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INSTITUTIONAL COMPARISON AND PRACTICAL PATH SELECTION FOR INTERDISCIPLINARY DEVELOPMENT IN CHINESE AND US RESEARCH UNIVERSITIES

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Abstract: This study delves into the institutional models and practical pathways for interdisciplinary development in research universities in China and the United States. It analyzes cross-national differences in institutional logic, cultural cognition, and organizational models, and proposes recommendations for optimizing China's pathways. The study finds that China's interdisciplinary development is constrained by traditional disciplinary evaluation and resource allocation systems, whereas the United States has fostered a bottom-up interdisciplinary ecosystem through market-driven flexible mechanisms. In contrast, China's top-down approach often offers advantages in mobilizing large-scale resources for major targeted national priorities. The two countries' models are complementary in innovation demand scenarios: the Chinese model is well-suited for addressing clearly defined technological bottlenecks, while the American model is more conducive to nurturing original breakthroughs. The article suggests that China should optimize its environment for interdisciplinary development through three levels: institutional innovation, shifts in cultural cognition, and reform of organizational models. It calls for establishing a new institutional framework aligned with the characteristics of interdisciplinary research, promoting the transition of interdisciplinary studies from the periphery to the center, and ultimately forming a distinctive system for interdisciplinary development with Chinese characteristics. Finally, these insights provide a very strong comparative foundation for concrete policy and practice.
Keywords: Interdisciplinary development; Chinese Research Universities; American Research Universities; Institutional comparison; Pathway innovation

1 INTRODUCTION

The world today is undergoing profound changes unseen in a century. The challenges facing humanity are intensifying, and the mode of knowledge production is undergoing a fundamental transformation. The major issues confronting contemporary society have long transcended traditional disciplinary boundaries, exhibiting unprecedented complexity and systemic nature. Challenges such as climate change, public health crises, energy transition, and artificial intelligence ethics cannot be fully understood or effectively resolved through a single disciplinary lens. These challenges demand that researchers break down disciplinary barriers, integrate knowledge and methods from diverse fields, and develop more comprehensive and innovative solutions.

Simultaneously, the science and technology innovation ecosystem is continuously evolving, with the cycle of technological innovation significantly shortened. The path from laboratory to industrialization is becoming increasingly blurred, and the boundaries between basic and applied research are continuously dissolving. In this environment, researchers confined to a single discipline often struggle to grasp the holistic picture of technological evolution, whereas teams with interdisciplinary perspectives are more likely to identify opportunities for disruptive innovation. The demand from industry for compound talents also reflects that solving real-world problems never presents itself according to disciplinary classifications. Moreover, numerous frontier fields, such as dark matter research, exploration of the nature of consciousness, and prediction of complex system behavior, inherently require multidisciplinary collaboration. The theoretical tools and methodologies of a single discipline often prove inadequate when facing these "unknown unknowns."

Knowledge production itself is undergoing a fundamental paradigm shift. The traditional linear model of knowledge accumulation is being replaced by networked knowledge innovation, with major scientific breakthroughs occurring with increasing frequency at the intersections of disciplines. This transformation is not only evident in the natural sciences; the humanities and social sciences also need to address new issues arising from digitalization and globalization through interdisciplinary dialogue. When quantum computing meets ethics, when gene editing encounters law, and when climate change intersects with economics, these cross-cutting areas are precisely where the most revolutionary sparks of thought and innovative potential are gestated.

Against this backdrop, the concept of interdisciplinarity has emerged. Cultivating talents with systemic thinking and comprehensive problem-solving abilities has become a global consensus in higher education. This requires educational systems to transcend traditional specialized divisions and create more opportunities for interdisciplinary learning and research. Through the intersection and collision of different knowledge domains, students can not only gain a broader perspective but also develop more adaptive innovative capabilities. The interconnectivity of global knowledge networks has created unprecedented conveniences for interdisciplinarity, while simultaneously raising higher demands. Digital

platforms have broken down both geographical and disciplinary isolation, enabling interdisciplinary collaboration to occur anytime and anywhere. However, for such collaboration to generate genuine value, participants need the ability to engage in interdisciplinary understanding and dialogue, which in turn drives the academic community to place greater emphasis on and invest more in interdisciplinarity. In this sense, interdisciplinarity is not merely a means to address challenges but also the inevitable form of knowledge production itself in the new era.

