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# THE END OF "LEARNING FROM THE WEST"? TRENDS IN CHINA'S CONTEMPORARY SCIENCE POLICY

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## OBSERVATIONS

**A short paper series presenting first observations on fascinating yet under-explored developments in science and society in China and beyond. The articles reflect ongoing studies by scholars and guests of the Lise Meitner Research Group "China in the Global System of Science" at the Max Planck Institute for the History of Science.**

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China's interactions with the world seem to be at a critical juncture. The deterioration of diplomatic relations between the People's Republic of China (PRC) with the US and its allies, the ongoing battle with the Covid-19 pandemic, and the government's unwillingness to condemn Russia's invasion of Ukraine have all contributed to the country's increased separation from the global West. These events may have far-reaching consequences also for Chinese ambitions in global science.

The CCP leadership aims to turn the country into the global science superpower by 2050. To this end, it planned to renew the National Medium- and Long-Term Plan for the Development of Science and Technology (MLP, 2006-2020). Although a new "grand" plan is not yet in sight, other policies and initiatives give hints about the dominant principles, approaches and directions in current science policy. For example, China aims to be carbon-neutral by 2060 and to become the world leader in artificial intelligence (AI) technology by 2030. Above all, the 14th Five-Year Plan (FYP) and the 2035 Long-term Target Outline published in March 2021 provide the country's broad policy blueprints. Science, technology, and innovation (STI) features heavily in both, signaling it is integral to China's overall development. For this purpose, the 14th FYP and the outline also emphasize international scientific cooperation.

A technocratic approach to science policy has occupied a central place in the national development agenda since the onset of Reform and Opening in 1978. This strategy has been augmented with an older, self-defined concept of learning from more advanced countries, originating in late imperial China: the "Chinese essence, Western application" approach (中体西用). The concept which advocated emulating other countries' experience and molding them to the local conditions is also regarded as key to China's modern development. Therefore, when Xi Jinping, during his recent visits to Tsinghua and Renmin universities, emphasized that Chinese institutions should avoid copying foreign models, it signified a clear break from the past. However, to what extent has the recent change tangibly transformed the earlier approach?

Given all the contextual changes, domestic and global, surrounding science and scholarship, it seems to be a good time to reflect on the core trends and contents of current Chinese science policy and to gauge its future orientation. In this short study, we understand science policy in a broad sense as the comprehensive policy architecture covering the development of all academic disciplines including the humanities, technology, and innovation. We ask whether Chinese science policy really is at a turning point, past the phase of learning from abroad, gradually scaling back on open exchange and possibly establishing a new national model of science infrastructure and the conduct of science—as recent domestic proclamations and international reporting seem to suggest. For this aim, we explore how current developments compare with the main lines of science policy across the reform era and reflect, in conclusion, on what they may mean for China, and for the global conduct of scientific collaboration with China.

## Learning From the West: Science Policy in the Reform Era

The pragmatic approach of following international (mostly Western) "best practices" has characterized China's modernization since the late 19th century and has ebbed and flowed ever since. The core meaning of the motto "Chinese essence, Western application" was that the outer shell of the application (用) could be practically adopted from abroad, as long as the Chinese essence (体) was preserved as the cultural identity. The concept encouraged "learning from the West" (which in the official Chinese understanding meant highly industrialized countries in Western (and more recently Northern) Europe and North America, and Japan) for over a century, despite the inherent tensions of separating the immaterial and material features of reform.

At the end of the Cultural Revolution in 1976, China's scientific community was decimated and its institutional capacity severely damaged.

To rebuild the country, a quick recovery was necessary which is why science became one of the four pillars of Deng Xiaoping's "Four Modernizations" (四个现代化) alongside industry, agriculture, and defense, announced in 1977. The government first turned towards a familiar Soviet model of a centralized science infrastructure. But it did not take long before the concept of "learning from the West" was readopted, and China started looking into what other, leading industrialized countries were offering on this front. The launch of Reform and Opening and the improvement of diplomatic relations with Western countries provided an opportunity to deepen international exchanges in all fields, including in science. The Chinese government began to support bilateral scientific exchanges, research cooperation, and the mobility of students and scholars with the USA, Western Europe, and Japan, to gain knowledge and improve domestic conditions. Finally, structural reforms were kicked off with the "Resolution of the Central Committee on the Reform of the S&T System" (1985) which resulted in a strengthening of the role of applied research and development (R&D) at the expense of basic research.

