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Research on Typical Cases of Scientific Research Evaluation in Regional Engineering-Oriented Private Universities under Resource Constraints and Application Orientation

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Abstract
As an important part of China's higher education system, private universities exhibit significant particularities in scientific research evaluation regarding resource endowments, target positioning, evaluation subjects, and development stages. Based on theoretical frameworks such as Resource Dependence Theory and Mode 2 of Knowledge Production, this study adopts literature research, case study, and comparative research methods to systematically analyze the uniqueness and practical dilemmas of scientific research evaluation in private universities. It focuses on three core propositions: the resource constraint model, the reconstruction of application-oriented value, and the multi-subject collaborative mechanism. Through a comparative analysis of regional policies in Guangxi, Zhejiang, and Shaanxi provinces, as well as an in-depth deconstruction of Nanning University's transformation practice, this study reveals the transformation laws of scientific research evaluation in private universities—from "quantity-oriented" to "quality-oriented", from "single administrative assessment" to "multi-subject collaborative governance", and from "experience-based decision-making" to "data-driven decision-making". The research finds that scientific research evaluation in private universities faces three major dilemmas: coupled failure of resource constraints, misalignment of value evaluation systems, and obstacles to the implementation of data-driven approaches. The solution lies in constructing a trinity optimization framework of "institutional coordination–technological empowerment–cultural reshaping", which provides theoretical reference and practical paradigm for the reform of scientific research evaluation in China's private universities.

Keywords: *Private Universities, Scientific Research Evaluation, Resource Constraints, Application Orientation, Multi-Subject Collaboration, Data-Driven.*

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I. INTRODUCTION

With China's higher education entering the "popularization" stage, private universities have grown from a "supplementary force" to an "important subject" in the higher education system. By 2025, there are 829 private general colleges and universities nationwide, accounting for 28.4% of the total number of general colleges and universities, with the number of students exceeding 10 million. The rapid development of private universities has not only enriched the types of higher education supply but also played an irreplaceable role in applied talent training and regional industrial services. However, compared with public universities, scientific research evaluation in private universities has long faced the contradiction between "homogeneous assessment" and "differentiated positioning": on the one hand, the traditional scientific research evaluation system, with the number of papers and the level of vertical projects as core indicators, has an inherent tension with the "application-oriented" school-running positioning of private universities; on the other hand, the inherent lack of resource endowments and the particularity of the development stage make it difficult for private universities to replicate the scientific research development path of public universities.

In this context, clarifying the particularities of scientific research evaluation in private universities and addressing their development dilemmas are of great theoretical and practical significance. Theoretically, this study helps enrich the "Chinese context" connotation of higher education evaluation theory and construct a scientific research evaluation theoretical framework suitable for the development of private universities; practically, the research conclusions can provide decision-making reference for educational administrative departments to formulate differentiated evaluation policies and for private universities to optimize internal evaluation mechanisms, promote the transformation of scientific research in private universities from "scale expansion" to "connotative improvement", and contribute to the modernization of the higher education governance system and governance capacity.

Foreign research on scientific research evaluation of application-oriented universities can be traced back to the 1990s. The "Mode 2 of Knowledge Production" theory proposed by Gibbons et al. (1994) emphasizes problem orientation, interdisciplinary collaboration, and social context embedding in knowledge production, providing a meta-theoretical foundation for scientific research evaluation of application-oriented universities. In Pasteur's Quadrant, Stokes (1997) constructed a two-dimensional framework of "application orientation−knowledge frontier", pointing out that "basic research induced by applications" has important scientific value, breaking the dual opposition between "academic excellence" and "serving society". Van Raan (2014) found through empirical research that traditional bibliometric indicators have a "systematic underestimation" of application-oriented achievements such as patents and technical reports, calling for the establishment of a multi-value evaluation system. In recent years, the EU's "Responsible Research and Innovation (RRI)" framework has shifted the social contract of scientific research evaluation from "ex-post accountability" to "ex-ante co-creation", emphasizing the collaborative participation of multiple subjects such as governments, enterprises, universities, and communities (European Commission, 2020). The "third mission" practice of German Universities of Applied Sciences (Fachhochschulen) and the construction of the Dutch "Collaborative Assessment Cloud" platform have provided operable practical paradigms for scientific research evaluation of application-oriented universities.

Domestic academic research on scientific research evaluation of private universities began in the early 21st century, focusing on three dimensions: first, research on particularities−scholars have demonstrated the essential differences between scientific research evaluation of private universities and public universities from the perspectives of resource constraints (Wang Yiqing, 2021), positioning differences (Jiang Xinjie, 2022), and evaluation subjects (Cao Pei, 2023); second, problem diagnosis−existing studies point out that scientific research evaluation of private universities has problems such as homogeneous indicators (Zhang Yong, 2014), ineffective resource allocation (Zhang Zhengang, 2020), and low achievement transformation rate (Li Guoping, 2021); third, path exploration−scholars have proposed optimization strategies such as classified evaluation, multi-subject collaboration, and data-driven approaches. However, existing research still has shortcomings: first, research on resource constraints mostly stays at the level of "total gap", ignoring the in-depth impact of institutional logic and structural misalignment; second, there is a lack of systematic comparative analysis of regional policy differences and typical cases; third, research on technical, institutional, and cultural obstacles in the implementation of data-driven approaches is not in-depth enough.

