Shouldering New Missions and Accelerating the Development of Science and Technology Innovation Think Tanks—Postprint

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Abstract

[Purpose/Significance] Science and technology innovation think tanks are of great significance to the formulation and implementation of science and technology public decision-making and the improvement of regional innovation systems. Studying the core mission of science and technology innovation think tanks and constructing them better holds important practical significance. [Method/Process] This study employs case study methodology to explore the working methods and institutional missions of world-class science and technology innovation think tanks, and discusses several key issues in the construction of such think tanks. [Results/Conclusions] The analysis reveals that science and technology innovation think tanks are not only designers and evaluation participants of science and technology public policy, but also shoulder important missions such as serving innovation entities, promoting information exchange, and guiding global cooperation that are conducive to enhancing regional innovation capability. With complex service objects and diverse work activities, they need to possess comprehensive research and communication capabilities. In order to build science and technology innovation think tanks effectively, it is essential to adequately balance the four relationships between government support and market selection, regularity exploration and policy-oriented projects, think tank experts and comprehensive integration talents, and self-cultivation and global cooperation, thereby enabling science and technology innovation think tanks to make greater contributions to regional development.

Full Text

Taking on the New Mission and Accelerating Science and Technology Think Tank Construction

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Abstract

[**Purpose/significance**] Science and technology think tanks play a crucial role in the formulation and implementation of public S&T decision-making and the improvement of regional innovation systems. Studying their core mission and development path holds significant practical importance. [**Method/process**] This paper employs case study methodology to examine the operational models and institutional missions of world-class S&T think tanks, and discusses key issues in think tank construction. [**Results/conclusion**] The analysis reveals that S&T think tanks serve not only as designers and evaluation participants in S&T public policy, but also shoulder important missions that enhance regional innovation capacity, including serving innovation actors, promoting information exchange, and guiding global cooperation. With complex clientele and diverse activities, they require comprehensive research and advocacy capabilities. To build effective S&T think tanks, four key relationships must be balanced: government support versus market screening, disciplinary development versus applied research, core experts versus integrated talent, and internal cultivation versus global cooperation, thereby enabling think tanks to make greater contributions to regional development.

Keywords: science and technology think tank; technological innovation governance; science and technology policy; think tank construction; innovation system
Classification Number: F204

1 Science and Technology Think Tanks and S&T Innovation Governance

Science and technology think tanks are social organizations that employ professional knowledge and scientific tools to conduct research and consultation on public policy and decision-making, addressing either decisions concerning S&T development itself or economic and social decisions based on S&T [1]. Generally, decision-making in the S&T field represents an organic integration of S&T development conditions and socioeconomic development needs [2], characterized by strong comprehensiveness, broad impact, and prominent forward-looking perspectives, thus requiring support from external experts [3]. S&T think tanks provide professional consultation from a scientific and technological perspective, possessing the capacity to support innovation strategic decision-making, supply S&T innovation policies, and lead innovation concepts [4], thereby playing im-

portant roles in S&T strategy, planning, layout, and related economic and social policies [5]. Against the backdrop of a burgeoning new technological revolution, as innovation chains continuously extend and the influence of S&T innovation expands, government S&T public decision-making needs to incorporate more participants and consider the interests of more stakeholders beyond the S&T field. As professional institutions external to government, S&T think tanks provide services for the formulation, implementation, and evaluation of S&T policies, constituting an important component of S&T innovation governance.

While providing assistance for S&T policy constitutes the foundation of S&T think tanks, practical experience from high-level think tanks both domestically and internationally reveals that their activities extend far beyond pure policy research. In addition to organizing policy research and disseminating decision-making information as important participants in the S&T governance system, they must also promote exchanges and cooperation among industry-academia-research actors, and help address common "system failures" in regional innovation system development [6]. Particularly in the process of S&T innovation governance, to enhance innovation system vitality and achieve long-term win-win outcomes for all participants, multiple stakeholders and actors—including government, enterprises, universities, research institutes, individuals, and social organizations related to S&T innovation—must engage in coordination, cooperation, exchange, and interaction, with rational division of labor to fulfill their respective missions [7]. Consequently, S&T think tanks must not only provide decision-making assistance services to government, but also devote greater efforts to information dissemination, exchange promotion, and driving global innovation cooperation.

