Research on the Application of an Integrated Outcome Management Model in Joint Research Institutes of Power Grid Enterprises

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Abstract

Against the background of the national innovation-driven development strategy and the "dual-carbon" goals, industry-university-research joint research institutes have become an important carrier for promoting industrial technological progress and achievement transformation. This paper takes the joint research institutes co-built by China Southern Power Grid and 13 universities as the research object and, through an internal and external dual-benchmarking evaluation method, systematically analyzes their operating effectiveness and problems. The study finds that the joint research institutes have achieved remarkable results in project planning and talent cultivation, but still have obvious shortcomings in high-value achievement output, interdisciplinary layout, and high-level talent cultivation. Therefore, this paper innovatively proposes an "integrated achievement management model." Centered on full-chain coverage and multi-level coordination, the model builds a closed-loop management system of "planning-research and development-transformation-evaluation" and, through goal orientation, process reengineering, and mechanism support, realizes effective integration from demand traction to value realization. The study shows that this model can systematically solve bottlenecks in achievement transformation, improve the overall efficiency of the innovation chain, and provide an operable reform paradigm for industry-university-research cooperation in central state-owned enterprises.

Keywords

Joint research institute, achievement transformation, integrated management, industry-university-research cooperation, evaluation system, power grid enterprise.

1. Introduction

Against the background of rapid digital and intelligent development, industry-university-research cooperation has become a key path for promoting scientific and technological innovation and industrial upgrading. To respond to the national "dual-carbon" strategy and the needs of new power system construction, China Southern Power Grid has jointly established joint research institutes with 13 universities, covering key fields such as power generation, transmission, distribution and storage, equipment manufacturing, and digital grids. However, in operation, joint research institutes generally face problems such as "emphasizing project approval while neglecting achievements" and "emphasizing process while neglecting transformation," which restrict their innovation efficiency. Based on a systematic evaluation of the joint research institutes of China Southern Power Grid, this paper reveals their operating bottlenecks and proposes the "integrated achievement management model" as a systematic solution, with a view to providing reference for the reform of systems and mechanisms in similar institutions. This paper first expounds the research background and significance, then systematically analyzes the operating status and core problems of the joint research institutes,

on this basis constructs the theoretical framework of the integrated achievement management model, explains its implementation path and supporting mechanisms in detail, and finally puts forward conclusions and policy suggestions, thereby forming a research system with a logical closed loop.

2. Background

At present, a new round of scientific and technological revolution and industrial transformation is developing in depth, and the energy and power industry is facing a profound transition toward green, digital, and intelligent development. The state attaches great importance to scientific and technological innovation and achievement transformation, and has successively issued a series of policies and regulations, including the Law on Promoting the Transformation of Scientific and Technological Achievements, providing institutional guarantees for state-owned enterprises to carry out industry-university-research cooperation and achievement transformation. As backbone forces in the national energy field, power grid enterprises shoulder the strategic mission of promoting breakthroughs in energy technology and supporting the construction of new power systems. As an important carrier of industry-university-research collaborative innovation, the operating efficiency of joint research institutes is directly related to whether enterprises can achieve independent controllability in key technologies and seize opportunities in industrial upgrading. Therefore, systematically evaluating the operating status of joint research institutes, identifying mechanism barriers in achievement transformation, and exploring a systematic management model adapted to the characteristics of power grid enterprises have important theoretical value and practical urgency. This study is precisely a systematic exploration carried out under this macro background and real demand.

From the perspective of existing studies, industry-university-research collaborative innovation and achievement transformation are research hotspots in the field of innovation management. The triple helix model proposed by Etzkowitz and Leydesdorff emphasizes interactive coordination among universities, industry, and government [1]; Carayannis and Campbell further proposed the quadruple helix model [2]; Rothwell's fifth-generation innovation model emphasizes system integration and networked collaboration [3]; and Tidd and Bessant pointed out that innovation management should shift from "stage-gate" to "whole-process coordination" [4]. Domestic scholars Li Lianshui et al. proposed the industry-university-research "strategic alliance" model [5]; Chen Jin et al. constructed a "knowledge transfer" framework for industry-university-research collaborative innovation [6]; Wang Xueyuan et al. introduced the technology readiness method to build an evaluation index system for the transformation of scientific and technological achievements [7]; and Zhang Yuchen et al. constructed a performance evaluation model for university scientific and technological achievement transformation from the three dimensions of "input-output-transformation" [8]. However, existing studies mostly focus on macro-level model construction or mechanism design for a single link, and lack systematic research on full-chain achievement management in joint research institutes. In particular, for joint research institutes with a central state-owned enterprise background such as power grid enterprises, there is still a lack of an operable management framework for embedding achievement transformation requirements into the full life cycle of scientific research.

