The Transformation of China's S&T Diplomacy

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Abstract

In recent years, China's S&T diplomacy has undergone a gradual transformation, characterized by the expansion of its S&T diplomacy partnerships, adjustments in S&T diplomacy models, and the shift in China's role and positioning within this sphere. This transformation is driven both by China's increasing scientific and technological capabilities and evolving international relations ideologies, as well as influenced by changes in the global political landscape. The transformation of China's S&T diplomacy faces several challenges, including a shortage of S&T diplomacy personnel, inefficient international cooperation mechanisms, and a slowdown in the trend of technological globalization. China must further deepen its domestic scientific and technological institutional reforms and respond appropriately to external pressures to overcome these challenges and pave the way for the transformation of S&T diplomacy.

Key words: S&T diplomacy; China; policy transformation

1. Introduction

S&T Diplomacy is the outcome of the mutual influence between the development of science and technology and international communication in the context of globalization. Since the start of the 21st century, developed countries like the United States, Germany, the United Kingdom, Japan, and France have actively advanced S&T diplomacy as a policy agenda[3], with the aim of achieving objectives such as attracting international science and technology resources, bolstering external influence, and addressing global challenges.

China does not have a specific S&T diplomacy policy. The concept of "S&T diplomacy" is rarely formally employed in China's policy documents. China's S&T diplomacy is, in fact, composed of various policies scattered across fields like science and technology, foreign affairs, and economic trade. As science and technology increasingly become critical factors in international relations, the importance of S&T diplomacy in China's foreign interactions has rapidly become more prominent. In fact, in recent years, China's S&T diplomacy has entered a crucial transitional phase. Due to the non-systematic and non-explicit nature of China's S&T diplomacy-related policies, this transition may not be easily discerned directly.

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2. The main manifestations of the transformation of China's S&T diplomacy

2.1 Expansion of S&T diplomacy partnerships

As global science and technology resources are primarily concentrated in developed countries, fostering scientific and technological relations with these nations is a top priority for the S&T diplomacy of all countries, particularly developing ones such as India[4] and Turkey[5]. China's previous S&T diplomacy partners were predominantly developed countries. However, in recent years, China has expanded its S&T diplomacy partners to include more developing countries, especially emerging nations and those situated along the Belt and Road initiative.

In 2018, within the framework of the BRICS cooperation mechanism, China proposed the establishment of the BRICS partnership on the new industrial revolution. This initiative aimed to enhance the coordination of relevant policies and promote cooperation in cutting-edge technologies and skills enhancement for human resources. Additionally, China took the lead in founding the BRICS Technology Transfer Center, marking the first official cooperation mechanism for technology transfer among BRICS countries.

China places significant emphasis on S&T diplomacy directed towards countries participating in the Belt and Road initiative. During the Belt and Road International Cooperation Summit Forum in 2017, China's leader proposed the transformation of the Belt and Road into a path of innovation and launched the Belt and Road Science, Technology, and Innovation Cooperation Action Plan. This plan primarily focuses on cooperation in four areas: scientific and cultural exchanges, joint laboratories, collaboration in science parks, and technology transfer. According to data from China's National Bureau of Statistics, as of the end of 2021, China had established scientific and technological cooperation relationships with 84 countries involved in the Belt and Road initiative. These partnerships supported 1,118 joint research projects with a total investment of 2.99 billion yuan. Furthermore, China initiated the construction of 53 joint laboratories in fields such as agriculture, new energy, and healthcare and wellness.

The expansion of China's S&T diplomacy partners has led to the change of China's S&T diplomacy connotation. Due to the difference in scientific and technological capabilities between developed and developing countries, China's S&T diplomacy towards these two types of countries also differs.

Developed countries still have a significant lead in scientific and technological capabilities in many fields. Scientific and technological cooperation with developed countries can more easily generate technological spillovers for China by approaching the research frontier, acquiring emerging technologies, expanding the technology market, attracting high-tech talents and investment[6]. Therefore, China's S&T diplomacy towards developed countries focuses on "diplomacy for S&T"[7], that is, promoting joint research and development and personnel exchanges through diplomacy, thereby enhancing China's scientific and technological capabilities.

Developing countries generally have weaker scientific and technological capabilities, and even lag behind China in many fields. Scientific and technological cooperation with developing countries can hardly directly promote China's scientific and technological capabilities, but instead increasingly takes the form of China's foreign scientific and technological assistance. Some forms of S&T diplomacy for "South-South cooperation" are committed to helping developing countries cope with global challenges such as climate change, which can bring diplomatic benefits such as improving China's international image and expanding

[4] Sharma, J., & Varshney, S. (2019). Science diplomacy and cooperation in science and technology in India. Science Diplomacy Review, 1(2), 11-22.