2 THE INSTITUTIONAL FRAMEWORK FOR INTERDISCIPLINARY DEVELOPMENT IN CHINESE RESEARCH UNIVERSITIES

The development of interdisciplinarity within China's higher education system is confronting a profound institutional contradiction. In 2021, the Ministry of Education officially added the "Interdisciplinary" category, incorporating emerging fields such as Integrated Circuit Science and Engineering and National Security Studies into the disciplinary catalog. This policy breakthrough reflects the national government's strategic emphasis on interdisciplinary research[1]. However, in practice, discipline evaluation and resource allocation still strictly adhere to the traditional first-level discipline framework. This duality within the institutional environment is creating structural obstacles that constrain interdisciplinary development.

The essence of this contradiction lies in the conflict between old and new institutional logics. The addition of the interdisciplinary category represents a positive response to the transformation of knowledge production models, acknowledging that major modern scientific issues and key technological breakthroughs often occur at the boundaries of disciplines. Taking the School of Integrated Circuits at Tsinghua University as an example, this school integrates multiple disciplinary strengths, including microelectronics, materials science, and computer science. However, when participating in discipline evaluations, its research achievements still need to be disaggregated and reported according to traditional discipline classifications such as Electronic Science and Technology and Materials Science and Engineering[2]. This disaggregation not only fragments the value of research but also places interdisciplinary teams at a disadvantage in resource competition.

The evaluation system is also a significant factor constraining the shift from traditional disciplinary classification to interdisciplinarity. The current evaluation mechanism, based on first-level disciplines, originates from the disciplinary management model of the last century and exhibits fundamental tensions with interdisciplinary research, which emphasizes boundary crossing. For instance, practice at Peking University's Academy for Advanced Interdisciplinary Studies shows that its faculty faces a "dual identity dilemma": they need to demonstrate interdisciplinary characteristics when applying for interdisciplinary projects, but must return to a traditional discipline for evaluation during title promotion reviews[3]. This institutional fragmentation forces researchers into difficult trade-offs between disciplinary loyalty and innovative exploration.

Although interdisciplinarity has gained policy recognition, key resources such as financial allocations and enrollment quotas are still distributed according to first-level disciplines. Zhejiang University discovered during the construction of its "Brain Science and Artificial Intelligence" interdisciplinary platform that the procurement of research equipment needed to be charged to multiple discipline budgets in a fragmented manner, while interdisciplinary courses were difficult to incorporate into any single discipline's curriculum plan[4].This resource allocation model essentially maintains disciplinary silos, making it difficult for interdisciplinary research to receive systematic support.

This duality within the institutional environment reflects the gradual nature of higher education reform. It represents both a significant attempt to break through traditional disciplinary barriers and reveals deep-seated systemic obstacles. To truly promote the integrated development of interdisciplinarity, coordinated reforms are needed in evaluation systems, resource allocation, and academic assessment, establishing a new institutional framework aligned with the characteristics of interdisciplinary research[5]. The persistence of this transitional state not only constrains the in-depth development of interdisciplinarity but may also lead to missing crucial opportunities presented by the new round of scientific and technological revolution and industrial transformation.

3 THE INSTITUTIONAL FRAMEWORK FOR INTERDISCIPLINARY DEVELOPMENT IN AMERICAN RESEARCH UNIVERSITIES

The most notable feature of interdisciplinary development in the United States lies in its market-driven, flexible mechanisms. Through diversified resource allocation, adaptable organizational forms, and a tolerant innovation culture, this mechanism has fostered a bottom-up interdisciplinary ecosystem. The success of Stanford University's Bio-X program vividly illustrates the essential characteristics and operational logic of this mechanism.

The core of the market-driven approach lies in establishing a problem-oriented resource allocation system. The Bio-X program's annual seed fund of $1.5 million may seem modest, but its unique value lies in supporting high-risk interdisciplinary research that struggles to secure traditional funding[6]. This funding does not set fixed disciplinary boundaries; it is determined entirely by scientific value and development potential, embodying the "venture capital" logic of market mechanisms. Projects that receive this funding often attract subsequent investment from corporations and foundations, forming a virtuous cycle.

