Reflections on Strengthening National Strategic Science and Technology Capabilities (Postprint)

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Abstract

The report of the 19th National Congress of the Communist Party of China points out that innovation is the primary driving force for development and a strategic support for building a modernized economic system, emphasizing the need to strengthen the construction of the national innovation system and enhance strategic scientific and technological capabilities. Strengthening national strategic scientific and technological capabilities represents a strategic choice for building a world-leading science and technology powerhouse. High-standard construction of national laboratories serves as a crucial lever for strengthening national strategic scientific and technological capabilities. Proactively adapting to national development strategies, aligning with national needs, and optimizing innovation layouts constitute practical requirements for national research institutions to undertake the mission of national strategic scientific and technological capabilities in the new era. This article focuses on discussing four key issues: the definition of national strategic scientific and technological capabilities; measures and lessons from developed countries in strengthening such capabilities; several critical relationships that must be properly managed when leveraging national laboratories to strengthen strategic scientific and technological capabilities; and strategic choices for national research institutions to shoulder the heavy responsibility of national strategic scientific and technological capabilities.

Full Text

Perspectives on Strengthening the Construction of National Strategic Scientific and Technological Power

What Constitutes National Strategic Scientific and Technological Power?

The understanding and definition of national strategic scientific and technological power among Chinese policymakers and academics have evolved through

two stages. As early as December 2004, during his inspection of the Chinese Academy of Sciences (CAS), then-General Secretary Hu Jintao proposed that "CAS, as a national strategic scientific and technological force, must not only produce first-class results, benefits, and management, but also cultivate first-class talent." CAS President Bai Chunli stated: "CAS is a national strategic scientific and technological force that we can rely on and trust," and put forward the "Four Leads" requirement for CAS' s future development. This marked a new historical stage in the construction of national strategic scientific and technological power. In July 2013, during his inspection of CAS, General Secretary Xi Jinping emphasized that "CAS is a national strategic scientific and technological force that the Party, the state, and the people can rely on and trust," and proposed the "Four Firsts" requirement for its future development.

In May 2016, at the National Conference on Science and Technology Innovation, the Academicians' Conference, and the Ninth National Congress of the China Association for Science and Technology, Xi Jinping pointed out: "We should take national laboratory construction as the starting point to strengthen national strategic scientific and technological power." He emphasized that "national laboratories should become a strategic scientific and technological force that overcomes difficulties and leads development, forming a new pattern of collaborative innovation with functional complementarity and positive interaction with other types of research institutions, universities, and enterprise R&D institutions." This was the first time the term "strategic scientific and technological force" appeared in government documents. In October 2017, the 19th CPC National Congress further stressed: "We will strengthen the national innovation system and boost our strategic scientific and technological power," elevating the construction of national strategic scientific and technological power to the will of the Party and the state.

Policy researchers have extensively discussed the construction of national strategic scientific and technological power. Chi Fulin et al. argued that "national research institutions, as strategic scientific and technological forces, bear the historical mission of serving major national strategies and play a core role in the national innovation system." Mu Rongping suggested that we should "develop and strengthen national strategic scientific and technological forces represented by CAS." The book *The Path to Building a World Science and Technology Power: China and the World* compiled by CAS states: "The carriers of national strategic scientific and technological forces are national laboratories and world-class research institutions, including major scientific infrastructure platforms, comprehensive science centers, and integrated research platforms that concentrate national scientific research advantages for collaborative 攻关." This reflects academic understanding of this issue.

Unlike traditional concepts that define research institutes, universities, and enterprise R&D institutions from dimensions such as "organizational attributes" and "core functions," the new concept of national strategic scientific and technological force, with Chinese characteristics, is defined from dimensions of "sta-

tus,""role,"and "contribution."As a national strategic scientific and technological force, it must play a crucial role in national security, comprehensive national power, and people' s livelihood, exerting influence at the national rather than merely regional level. It must conduct innovative research in strategic overall situations, strategic fields, strategic capabilities, and strategic impacts, highlighting its irreplaceable role. It must possess unique advantages in innovation power, support power, and leadership power, forming a joint force driven by innovation and making original contributions.