[5] Buyuktanir Karacan, D. (2021). Science diplomacy as a foreign policy tool for Turkey and the ramifications of collaboration with the EU. Humanities and Social Sciences Communications, 8(1), 1-12.

[6] Flink, T., & Schreiterer, U. (2010). Science diplomacy at the intersection of S&T policies and foreign affairs: toward a typology of national approaches. Science and Public Policy, 37(9), 665-677.

[7] Koppelman, B., Day, N., Davison, N.R., Elliott, T., & Wilsdon, J. (2010). New frontiers in science diplomacy: navigating the changing balance of power. https://royalsociety.org/topics-policy/publications/2010/new-frontiers-science-diplomacy/

market access[8]. Therefore, China's S&T diplomacy towards developing countries focuses on "S&T for diplomacy"[9] that is, using international scientific and technological cooperation to improve and strengthen diplomatic relations.

Overall, with the expansion of China's S&T diplomacy partners, the connotation of China's S&T diplomacy has also expanded from "diplomacy for S&T" to "S&T for diplomacy".

2.2 Adjustment of S&T diplomacy models

Due to its weak scientific and technological foundation, China's S&T diplomacy started relatively late. S&T diplomacy must follow the general law of gradual development, and it must improve and mature gradually through the accumulation of experience and resources. In the early stages of S&T diplomacy development, it is suitable to engage in specific and individual international scientific and technological cooperation activities, such as collaborative scientific and technological projects and exchanges of scientific and technological personnel. These activities have low entry thresholds and yield controllable results. They can be collectively referred to as "factor-based S&T diplomacy", with their primary carriers being factors like projects, funds, personnel, equipment, and information. As S&T diplomacy development gradually matures, it becomes possible to undertake more systematic and abstract international scientific and technological cooperation activities, such as participating in the development of scientific and technological regulations and governance of research ethics. These activities have higher entry thresholds and may yield unpredictable results. They can be collectively referred to as "rule-based S&T diplomacy", with their primary carriers being rules, institutions, concepts, values, and so on.

China's S&T diplomacy model is gradually shifting from factor-based S&T diplomacy to rule-based S&T diplomacy. On the one hand, the Chinese government has clearly shown its willingness to participate in the formulation of international science and technology rules, and has tried to propose new concepts of S&T governance. The "13th Five-Year Plan for National Science and Technology Innovation" proposes to "actively participate in the formulation of major international S&T cooperation rules" and "proactively set global issues". At the 2021 ZhongGuanCun Forum, China's leader advocated "shaping the concept of S&T for good, and improving global S&T governance". In 2021, China's leader proposed the "Global Development Initiative" at the 76th session of the United Nations General Assembly, which specifically advocated "creating an open, fair, just, and non-discriminatory environment for science and technology development". On the other hand, China has begun to substantially participate in the formulation of international science and technology rules. As an important member of UNESCO, China has worked with other members to promote the adoption of the UNESCO Recommendation on Open Science. China has also participated in the formulation of the Recommendation on the Ethics of Artificial Intelligence issued by UNESCO, and incorporated the concepts of "harmonious coexistence" and "sustainable development" from China's Governance Principles for the New Generation Artificial Intelligence and Ethical Norms for the New Generation of Artificial Intelligence into the Recommendation on the Ethics of Artificial Intelligence.

The difference between factor-based S&T diplomacy and rule-based S&T diplomacy lies not only in their carriers but also in their channels. Factor-based S&T diplomacy often operates through bilateral channels, while rule-based S&T diplomacy typically takes place through regional or multilateral channels. This is because the more countries rule-based S&T diplomacy involves, the greater the potential for substantial impact and the higher the likelihood of success. Therefore, as China adjusts its S&T diplomacy model, it is becoming increasingly active in regional and multilateral science and technology platforms.

2.3 Shifting role of China in S&T diplomacy

China's role in S&T diplomacy is gradually shifting from being a participant and follower to becoming an initiator and shaper. In short, China is actively transitioning from "participatory S&T diplomacy" to "initiatory S&T

[8] Özkaragöz Doğan, E., Uygun, Z., & Akçomak, İ. S. (2021). Can science diplomacy address the global climate change challenge?. Environmental Policy and Governance, 31(1), 31-45.

[9] Koppelman, B., Day, N., Davison, N.R., Elliott, T., & Wilsdon, J. (2010). New frontiers in science diplomacy: navigating the changing balance of power. https://royalsociety.org/topics-policy/publications/2010/new-frontiers-science-diplomacy/

diplomacy".

