# Multi-dimensional Evaluation and Incentive System for the Research Process: A Case Study of a Key Laboratory at the Chinese Academy of Sciences

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## Abstract

Purpose Research evaluation reform has achieved phased progress, yet problems remain to be solved, including a lack of innovation in evaluation methods and an imperfect evaluation system. Methods To address these issues, this study designs a multi-dimensional evaluation system for the research process based on the ICDP method, building upon existing research evaluation and incentive frameworks, and establishes a corresponding multi-dimensional evaluation platform for the research process. Results Using a key laboratory of the Chinese Academy of Sciences as a case study, the architecture of the indicator system for chemistry and chemical engineering disciplines is elaborated, and the calculation processes for both overall evaluation and participant evaluation are demonstrated. Limitations The evaluation system presented herein is developed by considering the disciplinary characteristics of the subjects under evaluation and employing a combination of subjective and objective evaluation approaches; it may be applicable to disciplines similar to the target discipline, while other disciplines may refer to its design principles to develop evaluation systems tailored to their own disciplinary features. Conclusion Multi-dimensional evaluation and incentive mechanisms for the research process, characterized by the documentation and recording of key node information, can effectively address prominent issues in research reform and promote the sustainable development of the research process ecosystem.

## Full Text

# Research Process Multiple Evaluation System and Incentive Mechanism: A Key Laboratory of Chinese Academy of Sciences as an Example

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## Abstract

[**Objective**] Reform of scientific research evaluation has achieved phased progress, yet persistent challenges remain, including a lack of innovative evaluation methods and incomplete evaluation systems. [**Methods**] To address these issues, this study designs a diversified evaluation system for the research process based on the ICDP methodology and establishes a corresponding platform for diversified evaluation of the research process. [**Results**] Using a key laboratory of the Chinese Academy of Sciences as a case study, this paper elaborates on the indicator system architecture for chemical engineering disciplines and demonstrates the calculation process for both overall evaluation and participant evaluation. [**Limitations**] The evaluation system described in this study considers the characteristics of the assessed discipline and employs a combination of subjective and objective evaluations. While potentially applicable to similar disciplines, other fields should refer to these design principles to develop evaluation systems tailored to their own disciplinary characteristics. [**Conclusions**] A diversified evaluation and incentive system for the research process, characterized by information documentation and recording at key nodes, can effectively address prominent issues in scientific research reform and promote the sustainable development of the scientific research ecosystem.

**Keywords:** Multiple evaluation; Research process; ICDP; Index system; Incen-

tive system

## 1 Introduction

Scientific research evaluation serves critical functions including judgment, prediction, selection, guidance, diagnosis, motivation, and rational resource allocation [1-2]. However, evaluation systems that primarily rely on paper counts and journal impact factors struggle to meet contemporary needs and stakeholder expectations in terms of evaluation metrics, methods, and target selection [3-4]. Several fundamental problems persist.

First, there is an overreliance on quantitative evaluation theories that assess academic journals rather than actual research impact. For example, *AIChE Journal*, widely recognized in chemical engineering, is ranked in the third quartile (Q3) in its subfield under current calculation methods—a issue strongly criticized by domain experts. Second, with numerous disciplinary categories, scientometrics and informetrics experts cannot deeply understand each discipline to develop evaluation indicators that reflect actual research practices, leading to the common phenomenon of "outsiders directing insiders" in research evaluation. In November 2022, the Ministry of Science and Technology and other departments launched pilot reforms for scientific and technological talent evaluation to address prominent issues such as inadequate innovation in evaluation methods and insufficient institutional development in evaluation systems [5].

This paper examines the research process as its object of evaluation, designing a diversified evaluation platform and establishing a research process evaluation system based on the ICDP method. The system employs fuzzy operators for subjective fuzzy comprehensive evaluation and calculates participant evaluation by combining objective and subjective results. We propose a multi-dimensional incentive scheme integrating "top-level design—implementation method—implementation cycle—incentive issuing department" and explore the relationships among contribution measurement, benefit measurement, and benefit distribution.

