# Postprint: Reflections on Constructing a New National Innovation System

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## Abstract

China has achieved remarkable accomplishments in the construction of its national innovation system; however, issues such as insufficiently high strategic positioning and inadequately concrete top-level design persist. To build a science and technology powerhouse, there is an urgent imperative to construct a new-type national innovation system. The key priorities for constructing this new-type national innovation system encompass: further strengthening the basic research system, accelerating the development of the industrial innovation system, further improving the comprehensive enterprise innovation system, further coordinating the regional innovation system, further enhancing the role of the education system within the national innovation system, and further strengthening the synergy between science and technology with finance, trade, and other related domains.

## Full Text

## Thoughts on Constructing a New National Innovation System

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### Abstract

While China has achieved remarkable progress in constructing its national innovation system, challenges persist in strategic positioning and detailed top-level design. Building a world science and technology powerhouse urgently requires establishing a new national innovation system. Key priorities include strengthening the basic research system, accelerating industrial innovation system development, improving the comprehensive enterprise innovation system, enhancing

regional innovation system coordination, reinforcing education' s role within the national innovation system, and promoting synergy between science and technology with finance, trade, and other sectors.

**Keywords:** world science and technology powerhouse, new national innovation system, institutional framework
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## Basic Requirements for Building a Science and Technology Powerhouse

The 19th National Congress of the Communist Party of China proclaimed that socialism with Chinese characteristics has entered a new era, signifying that China's scientific and technological innovation has also entered a new phase characterized by novel circumstances. The five years since the 18th Party Congress have been an extraordinary period in the development of the Party and the nation, witnessing historic achievements and transformative changes in scientific and technological innovation. Under the strong leadership of the Party Central Committee with Comrade Xi Jinping at its core, and through the concerted efforts of the scientific community and society at large, China' s scientific and technological innovation has sustained momentum, accelerating its catch-up and leapfrog development. This has resulted in historic, holistic, and structural changes, with major innovations emerging in rapid succession and scientific and technological strength increasing substantially, establishing China as a globally influential science and technology power.

The 19th Party Congress made comprehensive and systematic arrangements for scientific and technological innovation [1], placing new and higher demands on innovation to drive high-quality development, support supply-side structural reform, and accelerate the transformation of old and new growth drivers. The key is to uphold Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, enabling scientific and technological innovation to proactively lead economic and social development, creating endogenous drivers for economic growth, industrial upgrading, and livelihood improvement, and providing strong support for quality, efficiency, and power transformation.

Building a world science and technology powerhouse represents a major strategic decision for China' s scientific and technological innovation [2,3] and a strategic arrangement to enhance its international competitiveness. The primary tasks should encompass three dimensions:

First, rapidly enhance the capacity to supply original innovations at the frontier, becoming a global innovation leader in more fields. This requires comprehensively strengthening basic and applied basic research, promoting the integration of free exploration and goal-oriented approaches, and fostering interdisciplinary fusion between natural sciences and humanities/social sciences. The full implementation of the "Science and Technology Innovation 2030–Major Projects" should be launched, creating a tiered and continuous pattern with national sci-

ence and technology major special projects, conducting forward-looking deployments in strategically critical areas, and forming more innovation-led strategic advantages.

Second, significantly improve industrial technology innovation capabilities to accelerate industrial advancement toward the medium-high end. This involves strengthening systematic planning for key generic technologies, frontier leading technologies, modern engineering technologies, and disruptive innovations. Cross-boundary integration should be promoted in emerging technology fields and industrial development such as information, energy, biology, and materials. Digitalization, networking, and intelligence should drive the transformation and upgrading of traditional industries, supporting the cluster development of emerging industries.

Third, accelerate the enhancement of innovation and entrepreneurship factor aggregation capabilities. With technology-based innovation and entrepreneurship as the main thread, and guided by integrated development, high-end universal benefit, international expansion, and ecological optimization, the "mass entrepreneurship and innovation" initiative should be upgraded to higher levels, better quality, greater efficiency, and broader scope. The entrepreneurship incubation chain of "makerspaces—incubators—accelerators—science parks" should be improved, and makerspaces should be promoted toward specialization and market orientation. Universities, research institutes, and leading enterprises should be encouraged to open scientific and technological resources and transform achievements, lowering the threshold for new technology applications through open innovation and making China a global hotspot for innovation and entrepreneurship.

