IGCC REPORT

JULY 2022

China's Roadmap to Becoming a Science, Technology, and Innovation Great Power in the 2020s and Beyond: Assessing its Medium- and Long-Term Strategies and Plans

Tai Ming Cheung, Barry Naughton, and Eric Hagt

This report was compiled by researchers at the UC Institute on Global Conflict and Cooperation (IGCC), as part of IGCC's Project on Assessing China's New Plans for Science, Technology, and Innovation Development, and is supported by the U.S. Air Force Office of Commercial and Economic Analysis (OCEA). Any opinions, findings, conclusions, or recommendations expressed are those of the author(s) and do not necessarily reflect the views of OCEA.

IGCC | UC INSTITUTE ON GLOBAL CONFLICT AND COOPERATION

Table of Contents

Author Biographies

Tai Ming Cheung is director of the UC Institute on Global Conflict and Cooperation and professor at the University of California San Diego. His research areas include China's efforts to become a world-class science and technology power and the relationship between geo-economics, innovation, and national security. At UC San Diego, he teaches courses on the international relations and national security of China and Chinese security and technology policy.

Dr. Cheung is a long-time analyst of Chinese and East Asian defense and national security affairs, especially defense economic, industrial, and science and technological issues. He is the author of of *Innovate to Dominate: The Rise of the Chinese Techno-Security State* (Cornell University Press, 2022) and *Fortifying China: The Struggle to Build a Modern Defense Economy* (Cornell University Press, 2009); editor of *Forging China's Military Might: A New Framework for Assessing Innovation* (Johns Hopkins University Press, 2014); and co-editor of *The Gathering Pacific Storm: Emerging US-China Strategic Competition in Defense Technological and Industrial Development* (Cambria Press, 2018).

He was based Hong Kong, China, and Japan from the mid-1980s to 2002 covering political, economic, and strategic developments in Greater China and East Asia, first as a journalist for the *Far Eastern Economic Review* from 1988–1993 and subsequently as a political and business risk consultant for a number of companies, including PricewaterhouseCoopers. Dr. Cheung has a PhD in War Studies from King's College, London.

Barry Naughton is the Sokwanlok Chair of Chinese International Affairs at the School of Global Policy and Strategy at UC San Diego. He is one of the world's most highly respected economists working on China. He is an authority on the Chinese economy with an emphasis on issues relating to industry, trade, finance, and China's transition to a market economy.

His recent research focuses on regional economic growth in China and its relationship to foreign trade and investment. He has addressed economic reform in Chinese cities, trade, and trade disputes between China and the United States and economic interactions among China, Taiwan, and Hong Kong.

Naughton has written the authoritative textbook *The Chinese Economy: Transitions and Growth*, which has now been translated into Chinese. His groundbreaking book *Growing Out of the Plan: Chinese Economic Reform, 1978–1993* received the Ohira Memorial

Prize, and he most recently translated, edited, and annotated a collection of articles by the well-known Chinese economist Wu Jinglian. Naughton writes a quarterly analysis of the Chinese economy for *China Leadership Monitor*.

Eric Hagt earned a PhD in 2019 at the Johns Hopkins School of Advanced International Studies with a focus on China's civil-military integration strategy. He is currently editing his dissertation into a book with a university press. Between 2004 and 2012, he held the directorship of the China Program at the Center for Defense Information in Washington, DC, where he was founder and chief editor of the quarterly policy journal, *China Security,* and managed research projects on Sino-U.S. strategic relations in space, defense acquisition, science and technology as well as non-traditional security topics. He has undertaken studies on China's defense modernization efforts for the UC Institute on Global Conflict and Cooperation, the Naval War College, the National Bureau of Asian Research, and the RAND Corporation. He has testified before Congress's U.S.-China Economic and Security Review Commission and has authored articles in journals including *Survival, Journal of Strategic Studies, Naval War College Review*, and *China Security* as well as published chapters in *The PLA's Role in National Security Policymaking* (Stanford University Press, 2015) and *Forging China's Military Might* (Johns Hopkins University Press, 2013).

Introduction and Summary of Key Findings

In China's state-driven planning process, 2021 was a landmark year heralding a new and far more ambitious long-term cycle in the country's national development. The overarching goal is to decisively propel China into the front ranks of the world's most advanced and powerful countries from its current mid-tier status by the first half of the next decade.