## 2.1 Current Status of Research Process Evaluation

Research process evaluation assesses contributions made by researchers throughout the scientific process. With the rapid development of collaborative research and increasing numbers of contributors to research outcomes, journals such as *Nature* and *Cell* have introduced author contribution statements to examine individual contributions to scientific papers. Organizations including the American Chemical Society, International Committee of Medical Journal Editors, and American Sociological Association [6-8] have developed corresponding contribution components based on their disciplines' characteristics. A 2012 Harvard workshop identified nine issues related to authorship, including ambiguous definitions of authorship and uncertain individual contributions [9]. However, this approach, which attempts to delve into the research process, can only examine author contributions through "author contribution statements" at the end of articles, lacking credible evaluation evidence and failing to verify the authenticity of contributions in the actual research process. Survey results indicate that 68.7% of researchers believe "author contribution statements" only partially reflect their actual contributions.

Exploring research process evaluation systems requires foundational platform construction research. Li Yuling [10] proposed building an information service model embedded throughout the entire research process, using discipline services and novel technology searches as entry points, and explored a full-process information service model for research project initiation, execution, completion, and transformation at South China University of Technology Library. Li Wenxia et al. [11] examined models for precisely embedding services into various research process stages in big data environments, discussing data collection, processing, integration, and knowledge product delivery. Lin Yishan et al. [12] elaborated platform construction methods from service, collaboration, data, and resource layers based on service demands throughout the research lifecycle of university researchers. Liu Guifeng et al. [13] constructed an evaluation index system for open research data platforms by analyzing and comparing international research data evaluation systems and referencing data lifecycle theory.

## 2.2 Current Status of Research Incentives

Appropriate research incentives can effectively mobilize researchers' subjective initiative. International research began earlier, focusing primarily on performance evaluation and incentive models. The International Network of Research Management Societies proposed the SCOPE principles for responsible evaluation throughout the research process, emphasizing that responsible evaluation systems should be applicable to collaborative systems (including interdisciplinary and inter-institutional collaborations), reduce administrative burdens on participants, and avoid creating perverse incentives [14].

Chakoli et al. [15] constructed performance evaluation systems for engineering, natural sciences, humanities, social sciences, and medical fields through literature review, questionnaires, and interviews, obtaining weights, values, and ratios for papers, monographs, and patents in each field. Aleksandrova et al. [16] found that incentive systems establishing new performance and efficiency evaluation standards positively impacted publication activities in biomedicine. Lindner et al. [17] discovered that current bibliometric incentive mechanisms hinder innovative research, while evaluating methodological quality, result reproducibility, and intellectual innovation and diversity could serve as measures to advance science and provide incentives. Viiu et al. [18] assessed the actual citation impact of 10,000 articles whose authors received economic incentives under Romania's Research Results Reward Program (PR3), finding that financial incentives increased publication quantity but did not guarantee quality outcomes.

Domestic research on research incentives primarily focuses on personnel incentive mechanisms and income distribution. Suo [19] found that using paper quantity and quality as key metrics for academic performance, promotion, and funding has created publication pressure across China's 2,000+ universities and research institutes, rapidly increasing China's academic influence but also generating academic misconduct. Liu Guangshu et al. [20] constructed a theoretical framework for graduate students' research self-efficacy and innovation motivation, finding that normative pressure in incentive systems positively and significantly impacts graduate students' innovation motivation. Liu Xinmin et al. [21] built a principal-agent model between universities and faculty to optimize incentive strategies for improving research performance. Dong Tingmei et al. [22] explored incentive dilemmas between research institutes and researchers from a process perspective, proposing governance optimization paths to enhance incentive effectiveness. Chen Honghai and Li Hailin et al. [23-24] examined screening and weighting methods for research output keywords based on information contribution rates and time series clustering.

While research examining author contributions through "author contribution statements" and theoretical and practical explorations of research process evaluation platforms have emerged, few scholars have conducted research process evaluation with the process itself as the object. Although abundant international and domestic research exists on research incentives, most evaluates the quantity and quality of research outputs (papers, monographs, patents) rather than the research process, leaving process-based incentive research a gap in the field. To change the phenomenon of "valuing things over people" and failing to recognize human value in research [25], we must fundamentally transform output-oriented evaluation systems and establish research process-based evaluation systems to achieve positive researcher incentives.

This paper constructs a diversified research process evaluation system with a corresponding platform, establishes process-based evaluation indicators using chemical engineering as an example, and conducts participant evaluation calculations. The system comprehensively incorporates both objective evaluation factors and expert subjective opinions, providing more comprehensive evaluation dimensions. Based on this, we propose a process-based incentive system and benefit distribution method to provide reasonable incentives for participants' work content and contribution levels.