### Core Indicators of a Science and Technology Powerhouse

The core indicators of a science and technology powerhouse include: (1) possessing theoretical originality capabilities in natural sciences, social sciences, and humanities, with the capacity to conduct high-level, transformative basic and applied basic research; (2) mastering core technologies across almost all industries (including agriculture, manufacturing, and services) and maintaining the ability to continuously develop industrial leading and novel technologies; and (3) holding a favorable position in intellectual property trade while nurturing a large cohort of world-class innovative enterprises.

### Evolution of China' s National Innovation System Construction

The widely accepted definition of a national innovation system was provided by the Organisation for Economic Co-operation and Development (OECD) in 1997, which defines it as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." The origins of national innovation system research can be traced to 19th-century German scholar Friedrich List' s studies on national political and

economic development. British science and technology economist Christopher Freeman formally proposed the concept based on Japan's industrial development experience, emphasizing effective government intervention in technological innovation. Subsequently, Danish scholar Bengt-Åke Lundvall advanced a concept integrating science, technology, and education, calling for attention to vocational and technical education and developing a national innovation system for the learning economy. American scholar Henry Etzkowitz' s "triple helix" theory focused on cultivating entrepreneurial universities and further emphasized the positive contributions of higher education institutions to innovation.

Chinese academia began in-depth research on national innovation systems around 2003, quickly gaining high-level attention from national science and technology decision-making and management departments. The National Medium- and Long-Term Program for Science and Technology Development (2006–2020) stated the need to comprehensively advance the construction of a national innovation system with Chinese characteristics. The goal of deepening science and technology system reform is to promote and perfect the national innovation system. The national innovation system is a social system led by the government, giving full play to the fundamental role of market resource allocation, with various scientific and technological innovation entities closely connected and effectively interacting. Building a technology innovation system with enterprises as the main body and integrating industry, academia, and research should serve as the breakthrough point for comprehensively promoting national innovation system construction.

In September 2012, the Central Committee of the Communist Party of China and the State Council issued the "Opinions on Deepening Reform of the Science and Technology System and Accelerating the Construction of the National Innovation System" (hereinafter referred to as the "Opinions" ), putting forward specific requirements for deepening reform and accelerating system construction. The Opinions emphasized "adhering to enterprise-led, collaborative innovation" in the construction process, highlighting the principal role of enterprises in technological innovation, strengthening close integration among industry, academia, research, and application, promoting open sharing of scientific and technological resources, and enabling collaborative cooperation among various innovation entities to enhance overall system efficiency. The Opinions also stressed leveraging the new national system in implementing major national science and technology special projects, coordinating the implementation of national medium- and long-term plans for science and technology, education, and talent development, mobilizing enthusiasm at both central and local levels, strengthening local leadership in regional innovation, and advancing systematic reform in a holistic and orderly manner according to the inherent requirements of economic, social, and technological development.

The "13th Five-Year Plan for National Science and Technology Innovation" promulgated in July 2016 set new goals for building an efficient and coordinated national innovation system. Its main tasks include: (1) further clarifying

the functional positioning of various innovation entities, highlighting the core driving role of innovative talent, enhancing enterprises' principal and leading role, leveraging national research institutions as backbones and guides, utilizing higher education institutions as foundations and new forces, encouraging and guiding the development of new research and development institutions, fully utilizing the role of science and technology social organizations, stimulating the vitality of various innovation entities, and systematically improving their capabilities; (2) targeting world science and technology frontiers and industrial transformation trends, focusing on national strategic needs, strengthening systematic integration and layout according to innovation and industrial chains, using national laboratories as the guide to form fully functional and interconnected innovation bases that gather first-class talent, enhance innovation reserves, and improve full-chain support capabilities to lay an important foundation for achieving major breakthroughs and cultivating high-end industries; (3) creating high-end innovation growth poles, using national independent innovation demonstration zones and new areas as the foundation and regional innovation centers and cross-regional innovation platforms as the leading force to promote the development of advantageous regions into globally influential innovation highlands with major leading roles, forming a tiered regional innovation layout that drives overall regional innovation; and (4) building an open and collaborative innovation network, focusing on bridging the gap between science and technology and the economy, using technology markets, capital markets, and talent markets as bonds, and resource open sharing as the means to deploy innovation chains around industrial chains and improve capital chains around innovation chains, strengthening cooperation among various innovation entities, promoting close integration of industry, academia, research, and application, advancing integrated development of science and education, deepening civil-military fusion innovation, improving innovation and entrepreneurship service systems, and constructing an open and efficient innovation network that organically combines multi-entity collaborative interaction with mass innovation and entrepreneurship.

**Issues to be Addressed in New National Innovation System Construction**

Despite scientific institutional arrangements made during three important stages of China's development regarding national innovation system construction, obvious deficiencies remain relative to the strategic requirements for building a world science and technology powerhouse and the three core indicators, manifested in six aspects [4].