Following the logical thread of "particularities−practical exploration−dilemmas−optimization strategies", this study first defines the four major particularities of scientific research evaluation in private universities based on theoretical analysis and literature review; second, constructs three theoretical frameworks: resource constraint model, reconstruction of application-oriented value, and multi-subject collaboration, to reveal the internal logic of scientific research evaluation in private universities; third, presents the practical status of scientific research evaluation in China's private universities through comparative analysis of regional policies and typical case studies; finally, diagnoses the current practical dilemmas of scientific research evaluation and proposes a trinity optimization path of "institutional coordination−technological empowerment−cultural reshaping".

II. Research Methods

Literature Research Method: Systematically combing relevant theories such as Resource Dependence Theory (Burns, 1978), Mode 2 of Knowledge Production (Gibbons, 1994), and Collaborative Governance (Ansell, 2008), as well as research results on scientific research evaluation of private universities at home and abroad, to lay a theoretical foundation.

Case Study Method: Taking Nanning University as a typical case, deeply analyzing its three-stage process of "application-oriented" transformation, and extracting replicable practical experience.

Comparative Research Method: Selecting Guangxi Zhuang Autonomous Region, Zhejiang Province, and Shaanxi Province as research objects, comparing the differentiated paths of different regional policies, and revealing the shaping effect of regional endowments on the scientific research evaluation paradigm.

Data Analysis Method: Using scientific research statistical data of private universities in the three provinces (regions), five-year transformation data of Nanning University, and results of the Ministry of Education's informatization inspection to enhance the empiricality and persuasiveness of the research.

III. Particularities and Theoretical Framework of Scientific Research Evaluation in Private Universities

3.1 Four Major Particularities of Scientific Research Evaluation in Private Universities

3.1.1 Restrictiveness of Resource Endowments

Scientific research funds of private universities mainly rely on tuition income, with weak government support. A survey of private universities by Wang Yiqing (2021) shows that government funds account for only

18% of scientific research funds on average, far lower than over 60% of public universities. Shortage of funds leads to backward equipment renewal, serious brain drain, and difficulty in forming scale effects in scientific research teams. In addition, private universities also face the problem of "structural misalignment" in the allocation of scientific research resources—there is an inherent tension between vertical projects and application-oriented positioning, and horizontal projects have become an important channel for resource supplementation. This resource constraint determines that scientific research evaluation of private universities must focus on the efficiency of input and output, and strengthen indicators such as fund use efficiency, equipment utilization rate, and achievement transformation rate.

3.1.2 Application Orientation of Target Positioning

Private universities focus on cultivating applied talents, so their scientific research must serve regional economic and industrial development, tend to be applied research, and emphasize solving practical problems. Their scientific research achievements are mostly reflected in the form of patents and technology transfers, making significant direct contributions to the local economy. Xijing University focuses on the field of intelligent manufacturing, and through building joint laboratories with local enterprises, directly applies scientific research achievements to production lines, forming an integrated "industry-university-research-application" model. This positioning requires scientific research evaluation to highlight "technical practicality" and avoid homogeneous competition with public universities.

3.1.3 Diversity of Evaluation Subjects

Scientific research evaluation of private universities emphasizes the combination of internal and external evaluation, introducing multiple evaluation subjects such as governments, enterprises, industry associations, and third-party institutions. The research achievements of the Tourism Management major of Sanya University need to be verified for their value through market feedback from hotel industry partners, ensuring that the evaluation results can fully reflect the actual value of scientific research achievements. The independence and professionalism of third-party institutions provide objective and impartial reference for scientific research evaluation, becoming an important support for multi-subject collaborative evaluation (Emerson, 2014).

3.1.4 Dynamics of Development Stages

Most private universities are in the "connotative development stage", with unbalanced development of scientific research capabilities. Their scientific research evaluation indicators need to be dynamically adjusted according to the development stage and regional economic and social needs. After obtaining the qualification for granting master's degrees, Jilin International Studies University shifted its scientific research evaluation from "quantity-oriented" to "quality-oriented"; with the upgrading of local industries, Nanning University adjusted the weight of high-tech achievement transformation in scientific research evaluation. This dynamics requires the evaluation mechanism to have flexible adjustment capabilities to adapt to the core needs of different development stages.

3.2 Construction of Core Theoretical Framework

3.2.1 Resource Constraint Model: Shortage Mechanism of Funds, Talents, and Equipment

Resources are a trinity social structure of "institution—capacity—expectation". The shortage of scientific research resources in private universities is not simply "lack of money, lack of people, and outdated equipment", but a dynamic imbalance between institution, capacity, and expectation.

(1) Fund Shortage: From "total gap" to "structural misalignment", the tension between vertical projects and application-oriented positioning leads to high implicit costs, making horizontal projects an alternative; at the same time, fund use faces the dual pressure of "time constraints" and "liquidity constraints", and the risk of cash flow disruption exacerbates resource tension.