3. Operating Status and Problem Analysis of Joint Research Institutes

To comprehensively grasp the operating situation of the joint research institutes, this study used literature analysis, field investigation, expert interviews, and multidimensional benchmarking to conduct a systematic evaluation of the operating effectiveness of 13 joint

research institutes of China Southern Power Grid. The evaluation results show that the joint research institute system has achieved phased results in resource input, project initiation, and talent cultivation, but still has significant shortcomings in achievement transformation and innovation efficiency. These shortcomings do not exist in isolation, but are interrelated and mutually reinforcing, jointly constituting systemic obstacles that restrict the high-quality development of joint research institutes. Specifically, they are mainly reflected in the following five dimensions:

3.1. Research Directions Overlap and Lack Forward-Looking and Interdisciplinary Layout

The research directions of the institutes overlap significantly. For example, in fields such as new energy grid integration and intelligent control of distribution networks, the layouts of several university research institutes are similar, resulting in dispersed innovation resources and a failure to form a pattern of differentiated development and complementary advantages. Research content is mostly concentrated on solving specific technical problems existing in current engineering, while there is insufficient layout of forward-looking and disruptive technologies such as the basic theory of new power systems, next-generation energy storage materials, electric power artificial intelligence, and energy cyber-physical integration. In addition, research activities are mostly limited to the traditional discipline of electrical engineering and have not effectively integrated interdisciplinary knowledge such as materials science, computer science, economics, and environmental science, which restricts the ability to solve complex system problems such as power-carbon coupling and source-grid-load-storage coordination. This dispersion and short-sightedness in layout directly affects the strategic height and sustainability of innovation achievements.

3.2. High-Value Achievements Are Scarce, and Shortcomings in Core Dimensions Are Prominent

Evaluation data show that the average score rate of the "cultivation of major achievements" dimension is only 61%, making it the key shortcoming that restricts overall performance. Specifically, first, high-visibility scientific and technological awards are lacking. The awards obtained are mainly provincial and ministerial awards, while no breakthrough has yet been achieved in national scientific and technological awards. Second, the construction of high-level innovation platforms lags behind. Some joint research institutes have not yet led or participated in the construction of national key laboratories, engineering research centers, and other platforms, and support from basic research conditions is insufficient. Third, the industrial adaptability and maturity of achievements are not high. Although some patents and papers have academic value, they are still far from engineering application and large-scale promotion and have not effectively solved real pain points in power grid operation. This shows that the current output model still tends toward an "academic orientation" rather than a "value orientation."

3.3. High-Level Talent Is Insufficient, and Sharing and Cultivation Mechanisms Are Not Smooth

Although talent team construction has a relatively high overall score, it shows a phenomenon of emphasizing quantity while neglecting quality. The joint research institutes have not achieved obvious results in cultivating strategic scientists such as academicians and winners of the National Science Fund for Distinguished Young Scholars, and their reserve of high-end talent still lags behind top joint research institutes such as State Grid-Tsinghua. In terms of talent sharing, the two-way mobility mechanism has not yet been fully smoothed. Some university researchers spend insufficient time conducting research on the front line of power grid production, while the mechanism for power grid technical experts to deeply participate in

university teaching and research activities is also not sufficiently complete, affecting the deep integration of industry, university, and research and the efficiency of knowledge transfer. The inadequacy of the talent ecology has become another key factor limiting the improvement of innovation capability.

3.4. Process Control Is Uneven and Insufficiently Connected with Industrial Demand

Project management shows a phenomenon of "strict at the beginning and loose later." Early approved projects generally achieved higher-quality results because of strict management, while later batches of projects saw weakened efforts in process monitoring, milestone assessment, and other aspects, resulting in uneven quality of achievement delivery. In the demand matching link, the preparation of some project guidelines failed to fully absorb the real needs of grassroots units, such as provincial and municipal power supply companies and ultra-high voltage companies, under specific regions and special scenarios. This led to a disconnect between research and development achievements and actual application scenarios such as the safe and stable operation of west-to-east power transmission, typhoon protection in coastal areas, and operation and maintenance of equipment at high altitudes. The disconnection in management processes makes it difficult for scientific research activities to accurately respond to dynamic industrial demands.

3.5. Platforms and Funding Are Uneven, and Internal Coordination Is Weak

The institutes are unbalanced in platform resources and funding guarantees. A small number of institutes have built national-level scientific research platforms by relying on university advantages, while the testing and verification conditions of most institutes remain weak. In terms of funding, differences in annual support among institutes affect the development of long-term and exploratory research. In addition, among joint research institutes, and between joint research institutes and CSG's internal professional laboratories, there is a lack of normalized mechanisms for resource sharing, data connectivity, and project collaboration, so an innovation synergy has not yet been formed. The absence of resource allocation and coordination mechanisms further amplifies the negative impact of the above problems.