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## 3.1 Research Process Diversified Evaluation Platform

The research process diversified evaluation platform addresses the lack of foundational platforms supporting research process evaluation while providing solutions for building a digital research environment. Based on research process evaluation, the platform uses institute-wide unified identity authentication as its entry point, providing functions including personnel permissions, research process management, and research process evaluation. The system architecture is shown in [Figure 1: see original paper]. Development environment: server-side ASP.NET C#; front-end HTML+CSS3+JSON; database: MySQL; operation mode: B/S.

[Figure 1: see original paper] System architecture diagram of the research process diversified evaluation platform

The platform's main functions include personnel management, identity characteristic management, research group management, research process management, evaluation calculation, and announcements, as shown in [Figure 2: see original paper]. Personnel management includes two roles: administrators responsible for system maintenance and research process indicator management, and ordinary users who participate in research process maintenance and evaluation. Research group management organizes personnel and affairs by group type, with options for public visibility. The interactive collaboration module provides an information exchange platform for research communication and cooperation among users. Research process management records disciplinary classification, research type (basic research, applied research, etc.), research process stages, and progress. Evaluation calculation is the platform's core function, incorporating objective evaluation indicators, subjective evaluation indicators, and fuzzy operators constructed after expert evaluation to conduct diversified research process evaluation combined with research process and identity characteristic management.

[Figure 2: see original paper] Function diagram of the research process diversified evaluation platform

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## 3.2 Participant Categories

### (1) Frontline Researchers

Frontline researchers are the main drivers of scientific progress and primary producers of research outcomes, primarily comprising students and full-time technical personnel directly engaged in research, accounting for approximately 70-80% of participants [26]. However, traditional evaluation systems based on research outputs make it difficult to quantitatively evaluate research effectiveness, divide contributions, and prevent authorship misuse. The research process evaluation platform provides reasonable evaluation for frontline researchers through combined objective and subjective assessment.

### (2) Research Support Staff

In addition to conducting research, support staff may manage equipment, teach laboratory courses, and purchase materials [27]. With unclear job responsibilities, traditional evaluation systems lack established standards and procedures for this group. The platform can document support staff's work in the research process, enabling research managers to optimize their job content based on evaluation results and achieve positive feedback in the research process.

**(3) Peer Experts**
Peer experts are scholars with high academic attainment in specific disciplines or fields [28]. Traditional evaluation systems cannot directly reflect peer experts' contributions to improving research outcomes. In the research process evaluation system, peer experts serve as crucial judges of research activities and outcomes, providing constructive suggestions on research directions and improvement methods. The platform can record these interventions, making peer experts' contributions traceable.

**(4) Research Managers**
Research managers play key roles in project advancement and stable research output, but this diverse group cannot be objectively evaluated through traditional models. For example, personnel who secure funding can appear as sponsors in research outcomes, while those responsible for team management and coordination—similar to research support staff—cannot be directly represented in research outputs, facing promotion obstacles. By 细分 ing roles played by this group in the research process, the platform can 完善 the evaluation mechanism for research managers.

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## 3.3 Interaction and Collaboration

The general scientific research process exhibits non-linear characteristics, with data storage, analysis, and description occurring in parallel [29]. Participants interact and exchange information through interaction and collaboration, generating information flows ([Figure 3: see original paper]). Within a single research process, information flows transition horizontally across research stages, while information flows generated by participants across different research processes circulate vertically among multiple processes, continuously expanding research depth and breadth.

**(1) Interaction Mechanisms**
Modern information technology evolution is profoundly transforming interaction mechanisms from traditional hierarchical structures to three-dimensional network structures ([Figure 4: see original paper]). Network and instant communication tools have accelerated information flow among participants, making it easier for ideas and suggestions to spark new insights during high-speed information exchange. Traditional evaluation systems cannot effectively assess this interaction mode, suppressing communication dynamics among individual actors and creating information silos within disciplines. Computer science has pioneered effective models for other disciplines: open-source platforms like GitHub, Kaggle, CSDN, and Coding provide searchable solutions and methods,

while practitioners actively contribute new approaches. Leveraging modern networks, top scholars and engineers worldwide can efficiently iterate technologies and methods, with these platforms gaining recognition from enterprises and universities that further promote practitioner interaction. The research process diversified evaluation platform references this interaction mechanism, where participants jointly complete research process $a$, and research process $n$ interacts with processes $a$ and $b$ through the interaction mechanism, ultimately forming a networked interaction system for research processes.