The scientific community was just beginning to play a more important role in political discourse and decision-making, when the crackdown of the student protests culminated in the 1989 Tiananmen massacre. The repression marked an end to an intellectually more liberal period and Chinese academia's burgeoning ties with many Western research institutions were temporarily severed. The humanities and social sciences suffered notably under the growing political control over academia, while the STEM disciplines grew in importance. Deng's "Southern Tour" (南巡) in 1992 once again paved the way for reinforcing contacts with countries in Europe and North-America and with the international scientific community overall. The tour unleashed a new wave of far-reaching domestic reforms supposed to bolster the PRC's science infrastructure. For example, the 1994 Law on Scientific and Technological Progress proposed, among other things, selected regions' designation as special high-tech zones and the formation of some key state laboratories for basic research. Further steps were taken in 1996, when new industrial pillar industries were defined to develop research in globally competitive fields. Simultaneously, science and technology policies continued to be shaped by new, grand developmental blueprints. For example, sustainable development (可持续发展) appeared first in the 8th Five Year Plan (1991-1995), in the National Medium-Long Term S&T Development Plan (1992) and China's Agenda 21 (21世纪议程, 1992), suggesting a tension between precipitous industrialization and its environmental impacts—a realization that began to significantly influence top-down science policy planning. Importantly, at the same time the "Rejuvenating the Country Through Science and Education" (科教兴国) motto was proclaimed and elevated science, technology, and innovation to an even higher level, giving it a sense of nationalist urgency and made it inseparable from China's national development. The Chinese authorities introduced measures to address other well-known challenges, such as the huge regional imbalances, inefficient structural duplication, and many more flaws of China's scientific infrastructure. Overall, STI policy in the 1990s focused mostly on applied research for the sake of incentivizing industrial development. Such priorities shaped the Chinese system well beyond that decade.

After the 15th Party Congress (1997), further reforms increased support for domestic scientific infrastructure building and enhancement. As part of a larger sweeping scheme, the Ministry of Education launched two initiatives: Program 211 in 1995 to develop high-quality research-oriented universities and Program 985 in 1998 to strengthen China's top 30 higher education institutions. As a result, the number of university students rose by almost 120 percent between 1995-2000. The Ministry of Science and Technology (MoST) steered the Program 973 (1997) for basic research and Program 863 (1986) for advanced technologies. The Chinese Academy of Science (CAS) launched the 100 Talents Program (1994) and the Knowledge Innovation Program (1998). They were key interventions, yet none fundamentally changed the structure of the system's emphasis on application-oriented R&D coupled with a centrally steered selection of themes.

The close alignment of science with economic development through a top-down setting of research topics continued in the early 2000s. The leadership took into account the country's ever stronger position in global value chains. The promotion of key technologies and high-tech industrial fields became a stable feature of Chinese STI policy. Indigenous innovation (自主创新), appeared first as a term in 1999, reflecting the desire for greater technological independence. Interestingly, indigenous innovation became officially defined as "strengthening original innovation, integrated innovation, and re-innovation based on the assimilation and further development of imported technology, in order to enhance national innovative capabilities." At the same time, as a reaction to students and researchers leaving China, a new emphasis was given to highly-skilled human "talents" (人才) with initiatives launched to counter the brain drain.

When in 2006, the central government published the milestone MLP document referred to above, it once more amplified its highly ambitious goals. Firstly, China intended to increase its GERD (total expenditure on research and development expressed as a percentage of GDP) to 2.5 percent by 2020. Secondly, China aimed to be ranked fifth in the world in terms of both the number of its invention patents and citations of Chinese scientific publications. Most importantly, China aspired to become "one of the world's leading scientific nations" by mid-century. By improving the domestic innovation capacity, the country also was to become an "innovation nation." A key feature of the MLP was its focus on "megaprojects," large-scale infrastructures and expensive funding initiatives in strategic industries and frontier technologies. All existing policies and funding programs were to be aligned with the MLP, with priority fields postulated as sub-strategies to the development of indigenous innovation. In this spirit, China intensively promoted the so-called "seven strategic emerging industries" which featured prominently in the 12th Five-Year Plan (2011-2015). These were: energy saving and environmental protection, new generation information technology, bio-industry, advanced manufacturing industry, new energy, new materials, and new energy vehicles.

## Indigenous Innovation Amidst Continuous Reform

**Fig. 1: Architecture Design of Proposed Chengdu Future Science And Technology City, OMA/Chris van Duijn (Copyright OMA)**

After years of increased investments into STI, achievements became visible. China's R&D spending rose from 0.89 percent of GDP in 2000 to 1.71 percent in 2010. Nonetheless, some of the elements of this rapid growth were also criticized both by officials as well as the scientific community, who disapproved of the rather non-transparent top-down approach and feared that the system was valuing quantity more than quality. Some questioned how far China had managed to advance its innovation capabilities, and whether it achieved creating a research culture conducive to innovation. Therefore, it was clear that further reforms were necessary.