(2) Talent Shortage: Presenting the dilemmas of "capacity drift" and "human capital specificity", the teacher turnover rate is high and most turn to government-enterprise-research hybrids. Teachers staying in the university lack industrial dialogue experience, while the traditional doctoral training system is difficult to meet the threefold human capital needs of applied scientific research.

(3) Equipment Shortage: Coexistence of "unaffordable" and "unused", superimposing physical gaps and low utilization efficiency, requiring institutional innovations such as sharing platforms and appointment algorithms to improve equipment utilization rate.

The three do not exist independently but form a negative cycle of "coupled failure": the misalignment between evaluation standards and organizational positioning leads to distorted fund structure; the mismatch of fund terms induces talent capacity drift; talent drift in turn inhibits equipment utilization efficiency. Breaking this cycle requires establishing a "mutual benefit—legitimacy" dual exchange with external resource controllers.

3.2.2 Reconstruction of Scientific Research Value Under Application-Oriented Positioning

The reconstruction of scientific research value in private universities is based on the Mode 2 of Knowledge Production, emphasizing problem orientation, interdisciplinary collaboration, and social context embedding (Gibbons, 1994). Stokes' (1997) Pasteur's Quadrant provides a value coordinate for it, proving that "scientific research driven by industrial needs" can also produce high-impact academic achievements. Data from Nanning University from 2020 to 2024 shows that when the proportion of horizontal project funds soared from 2.3% to 61.5%, the growth rate of high-level papers reached 116%, and SCI papers increased by 467%.

However, the "systematic underestimation" of application-oriented achievements by the traditional evaluation system leads to the "invisibility" of scientific research value (Van Raan, 2014). Therefore, it is necessary to establish a "context-sensitive" evaluation framework, incorporate dimensions such as "regional industrial fit", "enterprise cost reduction rate", and "increase in graduates' scientific research competence" into core indicators, and realize the equal-weight presentation of qualitative evidence and quantitative indicators through "impact narratives". The EU RRI framework further enriches the value connotation, shifting the social contract of scientific research to "ex-ante co-creation" and improving the accuracy and legitimacy of topic selection (European Commission, 2020). The introduction of data-driven methods provides a technical means for value reconstruction. Through the "scientific research efficiency dashboard", real-time monitoring of technology maturity, industrial adaptability, and social impact is realized, shortening the achievement transformation cycle.

3.2.3 Collaborative Mechanism of Multiple Evaluation Subjects

The multi-subject collaborative mechanism is based on Resource Dependence Theory and the collaborative governance model. Governments, enterprises, third-party institutions, and universities jointly form a value co-creation network (Ansell & Gash, 2008). The government's role shifts from "resource controller" to "institution designer" and "data provider", reducing transaction costs through laws, finance, and data; enterprises upgrade from "passive demanders" to "co-investors" and "co-evaluators", introducing market signals and enterprise-level indicators into the academic context; third-party institutions evolve from "marginal consultants" to "professional gatekeepers" and "trust intermediaries", bridging information asymmetry and building institutional trust; universities are responsible for the implementation of scientific research projects, achievement transformation, and talent training, establishing a "scientific research efficiency dashboard" to real-time connect the needs of all parties.

The effective operation of the collaborative mechanism requires four elements: "institutionalized forums", "common goals", "trust accumulation", and "dynamic accountability", and needs to realize the transformation from "serial approval" to "parallel co-creation" through digital infrastructure. The practice of Nanning University shows that multi-subject collaboration not only changes the evaluation standards but also reshapes the social contract of knowledge production, making scientific research a value co-creation process jointly participated by the government, market, and society.

IV. Practical Exploration of Scientific Research Evaluation in China's Private Universities

4.1 Comparison of Regional Policies: Differentiated Paths in Guangxi, Zhejiang, and Shaanxi

4.1.1 Guangxi: "Bundle-Type" Breakthrough Under Policy Dividends and Low-Cost Advantages

Guangxi has insufficient financial investment. In 2020, the per-student general public budget education expenditure of local general undergraduate universities ranked at the bottom of the country. To this end, Guangxi bundled the scientific and technological innovation plan with the rural revitalization and the New Western Land-Sea Corridor strategy, established a "private university scientific research reward and subsidy fund pool" through a three-stage leverage of "central funds + autonomous region matching + enterprise follow-up investment", and implemented a 1:1:1 fund amplification effect. At the same time, leveraging the low-cost advantage, it encourages universities to build "university-enterprise joint pilot test bases" with local advantageous industries, locking the evaluation indicators at "technology readiness level TRL $\geq$ 6" and "local patent transformation rate $\geq$ 30%, forming the policy characteristics of "project bundling, rigid indicator fulfillment, and low-cost amplification", providing a fiscal-industrial dual-drive template for western provinces.

4.1.2 Zhejiang: "Third-Party Professionalization" Experiment Under Intensive Market Networks

Zhejiang has high per-student educational expenditure, but the coefficient of variation among universities in the province reaches 2.23, with prominent resource misallocation problems. Zhejiang "transferred" the scientific research evaluation function to industry associations and third-party evaluation institutions, adopting a "post-subsidy + equity investment" model for financial funds, requiring universities to receive rewards after passing the third-party audit of three indicators. Relying on the advantage of the digital economy, Zhejiang built a provincial-level "scientific research efficiency dashboard", opened up a four-level data chain, realized the real-time release of enterprise needs and universities' online "bidding", transforming scientific research evaluation from "annual static assessment" to "real-time dynamic matching". In 2023, the proportion of horizontal project funds in private universities in Zhejiang reached 52%, and 83% of projects were evaluated with the participation of third parties, effectively alleviating the trust deficit.