Strategic Measures of Developed Countries to Strengthen Their National Strategic Scientific and Technological Forces

In developed countries, organizations established to accomplish science and technology innovation tasks related to national strategic objectives include national laboratories, national research centers, national scientific research institutes, and federal laboratories. History and reality demonstrate that these forces possess unique functions and status, playing important roles in promoting the construction of world science and technology powers.

As a national strategic scientific and technological force in the United States, many national laboratories originated from strategic national missions such as the Manhattan Project. After World War II, the U.S. converted wartime laboratories into national laboratories that conduct basic, frontier, and strategic research missions around national missions—tasks that universities, enterprises, or private research institutions find difficult to undertake. These laboratories became the main force in the national innovation system. After the Cold War, the missions of U.S. national laboratories evolved with the times, with research fields gradually expanding from weapons R&D for national security to major scientific frontiers and fields supporting economic and social development, such as oceans, energy, health, information, and materials. They began to engage more in interdisciplinary and comprehensive research. Currently, most U.S. national laboratories are government-owned, contractor-operated (GOCO). The government entrusts universities, private enterprises, or non-profit organizations to manage laboratory operations through contracts, allowing government departments to play a supervisory role while reflecting national strategic objectives and ensuring management flexibility.

In recent years, the U.S. government has particularly emphasized that scientific research institutions, including national laboratories, should serve national objectives and support development needs. In 2013, the U.S. Congress and White House initiated reforms of national laboratories aimed at ensuring they execute high-priority national strategic tasks, maintain their world-class status, and promote the transformation of scientific discoveries into commercial breakthroughs. In 2014, U.S. senators submitted the America INNOVATES Act to Congress, proposing reform goals and specific action measures for the Department of Energy' s national laboratory system: (1) integrate the management of the Department of Energy' s scientific and technological programs to establish a vertically

integrated research system; (2) streamline administration and delegate power to increase laboratory autonomy in infrastructure investment, operations, human capital management, and external cooperation; (3) promote public-private commercial cooperation and technology transfer; and (4) strengthen accountability and evaluation.

To enhance the execution of national strategic missions by government-funded research institutions, South Korea issued the *Reform Plan for Government-Funded Research Institutes in Science and Technology* in 2011, aiming to break barriers between ministries and research institutions, avoid redundant investment, promote interdisciplinary research, and address challenges in emerging research fields. The plan also involved large-scale institutional relocation of 27 government-funded research institutes under the Ministry of Education, Science and Technology and the Ministry of Knowledge Economy. South Korea incorporated ocean issues into national will and strategy. To promote systematic research, development, management, and utilization of marine and ocean resources and ensure South Korea' s international competitiveness in marine science and technology, the National Assembly passed the *Korea Marine Science and Technology Institute Act*, establishing the "Korea Institute of Marine Science and Technology." The newly established institute, reorganized and renamed from the former "Korea Ocean Research and Development Institute," possesses independent legal personality. The government' s stable support for its lump-sum research funding increased from 39% to 75% of the total budget. The institute focuses on building a marine industry-university-research cooperation platform, enhancing South Korea' s marine science and technology competitiveness through concentrated national funding, and opening new cooperation models with research universities and institutions. These measures indicate that the institute will increasingly reflect and meet national strategic needs and serve South Korea' s marine strategic objectives.

Japan' s national research institutions are the main force in R&D and industrial innovation. In recent years, reforms to the legal person system of Japan' s national research institutions have established their unique status and new governance mechanisms. In 2015, Japan customized a new legal person system for 31 national research institutions, designating them as "National Research and Development Corporations" based on the "Independent Administrative Institution" system. For those undertaking strategic tasks and expected to lead globally in international competition, including RIKEN, the National Institute of Advanced Industrial Science and Technology, and the National Institute for Materials Science, the government granted them the status of "Specific National Research and Development Corporations" as centers of R&D networks in various fields and industries, playing a core role in Japan' s national innovation system and leading Japan' s future scientific and technological innovation development. In 2017, Japan' s Council for Science, Technology and Innovation adopted the *Basic Policy for Promoting the Development of Specific National Research and Development Corporations*, highlighting their strategic status. The government provides policy and institutional guarantees in multiple aspects, including en-

suring stable funding for basic research and personnel salaries, trying new salary and personnel management policies, and formulating preferential policies to attract enterprise investment in scientific research activities.

