scoring process guarantee the objectivity and reproducibility of empirical results. Second, prominent regional differences exist in labor organization optimization. Eastern enterprises take the lead in comprehensive strength, central enterprises have strong growth momentum, and western enterprises are restricted by basic development conditions. Third, digital capability upgrading and compound talent training are key factors restricting organizational optimization across the industry, and industry supervision norms will continuously standardize the operation of grassroots organizations. This study innovatively constructs a DOIT evaluation framework and carries out regional empirical research, which provides a new reference for labor organization optimization of power enter-

prises. Limited by sample size, follow-up research will expand samples and further optimize the evaluation model.

5.2 Regional Targeted Suggestions

Eastern power supply enterprises shall focus on innovative exploration, deepen the integrated application of digital and intelligent technologies, and summarize replicable reform experience for the whole industry. Central enterprises need to accelerate the sinking of digital capabilities, optimize cross-team collaboration mechanisms, and fully release late-development advantages. Western enterprises should prioritize basic digital construction, introduce professional talents through talent assistance policies, and promote organizational optimization in a steady and gradual manner.

From the industrial perspective, all power supply enterprises should take digital transformation as the starting point, improve the dynamic adjustment mechanism of labor organizations. While complying with industry management specifications, enterprises shall give full play to the value of digital technologies, balance operational efficiency, employee development and grid safety, and consolidate the foundation for the development of organizational productivity in power industry.

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