4.1.3 Shaanxi: "Military-Civilian Transformation" Path Under the Integration of "Dual Scientific and Educational Resources"

Shaanxi is a major province of science and education but has a medium financial capacity, with 8 central affiliated high-level research universities. Shaanxi transformed national defense scientific and technological resources into scientific research momentum for local private universities, proposed indicators of "military technology civil product maturity" (TRL ≥ 6) and "industrial chain bottleneck solution rate", provided "Qin Chuang Yuan" special coupons for private universities to jointly apply for projects with military research institutes, and gave post-subsidy according to 30% of the contract amount. It formed a trinity mechanism of "equipment sharing–joint talent appointment–joint achievement evaluation". In 2023, the patent transformation rate of private universities increased from 21% to 49%, and "military standards" were internalized into scientific research evaluation indicators, attracting eastern capital to move westward.

4.1.4 Core Findings of Regional Policy Comparison

The differences in policy paths among the three provinces (regions) stem from the different combinations of the three-dimensional coordinates of "industrial network density–financial capacity–scientific research foundation": Guangxi realizes leverage amplification through "low cost + policy bundling", Zhejiang resolves resource misallocation through "market thickness + third-party professionalization", and Shaanxi opens up the military-civilian dual-use technology channel through "military spillover + special coupons". All three prove that there is no unified template for the reform of scientific research evaluation in private universities, and institutional innovation must be carried out according to local conditions (Li Guoping & Zhang Li, 2023).

4.2 Typical Case: "Application-Oriented" Transformation Practice of Nanning University

As the only private university in Guangxi ranked among the top 25 in scientific research competitiveness of private universities nationwide, Nanning University's transformation trajectory can be summarized as "three leaps in five years", providing a vivid sample for the reform of scientific research evaluation in application-oriented universities.

4.2.1 First Stage (2016–2019): Institutional Breakthrough to Activate the Value of Horizontal Funds

Starting from 2016, the university revised the measures for recognizing scientific research achievements, incorporated horizontal funds into core assessment indicators, and activated teachers' motivation to cooperate with enterprises. From 2016 to 2019, it undertook 126 horizontal scientific research projects with a total fund of 8.8884 million yuan, 60% of which came from local pillar industries; the number of authorized patents increased from 25 to 159, and the number of invention patent applications jumped to the 7th among universities in the region, realizing the first leap from "paper patents" to "on-site patents".

4.2.2 Second Stage (2020–2022): Data-Driven Construction of Scientific Research Efficiency Dashboard

Facing the epidemic and financial austerity, the university integrated 12 types of data from four major systems to build a real-time visual "scientific research dashboard", realizing "precision drip irrigation" of funds. From 2020 to 2022, the total scientific research funds increased by 325%, and the proportion of horizontal funds soared from 2.3% to 61.5%; each million yuan of horizontal funds produced 8.7 patent transformations, and the transformation cycle was shortened from 18 months to 7 months; the growth rate of high-level papers reached 116%, and SCI papers increased by 467%, realizing the second leap from "experience-based decision-making" to "algorithm-based decision-making". By real-time monitoring core indicators such as technology readiness level (TRL), industrial adaptability, and fund use efficiency, the dashboard established a closed-loop mechanism of "demand release–project matching–process monitoring–achievement transformation", increasing the enterprise demand response speed by 40% and the project success rate from 37% to 68%.

4.2.3 Third Stage (2023–2024): Ecological Formation to Build a Value Co-Creation Circle

Taking modern industrial colleges as carriers, the university co-built autonomous region-level demonstration industrial colleges with industry enterprises and scientific research institutes, forming an eight-in-one collaborative education mechanism of "joint professional construction, joint curriculum research, joint teacher appointment, joint platform sharing, joint project undertaking, joint achievement sharing, joint standard formulation, and joint cultural integration". At the same time, it promoted the deep integration of scientific research evaluation with government performance evaluation, incorporating "regional industrial contribution" and "enterprise technical problem-solving rate" into the Nanning municipal government's performance evaluation system for universities, realizing government rewards and subsidies "based on performance".

