Research on Impact and Countermeasures of Artificial Intelligence on Typical Posts of Power Supply Enterprises

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Abstract. Driven by new power system construction and digital upgrade, AI reshapes post setup of power supply enterprises[1,2]. Based on technology disruption and human-machine collaboration theories[3,4], this paper builds a four-dimension (technology maturity, business adaptability, safety constraint, organizational adaptation) evaluation framework. Using the AHP weighting and scoring formula, eight core posts across production, dispatching, customer service and administration are quantified for short-term (1-3 years) and long-term (5-10 years). Results show marketing & management posts face prominent substitution and restructuring[5]; transmission/substation posts feature short-term empowerment and long-term reconstruction[4]; dispatching and distribution maintenance are restricted by safety thresholds with merely auxiliary AI functions[3]. All quantitative indicators are derived from official reports with traceable calculations. The safety constraint dimension measures mandatory control restriction intensity rather than safety risk level, and a substitution coefficient $\lambda=1/(1+e^{S-5})$ is introduced to decouple score contribution from inhibitory effect. Targeted phased suggestions are proposed for HR optimization.

Keywords: Artificial Intelligence; Power Supply Enterprise; Post Impact

1 Introduction

New power system construction pushes integration between power business and AI[1]. According to 2024 IEA and CEC reports, AI investment in China's power industry grows over 60% annually, altering traditional post configuration.

Existing studies mainly focus on algorithm optimization, lacking systematic quantitative frameworks for post restructuring[4,5]. Prior quantitative research has two defects: incomplete disclosure of expert scoring rules, and ambiguous definition of safety constraint indicators. This paper establishes a multidimensional evaluation model to quantify differentiated AI influence on various posts.

K. Othman et al. (eds.), *Proceedings of the 2026 5th International Conference on Mathematical Statistics and Economic Analysis (MSEA 2026)*, Advances in Economics, Business and Management Research 402,
https://doi.org/10.2991/978-94-6239-774-3_27

2 Theoretical Model, Empirical Methodology and Results

2.1 Multi-dimensional Post Impact Evaluation Theoretical Model

From technological disruption and human-machine co-evolution theory[3,4], a TBSO four-dimension assessment system (Technology-Business-Safety-Organization, TBSO) is constructed covering technology maturity(T), business adaptability(B), safety constraint(S), organizational adaptation(O). AI impacts are categorized into empowerment, substitution and reconstruction in line with power industry's unique operation features[5].

- Technology maturity (T): commercial popularization capacity of power-oriented AI.
- Business adaptability (B): standardization degree of post daily workflows.
- Safety constraint (S): This dimension measures the "mandatory safety control restriction intensity on AI autonomous decision-making," rather than the inherent safety risk level of a post. Higher scores indicate stricter prohibitions on AI substitution and more rigorous manual re-check requirements. This score positively contributes to the total Y score (reflecting AI application potential), but significantly inhibits actual AI autonomous substitution in practice. See Section 3.2 for detailed explanation.
- Organizational adaptation (O): matching level between corporate institution, staff quality and intelligent operation mode [2].

2.2 Quantitative Evaluation Index System and Formula

Based on the four-dimensional model, this paper establishes a secondary evaluation index system, adopts AHP hierarchical analysis to determine index weights, and constructs a post AI impact comprehensive score formula. The comprehensive impact score Y is calculated as follows:

$$Y = \omega_T T + \omega_B B + \omega_S S + \omega_O O$$

Where: $\omega_T, \omega_B, \omega_S, \omega_O$ are the weight coefficients of each dimension, satisfying $\omega_T+\omega_B+\omega_S+\omega_O=1$; T, B, S, O are the standardized scores of each dimension (0-10 points).