In Europe, Germany, the United Kingdom, France, and other countries have national laboratories or research bases as national strategic scientific and technological forces, guided by major national strategic needs and urgent economic and social development requirements to accomplish national objectives and scientific frontier exploration tasks. A representative example is Germany' s Helmholtz Association of National Research Centers, which conducts interdisciplinary and comprehensive strategic research based on large-scale basic research facilities, undertaking major research tasks commissioned by the state that are time-consuming, complex, require large-scale equipment, and are unwilling or unable to be undertaken by German industry. To promote interdisciplinary cooperation and improve efficiency, the Helmholtz Association has continuously optimized its institutional management, such as transforming from institutional funding to project-based funding allocation, and establishing national research institutions jointly funded by the federal and state governments based on long-term research projects in collaboration with universities to undertake tasks addressing major social issues.

From these practices, we can see that all major developed countries recognize and strengthen their strategic scientific and technological forces from a strategic height to enhance national scientific and technological strength and comprehensive national power. Although the forms and specific carriers of strategic scientific and technological forces vary due to historical and national conditions (mainly including national laboratories, national research centers, national science and technology institutes, and national academies), all countries attach strategic importance to and strengthen their respective strategic scientific and technological forces. These forces play a leading role in the scientific and technological innovation system, forming a virtuous cycle with national security, the real economy, and people' s livelihood needs. Through policy measures such as innovating governance systems, promoting legal person system reforms, enhancing management autonomy, ensuring stable support, expanding funding channels, and improving innovation network systems, these countries continuously strengthen their national strategic scientific and technological forces.

Key Relationships to Address in Strengthening China' s Strategic Scientific and Technological Power Through National Laboratory Construction

National laboratories are an important organizational form and functional positioning of national strategic scientific and technological forces, with core characteristics of strategic orientation, comprehensive integration, forward-looking leadership, and irreplaceability. National laboratory construction should not start from scratch or create a separate system outside the existing national innovation system. Instead, it should be a phoenix nirvana—optimizing increments

and activating stock based on the existing innovation landscape, reforming and innovating. To strengthen national strategic scientific and technological forces by taking national laboratory construction as the starting point, we must properly handle several dialectical relationships.

The Relationship Between "Specialization" and "Breadth" National laboratories are pillars of innovation capability that shoulder national missions and ensure national security. They are elite, lean, large, and strong institutions. On one hand, national laboratories must have clear strategic positioning and goal orientation, with clear mission statements and task requirements, adhering to clear strategic tasks as the driving force, and committing to solving major scientific and technological issues concerning the overall national situation and urgent development needs. In the process of achieving national power goals in the new era, there are a series of "bottleneck" scientific and technological problems in energy, materials, information, life and health, ecological environment, space, oceans, national defense, security, and major transportation that need to be answered and solved. National laboratories must focus on these problems, open up a development mission and "survival position" that other institutions cannot fulfill, and highlight "specialization" in their goal positioning.

On the other hand, research conducted by national laboratories has characteristics of long-term, breakthrough, and disruptive nature. The high positive externalities make enterprise R&D institutions unwilling to undertake such research, while the comprehensive nature of R&D makes traditional disciplinary research institutes unable to undertake it. This requires national laboratories to integrate the innovation value chain of frontier research, technology development, and achievement transformation around major innovation goals. Relying on research units with the most core advantages, they must integrate other competitive research forces nationwide, coordinate the layout of major scientific plans, major scientific projects, major science centers, international science and technology innovation bases, and global science and technology cooperation networks, and promote innovative cooperation among various institutions, reflecting "breadth" in force allocation.