Taking international mega-science programs and projects as an example, these initiatives serve as crucial means to expand the forefront of science and technology development and collaborate in addressing significant global challenges. In previous international mega-science programs and projects like the International Thermonuclear Experimental Reactor (ITER), the Group on Earth Observations (GEO), and the Square Kilometre Array (SKA), China predominantly participated by undertaking specific tasks without assuming a leading role. However, in 2018, the State Council of China issued the "Plan for Actively Leading and Organizing International Mega-Science Programs and Projects",marking the first time China has actively taken steps to lead and coordinate such international endeavors. This document also articulates the purpose behind this initiative, aiming to "enhance the capacity for building international consensus and fostering cooperative innovation,with the aspiration to become a proponent, promoter, and contributor to major international discussions and regulations in the realm of science and technology".

Rights and obligations are equal. China's evolving role in S&T diplomacy carries two important implications. Firstly, China must shoulder greater responsibility and allocate more resources to S&T diplomacy activities. Secondly, China must contribute additional global science and technology public goods, along with its wealth of experience and wisdom. Beyond international mega-science programs and projects, another example of China's proactive stance in sharing science and technology resources and providing public goods is the announcement made by China's leader in 2021 regarding the establishment of the globally-oriented scientific research fund.

3. The Driving Factors of China's S&T diplomacy Transformation

Generally speaking, there are many factors that affect S&T diplomacy, such as national interests, political systems, diplomatic concepts, scientific principles, scientific and technological capabilities, geopolitics and ideology, etc[10]. The main factors driving the transformation of China's S&T diplomacy are as follows.

3.1 The Enhancement of China's Technological Strength

In the past decade, China's scientific and technological capabilities have significantly improved. From 2012 to 2022, China's ranking in the World Intellectual Property Organization's "Global Innovation Index" advanced by 23 places (from 34th to 11th); research and development expenditure increased by nearly 2 times (from 1.03 trillion yuan to 3.09 trillion yuan); the number of research and development personnel increased by 85.9% (from 4.62 million in 2012 to 8.58 million in 2021); the proportion of SCI highly cited papers published by China in the world increased by 19.8 percentage points (from 7.5% to 27.3%); PCT patent applications increased by 2.7 times (from 19,000 in 2012 to 69,600 in 2021); high-tech product export value increased by 58.2% (from $601.19 billion to $951.33 billion); intellectual property royalty income increased by 11.8 times (from $1.04 billion to $13.3 billion); the number of enterprises entering the global top 2500 in research and development investment increased by 2.3 times (from 205 in 2014 to 678 in 2022).

The enhancement of scientific and technological capabilities is the most crucial prerequisite for the transformation of China's S&T diplomacy. It breaks through the previous constraints from two aspects and expands the scope of China's S&T diplomacy.

One aspect is breaking through the initial resource constraints. More proactive and dynamic S&T diplomacy activities will inevitably consume additional scientific and technological resources. In comparison to S&T diplomacy aimed at developed countries, diplomacy directed towards developing nations also demands more significant investments in scientific and technological resources from China. China's rapid growth in scientific and technological inputs and outputs offers the potential for these adjustments.

The second aspect is to overcome the initial constraints related to capabilities. To engage in international scientific and technological cooperation activities of

[10] Luo Hui, Li Zheng, Cui Fujuan & Wang Zining. (2021). The practice and characteristics of contemporary China's S&T diplomacy. Foreign Affairs Review (Journal of Foreign Affairs College) (06), 1-22+165.[罗晖,李政,崔馥娟 & 王梓宁.(2021).当代中国科技外交的实践与特色. 外交评论(外交学院学报)(06),1-22+165.]

a higher standard and level, it is necessary to possess both enhanced research and development capabilities and more robust scientific research organization and management capabilities. The research and development capabilities, as well as scientific research organization and management capabilities, of various scientific research entities in China (including institutions and personnel) have progressively improved. They can now assume more significant roles as initiators and organizers in international scientific and technological cooperation activities.

In general, thanks to the enhancement of its scientific and technological prowess, China is increasingly likely to transition from a recipient to a donor and from a taker to a giver in S&T diplomacy activities.

3.2 The pressure of the international political situation

The change in the international political situation is the key external factor driving the transformation of China's S&T diplomacy. At its core is the trend of politicization in international scientific and technological exchanges[11], especially the shift in U.S. science and technology policy toward China. Under the strategies of "technological decoupling", "de-risking", and "small yard and high fence", the United States actively severed many traditional channels of Sino-U.S. scientific and technological cooperation. Furthermore, it hindered the scientific and technological cooperation of other developed countries with China through diplomatic lobbying and extraterritorial jurisdiction. These measures constrained the space for China to conduct S&T diplomacy aimed at developed countries, thereby having a two-fold impact on China's S&T diplomacy.