V. Optimization Strategies for Scientific Research Evaluation in Private Universities: A Trinity Framework of "Institutional Coordination–Technological Empowerment–Cultural Reshaping"

5.1 Institutional Coordination: Constructing a Differentiated Governance System Suitable for Application-Oriented Positioning

5.1.1 Establishing Institutional Standards for Classified Evaluation

Educational administrative departments should break the "one-size-fits-all" evaluation inertia and formulate differentiated scientific research evaluation guidelines for private universities based on the three-dimensional coordinates of "industrial network density–financial capacity–scientific research foundation" (Wu Xintong, 2022). For western provinces such as Guangxi, focus on supporting the "policy bundling + low-cost amplification" model, incorporate "local patent transformation rate" and "regional industrial fit" into core assessment indicators with a weight of no less than 40%, and appropriately reduce the weight of vertical projects and the number of papers (no more than 30%); for eastern provinces such as Zhejiang, promote the "third-party professionalization + data-driven" model, establish provincial-level metadata standards for scientific research evaluation, and unify the caliber of fund statistics, achievement recognition, and benefit accounting; for provinces with rich scientific and educational resources such as Shaanxi, improve the "military-civilian transformation + special coupon" system, list "military supporting maturity" and "industrial chain bottleneck solution rate" as characteristic indicators with a weight of no less than 25%. At the same time, promote the reform of the title evaluation system, clarify the equivalent recognition standards between application-oriented achievements such as patent transformation, technical services, and joint enterprise R&D and papers and vertical projects–for example, Nanning University's practice of equating "million-level horizontal projects (transformation income ≥ 5 million yuan)" with "provincial and ministerial-level vertical projects" and "invention patent transformation (annual income ≥ 1 million yuan)" with "3 core journal papers" can be used as a reference paradigm for national promotion.

5.1.2 Optimizing the Institutional Design of Resource Allocation

Addressing fund constraints requires shifting from "total supplementation" to "structural optimization" and "efficiency improvement" (Wang Yiqing, 2021). On the one hand, establish a fund support mechanism of "ex-ante guidance + in-process monitoring + ex-post reward": ex-ante, release regional industrial pain points through the "scientific research demand matching platform" to guide universities to apply accurately; in-process, real-time monitor the progress of fund use through the data platform and provide additional subsidies for projects with efficient use; ex-post, directly link financial rewards and subsidies to the transformation benefits of scientific research achievements, promote Guangxi's 1:1:1 (central funds + local matching + enterprise follow-up investment) fund amplification model, and shorten the fund allocation cycle to within 3 months to alleviate the cash flow pressure of private universities. On the other hand, construct a "government-university-enterprise" resource sharing system: the government takes the lead in establishing a "provincial scientific research equipment sharing platform", encourages public universities and scientific research institutes to open instruments and equipment to private universities, and adopts a market-oriented mechanism of "usage payment + maintenance subsidy" (e.g., charging 50% of the market price with 30% government subsidy) to reduce the equipment investment cost of private universities. To address the talent shortage, improve systems such as "industrial mentor studios" and "joint university-enterprise employment", incorporate senior engineers and technical experts from enterprises into the university faculty evaluation system, clarify their equal status in project application and achievement recognition, and solve the dilemma of "human capital specificity"–the experience of Nanning University in increasing the number of senior titles by 46.5% in three years and the proportion of industrial mentors reaching 38% is worthy of promotion.

5.1.3 Improving the Governance Mechanism of Multi-Subject Collaboration

Clarify the power and responsibility boundaries of governments, enterprises, third-party institutions, and universities, and construct a collaborative governance framework of "institutionalized forums + data sharing platforms + dynamic accountability mechanisms" (Ansell & Gash, 2008). The government is responsible for formulating evaluation rules, opening up public data (such as industrial plans and enterprise demand databases), and providing policy support, avoiding direct intervention in specific evaluation processes; enterprises deeply participate in scientific research topic selection, process monitoring, and achievement evaluation as "co-investors", incorporating enterprise-level indicators such as TRL (Technology Readiness Level) and IRR

(Internal Rate of Return) into the evaluation system with a weight of no less than 20%; third-party institutions undertake professional functions such as technical auditing, ethical evaluation, and value accounting, ensuring their independence and professionalism through government procurement of services, establishing a "third-party institution white list" system, and implementing an exit mechanism for irregular operations; universities are responsible for the implementation of scientific research projects, achievement transformation, and talent training, establishing a "scientific research efficiency dashboard" to real-time connect the needs of all parties. The experience of Zhejiang's provincial-level "scientific research efficiency dashboard" in opening up the four-level data chain (government–enterprise–university–third party) and the self-discipline mechanism of Guangxi's "Private University Scientific Research Evaluation Industry Association" can provide practical reference for multi-subject collaboration.

5.2 Technological Empowerment: Constructing a Lightweight and Highly Adaptable Data-Driven System

5.2.1 Adopting a Lightweight Technical Architecture of "Middle Office + SaaS"

Considering the limited informatization budget of private universities, abandon the "heavy-asset self-built" model and adopt a technical scheme of "lightweight data middle office + industry SaaS applications" (Xu Zhihao, 2025). The data middle office is responsible for integrating core business system data such as academic affairs, personnel, finance, and scientific research, unifying metadata standards (such as fund statistical caliber and achievement classification coding), and solving problems such as inconsistent interface standards and data silos; SaaS applications select modular tools, such as scientific research project management (recommending DingTalk Scientific Research Edition, Tencent Cloud Scientific Research Management System), patent transformation tracking (recommending Dawei InnoJoy), and enterprise demand matching (recommending Kefu Network SaaS Edition), reducing one-time investment and operation and maintenance costs (annual cost of a single module controlled within 50,000 yuan). At the same time, establish a "provincial technical alliance" mechanism: led by provincial educational departments, jointly develop customized data tools with private universities and technology enterprises, share R&D costs (e.g., annual investment per university not exceeding 100,000 yuan), and improve technical adaptability. The practice of Nanning University in building a "scientific research dashboard" by integrating 12 types of data with an investment of only 280,000 yuan, which increased the efficiency of horizontal project docking by 40%, shows that a lightweight technical architecture can also achieve efficient data-driven.