[Figure 4: see original paper] Networked interaction mechanism of research processes

**(2) Collaboration Mechanisms**
With internet technology 普及, complex collaboration mechanisms in research processes can be realized through "horizontal and vertical collaboration" ([Figure 5: see original paper]). Horizontal collaboration, similar to traditional evaluation logic, involves cooperation within the same research process, including research guidance and idea exchange. In this scenario, evaluation subjects may simultaneously assume multiple roles within one research process or collaborate with other subjects to complete specific processes.

For long-cycle projects (such as gene mapping or physicochemical property database construction) requiring substantial time and manpower, personnel may undergo several rounds of turnover. Such basic research yields no immediate benefits but provides foundations for future studies. As China enters a critical period of technological development requiring strong support for basic and applied basic research, current systems cannot record or reasonably evaluate these complex relationships. Vertical collaboration mechanisms can document how basic research contributes to other studies, providing development security for participants and credible research proof for early contributors. By continuously recording such collaborative effects, vertical mechanisms incentivize researchers to 深耕 their fields and provide credible contribution evidence for those who "sit on cold benches."

Horizontal and vertical collaboration mechanisms are interrelated, connecting various research processes through researchers to form a research collaboration network.

[Figure 5: see original paper] Research process collaboration mechanism

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## 4 ICDP-Based Research Process Diversified Evaluation System

Any metric, no matter how well it achieves its intended goal, has limited utility [30]. Research process diversified evaluation should fully solicit expert opinions, incorporating not only objective indicators but also subjective evaluation indicators through expert judgment. The system evaluates research processes based on participants' identity characteristics (Identity), combines subjective and objective evaluation (Combination of Subjectivity-objectivity), fully considers disciplinary characteristics (Discipline), and examines the research process (Process)—hence the ICDP method.

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### 4.1 Indicator System Content

A key laboratory of the Chinese Academy of Sciences primarily conducts chemical engineering research with both basic and applied research capabilities. For this laboratory's research fields, the research process is divided into five stages: research design, experiment implementation, data processing, research outcome presentation, and organization/management. The ICDP method constructs the research process evaluation indicator system. To ensure persuasiveness and applicability, field interviews were conducted with eight researchers from the laboratory to establish indicator weights suitable for basic and applied research.

After indicator system finalization, expert questionnaires were distributed to determine judgment matrices and calculate weight coefficients for indicators at all levels. Based on laboratory requirements, the diversified research process evaluation indicator system and weight allocation were established, as shown in -2. Specific meanings of third-level indicators are provided in .

Basic research process evaluation indicator weights
Applied research process evaluation indicator weights
Meanings of third-level indicators

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### 4.2 Overall Evaluation Calculation Method

The research process diversified evaluation result is denoted as $E$, representing the sum of objective evaluation ($Eo$) and subjective evaluation ($Es$). The objective evaluation method operates as follows: when a research process yields clear outputs (academic papers, monographs, patents, etc.), the research outcome process ($AP$) receives full weight by default, and research outcome exposure ($AE$) is calculated based on output weights. For ongoing research processes, weighting is determined by the current stage, with $AE$ excluded from calculation. For example, if research has progressed to the data processing stage, the completed portion's weight is calculated.

Subjective evaluation employs fuzzy comprehensive evaluation by constructing fuzzy operators. Evaluation grades are divided into five levels: excellent, good, qualified, poor, and very poor. Expert scoring establishes the evaluation set membership matrix, which is weighted with the third-level indicator set and corresponding weight matrix. The maximum membership value determines the second-level fuzzy evaluation result, which is then weighted to obtain the subjective evaluation result. The weighted calculation is where $W$ is the indicator weight matrix and $M$ is the membership matrix.

For example, five experts evaluate basic research process $A$, with three rating it excellent, one good, and one qualified. The membership degrees are: excellent 0.6, good 0.2, qualified 0.2, yielding the membership matrix (0.6, 0.2, 0.2, 0, 0). Using process $A$'s subjective evaluation as an example, the specific fuzzy comprehensive evaluation process and results are demonstrated.