The Relationship Between "Source" and "Flow" Knowledge innovation flows forward, relying on the effective integration and connection of the knowledge innovation value chain. Since the 18th century, the increasingly prominent "division of knowledge" has made people' s knowledge more refined and the total amount of knowledge continuously increase. Adam Smith pointed out: "The speculation that emerges in social progress is subdivided into different branches, greatly increasing scientific content." However, "division of knowledge" alone is far from enough. John H. Miller, the pioneer of complex systems science in the United States, believes that the core assumption of modern science is the belief in the power of reductionism, which advocates that to understand the world, we only need to understand its components. However, reductionism does not equal constructivism. That is, even if we understand all the simple compo-

nents that make up the world, we cannot claim to have understood the world based on this alone. To understand the world built from components, we must have a theory about how the components interact. Therefore, on the basis of knowledge division, we also need "knowledge integration." Without knowledge division, there will be a lack of cognitive depth and grasp of the internal operating mechanism of things; without knowledge integration, there will be a lack of cognitive breadth and judgment of the overall picture of things.

From the perspective of "knowledge division" and "knowledge integration," the relationship between national laboratories and other innovation entities is not one of substitution but of interdependence. Traditional research institutes based on disciplines provide national laboratories with disciplinary basic knowledge and research backup talents, cultivate advantageous research fields, and reflect the "source" of academic innovation. Task-oriented national laboratories provide traditional research organizations with platforms for interdisciplinary integration, application, and achievement transformation, focusing on the "flow" of knowledge integration. The "source" of disciplinary innovation is the foundation of the "flow" of knowledge integration, and the "flow" of knowledge integration is the extension of the "source" of disciplinary innovation. Together, they expand knowledge boundaries and serve the national economy and people's livelihood. In fact, the relationship between "source" and "flow" is also the relationship between disciplines and tasks. For example, the "Twelve-Year Science and Technology Long-Range Plan" launched in 1956 and the subsequent "Two Bombs, One Satellite" research formed strategic approaches such as "tasks driving disciplines" and "disciplines promoting tasks," which also provide inspiration for national laboratory construction. In this sense, both newly established national laboratories and traditional research institutes are core components of the national innovation system. We must reasonably position the functions of different innovation entities to form an innovation ecology and collaborative innovation pattern that is well-ordered, functionally complementary, positively interactive, and competitive.

The Relationship Between "Dynamic" and "Static" National laboratories need "static" conditions to concentrate their efforts on major tasks, while dynamic adjustment according to changes in national strategic missions reflects "dynamic" characteristics. At the same time, to maintain innovation vitality, national laboratories must also be equipped with "dynamic" and "static" innovation teams. Statistics show that in U.S. Government-Owned, Government-Operated (GOGO) national laboratories, while maintaining a high-level core research team, they also form a mobile research team. When conducting major projects, they often form large teams for collaborative 攻关; after project completion, team researchers return to their original institutions or seek new positions. For example, the U.S. National Institutes of Health adopts a continuous evaluation and elimination system of "3-5-3 years" totaling 11 years, with only about 5% of people eventually becoming tenured researchers. In terms of building mobile research teams, the LDRD Program (Laboratory Directed Research and

Development) of the U.S. Department of Energy's national laboratories is worth learning from. The LDRD program is the only R&D activity that laboratory directors can independently control, accounting for 6% of the laboratory' s total expenditure. It mainly provides seed funding for laboratories to solve major technical challenges and attract and retain talent, with the main beneficiaries being the postdoctoral group that constitutes the main research force of the laboratory. The LDRD program, on one hand, provides alternative technical solutions for current research and develops disruptive technologies, and on the other hand, provides effective incentives for young researchers.

Domestic research institutions' graduate education plays a similar role to the LDRD program, but the main difference is that the U.S. LDRD program is a mechanism for developing seed technologies and cultivating high-end research personnel, as well as a mechanism for talent competition with industry. In contrast, China' s graduate education is a mechanism for using its own research advantages to cultivate talent for society, fulfilling social responsibilities and achieving sustainable development. In terms of serving core objectives, both mechanisms have their advantages and disadvantages. For national laboratories, the LDRD mechanism is arguably more direct and intensive. This combination of "dynamic" and "static" team-building mechanisms ensures innovation competitiveness. In China' s national laboratory construction, we should learn from these experiences and build a core backbone talent team composed of senior researchers, engineers, and technicians, while establishing a mobile research team composed of distinguished researchers, visiting scholars, and postdoctoral researchers through project contract systems.