2 Multiple Missions of S&T Innovation Think Tanks

Public S&T policy research represents the core value of S&T think tanks, while consulting products, cooperation networks, and global information platforms derived from such research constitute their social functions in serving regional S&T innovation.

2.1 Providing Professional and Comprehensive Services for Policy Formulation The forms, processes, and socioeconomic impacts of S&T innovation activities evolve rapidly with technological advances. Designing public S&T policies requires not only a thorough grasp of development mechanisms in frontier technologies such as intelligent manufacturing, new materials, and biomedicine, but also mastery of policy research tools and methods to identify core issues driving S&T development. Simultaneously, decision-makers need long-term vision and broad perspectives to anticipate the socioeconomic impacts of S&T policies. Evidently, decision-makers require professional assistants to sort, organize, and analyze information from various dimensions.

S&T think tanks play an important advisory role in public S&T decision-making, assisting in optimizing decision-making objectives, scientificizing

decision-making procedures, and innovating decision-making technologies [8]. Focusing on public S&T policy, these think tanks primarily undertake three responsibilities: first, decision-making consultation, providing recommendations on government macro-policies concerning S&T innovation and consulting on S&T innovation content in public policies; second, research evaluation, offering professional assessment of research funding policies and the implementation, outcomes, and impacts of R&D; third, policy popularization, promoting S&T innovation policies and fostering understanding of innovation issues among various sectors through publications, research reports, periodicals, and seminars.

2.2 Forecasting the Impact of Technological Transformation on Local Economy and Society Think tank research on public S&T policy not only addresses policymakers' consultation needs, but also represents an accumulation of information based on technology forecasting and policy studies. By releasing policy analysis reports and socioeconomic development reports grounded in scientific research, think tanks attract attention from organizations and the public outside government, while simultaneously providing early warnings of economic, industrial, urban, and social transformations for enterprises and citizens, thereby organically integrating specialized technical research with applied policy research.

Since the 1970s, Japan' s Institute for Future Engineering has published its research bulletin "21st Century Forum," publicizing annual discussion themes and conducting forward-looking explorations of numerous issues that might affect Japan' s development in the coming one to two decades. For instance, in 1990 it discussed end-of-life medical care and pension issues in response to potential aging trends; in 1991 it already noted that the integration of information technology with other disciplines would bring revolutionary S&T development; in 1997 and 1999 it twice explored the relationship between S&T and people' s livelihoods, predicting the emergence of large numbers of Japanese consumer technology products; around 2000 it began focusing on rural community depopulation issues that would fully erupt five years later; in 2002 it discussed the socialization possibilities of power networks brought by various new energy generation technologies, among other topics. Examination of the institute' s annual research themes reveals frequent appearance of keywords such as "transformation," "possibility," "new trends," and "future."

In the era of innovation globalization, regional S&T innovation faces intense competitive pressures both domestically and internationally, including competition in core technology R&D, industrial upgrading and elimination, and innovation resource outflow. By observing frontier technological breakthroughs and changes in industrial formats, S&T think tanks can closely connect regularity-based and mechanism-based research such as technology forecasting with actual local socioeconomic development needs. This means the work of S&T think tanks transcends pure policy research, requiring deeper exploration of how tech-

nological transformation will promote connections and integration among R&D forces, enterprises, and financial intermediaries. This represents the core value of S&T think tanks in leveraging their specialized technical expertise and distinguishing themselves from other general comprehensive think tanks. World-class S&T think tanks not only possess the capacity to conduct technology forecasting using scientific methods, but also maintain deep research accumulation on regional development realities, maximizing the benefits of their intellectual products.

2.3 Promoting Exchange and Cooperation Among Innovation Actors Contemporary regional innovation increasingly emphasizes the concepts of collaboration and networks. This collaboration includes not only industry-academia-research coordination, but also synergy across upstream and downstream industry chains, as well as cooperation among different administrative regions. Supported by information technology, collaboration methods have become extremely flexible and complex, with increasingly prominent interest integration and complicated innovation networks. Innovation is no longer confined within single entities, as innovation models have shifted from linear to networked innovation, with innovation sources diffusing to multiple nodes across industry chains. Therefore, intensifying and expanding innovation network chains through information exchange and sharing holds significant importance for the development of regional collaborative innovation systems.

