Accelerating the Construction of High-Level Science and Technology Parks and Creating a New Highland for Technology Transfer (Postprint)

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Abstract

The Report of the 19th National Congress of the Communist Party of China explicitly states: "Establish an enterprise-led, market-oriented technological innovation system with deep integration of industry, academia, and research, strengthen support for innovation in small and medium-sized enterprises, and promote the transformation of scientific and technological achievements." Consequently, accelerating the development of the sci-tech service industry, strengthening the deep integration of industry, academia, and research, and promoting the transfer and transformation of scientific and technological achievements represent important tasks for sci-tech workers in the new era. From the perspective of accelerating the construction of high-level sci-tech parks and based on a comprehensive review of international experience, this article proposes implementation pathways through which high-tech parks can facilitate the transfer and transformation of scientific and technological achievements.

Full Text

Accelerating the Construction of High-Tech Parks to Create New Heights for Scientific and Technological Achievement Transformation

The report of the 19th CPC National Congress clearly stated: "We will establish a market-oriented system for technological innovation in which enterprises are the main players and synergy is created through the deep integration of industry, universities, and research institutes, strengthen support for innovation by small and medium-sized enterprises, and promote the transformation of scientific and technological achievements." Premier Li Keqiang further emphasized in the 2018 Government Work Report: "We must strengthen collaboration

among industry, universities, research institutes, and end-users, pooling collective wisdom and converging strengths to accelerate China' s innovation." At the March 22, 2018 symposium commemorating the 40th anniversary of the "Spring of Science," CAS President Bai Chunli noted that "we must take Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era as our guide···to comprehensively deepen institutional reform and establish a modern research institute governance system that conforms to the laws of scientific and technological innovation." These statements underscore that accelerating the development of the science and technology service industry, strengthening deep integration of industry-university-research collaboration, and promoting the transfer and transformation of scientific and technological achievements are critical tasks for science and technology workers in the new era.

In recent years, to promote the industrialization of scientific and technological achievements, China has enacted the Law on Promoting the Transformation of Scientific and Technological Achievements and related policy documents, with local governments issuing supporting implementation plans and various institutions actively responding with management measures to improve transformation efficiency. For example, the Haixi Research Institute (Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences) has long explored effective models for achievement transformation, forming a distinctive "iron triangle" interactive innovation mechanism linking "research institutes—engineering centers—industrial bases." Based on differences in technology readiness levels, enterprise engineering capabilities, independent innovation capacity, and financial strength, the institute has explored multiple transformation models with significant industrialization results. However, we must also recognize that the overall rate of achievement transformation in China remains relatively low, with considerable room for improvement in the contribution of scientific and technological achievements to economic and social development.

To address this challenge, we conducted in-depth research on the transformation mechanisms of developed countries and found that high-tech parks play a crucial role. High-tech parks are important vehicles for attracting high-tech industries and promoting economic development. World-renowned high-tech parks such as Silicon Valley in the United States, Hsinchu Science Park in Taiwan, Bangalore Software Park in India, and Tsukuba Science City in Japan all provide quality innovation environments for achievement transformation, thereby vigorously promoting local economic and social development. In recent years, China has also witnessed the emergence of high-tech parks characterized by specialization, professionalization, and high-end development. According to statistics, by the end of 2016, China had 147 high-tech parks with combined GDP reaching 8.98 trillion yuan (approximately 12.1% of national GDP), R&D expenditure of 554.47 billion yuan (35.4% of China' s total R&D spending), 262,000 newly authorized patents, and 298,000 newly registered enterprises in 2016 alone. Their economic scale and innovation-driven development capabilities have attracted global attention. However, accompanying this growth are questions about uneven development quality and emerging issues. How high-tech parks can better

facilitate the transfer and transformation of scientific and technological achievements has become a question requiring deep consideration.

Strengthening Knowledge Innovation and Increasing the Supply of Mature Achievements

World-renowned high-tech parks play important roles in achievement transformation largely because they have opened channels for quality technology supply. For instance, Silicon Valley is surrounded by world-class universities including Stanford and UC Berkeley, which provide a continuous stream of cutting-edge research and high-end research talent. Bangalore Software Park is adjacent to over ten comprehensive universities and more than 70 technical colleges, supplying large numbers of senior software professionals annually. Tsukuba Science City houses 46 national research institutions and educational organizations, with large numbers of high-level researchers conducting frontier research across aerospace technology, biotechnology, and other fields. The close industry-university-research connections, mutual dependence, organic integration, and efficient cooperation among universities, research institutions, and enterprises provide strong technical support for achievement transformation.