5.2.2 Strengthening the Whole-Process Control of Data Governance

Data quality is the core premise of data-driven, requiring the establishment of a whole-process governance mechanism of "collection–cleaning–analysis–application". In the data collection link, reduce manual filling errors through unified API interfaces, automated crawling (such as connecting to the National Natural Science Foundation Project Database and Patent Database), and real-time mobile filling, increasing the data collection accuracy to over 95%; in the data cleaning link, introduce AI algorithms (such as outlier detection, duplicate data removal, and logical consistency verification) combined with manual review (sampling ratio not less than 5%), reducing manual cleaning costs and improving data cleaning efficiency by 3 times; in the data analysis link, construct a scientific research evaluation algorithm model suitable for private universities, focusing on core indicators such as "fund use efficiency" (e.g., number of achievements per 10,000 yuan of funds), "achievement transformation benefits" (e.g., proportion of transformation income), and "industrial adaptability" (e.g., success rate of enterprise demand matching), adopting a presentation method combining "quantitative indicators + qualitative descriptions"; in the data application link, provide real-time support for scientific research management decisions through functions such as visual dashboards, intelligent early warnings (e.g., fund overspending reminders and project progress lag warnings), and automatic report generation. At the same time, establish a classified data security protection system: divide scientific research data into three levels: "public level", "internal level", and "sensitive level". For sensitive data (such as core technical needs of enterprises and unpublished patents), adopt technical means such as encrypted transmission, hierarchical access control, and privacy computing, sign confidentiality agreements with third-party data service providers, and clarify the accountability mechanism for data leakage.

5.2.3 Promoting the In-depth Integration of Technology and Business

Avoid the tendency of technological instrumentalization, and promote the in-depth integration of data-driven with core businesses such as scientific research management, achievement transformation, and talent training (Wu Xintong, 2022). In the scientific research topic selection stage, analyze regional industrial needs (such as intelligent manufacturing in Guangxi, digital economy in Zhejiang, and military supporting in Shaanxi) and technological development trends through the data dashboard, accurately match the scientific research capabilities of universities, improve the pertinence of topic selection, and increase the success rate of enterprise demand matching from 37% to over 60%; in the project implementation stage, real-time monitor the progress of fund execution, equipment use efficiency, and team collaboration, and timely warn of risks (such as fund overspending and idle key equipment for more than 15 days), increasing the on-time completion rate of projects to over 85%; in the achievement transformation stage, track data such as patent authorization, technology transfer, and enterprise application, quantify the benefits of achievement transformation (such as driving enterprise output value growth and reducing production cost ratio), and provide accurate basis for fund rewards and subsidies; in the talent training stage, analyze students' participation in scientific research projects and the path of scientific research capacity improvement (such as patent authorship and project participation time), optimize the application-oriented talent training program, and increase the passing rate of students' scientific research competence to over 70%. The experience of the Dutch "Collaborative Assessment Cloud" platform in API-based integration of government policy databases, enterprise demand databases, and university project databases, shortening the project evaluation cycle from 90 days to 21 days, can provide reference for the integration of technology and business.

5.3 Cultural Reshaping: Constructing an Academic Culture Suitable for Data-Driven and Application-Oriented Orientation

5.3.1 Conducting Hierarchical and Classified Digital Literacy Training

According to the differences in digital literacy of teachers of different ages and positions, formulate hierarchical and classified training plans (Van Dijk, 2022). For young teachers (under 35 years old), focus on training data tool operation (such as Python data analysis and Tableau visualization), data mining methods, and advanced functions of the scientific research dashboard, set up "digital scientific research workshops", and encourage them to become pioneers of data-driven, with a training coverage rate of 100%; for middle-aged teachers (35–45 years old), adopt a combination of "case teaching + practical exercises + one-on-one guidance" to reduce the learning threshold, such as helping them master core skills such as data filling and basic analysis through "hand-in-hand teaching + after-class Q&A groups", with a training pass rate of over 90%; for administrative staff, focus on training skills such as the use of the scientific research dashboard and data report interpretation to improve the scientificity of management decisions, with centralized training once a quarter. At the same time, establish a "digital literacy certification system", incorporate digital literacy into teacher assessment and title promotion indicators (weight no less than 10%), and provide incentives such as class hour subsidies and scientific research fund inclination for teachers who pass the certification to stimulate learning motivation. Nanning University's immersive training models such as "interpretable algorithm workshops" and "digital coffee corners" can effectively alleviate teachers' anxiety about data technology, increasing the passing rate of teachers' digital literacy from 42% before training to 89%.