The rapid popularization of information networks also provides new opportunities for think tank operations, exemplified by the Silicon Valley Economic Development Alliance project organized by the Silicon Valley Joint Investment Venture. Leveraging its established regional collaboration network, the organization widely solicits suggestions from local governments, active social organizations, and businesses of all sizes within the region, concentrates resources, and has built a core website encompassing information resource platforms for innovation and entrepreneurship, including commercial land leasing databases, partner interaction maps, and national and regional administrative support resource platforms, attracting various innovation actors to exchange information on the platform and providing opportunities for improving innovation networks.

S&T think tanks maintain independence among different innovation actors and possess comprehensive understanding of various perspectives and intelligence. Particularly, their predictive research holds significant importance for market actors in selecting strategic directions and assessing future trends, naturally attracting market actors to engage with think tanks and thereby becoming hub nodes for innovation information and resource exchange. Think tanks should fully leverage their role as innovation information platforms, assisting enterprises, universities, research institutes, social organizations, and the public to jointly participate in the incubation and formulation of public S&T decision-making, achieving coordination among industry chains, capital chains, and innovation chains. As a globally renowned S&T innovation think tank in Silicon

Valley stated, "providing solutions" constitutes only part of a think tank' s work, while "establishing regional frameworks for thinking, analysis, and action" serves as the prerequisite for "providing solutions." Promoting S&T innovation information exchange holds particularly important significance in today' s context of open and decentralized innovation.

2.4 Building an Open Global Cooperation Platform With the comprehensive popularization of information networks, accelerated information transmission speeds, and rapid development of various mobile terminals, technical barriers for think tanks to connect with experts across fields worldwide have been overcome. In fact, high-end S&T innovation think tanks in developed countries all actively collect and understand perspectives from foreign experts, employing methods such as hiring part-time personnel, co-authoring articles, conducting online debates, and hosting virtual forums to absorb the strength of global high-end innovation talent, broadening channels for input and providing open perspectives for local innovation development.

In addition to publishing journals, reports, and articles, Japan' s Research Institute of Economy, Trade and Industry (RIETI) places great emphasis on developing its official website. The website supports Japanese, English, and Chinese languages. As the institute' s published articles have increased and social attention has risen, English website traffic has grown significantly, maintaining approximately 400,000 annual visits since 2009, with total visits approaching 1.6 million by 2013.

Figure 1 [Figure 1: see original paper] The site traffic of the official website of RIETI 2006-2013 (in three languages)
Data source: RIETI Annual Report, 2006-2013

As international exchange platforms, S&T innovation think tanks can drive the globalization and openness of their regions by continuously expanding research horizons, enhancing research depth, and maintaining timely follow-up on international frontier issues. As non-governmental organizations conducting active international exchange and cooperation, they help strengthen their cities' influence and discourse power in global innovation competition and regional competition. Capable S&T innovation think tanks also establish international exchange departments and overseas branches, organize international symposiums and thematic lectures, and invite experts and scholars from various countries to participate. Through discussions that coordinate different positions and viewpoints, experts can present and explore latest research findings, objectively helping to raise the international profile of their locations. Furthermore, open global exchanges by S&T innovation think tanks can facilitate access to innovation information, conduct innovation cooperation, and exert international influence for internal innovation actors in their locations.

3 Accelerating S&T Innovation Think Tank Construction Requires Balancing Key Relationships

Undoubtedly, S&T innovation think tanks currently face a series of conflicts and problems in their development. To enable think tanks to better stimulate innovation vitality and promote regional development, it is necessary to align with their missions and properly manage the relationships between assisting public policy and enhancing competitiveness toward enterprises, between deepening theoretical research in policy science and providing applied intellectual products, between shaping high-end images of core experts and building approachable publicity teams, and between strengthening internal capacity building and fully utilizing global external resources.