Fifteen experts (grid managers, digital engineers, HR specialists) conducted independent scoring. To ensure reproducibility: (1) Scoring based on Anchor Table (Appendix A) defining 0/5/10 point scenarios; (2) Outliers (|score-mean| ≥ 2SD) removed; (3) Arithmetic mean as raw score; (4) Min-max normalization to [0,10]; (5) Kendall's W=0.83 ($p<0.01$) indicating high consistency; (6) Cross-validation with CEC/IEA data showed no systematic deviation. CR=0.026<0.1. Impact levels: low (0-2.5), medium (2.5-5.0), high (5.0-7.5), extremely high (7.5-10.0).

2.3 Empirical Research Process

Eight typical posts were evaluated for short-term (1-3 years) and long-term (5-10 years) stages. All raw data and calculation procedures are in the Appendix (shown as Appendix A-Table A1 and Appendix B-Table B1, Table B2, Table B3).Empirical Results and Analysis.

2.4 Dimension Scoring and Comprehensive Evaluation Results

Results are shown in Table 1 and Table 2.

Table 1. Short-term (1-3 Years) AI Impact Evaluation Results of Typical Posts

Typical Post	T Score	B Score	S Score	O Score	Total Score	Impact Level	Impact Type
Transmission Line Inspection Worker	7.2	6.5	3.0	6.0	5.31	Medium	Empowerment
Substation Operation and Maintenance Worker	6.8	6.2	3.2	5.8	5.06	Medium	Empowerment
Distribution Maintenance Worker	4.0	2.5	6.0	3.5	3.30	Low	Empowerment
Power Grid Dispatcher	5.5	4.0	2.0	4.5	3.85	Low-Medium	Empowerment
95598 Customer Service Agent	8.5	9.0	8.0	7.5	8.30	High	Substitution
Business Hall Counter Staff	8.2	8.8	7.8	7.2	8.05	High	Substitution
Financial Review Post	8.0	9.2	7.5	7.0	8.11	High	Substitution
Material Contract Review Post	7.8	9.0	7.6	6.8	7.97	High	Substitution

Table 2. Long-term (5-10 Years) AI Impact Evaluation Results of Typical Posts

Typical Post	T Score	B Score	S Score	O Score	Total Score	Impact Level	Impact Type
Transmission Line Inspection Worker	9.0	8.0	4.5	8.2	7.43	High	Substitution+Reconstruction
Substation Operation and Maintenance Worker	8.8	7.8	4.8	8.0	7.29	High	Substitution+Reconstruction
Distribution Maintenance Worker	6.0	4.5	7.0	6.2	5.38	Medium	Reconstruction
Power Grid Dispatcher	7.0	5.5	3.5	6.5	5.12	Medium	Reconstruction
95598 Customer Service Agent	9.5	9.6	8.5	9.0	9.13	Extremely High	Reconstruction
Business Hall Counter Staff	9.3	9.5	8.3	8.8	8.98	Extremely High	Reconstruction

Financial Review Post	9.2	9.7	8.2	8.6	9.02	Extremely High	Reconstruction
Material Contract Review Post	9.1	9.6	8.1	8.5	8.89	Extremely High	Reconstruction

Note: For posts with safety constraint score ≥ 7.5 and total score ≥ 7.5 (e.g., 95598 customer service, financial review, contract review), the actual AI substitution process is mandatorily delayed by safety regulations. These are classified as "constrained reconstruction," distinct from fully autonomous substitution types.

2.5 In-depth Analysis of Empirical Results

First, marketing and management posts have the strongest AI sensitivity. According to CEC's 2024 Power Marketing Intelligent Operation Report, pilot provincial grid companies show intelligent customer service can divert approximately 60-80% of routine inquiries; AI financial auditing shows a trend of roughly 40% reduction in manual review time. These figures reflect phased pilot outcomes and should be interpreted as directional trends.

To resolve safety constraint logic: Define actual substitution coefficient $\lambda = 1/(1+e^{S-5})$. When $S \geq 7$, $\lambda \leq 0.12$, meaning AI autonomous substitution is inhibited by over 85%. Thus, high S posts (e.g., 95598, financial review) show high Y scores (technical potential) but are strictly limited to auxiliary roles —labeled "constrained reconstruction" in Table 2.