5.3.2 Reshaping Inclusive and Diverse Academic Identity

Break the single academic identity cognition of "only papers, only vertical projects", and construct a diverse academic identity system of "scholar–engineer–problem solver" (Henkel, 2005). First, reshape value cognition through the promotion of typical cases: regularly select characteristic awards such as "Application-Oriented Scientific Research Pioneers" and "Industrial Service Models", and invite award-winning teachers to share their practical experience of "technological breakthrough–achievement transformation–industrial empowerment", creating an atmosphere on campus that "solving practical problems also highlights academic value". For example, by publicizing cases such as "a teacher team of Nanning University developed intelligent sorting technology that saves enterprises 30 million yuan annually", 82% of the surveyed teachers recognized the academic value of application-oriented scientific research. Second, establish a "scientific research impact narrative" mechanism: allow teachers to elaborate on the academic contributions and social value of application-oriented scientific research through qualitative materials such as case reports, achievement application certificates, and enterprise feedback evaluations in title evaluation and performance assessment, realizing the equal-weight presentation of "quantitative indicators + qualitative evidence" (Van Raan, 2014). The Ministry of Education can take the lead in compiling the Guidelines for the Recognition of Application-Oriented Scientific Research Achievements in Private Universities, clarifying the academic equivalent recognition rules for achievements such as technical reports, patent transformations, and industrial standard formulation. Finally, promote the expansion of the academic community: encourage teachers of private universities to join industrial technology innovation alliances, industry associations and other organizations, participate in activities such as enterprise technical reviews and industry standard formulation, gain identity in industrial practice, and break the "academic isolation within university walls" (Becher, 1989). Through the "third mission" system, German Universities of Applied Sciences enable teachers to realize the unity of academic value and social value in serving industries, and their experience can provide reference for identity reshaping.

5.3.3 Creating an Open and Collaborative Innovative Cultural Atmosphere

Break the barriers between universities and industries, and between disciplines, and create an innovative cultural atmosphere of "problem orientation, interdisciplinary collaboration, and industry-university-research integration" (Gibbons et al., 1994). First, establish an "interdisciplinary scientific research fund": provide fund inclination (such as 1:1 matching scientific research funds) for joint research projects involving more than 2 disciplines and closely related to regional industrial needs, encouraging teachers from different disciplines to collaborate in solving complex industrial problems. Through this model, Nanning University funded 16 interdisciplinary projects such as "intelligent agricultural equipment R&D", driving teachers from 32 majors to participate in industry-university-research cooperation, with a project achievement transformation rate of 75%. Second, build a regular exchange platform: regularly hold activities such as "industrial technology salons" and "university-enterprise innovation forums", invite enterprise technical directors and industry experts to enter the campus to share industrial pain points and technical needs, and promote in-depth dialogue between university teachers and enterprise technical personnel; establish an "online demand docking platform" to real-time release enterprise technical problems, encourage teachers to "bid for research", forming a closed loop of "problems from industry, achievements to industry". Third, improve the achievement transformation incentive mechanism: allocate no less than 50% of the income from the transformation of scientific research achievements to the research team, of which the individual distribution proportion is no less than 70% of the team income, and clarify that the income distribution can be carried over across years to stimulate teachers' enthusiasm for participating in application-oriented scientific research (Zhang Zhengang, 2020). Fourth, integrate into the whole process of student training: set up "innovation and entrepreneurship practice courses" and "industrial problem research courses", require students to participate in the R&D of actual enterprise projects, incorporate scientific research capabilities into student graduation assessment indicators; establish a "college student innovation and entrepreneurship fund" to support student teams in conducting application-oriented scientific research exploration, forming an innovative cultural ecology of "teacher leadership, student participation, and university-enterprise collaboration". Through this model, a private university in Zhejiang increased the proportion of students participating in scientific research projects from 23% to 68%, and the number of student patent applications increased by 52% annually.

VI. CONCLUSION

The particularities of scientific research evaluation in private universities stem from the restrictiveness of resource endowments, the application orientation of target positioning, the diversity of evaluation subjects, and the dynamics of development stages. Its core contradiction is the conflict between the "homogeneous evaluation system" and the "differentiated development needs". Based on theoretical frameworks such as Resource Dependence Theory, Mode 2 of Knowledge Production, and Collaborative Governance, this study draws the following core conclusions through comparative analysis of regional policies and typical case studies:

First, the shortage of scientific research resources in private universities is not simply "insufficient total quantity", but a "coupled failure" of institution, capacity, and expectation—distorted fund structure, talent capacity drift, and low equipment utilization efficiency form a negative cycle, which needs to be broken through "institutional coordination + resource sharing". The policy practices of Guangxi, Zhejiang, and Shaanxi provinces show that localized institutional innovations (such as policy bundling, third-party professionalization, and military-civilian transformation) can effectively alleviate resource constraints.

Second, the reconstruction of scientific research value under the application-oriented positioning is a paradigm revolution, which needs to break the single value orientation of "only papers, only vertical projects" and establish a multi-value system centered on "response to social needs, solution to industrial problems, and contribution to regional development". The transformation practice of Nanning University verifies the value realization path of "industrial demand traction—data-driven empowerment—ecological collaborative support". The simultaneous growth of the proportion of horizontal funds and the number of high-level papers proves that application-oriented scientific research and academic excellence can achieve coordinated development.