3.1 Balancing Government Support and Market Screening The core users of S&T innovation think tanks are government S&T management departments—the makers of public S&T policy. Regardless of type, field, or institutional nature, the most direct purpose of think tanks' work is to influence government and public decision-making. Without adhering to this fundamental criterion, so-called think tank institutions would be difficult to distinguish from other social organizations or even survey companies. Balancing the relationship between government and market in think tank development requires properly arranging relationships among the public sector, private sector, and think tanks themselves, while promoting the formation of a social culture conducive to better think tank development.

As government departments, it is essential to recognize that the core object of think tank work is public decision-making, and thus provide necessary facilitation for think tank development, including open information resources, public decision-making demand catalogs, improved procurement service processes, and established evaluation and incentive mechanisms. It must be clarified that think tanks are think tanks precisely because their core value lies in serving public policy; therefore, government must not be absent in the development process of S&T innovation think tanks. Especially given China's currently imperfect think tank market mechanisms and environment, government should also devote sufficient attention to the construction and reform of S&T innovation think tanks.

On the other hand, the development of S&T innovation think tanks must regard the private sector as a primary "client source." From the perspective of funding sources, numerous think tanks in Western developed countries such as Europe and America, as well as Asian countries like Japan and South Korea, rely on funds from non-governmental sources including enterprises, schools, and social organizations. From the perspective of management affiliation, according to statistics from the 2015 Global Go To Think Tank Index Report by Professor James G. McGann's team, think tanks can be categorized into at least seven types: fully independent operations, semi-independent operations (established with government support but with independent funding sources and management systems), government affiliates (formal parts of government),

quasi-governmental organizations (independent organizations funded by government contracts), university-affiliated organizations, political party-affiliated organizations, and for-profit organization consortia [9], with many think tank institutions not having close relationships with government. From the perspective of relationship networks, the resource chain for S&T innovation think tanks – "receiving capital support from society → providing information of interest to social actors → becoming a focus of attention for social actors → gaining influence → guiding and promoting government decision-making" –is quite evident. Therefore, the interaction between S&T innovation think tanks and government decision-makers cannot be a "bilateral" relationship, but must necessarily be an event within a multi-actor network environment. Consequently, accelerating S&T innovation think tank development should also explore how to engage think tanks more extensively in market interactions.

However, market orientation for S&T innovation think tanks does not mean that seeking corporate financial support should become their core value. Rather, through market screening and functioning, different think tanks can clarify their positioning and value within the entire public decision-making network and regional innovation system, achieving market-based resource allocation, and ultimately promoting the goal of specialized professionals conducting specialized work on professional platforms. As S&T innovation think tanks themselves, efforts should focus on enhancing research depth and influence, drawing on development experiences from top consulting firms and world-class foreign S&T innovation think tanks, and grasping three key priorities to build commercial brands through long-term, in-depth public policy research.

These include: first, focusing on improving the quality of decision-making outcomes and shaping core competitiveness; second, considering the interest demands of both public and private sectors to build in-depth analysis platforms; third, clarifying differentiated development and inter-think-tank division of labor to foster healthy competition within the industry.

To maintain survival balance between government and market, it is necessary to guide both government and the public to establish a more mature concept of paid information consumption, making "paying for information" a social consensus. Combined with the characteristics of S&T innovation think tank work, intellectual property protection mechanisms should be further improved, particularly addressing how to protect information and outcomes and maintain interests when experts move between or hold concurrent positions in multiple think tank institutions, thereby shaping a harmonious cultural atmosphere.

3.2 Balancing Disciplinary Development and Applied Research As people recognize the significance and value of technological transformation for socioeconomic development, S&T innovation think tanks currently face fierce market competition. Users of decision-making solutions increasingly favor short-term, targeted projects to enable advanced technologies to promptly serve economic industries and social livelihood needs; policy research institutions estab-

lished by large enterprises and industry alliances further encroach upon the think tank market; and ubiquitous, constantly updated new media deliver information faster than think tanks' conventional reports. Competition from all fronts requires S&T innovation think tanks to efficiently process and analyze vast amounts of information and ideas from all corners of the world, examine the same issues and policy challenges from different perspectives, and consider policy recommendations from social, economic, political, managerial, legal, and quantitative angles simultaneously. By rapidly absorbing the latest practical experiences from other countries and providing actionable, transferable policy solutions for their own regions, they can address "more problems, more stakeholders, more competition, and more conflicts" in regional development [10].