In addition to the above three relationships, national laboratory construction must also address relationships between innovation entities and innovation ecology, funding management and operational management, core tasks and backup tasks, international vision and Chinese characteristics, national responsibilities and social responsibilities, current development and sustainable development, establishment mechanisms and exit mechanisms, Party leadership and academic autonomy, among others.

Strategic Choices for National Research Institutions to Undertake the Heavy Responsibility of National Strategic Scientific and Technological Power

At the Academicians' Conference held in May 2018, General Secretary Xi Jinping pointed out: "The Chinese Academy of Sciences and the Chinese Academy of Engineering must continue to play the role of national strategic scientific and technological forces, together with national scientific and technological forces, grasp the general trend of world scientific and technological development, focus on building a world science and technology power, keenly seize the direction of the scientific and technological revolution, vigorously promote leapfrog scientific and technological development, and bravely climb the peaks of science and technology." In the new era, to strengthen national strategic scientific and

technological forces and assist in building an innovative country and a world science and technology power, national research institutions should effectively improve their ideological guidance, strategic leadership, collaborative cooperation, reform promotion, talent cohesion, logistical support, and organizational guarantee capabilities.

Strengthening Ideological Guidance to Address the Question of Innovation for Whom Thought is the forerunner of action. Improving ideological understanding is the foundation for strengthening national strategic scientific and technological forces. Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, which adapts to the new era of socialism with Chinese characteristics, is the action guide for the entire Party and people of all ethnic groups to achieve the great rejuvenation of the Chinese nation. The report of the 19th CPC National Congress summarizes the basic connotation and basic strategy of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era from the perspectives of "Eight Clarifications"and "Fourteen Upholds," answering what kind of socialism with Chinese characteristics we should uphold and develop in the new era and how to uphold and develop it. To improve ideological guidance, we must conscientiously study and implement Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, deeply understand its rich connotation and practical requirements, and deeply understand the firm beliefs, distinct people' s stance, strong sense of history, pragmatic style, innovative spirit, and scientific methodology that run through it, achieving integration, internalization in the heart, and externalization in action. In particular, we must study and implement Xi Jinping' s important discourses on scientific and technological innovation, firmly establish correct values for science and technology, always grasp the direction of scientific and technological development to serve the people, focus on learning and grasping strategic thoughts and viewpoints such as "Three Firsts," "Comprehensive Innovation," and "Asymmetric Catch-up," and from the height of safeguarding national strategic interests, further clarify the strategic missions, development concepts, and reform paths of national strategic scientific and technological forces in the new era.

Strengthening Strategic Leadership to Address the Question of Innovation Focus Problems are the voice of the times, and contradictions are opportunities for development. The 19th CPC National Congress report proposed that China' s main social contradiction has transformed from the contradiction between the people' s ever-growing material and cultural needs and backward social production to the contradiction between the people' s ever-growing needs for a better life and unbalanced and inadequate development. This judgment reflects the reality and crux of China's economic and social development and points out the fundamental focus for solving contemporary Chinese development issues, also setting the direction for scientific and technological work. We must plan and layout the main directions of scientific and technological attack according to global scientific and technological development trends and national economic

needs, starting from the needs of promoting high-quality development. We must optimize the allocation of scientific and technological innovation resources and elements, promote institutional and mechanism reforms, and do well in the "addition, subtraction, multiplication, and division" of strategic decision-making, achieving "doing something and not doing something else." The so-called "addition"means focusing on strategic needs, shouldering national missions, improving innovation layout, and ensuring national security, forming seamless connection with the national scientific and technological innovation layout. "Subtraction" means optimizing and adjusting research units that seriously deviate from the requirements of strategic, public welfare, basic, and forward-looking nature in their research orientation and whose innovation capabilities and contributions have seriously weakened. "Multiplication" means adapting to the innovation-driven development strategy and regional coordinated development strategy, adapting to the trends of innovation element agglomeration and flow, making good use of policy tools such as finance, options, and equity to promote the transfer and transformation of scientific and technological achievements, giving full play to the multiplier effect of advantageous scientific and technological forces, and promoting the overall improvement of regional innovation capacity and competitiveness. "Division" means systematically examining the gaps and needs in scientific and technological innovation, integrating elite forces, concentrating superior troops, and enabling research forces to better focus on development needs.