The indicator membership degrees for process $A$'s subjective evaluation are shown in .

Indicator membership degrees for process $A$ subjective evaluation

**(1) Second-level fuzzy evaluation**
The fuzzy evaluation matrix for basic research process contribution is:

With weight vector , the comprehensive evaluation vector for process contribution is . According to the maximum membership principle, process contribution is .

The fuzzy evaluation matrix for basic research process potential is:

With weight vector , the comprehensive evaluation vector for process potential is . According to the maximum membership principle, process potential is .

**(2) Subjective evaluation result**
After second-level fuzzy evaluation yields process contribution ($PC$) and process potential ($PP$), process $A$'s subjective evaluation result is the sum of $PC$ and $PP$: .

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### 4.3 Participant Evaluation Calculation

Research process participants have diverse identities and contribution levels, making equal distribution inappropriate. Field interviews with eight laboratory researchers determined identity weights for participants in the research outcome process, as shown in , transformed into matrix $SP$ as Equation 1. Interviewees covered frontline researchers, research support staff, peer experts, and research managers.

Identity weights of participants in research outcome process

From the basic research weights in , the research outcome process weight vector is . Multiplying this vector by the participant identity weight matrix yields participant identity weight vector $IB$, which after normalization becomes the contribution vector $IBn$ for basic research participants.

Similarly, from the applied research weights in , the research outcome process weight vector is . Multiplying this vector by the participant identity weight matrix yields participant identity weight vector $IA$, which after normalization becomes the contribution vector $IAn$ for applied research participants.

After experts complete the diversified evaluation, participants receive corresponding evaluations based on research nature and identity characteristics. The calculation method is as follows: using the method in Section 4.2 to calculate the diversified evaluation result $E$, if participant $n$ conducts basic research, their allocated evaluation coefficient is ; if participant $n$ conducts applied research, their allocated evaluation coefficient is .

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## 5.1 Multi-dimensional Incentive System

Research teams internally prioritize projects based on participants' contributions to the research process, employing target incentives, bonus structures, and technology transformation as incentive mechanisms. The solution integrates "top-level design—implementation method—implementation cycle—incentive issuing department" to construct a multi-dimensional incentive system ([Figure 6: see original paper]). The scientific community and society should provide greater attention to researchers, establishing additional special contribution titles, special contribution bonuses, and exceptional promotion nomination systems beyond existing honors to motivate researchers.

[Figure 6: see original paper] Multi-dimensional incentive system for research process

Regarding bonus structures, since most research institutes operate as public institutions, researchers can be rewarded through basic salary, short-term incentives, medium-to-long-term incentives, and long-term incentives. Basic salary, as fixed income, is currently generally low and should be appropriately increased. Short-term incentives, as variable income linked to contributions, can be subdivided into year-end bonuses and project-specific awards. Medium-to-long-term incentives span five years, with increased rewards for researchers engaged in long-cycle projects, adjusted dynamically based on project progress. Long-term incentives, primarily established by national and institutional authorities, grant honors and awards to researchers and teams making special contributions in specific fields—these measures are relatively standardized but require expansion. Bonus incentives should avoid unreasonable salary inversion and promote healthy internal competition.

Technology transformation serves as an effective supplement to the multi-dimensional incentive system, providing both proof of research contribution and incentive extension. In 2019, technology transformation contracts from over 3,000 Chinese universities and research institutes increased by 32% year-over-year, indicating strong market demand [31]. However, because research institutions involve state-owned asset disposal issues, equity and dividend rights lack legal and institutional guarantees, hindering implementation of technology transformation benefit distribution incentives [32]. The process-based multi-dimensional incentive system provides reference basis for contribution proportions during technology transformation, filling the gap in equity and dividend rights certification. Researchers and institutions should seize the "window" of enterprise development reform to find the "balance point" between research topics, market conditions, and enterprise needs.

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## 5.2 Benefit Distribution Method

As scientific research deepens, cross-disciplinary and cross-institutional collaboration becomes increasingly frequent. Without reasonable benefit distribution systems, unfair allocation may cause cooperation breakdowns and hinder scientific progress. This study proposes a process-based benefit distribution method comprising contribution measurement, benefit measurement, and benefit distribution ([Figure 7: see original paper]). Benefit distribution is built upon contribution measurement, achieving reasonable allocation by measuring relationships between research subjects and tangible/intangible assets. Properly handling these aspects effectively safeguards interests and promotes sustainable development of the research ecosystem.