However, as public decision-making assistants, S&T innovation think tanks cannot focus solely on short-term policy instruments and effects. They also need to establish their own analytical frameworks and research networks through long-term development of policy science disciplines to grasp the general direction of innovation development and maintain overall consistency in policy proposals. Therefore, S&T innovation think tanks must balance the increasingly high-quality demands of short-term policy research solutions with their own long-term adherence to policy research fields and directions, particularly for highly specialized and potentially impactful policies such as regional S&T innovation, tightly integrating basic policy science research with real-world demands. The key work focus is maintaining stability in research directions, fields, and core personnel, selectively undertaking projects based on institutional strategic vision and research foundation, and improving proactivity in project screening, thereby maximizing research advantages while providing further research accumulation through applied project implementation.

3.3 Balancing Core Experts and Integrated Talent Team building in S&T innovation think tanks should pay special attention to cultivating and introducing two types of talent: "viewpoint providers" and "solution designers." Viewpoint providers are think tank experts who specialize in original research and possess deep accumulation in understanding the mechanisms of public policy processes and S&T innovation patterns. Solution designers are sometimes perceived as "marketing personnel,"but experience from top-tier think tanks demonstrates that their value and professionalism far exceed the concept of publicity —they are integrated talent. As professionals who transform think tanks' specialized viewpoints into marketable products, these individuals hold advanced degrees, have long-term work experience, and maintain relatively extensive social networks. They understand the reading habits, potential concerns, and thinking patterns of think tank clients (including government departments and enterprises), and can "translate" experts' core viewpoints into marketable commodities through commentaries, writings, and other means. Experts should not hold narrow positions; their concern lies in whether the entire matter is rational and where its internal evolution mechanisms lie, enabling continuous mechanism research. Solution designers, however, can adopt specific positional

perspectives as needed to deliver sharp commentaries and conduct highly skillful "marketing" to guide and promote the design, formation, implementation, and evaluation of public policies. Due to the specialized and complex nature of S&T policy issues, such solution designers are particularly important for S&T innovation think tanks.

The reason for maintaining expert impartiality is that if think tank experts, as research cores, represent overly distinct stakeholder positions, it will directly affect their objective reputation. This trend is particularly evident among American think tanks: think tank experts increasingly, or rather are compelled to, pursue influence over policy, losing the impartial stance of long-term scientific research to the point of being described as "smooth-operating marketing machines" [11]. While think tank institutions may hold radical or biased attitudes, their argumentative foundations must be held by relatively independent experts, who must avoid excessively pursuing attention from decision-makers and the public to the extent of damaging credibility.

The rationale for emphasizing the cultivation and recruitment of integrated solution design talent is that transforming decision-making outcomes requires highly composite capabilities, imposing demanding requirements on personnel. S&T innovation think tanks influence government, academia, industry, and the public in various forms. Such personnel must possess acute sensitivity to engage in discussions on relevant specialized issues at appropriate times; they must have comprehensive understanding and judgment to appropriately choose whether to make indirect suggestions or take clear and sharp positions; and they must possess outstanding communication, writing, and organizational skills to complete different forms of decision-making consultation solutions. China' s think tank builders and managers must reverse the traditional mindset that equates such talent simply with "publicity personnel" or "support staff," establishing specialized talent cultivation plans and mechanisms, and treating this as an important task in think tank capacity building.