On the one hand, it led to the reallocation of China's S&T diplomacy resources. Some of China's scientific and technological cooperation activities aimed at developed countries were forcibly interrupted. The S&T diplomacy resources of China, including funds, personnel, equipment, and more, originally designated for these activities, were naturally redirected to other areas, particularly S&T diplomacy activities aimed at developing countries.

On the other hand, it promoted the transformation of China's scientific and technological diplomacy channels. Compared to bilateral scientific and technological diplomacy activities, regional or multilateral scientific and technological diplomacy activities are more likely to avoid the interference of political factors. Some countries wish to enhance their scientific and technological relations with China but are concerned about the impact of US extraterritorial jurisdiction measures. Therefore, they tend to engage in scientific and technological cooperation with China through regional or multilateral channels.

3.3 The Evolution of China's International Relations Concepts

Under the impetus of changes in the global landscape and the demands of its own development, China's international relations concept has gradually evolved. This evolution is mainly reflected in its shift from a more grandiose worldview towards envisioning a more just and equitable international order. In 2013, China's leader introduced the concept of "a community of shared future for mankind", recognizing the deepening interconnectedness and interdependence among nations and the inability of any single country to address the common challenges faced by humanity in isolation. In 2018, "promoting the building of a community of shared future for mankind" was enshrined in the Constitution of the People's Republic of China. Building upon the concept of "a community of shared future for mankind", China advocates the creation of a "new type of international relations" with mutual respect, fairness, justice, and win-win cooperation at its core, while also upholding the principles of "true multilateralism". To realize these ideals, China has been actively promoting and enhancing an "all-round, multi-level, and three-dimensional diplomatic strategy".

The evolution of China's international relations concept extends to the field of science and technology. China's overarching science and technology policies, such as the "Outline of the National Innovation-Driven Development Strategy" and the "13th Five-Year Plan for National Science and Technology Innovation," consistently underscore the importance of "actively integrating into the global innovation network" and "planning science and technology innovation with a global vision". In 2021, the revised "Law on the

[11] Rungius, C., & Flink, T. (2020). Romancing science for global solutions: on narratives and interpretative schemas of science diplomacy. Humanities and Social Sciences Communications, 7(1), 1-10.

Promotion of Scientific and Technological Progress" introduced Article 79, stating, "The state promotes open, inclusive, mutually beneficial, and shared international scientific and technological cooperation and exchange, and supports the construction of a community of shared future for mankind". This projection represents another factor propelling the transformation of S&T diplomacy. To serve the goal of an "all-round, multi-level, three-dimensional diplomatic strategy", China must expand the scope of its S&T diplomacy and reallocate diplomatic resources accordingly. In pursuit of building a "new type of international relations", China is poised to support the establishment of an international science and technology exchange model based on "rules" rather than "power". Furthermore, to advance the construction of a "community of shared future for mankind", China's S&T diplomacy will inevitably adopt a more "ambitious" approach, seeking greater international influence while undertaking increased international responsibilities.

4. The challenges facing China's transformation of S&T diplomacy

4.1 Lack of S&T Diplomacy Personnel

Effective S&T diplomacy demands a substantial cadre of frontline diplomats with a unique skill set, encompassing strong diplomatic acumen, organizational management proficiency, and specialized expertise. However, China currently faces a shortage of science and technology diplomats, which hinders the advancement of its S&T diplomacy during this transformative phase. To illustrate, in terms of individuals holding key positions (including chairs, vice chairs, secretaries-general, and executive committee directors) within major international academic organizations, data from the China Association for Science and Technology in 2019 revealed that China had only 98 such individuals, constituting a mere 8% of the global total, whereas the United States boasted 368 individuals, comprising a substantial 30% of the global total.

The issue of China's shortage of science and technology diplomats presents a challenging long-term problem. Cultivating science and technology diplomats is a lengthy process that necessitates significant investments in education resources, including adjustments to academic disciplines, and the provision of ample opportunities for prospective personnel to gain experience. Additionally, S&T diplomacy activities frequently involve working in non-native languages, further affecting China's ability to efficiently develop science and technology diplomats.

4.2 Constraints Arising from the Domestic Science and Technology System

The science and technology resources and elements utilized in S&T diplomacy primarily originate from within the country. Therefore, the transformation of China's S&T diplomacy is also influenced by the domestic science and technology resource allocation and management systems.