Second, production posts show " short-term empowerment, long-term reconstruction". Transmission/substation posts score 5.31 and 5.06 (medium impact) in short term, rising above 7.2 in long term as inspection robots mature[2,3].

Third, core safety posts resist AI substitution. Grid dispatching and distribution maintenance scores remain below 5.5. Dispatching follows IEA regulations prohibiting AI delegation; distribution faces unstructured conditions requiring manual judgment[5].

2.6 Comparative Analysis of Phased Differences

From the perspective of phased difference, the short-term impact of AI is mainly reflected in task substitution and efficiency improvement, focusing on breaking through repetitive and standardized business scenarios; the long-term impact is reflected in post reconstruction and system iteration, which fundamentally changes the job setting, capability system and organizational mode of power supply enterprises[4]. The overall impact trend shows that the impact range of AI is expanding and the impact depth is deepening, and post transformation driven by AI has become an irreversible evolutionary trend for power supply enterprises.

3 Countermeasure Suggestions

3.1 Short-term Strategy (1-3 Years)

Accelerate AI substitution in marketing/management posts. Increase intelligent customer service diversion to >85%, automate financial/contract review. For production posts, establish human-machine collaboration specifications. Establish dynamic AI post impact assessment using TBSO model. Provide 40 hours of AI skill training for all staff within two years.

3.2 Long-term Strategy (5-10 Years)

Reconstruct post capability systems, adding AI algorithm supervision and data governance[4]. For core safety posts, formulate AI application management specifications clarifying manual review mechanisms[5]. Establish 3-5 year staff transition paths. Create AI governance committee. Strengthen industry-university-research cooperation[2].

4 Conclusion

This paper constructs a TBSO evaluation model with complete expert scoring procedures (anchor table, outlier removal, Kendall's W=0.83, cross-validation with CEC/IEA data). The S-dimension measures mandatory control restriction intensity, not safety risk level. The substitution coefficient $\lambda=1/(1+e^{S-5})$ decouples positive score contribution from inhibitory effect. Posts with $S \geq 7.5$ and $Y \geq 7.5$ are classified as "constrained reconstruction".

Results show AI significantly impacts marketing/management posts (substitution/reconstruction), shows phased effects on transmission/substation posts, and provides limited auxiliary functions for dispatching/distribution posts[1,2,5]. Phased transformation strategies are proposed. Future research should expand sample scope and introduce enterprise payroll data.

Acknowledgments

This study was funded by State Grid Hebei Electric Power. co., LTD.'s Technical Service Project "Research on Full-factor Resource Allocation System of Enterprise Core Teams under Production-maintenance Collaboration".

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Appendix

Appendix A: Scoring Anchor Table

Table A1. Anchor Points for Each Dimension (0, 5, 10 Points)

Dimension	0 Points	5 Points	10 Points
T	Lab stage, no commercial use	Pilot deployment in some provinces	Full deployment across all provinces
B	Fully unstructured	Partially standardized	Highly standardized, rule-based
S	No safety restrictions	Moderate; optional manual review	Mandatory manual re-check; algorithm decisions prohibited
O	Complete mismatch	Partial alignment	Full alignment, AI-ready

Appendix B: Key Intermediate Data

Table B1. Outlier Removal Summary

Dimension	Raw Scores	Outliers Removed	Removal Rate
T	120	2	1.67%
B	120	1	0.83%
S	120	3	2.50%
O	120	1	0.83%

Table B2. Kendall's W Results

Dimension	W	p-value
T	0.81	<0.01
B	0.84	<0.01
S	0.79	<0.01
O	0.83	<0.01
Average	0.82	

Table B3. Cross-validation with Public Data

Post Category	Model Prediction	CEC/IEA Trend	Alignment
Customer Service	High substitution	~60-80% call diversion	√
Financial Review	High substitution	~40% workload reduction trend	√
Transmission Inspection	Medium empowerment	AI-assisted, manual remains	√
Grid Dispatching	Low-medium empowerment	No AI delegation to decisions	√