Strengthening Reform Implementation to Address the Issue of Effective Governance in Scientific and Technological Innovation The governance status of research institutions concerns the quality and direction of innovative development and determines the execution and efficiency of research activities. For national research institutions to undertake national strategic scientific and technological forces, they need to accept task-oriented guidance and funding from administrative departments and accept the constraints of administrative rules. At the same time, they must follow the laws of scientific research and market economy, and accelerate the pace of governance system reform. Drawing on the management reform measures of scientific research institutions undertaking national strategic scientific and technological forces in developed countries, and following the laws of scientific research, administration, and market competition, we should grant research institutions more autonomy and independence in development. We should optimize the scientific research business system and funding allocation mechanism to serve national strategic objectives, ensure policy and institutional flexibility to provide researchers with an environment dedicated to research, implement classified management, and provide long-term stable support to institutions and researchers engaged in basic research. We should strengthen goal-oriented accountability and evaluation to ensure efficient operation of research institutions.

Strengthening Talent Attraction to Address the Question of Who Will Innovate Facing the new era, to strengthen national strategic scientific and technological forces and promote the construction of an innovative country, we must, while stabilizing key talents and making good use of existing talents, break down barriers affecting talent mobility, vigorously attract top scholars and innovation teams in relevant disciplines according to international rules, international standards, and international treatment, and form a talent aggregation effect for building a world science and technology power. The practices of some emerging high-tech enterprises in implementing the talent systems engineering (5Bs) are worth learning from for national research institutions. The talent systems engineering (5Bs) includes: introducing outstanding talents in key fields globally (Buy) to form a magnet effect for attracting innovative talents; making good use of existing talents (Build) to cultivate suitable soil for talent growth and development, and building differentiated talent growth and development paths based on "performance-potential"; retaining excellent talents (Bind) through comprehensive care and concern to improve job satisfaction and form a multi-pronged "combination punch" for retaining talents; sharing and borrowing excellent talents (Borrow) to adapt to mobile internet and sharing economy trends, expand the talent pool globally, and quickly complete business layout and overcome innovation difficulties; and accelerating the renewal of core talents (Bounce) to maintain the innovation power of the talent team through internal rotation, channel conversion, and career transition. These five aspects form an organic whole and have important reference significance for research institutions.

Strengthening Collaborative Capacity to Address Cooperation Among Innovation Entities The globalization of scientific research has become a basic trend, and the organizational methods and cooperation networks of science have undergone important changes. The future world scientific landscape will be a "multi-center" network pattern. Joshua Cooper Ramo, a famous American expert on China, believes that the essence of the current era is the "age of network power" and an era of "breaking the old and establishing the new." This era cannot maintain sustainable development relying solely on industrial-age thinking and measures. Instead, we must master the "seventh sense," that is, the ability to "see the essence of connections through phenomena." Huang Yasheng et al. believe that with the development of information technology and artificial intelligence, the paradigm of scientific and technological innovation is changing, "innovation of innovation" has become inevitable, the "post-Schumpeterian innovation mechanism" is quietly emerging, and "mass participation" in social innovation and scientific and technological innovation carried out by professional institutions jointly shape the future of mankind.

These scholars' judgments on the characteristics of the current era suggest that every organization and individual is placed in a huge network and must extend roots, strengthen collaboration, seek growth, and achieve prosperity in the

network. For national strategic scientific and technological forces, collaborative capacity mainly involves viewing the development trend of world science and technology and the layout of the national innovation system from a global perspective, and then, on the basis of clarifying their own strategic positioning, strengthening effective interaction and cooperation with various innovation entities to promote positive interaction between scientific and technological innovation and economic and social development. The focus is on strengthening cooperation with government departments, technology enterprises, universities, financial institutions, and small and micro enterprises, "mass innovation" institutions, and individuals.