In recent years, China has been actively reforming its science and technology system. However, some imperfections in the system indirectly impede the transformation of S&T diplomacy in various ways:

- The internationalization level of China's science and technology plans remains insufficient. Fiscal science and technology funds cannot be used abroad, posing challenges for deepening science and technology relations with other countries through these plans;
- Complex approval procedures for scientific researchers traveling abroad create obstacles for science and technology diplomats participating in international activities;
- There is no specific registration and management system for international science and technology organizations, hindering their establishment and growth in China;
- The absence of specialized science and technology intermediary service agencies makes it challenging to support cross-border technology transfer and achievement transformation;
- The domestic science and technology ethics governance system is incomplete, limiting China's ability to participate effectively in the formulation of international science and technology rules in related fields.

4.3 Resistance Stemming from Slowing Technological Globalization

The cornerstone of science and technology globalization lies in the trust relationships among major countries in the field of science and technology. When certain countries

implement technology protectionism measures, they undermine this trust, leading to a cycle of imitation and retaliation, ultimately damaging the prospects of science and technology globalization. In recent years, an increasing number of countries have started prioritizing "technology sovereignty"[12], and their commitment to international science and technology cooperation has waned. This shift signals a significant slowdown in the progress of science and technology globalization.

The slowdown of science and technology globalization signifies a decline in the overall international science and technology cooperation environment, which, in turn, negatively impacts China's S&T diplomacy transformation. Firstly, it increases the overall cost of China's S&T diplomacy. Partner countries now prioritize science and technology security concerns, necessitating increased resource allocation by China to maintain or strengthen existing science and technology cooperation relationships. Secondly, China's science and technology development is often associated with negative labels like "innovation mercantilism"[13], tarnishing its international scientific and technological image and weakening partner countries' public support for cooperation. When China aims to take on the role of an initiator and shaper in S&T diplomacy, it frequently faces an unfavorable public opinion environment, often characterized by "China's science and technology threat theory".

Furthermore, China's S&T diplomacy activities on multilateral platforms face competition from the United States. A notable example is the United States' withdrawal from UNESCO in 2018 and subsequent rejoining in 2023. The primary motivation for the U.S. to rejoin UNESCO is to counteract China's growing influence. On March 22, 2023, U.S. Secretary of State Blinken articulated this intention during a speech to the Senate Foreign Relations Committee, which is to help UNESCO "establish rules, norms, and standards for artificial intelligence" to prevent potential dominance by China.

5. Outlook for the Transformation of China's S&T Diplomacy

The three driving factors behind China's S&T diplomacy transformation are long-term trends that are unlikely to change in the short run. China's scientific and technological capabilities will continue to strengthen. Its evolving international relations concept, particularly the notion of a "community of shared future for mankind" and a sense of great power responsibility, will further mature. The global rise of populism and protectionism, along with the politicization of international science and technology exchanges, are challenging to reverse in the short term. Consequently, China's S&T diplomacy transformation will be an enduring process. The ultimate goal of this transformation is not only to align with China's own conditions and requirements but also to foster better interaction between China's science and technology system and diplomatic system with the rest of the world.

As for the progress made, China's current transformation in S&T diplomacy has not yet reached a turning point where a "quantitative change" leads to a "qualitative change". Science and technology relations between China and developing countries still lack maturity and stability, with relatively small-scale joint funding for projects and technology personnel exchanges. China's effectiveness in conducting "rule-based S&T diplomacy" remains limited, with lower participation levels in shaping international rules for areas like artificial intelligence and the digital economy compared to developed countries. Furthermore, China has initiated only a few international mega-science projects and programs, with its influence trailing behind those led by developed countries, such as ITER, GEO, and SKA.

To accelerate the transformation of S&T diplomacy and expand its influence, China must persist in advancing reforms within its domestic science and technology system. This involves enhancing the efficiency of both the production and allocation of science and technology resources, eliminating unnecessary barriers that impede the global flow of scientific and technological elements, and adeptly managing the challenges posed by the external environment. By doing so, China can construct a more equitable, efficient, and enduring global network of science and technology relationships, ultimately solidifying its standing and influence in the realm of S&T diplomacy.

[12] Edler, J., Blind, K., Kroll, H., & Schubert, T. (2023). Technology sovereignty as an emerging frame for innovation policy. Defining rationales, ends and means. Research Policy, 52(6), 104765.

[13] Atkinson, R. D. (2021). Industry by Industry: More Chinese Mercantilism, Less Global Innovation. Information Technology and Innovation Foundation. https://itif.org/publications/2021/05/10/industry-industry-more-chinese-mercantilism-less-global-innovation.