4. Theoretical Construction of the Integrated Achievement Management Model

The above analysis shows that the many challenges faced by joint research institutes are rooted in the fact that the traditional "segmented and linear" management model causes each link of the innovation chain to be separated from the others. To fundamentally solve this systemic dilemma, this paper proposes constructing an "integrated achievement management model." This model is not a simple repair of existing management practice; rather, it aims to establish a dynamic management system with full-chain coverage, multi-subject coordination, and closed-loop feedback through systematic reconstruction, thereby realizing a paradigm shift from "scientific research management" to "innovation governance."

4.1. Core Concepts and Design Principles

This model takes "market value realization" as its ultimate orientation and emphasizes that scientific research activities must begin with industrial demand and end with market application. Its design follows two core principles. First, innovation incentives and responsibility implementation are equally emphasized; that is, while creating an environment tolerant of failure, clear definition of rights and responsibilities ensures that the actors in each link are responsible for achievement output. Second, goal penetration and process coordination are emphasized; that is, transformation goals are taken as the main line, and the entire process

from the source of planning to the industrial end is designed in an integrated way to ensure seamless connection and aligned efforts across all links. The theoretical foundation of this model mainly comes from four aspects. First is PDCA cycle theory: Deming's plan-do-check-act cycle emphasizes continuous improvement and closed-loop management [9]. Second is technology readiness theory: the technology readiness method proposed by the National Aeronautics and Space Administration divides technology from concept to application into nine levels [10]. Third is innovation chain theory, namely the interactive process from basic research to applied research and then to industrialization [11]. Fourth is the triple helix model, which provides theoretical support for multi-subject coordination [1].

4.2. "Three-Layer, Four-Step, Five-Mechanism" System Architecture

To realize the above concepts, this study designs a system architecture of "three-layer organizational system, four-step process closed loop, and five supporting mechanisms."

Three-layer organizational system: Build a vertical coordination organizational architecture of headquarters decision-making layer (strategic coordination), transformation service layer (resource matching and platform support), and application implementation layer (achievement landing). This design aims to clarify the strategic, service, and execution functions of each level, break down departmental walls, and form management synergy.

Four-step process closed loop: Based on the PDCA cycle, innovation activities are systematically integrated into four stages: planning (demand planning and goal setting), research and development (technical research and path design), inspection (pilot-scale verification and effectiveness evaluation), and transformation (industrial promotion and value realization). Evaluation and decision nodes oriented toward achievement transformation are embedded in each stage, forming a management closed loop of continuous optimization and spiral upgrading.

Five supporting mechanisms: To ensure the operation of the architecture, five key mechanisms are established. 1) A target responsibility mechanism decomposes macro transformation goals into assessable micro tasks. 2) A whole-process evaluation mechanism establishes a dynamic evaluation system centered on technology readiness level (TRL). 3) A deep integration mechanism for industry, university, and research promotes a project formation model of "enterprise posing questions, institutes answering questions, and collaborative problem solving." 4) An incentive and fault-tolerance mechanism designs incentive tools that combine material and spiritual rewards with compliance exemption clauses. 5) A platform service mechanism builds pilot maturation and proof-of-concept platforms to reduce transformation risks. Through systematic design, this architecture embeds achievement transformation requirements into the full life cycle of scientific research.

5. Implementation Path and Supporting Mechanisms

The implementation of the theoretical model requires specific implementation paths and a solid supporting system. The successful application of the integrated achievement management model depends on coordinated change and systematic support in four dimensions: process, incentives, evaluation, and organization.

5.1. Process Reengineering and Mechanism Innovation

First, the full process of existing scientific research management must be fundamentally reengineered. In the planning stage, a joint demand mining and demonstration mechanism involving industrial departments and research and development units should be established to ensure that research directions come from real pain points. In the project approval stage, the prospects for achievement transformation, market potential, and technical feasibility should be taken as core review bases, so that high-value projects are selected from the source. In the research and development stage, project teams should be required to formulate and

dynamically update technology transformation roadmaps in parallel, clarifying key nodes and milestones. In the acceptance stage, final user evaluation should be introduced, and the assessment weight of industrial application value and maturity of achievements should be greatly increased. Fully implementing the research organization model of "enterprise posing questions" is a key measure for ensuring that research and development activities always resonate with industrial demand at the same frequency.