[Figure 7: see original paper] Schematic diagram of benefit distribution method

Contribution measurement assesses participant contributions during the research process, serving as the primary basis for benefit distribution, involving contribution division across research stages, contribution indicators for all parties, and role weightings. Using the CAS key laboratory as an example, contribution measurement can employ the ICDP-based diversified evaluation method and the participant evaluation calculation method proposed in Section 4.3, yielding contribution measurement results .

Benefit measurement evaluates research outcomes, categorized as tangible or intangible assets. Tangible assets include systematic research entities such as scientific literature and patents, projects or funds applied for based on these entities, and other tangible experimental conditions. Intangible assets are completed research processes that provide experience and cases for future research, including both successful and unsuccessful processes.

Benefit distribution uses contribution and benefit measurement as allocation bases, typically distributing research entities, projects, or funds. Frontline researchers contribute significantly to individual research processes and need research outcome accumulation to increase academic visibility, so their contribution proportions in research entities can be appropriately increased, such as elevating their authorship rankings. Research support staff, managers, and peer experts often undertake multiple research tasks simultaneously, making increased contributions to research entities less meaningful for them. Their proportions in the incentive system should be appropriately increased to encourage participation in target incentives, bonus structures, and technology transformation distribution.

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## 6.1 Strengthening Policy Support for Process-Oriented Research Evaluation

Process-oriented research evaluation is highly exploratory and forward-looking. The state should fully leverage macro-control and strategic planning roles, actively promoting unconventional paradigm research while supporting conventional research evaluation. First, increase emphasis on the research process and weaken the dominant position of research papers in evaluation. As the foundation of scientific development, the research process should receive greater weight in future evaluation systems, nurturing research growth, tolerating failure, encouraging researchers to pioneer new fields, and creating favorable research environments. Second, explore process-oriented evaluation policies aligned with disciplinary characteristics. Strengthen national policy support to develop process-based evaluation systems according to disciplinary features, supporting representative units in piloting process-oriented evaluation.

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## 6.2 Enhancing Digital Technology Depth in Research Evaluation

As a breakthrough technology, digital technology has substantial development potential in research evaluation. Science and technology policies should be grounded in the present while looking to the future, increasing support for digital research evaluation. First, build evaluation platforms and improve expert databases for research management and disciplinary specialists. Break down barriers between research management and disciplinary talent, supporting policy communication between research management experts and disciplinary specialists to motivate the latter's participation in evaluation system construction. Second, strengthen discipline-specific research evaluation databases. For instance, mathematics and chemistry, both natural sciences, have different research process stages and publication difficulties, making unified evaluation standards inappropriate. Improving discipline-specific evaluation systems is highly significant. Third, support dynamic evaluation platform development. Societal recognition of research importance changes over time, and the impact of excellent research may only become apparent after decades. Building digital real-time dynamic evaluation platforms provides foundations for continuous and reasonable research evaluation.

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## 6.3 Exploring Diversified Research Incentive Policies

Research institutes should recognize the limitations and conservatism of current incentive strategies and explore incentive policies suitable for China's research landscape. First, research institutes should actively explore and establish incentive strategies aligned with their disciplinary and talent characteristics. Promote diversified talent incentive systems, providing special incentives for researchers with special contributions, and encourage units to develop incentive systems that adapt to disciplinary development, solve technological challenges, and break foreign technology blockades to identify and cultivate outstanding researchers promptly. Second, the state should actively adjust top-level design and promote excellent experiences from pilot units. Facilitate learning and exchange mechanisms between pilot units and broader research institutions to continuously optimize diversified incentive policies.

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**Author Contribution Statement:**
Liu Lujing: Conceptualization, methodology, original draft, revision;
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Liu Huizhou: Revision.

*Author contributions can be categorized as: 1) Research conceptualization and design, including specific ideas or methods; 2) Research implementation, such as experiments or surveys; 3) Data acquisition, provision, and analysis; 4) Original draft or final version revision. Each paper can detail contributions according to its research characteristics. Some research may involve additional activities that can be specified. For multi-author papers, each author's specific contributions across these four aspects must be indicated at the end of the paper.