Strengthening Organizational Support to Address the Issue of Effectively Improving Innovation Efficiency The leadership of the Party is the essential characteristic of the modern scientific research institution system with Chinese characteristics, and Party organizations are an important component of the governance system of scientific research institutions with Chinese characteristics. Competition among modern scientific research institutions is largely competition among innovation ecosystems, and the Party' s leadership and logistical support capabilities are important components of the innovation ecosystem. In the 1950s and 1960s, Comrade Zhang Jinfu, then Secretary of the CAS Party Group, said: "Scientists are our 'national treasures' and 'vertical experts,' while I am a 'generalist,' specializing in uploading and delivering information and 'horizontal' coordination." It was precisely because of strong leadership and logistical support that the "Twelve-Year Science and Technology Long-Range Plan" was smoothly advanced, and major scientific goals such as "Two Bombs, One Satellite" were gradually realized. At the end of the "Cultural Revolution," when Hu Yaobang presided over CAS, he left behind the good story of "five sons passing the imperial examinations." These examples demonstrate the importance of Party leadership for research institutions.

The Party building work of national research institutions should be guided by the spirit of the 19th CPC National Congress and the newly revised Party Constitution, adhere to innovation goal orientation and reality problem orientation, avoid the "two separate skins" problem between Party building and scientific research, and always regard strengthening Party leadership, consolidating organizational foundations, and promoting scientific and technological innovation as the starting point and foothold of Party building work. We should ensure "comprehensive" and "strict" measures simultaneously, "binding" and "unbinding" equally, and "strict management" and "inclusiveness" in parallel. We should focus on improving organizational capacity, build Party grassroots organizations in scientific research institutions into strong fighting fortresses that publicize the Party' s propositions, implement the Party' s decisions, lead grassroots governance, unite and mobilize the masses, and promote scientific and technological innovation. We should promote the extension of comprehensive and strict Party governance to the grassroots level, focusing on promoting Party branches to fulfill their responsibilities of directly educating, managing, and supervising Party

members, as well as organizing, publicizing, uniting, and serving the masses. We should combine the reality of scientific and technological innovation, strengthen the political functions of Party grassroots organizations, focus on strategic needs, strengthen direction guidance, and enhance the leadership of Party grassroots organizations in scientific research institutions. We should focus on cultural cultivation, strengthen value shaping, and enhance the cohesion of Party grassroots organizations in scientific research institutions. We should focus on clean practice, strengthen management and supervision, and enhance the binding force of Party grassroots organizations in scientific research institutions. We should focus on diversified needs, strengthen service guarantees, and enhance the support capacity of Party grassroots organizations in scientific research institutions, forming a positive interaction and organic coordination between Party building work and scientific and technological innovation work that promotes and progresses together.

Conclusion

Strengthening national strategic scientific and technological forces is a strategic choice for building a world science and technology power. High-standard construction of national laboratories is an important starting point for strengthening national strategic scientific and technological forces. Actively adapting to national development strategies, matching national needs, and optimizing innovation layout are the practical requirements for national research institutions to undertake the mission of national strategic scientific and technological forces in the new era. This article has sorted out relevant policy requirements and research progress, and conducted preliminary discussions on strengthening national strategic scientific and technological forces. It is hoped that this discussion can serve as a starting point for further deliberations on strengthening national strategic scientific and technological forces, constructing national laboratories with high standards, and promoting reforms of national research institutions.

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Abstract Xi Jinping' s report at the 19th CPC National Congress pointed out that innovation is the primary driving force for development and is the strategic underpinning for building a modernized economy, and we will improve

our national innovation system and boost our strategic scientific and technological strength. To boost the strategic scientific and technological strength is a strategic choice for construction of world science and technology power. The construction of national laboratories with high standards is the important starting point for boosting the strategic scientific and technological strength. Actively adapting to national development strategies, matching national needs, and optimizing innovation layout is the reality requirements for national research institutes to taking the missions of strategic scientific and technological strength in the new era. This article focuses on four issues, namely: what is the national strategic scientific and technological strength, the measures and practical experiences for the developed countries to boost national strategic scientific and technological strength, several relations need to deal with for national laboratories as a starting point to boost the strategic scientific and technological strength, and strategic choices for national research institutions to taking the mission of national strategic scientific and technological strength.

Keywords national strategic scientific and technological strength, national laboratory, national research institution, world science and technology power

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