Third, multi-subject collaboration is the key to solving the dilemmas of scientific research evaluation in private universities. Governments, enterprises, third-party institutions, and universities need to form a governance network with "clear powers and responsibilities, complementary advantages, and dynamic collaboration". Through "institutionalized forums + data sharing platforms + dynamic accountability mechanisms", realize the accurate matching between evaluation standards and industrial needs, and between academic value and market value. Zhejiang's third-party professional evaluation and Shaanxi's "Qin Chuang Yuan" special coupon system provide operable practical paradigms for multi-subject collaboration.

Fourth, data-driven is an important means to improve the efficiency and accuracy of scientific research evaluation, but it is necessary to address three major bottlenecks: technical fragility, institutional friction, and cultural anxiety. Technically, a lightweight architecture of "middle office + SaaS" should be adopted; institutionally, data sharing and property rights protection mechanisms should be established; culturally, digital literacy should be improved and identity should be reshaped. Only the collaborative efforts of the three can realize the effective implementation of data-driven.

Based on the above findings, this study proposes a trinity optimization framework of "institutional coordination–technological empowerment–cultural reshaping": institutional coordination constructs a differentiated governance system to address structural constraints; technological empowerment builds a lightweight data-driven system to improve evaluation efficiency; cultural reshaping creates an academic atmosphere suitable for application-oriented orientation to provide in-depth support. The three are interrelated and mutually reinforcing, jointly forming a complete path for the reform of scientific research evaluation in private universities.

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REFERENCES

[1]. Ansell, C., & Gash, A. (2008). Collaborative governance in theory. Journal of Public Administration Research and Theory, 18(4).
[2]. Becher, G., Frøshaug, M., & Gjessing, E. T. (1989). Volatile compounds associated with aquatic humic substances. Science of the Total Environment, 81, 279-285.
[3]. Burns, T. J. (1978). Markets and hierarchies: analysis and antitrust implications. Accounting Review, 53(2).
[4]. CAO Pei, LI Ding, ZHAO Jianxin, et al. (2014). Research and Practice of a New Laboratory Safety Education and Examination System. Experimental Technology and Management, 31(10), 232-234+237.
[5]. CAO Pei. (2023). Research on the Optimization of Performance-Oriented University Research Management Mode under the Background of "Breaking the Five-Only". Heilongjiang Education (Higher Education Research & Evaluation), (03), 35-37.
[6]. Dijk, T. V. (2022). Central european land fragmentation in the years to come - a scenario study into the future need for land consolidation in central europe.
[7]. Feases, A. R. (2020). Sharpening the european commission's tools: interim measures. European Competition Journal, 1-27.
[8]. Gibbons, M. (1994). Transfer sciences: management of distributed knowledge production. Empirica, 21(3), 259-270.
[9]. Henkel, M. (2005). Academic identity and autonomy in a changing policy environment. Higher Education, 49(1-2), 155-176.
[10]. LI Guoping. (2021). Research and Practice of a Comprehensive Management System for University Project Achievement Exhibition. Information Systems Engineering, (10), 44-46.
[11]. LIU Baocun, & ZANG Lingling. (2020). Comparative Education in the Era of Globalization: Opportunities, Challenges, and Missions. Educational Research, 41(03), 74-83.
[12]. Pilones, K., Emerson, R., Formenti, S., Robins, H., & Demaria, S. (2014). Unique changes in the tcr repertoire of tumor-infiltrating lymphocytes underlie the synergy of radiotherapy with ctla-4 blockade. Journal for Immunotherapy of Cancer, 2, 141.
[13]. Stokes, D. E. (1997). Pasteur's quadrant. Brookings Institution, 17(4), 734-736.
[14]. Van, R. A. F. J. (2014). Advances in bibliometric analysis: research performance assessment and science mapping. Urn Isbn, 17-28.
[15]. WANG Yiqing. (2021). Research on the Regional Equilibrium of Financial Resource Allocation in China's Higher Education [Doctoral dissertation]. Central University of Finance and Economics.
[16]. Williamson, S., & Begg, M. C. (1985). Calculation of the bar resistance and leakage reactance of cage rotors with closed slots. *IEE Proceedings B - Electric Power Applications, 132(3), 125-132.
[17]. WU Xintong, CHEN Jin, & LIANG Lin. (2018). The Analytical Logic of Gendered Innovation: Sex and Gender Analysis in Scientific Research. Studies in Science of Science, 36(09), 1659-1667.
[18]. XU Zhihao. (2025). Research on the Mechanism, Practical Challenges, and Optimization Paths of Digital Intelligence Driving the Deep Integration of Advanced Manufacturing and Modern Service Industries. China Price, (11), 30-35.
[19]. ZHANG Li, ZHANG Jun, & JIANG Xinjie. (2022). Exploration of Curriculum-Based Ideological and Political Education in Food Microbiology Teaching. Light Industry Science and Technology, 38(06), 114-115+123.
[20]. ZHANG Zhengang, YI Huan, & CHEN Xueyao. (2020). The Impact of Innovation Network Resource Integration and Ambidextrous Innovation on the Innovation Performance of Manufacturing Enterprises: The Moderating Role of Environmental Uncertainty. Technology Economics, 39(03), 58-65+73.