Flexible mechanisms are particularly evident in personnel systems. Over half of the professors in the Bio-X program are appointed through joint appointment arrangements, which break the monopoly of traditional schools and departments

over human resources. Professors can belong to two or even more academic units simultaneously, with their performance evaluations comprehensively considering contributions across various fields[6]. The dynamic allocation of laboratory space further subverts the traditional notion of "territory," with research facilities flexibly adjusted based on project needs to ensure resources flow to areas of greatest demand[6]. This highly fluid model of personnel and space management significantly reduces the institutional costs of interdisciplinarity.

In terms of the evaluation system, the development of interdisciplinary studies in the United States demonstrates a rare institutional tolerance. The National Science Foundation's (NSF) "Convergence Research" program grants researchers a five-year period free from assessment, allowing them to engage in deep exploration without the pressure of short-term output. The MIT Media Lab's "failure report" system treats research setbacks as valuable experiences, and this tolerance for failure greatly encourages high-risk innovation[7]. These institutional designs essentially introduce a "risk hedging" mindset from market mechanisms into research management, fostering original innovation by creating room for error.

The flexibility of market-driven mechanisms is also reflected in the collaborative participation of diverse entities. In addition to internal university resources, corporations, foundations, and individual donors are deeply involved in the development of interdisciplinary studies. This diversity of investment not only brings financial support but also integrates real-world demands directly into the research process. Close interaction with industry ensures that interdisciplinary research remains oriented toward practical problems, avoiding academic isolation. The equal participation of various entities fosters a competitive innovation ecosystem, where the most promising interdisciplinary directions naturally receive greater resource support.

The effectiveness of this market-driven flexible mechanism lies fundamentally in its establishment of a bottom-up selection system. Unlike administrative directive-based resource allocation, it leverages diversified investment, free competition, and survival of the fittest to allow the most vital interdisciplinary fields to emerge naturally. Although this mechanism may appear loosely structured, its inherent competitiveness and adaptability enable it to continuously generate groundbreaking interdisciplinary innovations. The success of Stanford's Bio-X program is not an isolated case but rather a microcosm of the U.S. model for interdisciplinary development, whose core lesson lies in creating an institutional environment that allows interdisciplinary studies to flourish naturally.

4 A COMPARATIVE ANALYSIS OF INSTITUTIONAL DIFFERENCES AND INTERNAL LOGIC IN INTERDISCIPLINARY DEVELOPMENT BETWEEN CHINA AND THE UNITED STATES

4.1 Differences in Institutional Traditions

The development of interdisciplinary studies in China and the United States exhibits deep-seated institutional differences, rooted not only in the political and economic systems of the two countries but also reflecting distinct traditions of innovation culture. China’s “national goals–key breakthroughs” model embodies the institutional strength of socialism in concentrating resources to accomplish major tasks, promoting the development of interdisciplinary studies through top-level design and strategic planning[8]. The establishment of Tsinghua University’s School of Integrated Circuits, for example, directly serves the national strategy for semiconductor self-sufficiency, integrating multiple disciplines such as microelectronics, materials science, and computer science[8]. This model enables the concentration of superior resources to achieve breakthroughs in critical technological bottlenecks within a short timeframe. However, this highly goal-oriented approach also has limitations: an overemphasis on applied research may lead to the neglect of foundational and exploratory interdisciplinary research, potentially hindering the emergence of original breakthroughs in the long run.

In contrast, the American “market selection–free exploration” model follows a completely different development path. Characterized by the participation of diverse actors and market competition, this model supports interdisciplinary research through a variety of channels, including foundations, corporations, and universities[9]. Rather than predetermining specific research directions, it encourages scientists to form cross-disciplinary collaborations spontaneously based on their interests and academic values. This mechanism of free exploration has nurtured numerous disruptive innovations and contributed to many groundbreaking scientific discoveries. While its strength lies in fully unleashing the creativity of researchers, it also faces challenges such as fragmented resources and difficulty in forming a concerted effort to tackle major problems.