Of uppermost priority is the strengthening of China's capabilities in the defense, strategic, science, technology, innovation, and industrial arenas. Several new medium- and long-term planning initiatives are tasked with this responsibility. The most consequential of them are the 2021-2025 People's Republic of China 14th Five-Year Plan (FYP) for National Economic and Social Development (中华人民共和国国民经济和社会发展第十四个五年规划) and the 2021-2035 Medium- and Long-Term Science and Technology Development Plan (2035 MLP; 国家中长期科技发展规划). A proliferation of sector-specific plans are nested under the national 14th FYP, including those devoted to military building, defense industry, and science, technology, and innovation.

The national 14th FYP was publicly released in March 2021, and many sectoral FYPs have been released since. However, the 2035 MLP has not been published and press references have become vanishingly scarce. While the 2006-2020 MLP and 13th Science and Technology (S&T) FYP were published in full, a tight information clampdown in the past few years on science, technology, and national security-related matters means that the new versions of the MLP, S&T FYP, and related strategies and plans may no longer be publicly released.

This report provides a detailed and extensive analysis of China's approach to the context, formulation, and content of its national and security-focused science, technology, and innovation plans for the 14th FYP and 2021-2035 periods. It also provides an initial assessment of the key significance of those contents.

This report is the result of funding support from the Secretary of the U.S. Air Force's Office of Commercial and Economic Analysis (OCEA). While support was provided by OCEA, this product does not represent an official view of the U.S. Department of the Air Force nor should it be used for the purposes of representing an official government position.

Summary of Key Findings

Part One: Track Record of the 13th Five-Year Plan

The 13th FYP was the first five-year plan that the Xi Jinping administration was responsible for drawing up and there was extensive continuity with the FYPs pursued by his predecessors. While the 13th FYP emphasized the importance of S&T innovation, top priority continued to be placed on economic growth. The 14th FYP though makes innovation the very highest priority for China's national development.

China met most of the S&T-related targets that were laid out in the 13th FYP. The most noteworthy achievements included the following: 1) climbing from 29th to 14th place in the Global Innovation Index, which is put together by the World Intellectual Property Organization, Cornell University, and the European business school INSEAD; 2) China became the world's leading filer of patents, and Huawei became the global leader for patent filing by companies; 3) China achieved its goal for the number of citations of its S&T publications, which propelled it to second in global ranking, close behind the United States.

Research and development (R&D) investment intensity was the only target that was not achieved in the 13th FYP. It reached 2.4 percent of Gross Domestic Product (GDP), narrowly missing the goal of 2.5 percent. While this 0.1 percent deficit appears trivial, it represents around RMB 100 billion or US$15 billion, which is more than the combined budgets of the Pentagon's Defense Adavanced Research Projects Agency and the U.S. National Science Foundation in 2020. China's absolute R&D spending is second only to the United States, and its goal in the 14th FYP of raising this funding by at least 7 percent annually over the next five years will bring China to parity with the United States both in terms of absolute investment and as a percentage of GDP.

Part Two: The 14th Five-Year Plan and the Status of the 2021-2035 MLP

Key Goals and Themes of the 14th Five-Year Plan

The 14th FYP signals that China will "stay the course" in the pursuit of the strategic vision and policies that Xi and his regime have established since coming to power in 2012. The underlying assumption running through the plan is that all of China's current policies are optimal and will be continued, and in some areas intensified. China is already on a road toward greater state control and a growing government push to control technology. By "staying the course," China is committing to traveling farther down that road, which will make the Chinese system even more unique and challenging and will inevitably increase international tensions.

Three key policy messages can be discerned from the 14th FYP. First, China will press ahead with, and intensify, its program of government-developed S&T and infrastructure construction; this in turn will require the government to exercise more comprehensive planning. Second, China currently lacks a vision of overall structural change in the economy and will temporarily ease up its efforts to drive structural change. Third, China will continue to combine market-oriented institutions with stepped-up planning and will continue to have an open economy to the extent possible. Chinese policymakers believe they have found a way to combine their increased steerage of the economy with a market foundation, and they will seek to achieve their objectives in this environment.

The 14th FYP does not explicitly define a government-driven strategy, but the scope of China's ambitions and the type of instruments and interventions envisioned make clear that the government plays a pivotal, active, and expansionist interventionist role. This can be seen in five areas of the plan: 1) The plan calls for intensified investment in basic science, including an altogether new commitment to self-reliance in S&T; 2) Planners have laid out a strategic vision of "domestic circulation," in which the large and formidable domestic market plays an increasingly dominant role compared to international circulation; 3) China's ongoing industrial policies have all been reaffirmed and supplemented by an increasingly activist and transformative smart infrastructure investment program; 4) Regional land use and communications plans have much greater importance than ever before; and 5) China is unveiling a new vision of the 14th FYP that serves as an unifying vision for an entire system of specialized and local plans. These five dimensions add up to a sharply increased level of government intervention in the economy.