In contrast, China' s high-tech parks have yet to establish sound industry-university-research cooperation mechanisms. Although most parks are located near universities and research institutes, collaborations remain loose. This results in a disconnect between university research and enterprise needs, creating large gaps between technology readiness levels and enterprises' engineering research capabilities, while enterprises lack access to quality research results and breakthroughs in key common technologies. To address these issues, various sectors have actively explored solutions with many replicable and scalable experiences. For example, the Haixi Research Institute, based on the positioning and characteristics of the Haixi High-tech Industrial Park where it is located, has explored diversified industry-research cooperation models: collaborating on commissioned R&D projects targeting specific technical problems identified by enterprises; jointly establishing engineering R&D centers with industry backbone enterprises to form long-term partnerships; and implementing multiple measures to accelerate achievement transformation with notable results.

Moving forward, high-tech parks should further leverage market guidance for technology R&D. On one hand, they should emphasize source innovation and integrated innovation to provide technological innovation sources for engineering and industrialization, further catalyzing transformative innovations that drive industrial technology revolution. They should establish communication channels between achievement suppliers and demanders, organize universities and research institutions to conduct enterprise surveys to identify major enterprise needs and industry-wide technical challenges, and build a "one-stop" system from scientific research to product development. This involves constructing an "innovation value chain" that tightly links basic research, applied research, and industrialization development to promptly track and resolve difficulties in the

transformation process. On the other hand, they should explore building a "science polygon," creating top-tier innovation platforms and institutions centered on national laboratories, major basic research equipment, large scientific facilities, and national innovation centers. By partnering with universities, research institutes, and leading enterprises to establish new R&D institutions, they can provide sustainable innovation momentum for enterprises within the park, continuously injecting innovation vitality through flexible mechanisms to unblock pathways for achievement transformation.

Introducing Venture Capital Markets to Provide Funding for Critical Transformation Links

Mature venture capital markets play an irreplaceable role in the transformation of achievements within high-tech parks, serving as a necessary condition for parks to promote technology marketization. Taking world-renowned parks as examples: Silicon Valley is an agglomeration of venture capital funds with rich business models—data show that in 2014, Silicon Valley received $14.5 billion in venture investment, accounting for 43% of total U.S. venture capital. The UK Cambridge Science Park has established a complete market economic system comprising traditional financial institutions, venture capital markets, and securities markets to promptly fill funding gaps in achievement transformation. Israel' s Tel Aviv High-Tech Park created the Maya Incubator to help high-tech enterprises through early-stage funding and equity adjustments.

However, China' s high-tech parks still have immature venture investment mechanisms. On one hand, government guidance funds lag behind, making it difficult for private capital to enter the venture investment market. On the other hand, the uncertain outcomes of achievement transformation deter many enterprises from entering capital investment markets. The lack of risk capital and single financing channels severely constrain high-tech park development and stall the transformation of numerous scientific and technological achievements.

In the future, China' s high-tech parks should "build nests to attract phoenixes" by accelerating the introduction of venture capital markets and improving venture investment mechanisms. They should provide venture investment, venture insurance, and venture guarantee services for park enterprises through business expansion and financial innovation by traditional financial institutions and efficient securities markets. They should explore effective models for "capitalizing and industrializing" achievements based on technology readiness levels, enterprise engineering capabilities, independent innovation capacity, and financial strength. They should establish risk capital exit mechanisms to stimulate investor enthusiasm and provide funding guarantees for achievement transformation. Additionally, parks should explore increasing the proportion of government guidance funds during the startup phase of high-tech enterprises and the initial stage of achievement transformation, using government credibility to attract strategic investors, venture capital funds, and industrial investment funds from home and abroad to jointly invest and meet funding needs at critical

transformation stages.

Leveraging Industrial Cluster Effects and Rationally Planning Industrial Structure

World-renowned high-tech parks are typically high-density agglomerations of similar industries. This not only stimulates innovation and spin-offs among park enterprises, promoting diverse cooperation while engaging in fierce market competition, but also enhances the competitiveness of entire industries and regions through cost reduction, innovation stimulation, efficiency improvement, and intensified competition, thereby creating conditions for accelerated achievement transformation. Cambridge Science Park in the UK hosts a world-famous high-tech biotechnology cluster, with the world' s most influential biotech, pharmaceutical, and medical device companies concentrated in the park. This high agglomeration provides fertile ground for healthy competition and rapid development among enterprises, greatly improving their innovation capacity and technological renovation speed. Taiwan' s Hsinchu Science Park possesses a complete integrated circuit industry chain from upstream to downstream, significantly reducing transformation costs and production/transportation costs for the industry and greatly promoting the development and growth of the integrated circuit industry. Currently, IC industry output accounts for nearly 70% of the park' s total output, making it the park' s leading industry.