The political focus on science policy reform and support for indigenous innovation reached new heights once Xi Jinping came to power. STI was elevated to a top priority, discussed by the newly-established "small leading groups," which assemble the highest-ranking politicians representing diverse government departments. The remobilization of STI reforms in China started in 2012 and continued with a State Council paper named Document no. 64 in 2014. This ambitious proposal called for the establishment of new, specialized funding organizations and research executive agencies, some of them emulated after especially European organizations, which would introduce a better management and finally overcome the systemic inefficiencies, fragmentation, and waste of funding.

In addition, China launched the "Made in China 2025" (中国制造 2025) initiative in 2015 to reduce reliance on Western technology. This initiative, similar to Germany's "Industrie 4.0," brought together all existing policies across related fields, some of the "strategic emerging industries" and targeted priorities in automation, IT, robotics, AI, and much more under one umbrella. Drawing concern from the US and other Western countries, it was also a clear message to global scientific players to pay close attention to China's intentions and the capacities the country had amassed. At the same time, Xi Jinping's anti-corruption campaign (反腐倡廉) gained momentum which paralyzed Chinese institutions and delayed the implementation of a wide range of measures.

The 13th Five Year Plan (2016-2020) nevertheless set innovation-driven development as its central strategy. The effort to pursue indigenous innovation in order to reduce dependency on the US continued. New mega projects were to be constructed in line with the MLP. By 2019, China's GERD had further risen to 2.23 percent in 2019, translating into RMB 2.2 trillion. However, as 2020 drew close and both the 13th FYP and the MLP were to run their course, some of their goals had not been achieved, e.g., the goal to reach 2.5 percent of GERD. Another remaining challenge was the constant underinvestment in basic research. The Natural National Science Foundation of China (NSFC) continued to be the cornerstone of basic research funding, following a Western model of investigator-driven research. However, such bottom-up basic research was again overshadowed by the drive to pursue innovation in niche, preselected areas, decided in a top-down manner. It took until the 14th Five Year Plan (2021-2025) before a tangible goal for basic research was set: it called for formulating a ten-year action plan and for raising the share of basic research in overall R&D funding to at least 8 percent.

Similarly, ambitious plans envisaged newly defined research excellence in higher education too, phasing out the 985 and 211 projects and launching the "Double First Class University" program in 2016, with a second phase announced in 2022. Its goal is to increase the global competitiveness of Chinese universities and selected academic disciplines. What's more, STI became officially included in China's global outreach through the construction of the Belt and Road Initiative. The Party-state also continued its focus on attracting international scientists with dozens of talent schemes at the national, regional or institutional levels. These were to attract mostly Chinese returnees (and to a minor extent also foreign researchers) to work in China on a full-time or part-time basis. In addition, China's international visibility rose, for instance with its first Nobel prize in the natural sciences for Tu Youyou in 2015. The country demonstrated its scientific ability by several high-profile achievements such as the launch of the FAST radio-telescope in Guizhou, the Tianhe supercomputers, exploration programs on the Moon and Mars, and more. Yet, other stories, such as He Jiankui's gene editing of babies with CRISPR technology in 2018 also exposed ethical loopholes and ongoing issues with research integrity. Despite some shortcomings, China's presence in global science has become palpable. On the one hand, Chinese projects, institutions, and researchers have become more attractive for international partners to work with. On the other hand, countries in the global West are also growing increasingly suspicious of China's official intentions. Questions relating to the extent to which China's unprecedented scientific rise was driven by unfair, unethical or even illegal practices, have become more prominent in recent years.

## Current Renaissance of Party Ideology and Nationalism in Chinese Science Policy

With the global increase of attention on the PRC's ascent in science, some further conflicting signals since the 2010s left observers struggling to define the main characteristics of–or potential grand strategy behind–current Chinese STI policies, including its global orientation.

Soberly worded technocratic policy documents issued by the State Council and the Ministries of Science & Technology and Education are, with increasing frequency and vehemence, accompanied by blazing statements and speeches by which the Communist Party–in keeping with the overall tone of the moment–asserts its dominance over academia and stresses its ambition to determine the direction of research and teaching. In fact, similar to other policy areas under Xi's leadership, the formal role of the Party, i.e., of Party cells, Party secretaries and committees, and Party content is being re-established in all institutions of higher education and research.


**Fig. 2: "Innovate with the Party," poster in Shenzhen, China. (Halldór Berg Harðarson, 2019)**

Therefore, ideological training and adherence to the Party line is monitored more systematically than ever since the start of the reform era. The Party-state not only predefines research themes, it also sends warnings regarding those it sees as detrimental to the national interest. Scientists and scholars are called upon to help weave the "China Dream" in the "New Era," and to excel globally—while not forgetting their affiliation with the "motherland" in whose interest they compete. Chinese authorities have called for a reduction in importing foreign research and education models and content (expressed e.g., by the curtailing of international education services operating in China, or the declared ban of foreign textbooks).