First, the division of labor among basic research, applied research, experimental development, engineering, and industrialization remains unclear, with the basic research system being notably weak. Second, the enterprise innovation system lacks specificity, with no detailed design or planning tailored to China's national conditions, and the status and role of state-owned enterprises have not been sig-

nificantly reflected. Third, the industrial innovation system is clearly missing, with no scientific arrangements for developing core and future industrial technologies. Fourth, regional innovation systems lack distinctive features and have similar functions, failing to form synergistic designs. Fifth, the role of education has been seriously neglected in national innovation system design, with scientific and technological innovation failing to develop synergistically with education development, and the shortage of top-notch innovative talent remaining a major constraint on China' s scientific and technological innovation. Sixth, the integration of scientific and technological innovation with building a trade powerhouse and financial innovation needs strengthening.

To address these challenges, six priority areas warrant attention in constructing the new national innovation system.

First, build a robust basic research system to make greater efforts in theoretical originality. Actively mobilize the enthusiasm of universities, research institutions, and enterprises in conducting basic and applied basic research. Encourage qualified universities to engage in high-level basic research, cultivating a large pool of high-end basic research talent through such endeavors. Fully leverage the role of the Chinese Academy of Sciences and Chinese Academy of Social Sciences in basic research. As China' s highest academic institution in natural sciences, the Chinese Academy of Sciences should prioritize high-level, transformative basic research. Encourage mature enterprises to establish corporate research institutes actively engaged in applied and even basic research. Only through continuous investment in basic research and active exploration of theoretical discoveries across all scales from micro to cosmic can we provide solid knowledge guarantees for industrial technology innovation.

Second, construct a powerful industrial innovation system. Traditional national innovation system design and construction have clearly neglected the industrial innovation system, resulting in China' s lack of core technologies in many industrial fields. Therefore, while actively playing the role of ministries and industry-leading enterprises, we should build industrial innovation systems covering agriculture, manufacturing, services, and other sectors. Actively explore the construction of new research and development institutions, striving for significant breakthroughs in the research and trial production of industrial generic technologies.

Third, establish a more scientific enterprise innovation system. Actively leverage the role of large enterprises in scientific and technological innovation, particularly state-owned enterprises (SOEs) and centrally administered SOEs in strategic, foundational, and public welfare scientific and technological innovation. Through institutional innovation, further mobilize the enthusiasm and creativity of scientific and technical personnel in SOEs. Fully utilize the innovation demonstration role of large private enterprises in competitive fields. Small and medium-sized enterprises are active developers of disruptive innovations and require further attention. Therefore, in the enterprise innovation system, we should fully leverage the strategic complementarity between SOEs

and private enterprises and the capability complementarity between large and small/medium-sized enterprises, building an integrated enterprise innovation system with coordinated linkages between SOEs and private enterprises and collaborative development among enterprises of all sizes.

Fourth, actively build high-end collaborative regional innovation systems. Develop regional innovation systems in Beijing, Shanghai, Shenzhen, and Xiong' an into important domestic and international science and technology innovation centers. Actively promote the construction of various regional science and technology innovation platforms, forming multiple regional innovation systems that support the science and technology powerhouse. Further develop regionally integrated innovation systems with synergistic effects, highlighting strategic coordination among regional innovation systems. Taking the Yangtze River Delta as an example, we should actively build a super-city cluster regional innovation system centered on Shanghai with coordinated development of Jiangsu, Zhejiang, and Anhui. Pay attention to the research and construction of rural innovation systems, achieving coordinated development between urban and rural innovation systems through rural innovation system construction, promoting integrated urban-rural development and coordinated regional development, forming intra-regional and cross-regional integrated innovation development, and implementing the strategic goals of Beautiful China, targeted poverty alleviation, and sustainable innovation.

Fifth, attach great strategic importance to educational innovation in building a science and technology powerhouse. Actively cultivate strategic talents with patriotic sentiments, scientific and technological capabilities, innovative qualities, and humanistic literacy. To this end, we should vigorously strengthen socialist and patriotic education, and intensify the development of creativity, engineering practice capabilities, and entrepreneurial spirit.

Sixth, strengthen integrated thinking on scientific and technological innovation. Strive to build close integration between scientific and technological development and ecological civilization, trade powerhouse development, and civil-military fusion, constructing a national innovation system that integrates science and technology, finance, trade, and military diplomacy.

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*Note: Figure translations are in progress. See original paper for figures.*