In contrast, China' s high-tech parks mostly attract enterprises by providing land and preferential policies. This form of spatial agglomeration is not based on local resource endowment advantages or internal mechanism linkages. With low inter-enterprise correlation and underdeveloped specialized division of labor and cooperation networks, industrial cluster effects are weak and spatial agglomeration forms are extremely fragile. Once preferential policies change, enterprises flow to other parks with better policies, resulting in convergent industrial structures among parks, incomplete internal industrial chains, and greatly increased difficulty in achievement transformation.

Moving forward, high-tech parks should shift away from the past concept of pursuing "comprehensive and complete" industrial structures. They should rationally plan internal industrial structure with the aim of enhancing specialization and core competitiveness, building high-tech enterprise clusters with local advantages and characteristics to facilitate selection of "incubation hotbeds" for achievements based on technical conditions and industrialization needs. On the other hand, parks should create "industrial biological chains" internally, emphasizing the establishment of networks for similar and related industries. With large and medium-sized high-tech enterprises as leaders, they should spawn batches of related enterprises with close division of labor or cooperation relationships, improving supporting products and related services to strengthen internal industry cooperation and reduce costs, difficulty, and risks for achievement transformation.

Amplifying Government Service Functions and Improving Achievement Transformation Systems

Throughout the development of world-renowned science parks, governments have played major roles in creating innovation environments. For example, Bangalore Software Park has established park management agencies to perform government functions, creating single-window services to simplify administrative procedures and accelerate project approval and software export processing. Silicon Valley has built a complete innovation protection and incentive system, such as the Bayh-Dole Act and apprenticeship programs, creating favorable environments for innovation and entrepreneurship and providing institutional guarantees for achievement transformation.

In the future, governments should better perform service functions by building both hard and soft environments in high-tech parks, benchmarking international standards in planning and constructing infrastructure, and creating preferential and lenient policy environments. They should improve legal frameworks to provide legal consultation and protection for intellectual property and patents; optimize administrative agencies and social service systems; establish incentive mechanisms for risk-sharing and benefit-sharing; explore diversified distribution methods such as equity incentives; and move beyond using papers as the sole evaluation criterion. Instead, they should explore talent evaluation systems based on achievement quality, transformation economic benefits, and impact assessments according to different R&D attributes to attract high-level research and management talent to high-tech parks. Under government guidance, the Haixi Research Institute (Fujian Institute of Research on the Structure of Matter) has explored implementing a "flexible talent introduction + mixed talent formation" mechanism, enabling two-way flow and mixed teams of scientific and technical personnel between enterprises and research institutes to achieve seamless connection between enterprise needs and R&D work, helping research results achieve rapid industrialization.

Building Intermediary Service Networks and Improving Achievement Transformation Support Systems

Successful high-tech parks typically possess well-developed intermediary service networks: Silicon Valley has over 3,000 intermediary agencies; Taiwan's Hsinchu Science Park has a complete intermediary chain including scientific and technological achievement and technical consulting service institutions; and Japan's Tsukuba Science City has a mature intermediary service system that effectively promotes technological innovation activities. These intermediary organizations not only serve as communication bridges between enterprises and government but also provide market information and recommendations to both parties, making achievement transformation more efficient.

Currently, China's high-tech parks still lack sound intermediary service networks. Many institutions are exploring the establishment of platforms incorpo-

rating S&T intermediary services to address internal coordination gaps, such as forming industrial alliances and manufacturing innovation centers. These initiatives unite relevant enterprises, research institutions, and universities to break through industrial and technological chains, forming joint forces for achievement transformation while serving as information sharing platforms that provide policy and demand information for industrial development and act as communication links and industrial service intermediaries within high-tech parks.

In the future, high-tech parks should further improve internal support systems for achievement transformation by exploring the establishment of specialized information management consulting agencies, technology property rights trading agencies, venture capital intermediaries, and achievement incubation centers. These would build bridges and platforms connecting science and technology with economy and industry, minimizing information asymmetry between achievement suppliers and demanders, actively cultivating market environments, and creating green channels for rapid docking and efficient transformation between achievements and enterprises. This would better realize the incubation functions of high-tech parks, truly making them growth incubators for scientific and technological achievements.

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Abstract

The report of the 19th CPC National Congress clearly stated: "We will further reform the management system for science and technology, and develop a market-oriented system for technological innovation in which enterprises are the main players and synergy is created through the joint efforts of enterprises, universities, and research institutes. We will support innovation by small and

medium-sized enterprises and encourage the application of advances in science and technology." Therefore, accelerating the development of science and technology service industry, strengthening the in-depth integration of industry, university, and research institute, and promoting the transfer and transformation of scientific and technological achievements are the important tasks of scientific workers in the new era. This study, based on international experience, proposes a new way to propel the transfer and transformation of scientific and technological achievements through faster construction of high-tech parks.

Keywords: high-tech parks, scientific and technological achievements, transfer and transformation

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