The leadership continuously encourages the creation of national characteristics in science, including the building of "Chinese theory," and world-class universities "with Chinese characteristics." To date, it is not clear whether this is rather an encouragement to resolutely flag scientific output, contribution, and innovation from China (i.e., that can clearly be traced to individuals and institutions in the PRC) and to accentuate, at least discursively, that China is no longer dependent on learning how to become a global science power from the West, or whether it is truly a push for a distinctly Chinese science, scholarship, and education. At the same time, Xi regularly emphasizes the support of international science governance and the authority of scientific ethics and rules. The Party-state's nationalistic tone has been mixed with a clear commitment to international scientific cooperation, global exchanges of talents, and the "cosmopolitan nature" of science. Not least, the awareness of the importance of international cooperation and the willingness to participate in global science is also figuring strongly in several articles of the recently revised Law of the People's Republic of China on Scientific and Technological Progress (2021).

Recently, another dynamic that could signal more foreclosure is the juridification of national rules for international academic exchange and collaboration that were formerly handled relatively loosely in the PRC. Among the new Chinese laws or quasi-laws with relevance to STI are the 2018 State Council notice on the establishment of government centers for the control of scientific data (export), further backed by the general Export Control Law (2020), the Cyber Security Law (2017), or the 2020 notice by the Ministry of Education that calls upon scholars in the social sciences and humanities to not "vilify" their country in order to get published internationally. Despite concerns raised by international cooperation partners and anecdotal evidence of frictions posed by these new regulations, it is still difficult to assess what the medium to long-term effects on international scientific cooperation with the PRC may yield. Partners from the global West raise further issues with the lack of transparency in the Chinese science system, including heavy military-civil integration, and the support of dual use technology development.

In fact, while structural domestic changes in recent years have started to affect international collaboration projects, there is no clear indication yet of an overall (quantitative) decline in scientific collaboration as fostered by the PRC. Some preliminary data suggest that US-China scientific co-authorship indeed is waning, but this is not the case for China's other top collaborators–the UK, Australia, Canada, and Japan. In fact, scientific co-authorship between researchers located within China and abroad is steadily increasing, and, in general, partnership agreements are not halted by the Chinese side as of yet. Most currently, the Covid-19 pandemic has seriously affected researchers' and students' mobility, especially the possibility of entering China. It remains to be seen whether this represents a temporary crisis, or whether it will mark the beginning of a new phase of more restricted access to the PRC, including to its academia, and whether this could benefit the creation of "more Chinese" institutions in science and scholarship.

## Outlook: Copying, re-modeling, or closing off?

Is China's science policy attempting to end "learning from the West" and if so, where is it heading instead? This short study pointed to certain trends to argue that, no matter how dynamic the development of the science system has been since the start of the reform era, there has been no major turning point in China's science policy under Xi Jinping. The current concepts, including the allusions to independence and indigenization, do not deviate from the previous trajectory. In fact, they are fully in line with the long-term conduct of China's science policy and the top-down support of home-grown innovation with a strategic industrial focus. Its objectives have always been to serve national development and to increase China's global competitiveness. Corresponding with the "Chinese essence, Western application" concept, the central plans and statements continue to pledge for international cooperation and global scientific exchange. However, the current overall re-emphasis on nationalism, ideology, and indigenous innovation has added a stronger inward-looking tendency to China's science policy as much as it encourages more self-confidence in interactions with international partners. On the surface, this signals a turn away from the mere "application" of Western European, North-American and Japanese models, and a strengthening of the "Chinese essence." A new model to build upon has, however, not been defined yet, and it is questionable whether this is the ultimate goal after all.

More significantly, this re-orientation takes place under dynamic and ever more complex environmental conditions, which include global decoupling tendencies, the ever-growing rivalry with the US and its allies, and the domestic emphasis on security, moral streamlining, and Party discipline. This mix has the potential to tangibly alter the direction of Chinese science policy and the patterns of global cooperation in the near future. It puts more pressure to re-politicize the scientific community, to develop indigenous solutions and to look domestically to e.g., get equipment, and to reduce cooperation with Western entities unless in specific areas where such cooperation is designated as necessary or useful. Lastly, the Russian invasion of Ukraine against the backdrop of the Chinese-Russian strategic partnership may drive China further away from the global West, including in science. However, the ultimate implementation of these initiatives and policies in practice lies within the Chinese science system, its institutional infrastructure, and most importantly, with the scientists themselves. And it is at these junctions that further in-depth studies of the orientation of contemporary Chinese science policy are most warranted.

## Further Readings


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