An in-depth analysis of the complementarity between these two models reveals that each is suited to different innovation scenarios. China’s model of concentrated efforts is particularly effective in addressing clearly defined technological bottlenecks, especially in catch-up innovation. The American model of free exploration, on the other hand, is more conducive to fostering original, disruptive scientific breakthroughs. Amid the current landscape of global technological innovation, the two models are increasingly drawing on each other’s strengths. China, while maintaining its strategic focus, has begun to introduce more flexible mechanisms, such as establishing non-directed interdisciplinary research funds. The United States, meanwhile, has strengthened national-level resource coordination in key strategic areas such as artificial intelligence and climate change. This trend toward convergence suggests that a new organizational paradigm for interdisciplinary studies may take shape in the future—one that balances strategic focus with the vitality of innovation.

4.2 The Cultural Cognitive Divide

Differences in cultural cognition between China and the United States in the field of interdisciplinary studies

profoundly influence the behavioral choices of researchers and the innovation ecosystem. According to the 2022 Survey Report on Interdisciplinary Development in "Double First-Class" Universities released by the Higher Education Teaching Evaluation Center of the Ministry of Education, a survey conducted across 15 top-tier universities, including Peking University, Tsinghua University, and Fudan University, found that over 70% of young faculty members believe that participating in interdisciplinary collaboration negatively impacts their chances for professional promotion[9]. This cognitive dilemma has led many accomplished scholars to hesitate in pursuing interdisciplinary research. For instance, an associate professor at Shanghai Jiao Tong University, who specializes in both biomedical engineering and artificial intelligence, mentioned in an interview that he had to divide his research outputs into two traditional disciplines to apply for promotion.

In contrast, a 2021 survey by the Association of American Universities (AAU) revealed that 54% of its member institutions have established dedicated promotion pathways for interdisciplinary faculty[7]. Taking Stanford University's Bio-X program as an example, it not only allows faculty to choose an interdisciplinary evaluation path but also innovatively employs a "matrix of contributions" assessment method, requiring external reviewers to evaluate research based on three dimensions: originality in interdisciplinary integration, depth of integration, and practical impact[6]. The MIT Media Lab goes even further, with its promotion criteria completely disregarding traditional disciplinary journal publications and instead focusing on the interdisciplinary innovation and social impact of research outcomes.

The formation of these cultural cognitive differences is rooted in deep-seated institutional origins. The long-standing disciplinary evaluation system in Chinese universities originates from the Soviet model, emphasizing clearly defined disciplinary boundaries and the integrity of knowledge systems. The primary discipline evaluation indicators of the Academic Degrees and Graduate Education Development Center of the Ministry of Education still lack effective criteria for evaluating interdisciplinary research outcomes. In contrast, the United States has explicitly called for establishing differentiated standards in project evaluation and outcome assessment. This divergence in institutional orientation directly influences researchers' behavioral patterns and explains why interdisciplinary studies have become the norm rather than the exception at institutions such as Stanford University and MIT.

Notably, this cognitive divide is prompting profound reflection within China's higher education community. Tsinghua University, in its faculty appointment system reform pilot launched in 2023, introduced for the first time a "Distinguished Professor in Interdisciplinary Studies" position, with evaluation criteria completely different from those of the traditional disciplinary system. Peking University's Institute of Advanced Interdisciplinary Studies has also begun experimenting with a "statement of contribution to outcomes" system, requiring academic committees to consider the integrative and innovative value of interdisciplinary research in addressing complex problems when evaluating such work. Although these reform efforts are still in their early stages, they signify that Chinese universities are striving to build a more inclusive cultural ecosystem for interdisciplinary studies.

4.3 Differences in Organizational Models

The differences between China and the United States at the practical level of interdisciplinary engagement fundamentally reflect the distinct operational logics of their innovation ecosystems. China's "task-oriented interdisciplinary" model is driven by major national needs, achieving interdisciplinary collaboration through organized research efforts. This model of concentrating resources to accomplish major tasks demonstrates unique advantages in addressing critical technological bottlenecks, yet it also has the limitation of overly focused research directions. Among national-level interdisciplinary research projects, most are concentrated in applied fields such as electronic information and new materials, while interdisciplinary integration in basic disciplines remains relatively insufficient[10].