3.4 Balancing Internal Cultivation and Global Cooperation High-level S&T innovation think tanks both domestically and internationally, regardless of their degree of internationalization, all regard local development issues as their core research objects. Although current information technology and virtual research networks are highly advanced, think tanks' investigations and research on local economic, social, S&T, and cultural conditions are obviously still easier to conduct and more likely to identify potential problems. Additionally, in some major Chinese cities with high S&T development levels, the number of S&T innovation think tanks has increased rapidly in recent years, with active think tanks emerging that command substantial research resources and possess certain original innovation capabilities. For example, as the city with the largest number of think tanks nationwide, Beijing serves as both a political center and an international exchange hub. Some think tanks in the region have already achieved certain global influence, with numerous relatively active and high-level

S&T innovation think tanks clustering in Beijing, and some think tanks'influence has entered the global top tier. Therefore, in regions rich in S&T innovation think tank reserves and with enormous potential, making good use of existing think tanks and experts should be the focus of S&T innovation think tank construction.

However, the role of external think tanks should not be neglected, especially as information networks facilitate important global think tank cooperation around innovation issues. Today, continuous political and economic openness has expanded markets, while technological revolutions have promoted rapid development in global communications and internet technology. Policy networks and knowledge networks are becoming a key trend in global think tank development. Compared with individual think tank institutions, policy networks can more conveniently coordinate different participants, connecting public sectors, private sectors, and social groups worldwide. With the help of information technology, even smaller-scale think tanks can transcend traditional concepts within existing sectors and exert high-level policy guidance. Leveraging technological advances, S&T innovation think tank personnel can conduct cross-national work and exchanges more effectively, making such exchanges routine and providing training and capacity building for partners worldwide.

Therefore, accelerating S&T innovation think tank development to serve S&T innovation requires further clarifying the relationship between "cultivation"and "cooperation." On one hand, through information disclosure, personnel exchanges, and removal of barriers between management departments, think tanks at different levels, in different fields, and with different strengths can fully exert their professional roles, achieving improvement in the S&T innovation think tank system and collaboration networks. On the other hand, it is necessary to explore exchange methods between S&T innovation think tanks and external, particularly foreign high-level think tanks, establish global cooperation networks based on information technology, and explore more diverse activities in cooperative research, education and training, and viewpoint exchange, thereby advancing capacity building and leveraging think tank functions and "track II diplomacy" effectiveness.

4 Prospects for S&T Innovation Think Tank Construction

On one hand, the global innovation landscape and competitive structure are undergoing profound changes. S&T innovation has become a new arena for national competition, with agglomeration of high-end innovation factors such as talent, technology, and capital, and the emergence of new cultures, ideas, models, and industries becoming major forces driving socioeconomic development and key determinants of competitive success or failure. In this new development stage, S&T innovation activities face more complex domestic and international challenges than ever before. Particularly as China' s socioeconomic transformation and S&T system reform deepen continuously, various deep-seated problems and contradictions have become prominent, with increasing complex-

ity, difficulty, diversity, and even globality of these issues and contradictions. There is an urgent need for S&T innovation think tanks to leverage professional knowledge and backgrounds, propose strategic, forward-looking, scientific, and comprehensive policy recommendations and solutions based on in-depth analysis of domestic and international development situations, improve the scientific nature and targeting of S&T decision-making, and solve difficult problems in S&T innovation development and reform.

On the other hand, as the world' s second-largest economy, China has become a focus of attention for international think tanks, particularly those from developed countries. In 2006, the Tsinghua-Brookings Center for Public Policy was established; in 2009, Columbia Global Centers (East Asia, Beijing) was established; in 2010, the Tsinghua-Carnegie Center for Global Policy was established, quickly entering the top tier of Chinese think tank institutions in the University of Pennsylvania' s Global Go To Think Tank Index by virtue of strong external research accumulation. Peer competition among think tanks is becoming increasingly fierce. As think tanks' own research fields continuously generalize and the impact of S&T innovation issues expands, the entry of these world-class think tanks will inevitably bring pressure to China' s original S&T innovation think tanks.

With challenges and opportunities coexisting, S&T innovation think tanks must properly handle their dual roles as members of innovation networks and guides of public S&T policy, actively advance their own capacity building, strengthen cooperation and exchange, exert greater influence, guide and drive the improvement of S&T innovation capabilities across society, and accelerate regional development.

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Author Contributions

Wu Feifei: Responsible for material organization and writing;
Wang Zheng: Responsible for research design and manuscript revision.

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