The 14th FYP provides a brief outline of a longer-term 2035 Vision that declares that China will "basically realize socialist modernization" by 2035. This means that the country's comprehensive national strength, of which economic, scientific, and technological capabilities are explicitly highlighted, will "rise sharply." Major breakthroughs in key core technologies will occur and China will reach the global innovation frontier. A modern economic system will be built from new modes of industrialization, informatization, urbanization, and agricultural development, which will allow China to reach the per capita income levels of a moderately developed country. China will also reach a higher level of security and stability, of which a key contributing factor is the "basic realization" of defense modernization. The Ministry of Science and Technology (MOST) has been leading an extensive effort to draft a detailed 2021-2035 MLP since 2019.

More than a quarter of the 14th FYP is concerned with matters related to technology, innovation, and security issues. The plan begins with a sober assessment of the "profound and complex changes" that China is facing in the international environment, which has not been witnessed in a century. In other words, the external arena is more volatile and worrisome than at any time in the existence of the People's Republic of China, even during the Cold War days of bitter Sino-Soviet and Sino-U.S. rivalry. The developmental response has been to place science, technology, and innovation firmly at the commanding heights of the 14th FYP policy agenda. The plan points to the critical importance of "adhering to the core position of innovation in China's modernization drive" and to "take science and technology independence and self-reliance as the strategic support for national development."

National security also receives central billing in the 14th FYP compared to its cameo appearances in past five-year plans in the reform era. National security and economic development are treated as of coequal importance and the plan emphasizes the need to closely integrate these two domains. Key security-related themes addressed in the plan are technological self-reliance, economic securitization, industrial policy, and military modernization.

These themes offer important clues as to what the next stages of China's techno-security grand development strategy will entail:

1. The urgent need to achieve techno-nationalist independence and self-reliance. The ease of access that China has had to foreign technology and knowledge over the past few decades has meant that self-reliance has been an aspirational long-term objective, but the rapid tightening of U.S.-led export controls since the mid-2010s has forced the Chinese authorities into concerted action to prevent technological "strangulation."

2. Securitization of and increased orientation toward the domestic bases of the Chinese economy to balance against excessive reliance of an increasingly treacherous international economy. This is set out in the "dual circulation" concept in which "China will form a formidably large domestic market and create a new development framework."

3. Continuing emphasis on the pursuit of industrial policy, especially in the advanced manufacturing and techno-industrial domains. The plan talks about the need for China to become a manufacturing superpower, although it avoids the use of terms that have sparked international backlash such as Made in China 2025 and Military-Civil Fusion (MCF).

4. While MCF as a phrase has disappeared from the 14th FYP, the pursuit of the convergence between the civilian and defense economies remains a pressing priority. The general objective outlined in the plan is to build an overarching

integrated strategic system in which the civilian, defense, and national security sectors are closely aligned and coordinated.

5. Accelerating the pace and scale of defense modernization, especially with the goal of "improving the strategic ability to defend national sovereignty, national security, and development interests" by the hundredth anniversary of the founding of the PLA in 2027.

6. The relationship between state planning and the market. The 14^{th} FYP calls for the continuation of market reforms and opening up to international engagement as well as expanded state intervention and control of the economy.

The 14^{th} FYP addresses supply chain issues extensively and much more broadly than standard frameworks of supply chain management. The plan declares that the "modernization of the production chain" is among China's highest priorities over the next five years. The discussion of supply chains is wide-ranging and includes raw materials, manufacturing, and production, innovation, technology, R&D, design, and even marketing and services. There is also emphasis on securing entire supply chains in sectors where China has a lead or competitive advantage. Moreover, the 14^{th} FYP highlights the domestic foundations of supply chain resiliency and the utmost importance of sovereign control and independence.

Status of the 2021-2035 Medium- and Long-Term Science, Technology, and Innovation Development Plan (MLP)

Drafting of the 2021-2035 MLP began in the fall of 2018 and there was regular media reporting of the planning activities of state agencies, academic institutions, and think tanks. This included the convening of high-level policy meetings and research projects to support the detailed formulation of the MLP. The COVID-19 pandemic appears to have significantly slowed down the MLP planning process in the first half of 2020, but work resumed from mid-2020 and senior officials talked about the urgent need to finalize the MLP along with the 14^{th} FYP for Science and Technology as the drafting deadline neared in the fall of 2020.