In contrast, the American "interest-oriented interdisciplinary" path exhibits distinctly different characteristics. The operational model of Stanford University's Bio-X program is highly representative: the program invests $1.5 million annually in seed funding to support high-risk interdisciplinary research, requiring applicants only to demonstrate the interdisciplinary innovativeness of their research without prescribing specific application goals. This essentially represents a deconstruction and reconstruction of traditional disciplinary structures, with its underlying logic reflecting a philosophical reflection on the paradigm of knowledge production[11]. This form of free exploration-oriented interdisciplinary research is not merely a research method but also an epistemological stance—it questions the artificiality of disciplinary boundaries, challenges existing systems of knowledge classification, and advocates for problem-oriented rather than discipline-oriented knowledge construction. Under this model, interdisciplinary research is no longer a simple instrumental combination but instead forms a new form of knowledge with ontological significance, whose value lies not in serving a predetermined goal but in creating new cognitive possibilities. This epistemological shift has moved interdisciplinary research from the margins to the center, evolving from temporary collaboration to an institutionalized mode of knowledge production.

An in-depth analysis of these two models reveals their complementary advantages along the innovation chain. China's "task-oriented interdisciplinary" model demonstrates significant efficiency in the technology breakthrough stage, while the American "interest-oriented interdisciplinary" model excels at original innovation. Notably, the two models are showing a trend of mutual learning: Tsinghua University's "Interdisciplinary Innovation Seed Fund," established in 2023, draws on the American seed fund mechanism, while the United States has strengthened targeted interdisciplinary research oriented toward national security[12]. This integrative development suggests that future practices in interdisciplinary research may require the construction of new organizational models capable of both focusing on

national needs and stimulating free exploration.

5 RECOMMENDATIONS FOR OPTIMIZING CHINA'S PATH

5.1 Reconstructing the Institutional System

The core experience we can draw from the American "market selection and free exploration" model lies in how institutional design can provide an "undirected" space for interdisciplinary studies. With multiple funding entities—foundations, enterprises, universities—operating independently, researchers can seek different types of support at various stages of their work, rather than being required to lock down specific technical routes and application goals from the outset. China could introduce a new category for "undirected exploration" specifically for interdisciplinary research within its existing national science and technology programs. Such projects would not set specific goals or technical targets; instead, the evaluation criteria would focus on the interdisciplinary innovativeness of the research and the academic judgment of the applicant, rather than the feasibility of a predetermined technical path. More importantly, these projects should combine long-term funding with periodic evaluation, granting researchers ample room to adjust direction and avoiding premature convergence driven by midterm assessment pressures.

Another important insight from the American model in resource allocation is that interdisciplinary development requires institutionalized "redundant space." The Bio-X program, for instance, invests $1.5 million annually in seed funding for high-risk interdisciplinary research. Applicants need only demonstrate the interdisciplinary innovativeness of their projects without having to preset application goals. This mechanism essentially carves out space for exploratory research that allows failure, outside the mainstream funding system. China's current allocation of national science and technology resources is heavily concentrated on mission-oriented projects with clear goals and expected outcomes. While highly efficient for tackling critical technological bottlenecks, this approach objectively squeezes the space for high-risk exploratory research. Drawing on the American experience, China could establish a national "Interdisciplinary Exploration Fund" with a management logic entirely different from that of existing science programs—no annual assessments, no mandatory progress reports, no predetermined forms of deliverables, and a funding cycle extended to seven to ten years. The scale of such a fund need not be large, but its very existence would represent an institutional recognition of the developmental patterns of interdisciplinary research, offering researchers the institutional protection needed to take risks and learn from failure.

Beyond this, institutional design for interdisciplinary studies should also emphasize the diversification of funding entities and differentiation of funding mechanisms. In the United States, the sources of funding for interdisciplinary research are highly decentralized—federal agencies, private foundations, corporate R&D departments, and university internal funds each have their own funding logic and cycle characteristics, allowing researchers to flexibly combine them according to the needs of different research stages. This landscape of multiple coexisting funding bodies forms an "institutional ecosystem," where the complementarity among different funding mechanisms supports interdisciplinary research across its full lifecycle, from seed stage to maturity. In China, the current funding landscape is relatively centralized, with national science programs occupying a dominant position; internal resource allocation within universities is heavily tied to national evaluation orientations, while corporate engagement in basic research remains weak. Rebuilding the institutional system requires promoting a multi-level funding structure that integrates "national, local, corporate, and university-led autonomous" funding streams. At the university level, internal seed funds for interdisciplinary research could be established, decoupled from disciplinary assessments, allowing faculties to allocate resources autonomously based on research needs. At the corporate level, policy tools such as tax incentives could encourage leading industry players to collaborate with universities in establishing long-term interdisciplinary research laboratories, with corporate contributions not required to yield short-term outcomes and instead focused on frontier exploration.