5.2. Design of Incentive and Fault-Tolerance Mechanisms

An effective incentive mechanism is the core of stimulating endogenous motivation. An incentive system that gives equal attention to material incentives and spiritual honors needs to be improved. Specifically, the Guidelines for Incentive Work on the Transformation of Scientific and Technological Achievements should be refined to clarify the income dividend ratios, such as not less than 50% of net income, and distribution procedures under different transformation methods such as transfer, licensing, and investment at an appraised value, so as to ensure that incentive policies are operable and predictable. The innovative incentive model of "distribution before transformation plus cooperative implementation" should be actively explored, using direct payment agreed in contracts to break the constraints of traditional financial management on the realization of incentive funds. The reform of empowering ownership or long-term use rights of job-related scientific and technological achievements should be prudently advanced. On the premise of protecting the rights and interests of state-owned assets, researchers should be given greater rights to dispose of achievements and share benefits. At the same time, a clear fault-tolerance exemption list and standardized determination procedure should be established to clearly distinguish exploratory failure from violations, thereby providing institutional guarantees for scientific research and management personnel who dare to take responsibility and perform their duties diligently.

5.3. Reconstruction of the Evaluation System

Reforming the "baton" is the key to guiding behavioral change. The previous evaluation orientation that emphasized the number of papers while neglecting technical effectiveness must be changed, and a new comprehensive evaluation index system covering the three dimensions of "scientific and technological input-achievement output-transformation benefits" should be built. In the achievement output dimension, the weights of indicators such as high-value patents, international or national technical standards, and first major technical equipment sets should be greatly increased. In the transformation benefit dimension, emphasis should be placed on assessing the direct economic benefits brought by achievements, benefits in improving power grid safety, and benefits in energy conservation and emission reduction. In terms of evaluation methods, a scientific weighting method combining hierarchical scoring and order relation analysis should be adopted to ensure that evaluation results are objective and fair and can effectively guide scientific research activities to focus on industrial value creation.

5.4. Organizational and Platform Support

Organization and platforms are the physical foundation for the operation of the model. The governance structure of joint research institutes should be optimized, the decision-making function of the management committee in strategic direction and resource coordination should be strengthened, and the secretariat responsible for daily operations and coordination services should be located in a professional achievement transformation institution, such as a science and technology innovation center, to improve operational efficiency and professionalism. The formation of flexible research teams across research institutes and disciplines should be actively promoted, and innovation resources should be integrated in a task-oriented manner. At the same time, it is necessary to accelerate the layout and construction of industrialization-oriented pilot maturation platforms, testing and certification platforms, and demonstration

application scenarios, practically making up for the "valley of death" shortcoming from laboratory prototypes to reliable products and providing indispensable engineering support for achievement transformation.

6. Conclusion and Suggestions

Through empirical analysis, this paper reveals the systemic bottlenecks currently existing in achievement transformation in joint research institutes of power grid enterprises. Their root cause lies in the fact that the traditional "segmented and process-emphasizing" management model disconnects all links of the innovation chain. In response to this problem, the "integrated achievement management model" proposed in this paper provides a complete solution for achieving efficient full-chain integration from the demand source to the industrial end by constructing a system architecture of goal penetration, process closed loop, and mechanism coordination. This model is not only an upgrade of management tools, but also an innovation in the concept and paradigm of industry-university-research cooperation. Its value lies in transforming achievement transformation from the "end point" of scientific research activities into the "main line" running throughout them.

To promote the implementation and effectiveness of this model and facilitate the sustainable development of joint research institutes, the following suggestions are proposed. First, strengthen top-level design and strategic guidance. Around major strategic needs such as the national "dual-carbon" goals and new power system construction, dynamically evaluate, optimize, and integrate the research directions of joint research institutes, focus on advantages, and form distinctive characteristics. Second, increase overall resource coordination and collaborative input. In particular, plan and build a number of pilot verification and proof-of-concept platforms shared across units, and establish sound mechanisms for resource sharing and cost sharing to improve resource use efficiency. Third, deepen reform of the talent development mechanism. Strongly implement systems such as "dual university-enterprise appointments" and "industry mentors," build an integrated flexible talent ecology covering attraction, cultivation, use, and retention, and promote efficient two-way flow of knowledge and personnel among industry, universities, and research. Fourth, establish a normalized mechanism for monitoring, evaluation, and iterative optimization. Regularly conduct third-party evaluations of the operating effectiveness of the integrated management model, continuously adjust and improve relevant policy tools based on practical feedback, and realize the self-evolution of the model.

The limitation of this study is that the proposed model has not yet undergone large-scale and long-cycle practical testing. Future research may select typical joint research institutes to carry out in-depth case tracking and action research, empirically test the effectiveness of the model, and refine its application conditions. At the same time, cross-industry comparative studies, such as those in equipment manufacturing and information communication, may be carried out to further extract and enrich the theory of industry-university-research collaborative innovation management that conforms to the characteristics of large central state-owned enterprises in China, thereby providing reference for innovation practices in broader fields.

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