The media coverage of the MLP planning process though was halted between late 2020 to June 2021, strongly suggesting that the authorities had thrown a cloak of secrecy around the program. Senior S&T officials said in the summer of 2021 that the new MLP would be released soon, but no details have been released as of the beginning of 2022. As other major S&T development plans such as the Science, Technlogy, and Innovation 2030 Program that was started in 2016 have not been publicly issued, the track record of the Xi regime indicates that the MLP will not be openly disseminated.

Part Three: Assessments of the Strategic Emerging Industries Initiative, Semiconductor Industrial Policy, and Science, Technology, and Innovation 2030 Program

The Changing Nature of the Strategic Emerging Industries Initiative

The Strategic Emerging Industries (SEI) Initiative is the work horse of Chinese industrial policy and dates back to 2010 when it was first established under the Hu Jintao/Wen Jiabao administration. The SEI Initiative has undergone three major changes since its creation. Between 2010 and 2015, the SEI program was a response to perceived opportunity in sectors newly emerging on a global scale. The SEIs were reshaped from 2016 to conform with the innovation-driven development strategy (IDDS). This second iteration was more coherent and internally consistent, but also more government dominated. In 2020, a third incarnation of the SEI program was rolled out incorporating still more government direction that was designed to respond to the technological challenge from U.S. sanctions.

Attention to the strategic components of SEIs has increased in this third round of adjustments to the SEI Initiative. China is now dramatically increasing its resource commitment to SEIs, even though the program has so far not been very successful. The initially market-based SEI program has now turned into a program that is predominantly government guided. A program initially targeted at vacant spaces and opportunities in the global landscape has turned into one focused on replicating existing production links and insulating China from the outside world. SEIs have survived and maintained their centrality, but only by being redefined into something quite different from their initial form.

Semiconductor Industrial Policy and the Rise of National Champions

The upheavals in the development of the Chinese semiconductor sector since the late 2010s offers a vivid example of the highly interventionist nature of industrial policy by the Xi regime, especially in the face of serious external threats. The Chinese authorities became alarmed by the threat of being choked off from access to semiconductor supplies from the United States and other Western states in 2018 after sanctions were imposed on Chinese telecom firm ZTE and subsequently to other Chinese technology firms such as Huawei. These actions spurred the Chinese government to intensify already extensive efforts to develop the Chinese semiconductor industry to ensure self-reliance. Between 2019 and 2020, hasty increases in incentives induced massive entry of newcomers into the sector. Most new firms were unqualified though, and the result was massive waste and little improvement in China’s developmental effort. Many hugely expensive large-scale projects failed and the government had to step in to clean up the situation.

While there have been many losers, a small group of handpicked “national champions” have emerged as clear winners. They include the likes of Semiconductor Manufacturing International Corporation (SMIC), Cambricon, Verisilicon, Amec, HiSilicon, and Yangtze Memory Company (YMC). This portends a shift to more direct centralized state control and support over a smaller number of national champions.

Science, Technology, and Innovation 2030 Major Projects Program

The Chinese authorities launched a new long-term initiative on mastering core technologies in October 2015 called the Science, Technology, and Innovation 2030 (STI 2030) Major Projects program. STI 2030 covers sixteen large-scale megaprojects that include aircraft engines and combustion turbines, technologies for deep-sea exploration and deep-sea stations, quantum communications and quantum computing, neuroscience and brain-related research, cybersecurity, deep-space exploration and in-orbit spacecraft, clean and efficient use of coal, smart power grids, space-earth integrated information network, intelligent manufacturing and robotics, and key new materials research and applications. In explaining this program, Xi Jinping has said that it was needed to help China “capture the science and technology strategic commanding heights.”

Part One: Assessing the Track Record of the Implementation of the 13th Five-Year Plan

The 13th FYP covered the second half of the 2010s and shortly after its conclusion Premier Li Keqiang declared that it was a resounding success.[1] “After five years of continuous struggle, the main goals and tasks of the 13th FYP have been successfully completed, and the great rejuvenation of the Chinese nation has taken a new step forward.” Science and Technology Minister Wang Zhigang was more circumspect in his appraisal: “Overall, my country’s S&T innovation has achieved an increase in both quantity and quality, and significant progress has been made in building an innovative country.” But he added, “at present, my country is still facing some problems in basic research and scientific and technological system reform.”[2]

The 13th FYP was the first five-year plan begun under Xi Jinping’s rule, yet it was also a bridge from the prior Hu Jintao administration, particularly in terms of prioritizing GDP goals—and in this way consistent with past FYPs—and meeting the target of the first of the centenary goals, which was to double China’s per capita income between 2010-2020. While the 13th FYP certainly prioritized S&T innovation with many projects and goals, it was nonetheless of secondary importance to economic growth. The 14th FYP on the other hand gives innovation the very highest priority as a “strategic pillar” for China’s future national development. It is the first FYP that is completely designed by Xi and demonstrates his full commitment to a techno-nationalist, state-led model about which the previous five-year plan was more tentative.