In summary, the most valuable lesson from the American institutional tradition lies in its institutional safeguarding of academic autonomy, underpinned by market selection. The development of interdisciplinary studies in the United States has not been driven by top-down planning; rather, it has been enabled by institutional arrangements that grant researchers ample autonomy to choose collaboration partners, adjust research directions, and decide on the forms of their outputs. This autonomy is not laissez-faire—it is structured through mechanisms such as peer review, long-term funding, and tolerance of failure, which entrust academic judgment to the researchers themselves. While maintaining its strengths in strategic focus, China can expand the space for researcher autonomy through institutional design. A path of "free exploration within a strategic framework" could combine the systemic advantage of concentrating resources to tackle major challenges with respect for academic autonomy and innovation freedom, potentially offering a third way suited to China's institutional context.

5.2 Transforming Cultural Cognition

At the level of cultural cognition, advancing interdisciplinarity requires systematic reform through multiple approaches. Conceptually, it is necessary to foster an institutional culture that encourages interdisciplinarity. This can be achieved by organizing interdisciplinary academic events, strengthening media promotion, and facilitating international exchanges to break down entrenched disciplinary mindsets. Concurrently, evaluation orientation must be properly guided, taking into full consideration the unique characteristics of interdisciplinary research during processes such as title promotion and project application, establishing a more scientifically sound evaluation system. This transformation requires joint

efforts from university administrators and researchers to gradually change deeply ingrained disciplinary parochialism through continuous education and demonstration.

Cultural adaptation is the most challenging yet fundamental breakthrough point. Establishing an "Interdisciplinary Mentorship System" is an effective approach for cultivating a new type of academic culture. This system is not a simple extension of traditional mentorship; it aims to build a new type of student-mentor academic community that integrates professional depth with cross-disciplinary perspective. Operationally, it requires designing mechanisms for co-mentorship by double or multiple advisors, establishing certification systems for interdisciplinary learning outcomes, and innovating curriculum modules and research training models for interdisciplinary education. More crucially, this mentorship system should subtly transform the academic mindsets and value orientations of both faculty and students, cultivating a new generation of scholars who respect disciplinary traditions while daring to transcend boundaries. Such cultural change requires long-term accumulation, but once formed, it will yield the most lasting and far-reaching institutional innovation effects. These three breakthrough points support each other and are mutually interdependent, collectively forming an institutional innovation system for promoting interdisciplinary development in China.

Talent cultivation is the foundational project for interdisciplinary development. Universities need to optimize curriculum systems, offering interdisciplinary course modules to cultivate students' integrative thinking abilities. Intra-university interdisciplinary joint training mechanisms should be established, encouraging students to choose mentors and projects from different disciplines. Cooperation with domestic and international institutions should be strengthened to develop joint training programs and broaden students' academic horizons. Through systematic curriculum reform and practical training, new talents possessing both professional depth and cross-disciplinary breadth can be cultivated, providing sustained talent support for interdisciplinary research. Reforms in these three areas must be promoted synergistically to form a virtuous cycle of conceptual guidance, institutional support, and talent cultivation, fundamentally changing the difficulties currently facing interdisciplinary development.

5.3 Promoting Organizational Change

A "Pyramid Model" for strategic balance can be attempted, encompassing systematic institutional innovation across three levels: top-level design, mid-level linkage, and grassroots activation. At the top-level design, the National Science and Technology Leading Group should coordinate planning, focusing on strategically critical fields such as quantum information, artificial intelligence, and biomedicine, establishing a cross-ministerial coordination mechanism for major interdisciplinary initiatives. Such projects should combine "open competition for selection" with a "tournament mechanism," organizing universities, research institutes, and enterprises to form innovation consortia, providing stable support periods of 5-10 years, while establishing systems for dynamic adjustment and phased evaluation. Crucially, such top-level targeted efforts should not simply be about resource accumulation; they must aim to build innovation ecosystems characterized by deep interdisciplinary integration. Project designs must reserve 20%-30% of funds for exploratory research directions.

The core of mid-level linkage lies in building a collaborative innovation network involving industry, academia, and research. The Ministry of Education, in conjunction with the State-owned Assets Supervision and Administration Commission, the Ministry of Industry and Information Technology, and other departments, should issue targeted policies encouraging key universities and leading industry enterprises to jointly establish entity-based interdisciplinary innovation laboratories. Such laboratories should transcend the superficial model of traditional university-industry collaboration, establishing deep cooperation mechanisms involving shared talent, shared data, and co-owned intellectual property. Operationally, a "dual-base" model can be adopted, where researchers are provided with suitable working conditions both at the enterprise site and the university laboratory, enabling real-time interaction between theory and practice. Particular attention should be paid to establishing outcome transformation mechanisms suitable for interdisciplinary research, allowing researchers to participate in the industrialization process through avenues such as technology equity, while improving mechanisms for benefit distribution and risk sharing.

The key to grassroots activation lies in cultivating an innovation culture for interdisciplinarity. It is recommended to establish an "Interdisciplinary Exploration" special fund within the National Natural Science Foundation of China, adopting a "negative list" management approach that only specifies unsupported directions without overly restricting research content. The evaluation of such fund projects should adopt a "representative work + research vision" model, focusing on the interdisciplinary novelty and potential impact of the research. A performance evaluation mechanism that tolerates failure should be established, implementing an "evaluation-free period" system for exploratory projects, where quantitative assessments are not conducted for 3-5 years. Simultaneously, universities should be encouraged to establish informal exchange platforms such as interdisciplinary salons and innovation workshops to facilitate spontaneous interaction among scholars from different fields. Cultivating such a grassroots innovation ecosystem requires long-term investment but can provide a continuous stream of talent and creative ideas for the pyramid system.

The coordinated operation of the three levels requires establishing a dynamic balance mechanism. Top-level targeted projects should regularly release technological demands and research propositions to the mid-level and grassroots levels. Feedback from industrialization generated through mid-level linkages should promptly guide adjustments in top-level planning. New directions emerging from grassroots exploration, after validation, can be upgraded to mid-level or top-level projects. This top-down integrated system can both ensure the fulfillment of national strategic needs and maintain the vitality and diversity of the innovation system. Regarding the implementation pathway, it is suggested to select 3-5 "Double First-Class" universities for pilot programs, gradually expanding the mechanism after it matures,

ultimately forming an interdisciplinary innovation system with Chinese characteristics.

6 CONCLUSION

A comparative study of interdisciplinary development in Chinese and American research universities not only reveals the fundamental divergence in their governance logics but also points toward a possible pathway for the future.

China's "state-led, breakthrough-oriented" model demonstrates notable efficiency in tackling clearly defined technological bottlenecks and concentrating resources to achieve strategic goals. However, path dependencies inherent in traditional disciplinary evaluation, resource allocation, and faculty promotion systems objectively constrain high-risk, original interdisciplinary exploration. By contrast, the US "market-driven, free-exploration" model, while capable of nurturing disruptive innovations, may struggle to form concentrated research capacity due to fragmented resources.

Admittedly, these two models are not mutually exclusive; they can complement each other at different stages of the innovation chain. For China, the direction of optimization lies not in entirely transplanting the US system, but in prudently drawing from its market flexibility, cultural tolerance, and organizational adaptability. While preserving the advantage of strategic focus, China should create more institutional space for scholars to pursue autonomous exploration. This requires coordinated efforts on three fronts: restructuring the institutional system by establishing non-targeted, long-cycle exploratory funds and a diversified funding landscape; transforming cultural cognition by building evaluation criteria that embrace interdisciplinary outcomes and fostering a new academic community mindset; and driving organizational change to construct a "top-level breakthroughs — mid-level synergy — grassroots activation" pyramid innovation ecosystem. Only by doing so can interdisciplinary research move from the margins to the center, forming a system of interdisciplinary development that both embodies Chinese institutional characteristics and adheres to the laws of knowledge production, thereby providing a sustained source of innovation to meet the challenges of a complex era.

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