---

1 In his work report to the government at the fourth session of the National People’s Congress, see Zhang, Yanling (张艳玲), Wei Jing (魏婧), and Liu Hongqing (刘洪庆), “The ‘13th Five-Year Plan’ Report Card: GDP Increased from Less than 70 Trillion Yuan to More than 100 Trillion Yuan (‘十三五‘成绩单：GDP 从不到 70 万亿元增至超 100 万亿元),” 2021 National Two sessions (2021 全国两会). China Net (中国网), March 5, 2021, http://www.china.com.cn/lianghui/news/2021-03/05/content_77274452.shtml.

2 Zhang, Qian (张茜), “MOST Publishes 13th FYP S&T Innovation Report Card,” China Youth Daily (中国青年报), October 22, 2020, https://dt.youth.cn/dtxw/202010/t20201022_12541068.htm.

Quantitative Assessment

A good starting point in assessing China's achievement in S&T during the 2016-2020 period is to look at the goals it set out for itself, which are encapsulated in the 13th FYP and the 13th FYP for S&T Innovation (13th S&T FYP). It should be noted that these are not the only S&T-related plans promulgated by China during this period. The 13th FYP contains a total of 22 sub-FYPs for special projects and industries.[3] In addition, Made in China 2025, Internet+, and action plans for artificial intelligence (AI), 5G, additive manufacturing, and semiconductors, were released during the period covered by the 13th FYP, and all touch on various aspects of S&T development.[4] The IDDS was also released in 2016 and includes many of the same aspirations for S&T innovation that appear in the 13th FYP. This section focuses on the 13th FYP and the 13th S&T FYP.

Performance on Key Indicators

By the metrics described in the 13th FYP, China has made substantial progress in S&T innovation. It has met all but one indicator of success and has even exceeded its targets in several other areas. Particularly when compared to the United States (see Table 1), China's performance is impressive:

- China has moved from 29th to 14th place overall in the Global Innovation Index (GII).[5] GII is one of the most comprehensive, balanced, and commonly cited indexes. Most advanced economies still rank above China, with the United States in 3rd place, but among upper middle-income countries, China is in 1st place. This is a significant achievement and exceeds China's target.
- Regarding the contribution rate of S&T progress to economic development, China has met its goal of 60 percent; however, as a measure unique to China, its relative significance is difficult to gauge.
- One of the most basic and universal indicators of progress is spending on R&D as a percentage of GDP. This is the one target that China has not met. On the face of it, missing the goal by 0.1 percent seems relatively minor. However, given that China's GDP for 2020 was RMB 101.6 trillion, China fell short in R&D spending by over RMB 100 billion, or roughly US$15 billion—more than the combined budgets of Defense Advanced Research Projects Agency (DARPA) and

---

3 "Experts interpret the '13th Five-Year Plan' National Science and Technology Innovation Plan (专家解读《"十三五"国家科技创新规划》)," China Coated Abrasives Network (中国涂附磨具网). Xinhua Net (新华网), August 9, 2016, http://news.cncaa.org/27842.html.

4 Innovation-driven Development Plan, Made in China 2025, and Internet+ came out in 2015; action plans for AI and additive manufacturing came out in 2017.

5 Jointly published by the World Intellectual Property Organization (WIPO), Cornell University's SC Johnson College of Business, and the European business school INSEAD, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020/cn.pdf.

the National Science Foundation in 2020.[6] However, China's absolute R&D spending is second only to the United States, and at 2.4 percent of its GDP, spending on R&D totaled RMB 2.443 trillion (US$376 billion), compared to U.S. spending of $656 billion (2019).[7] China's goal of raising that amount by at least 7 percent over the next five years will bring China to parity with the United States both in terms of absolute amounts and as a percentage of GDP.

- Basic R&D spending as a percentage of overall R&D is perhaps the more interesting story in that it has increased far less than overall R&D spending and pales in comparison to the United States, where it accounts for 16.6 percent of R&D spending. This is possibly the most remarkable failure of the 13th FYP and is probably the reason there is so much emphasis in the 14th FYP on raising the levels of both basic R&D spending and enterprise participation.
- China significantly exceeded its targets by a large margin in four respects. The operating revenue of high-tech enterprises not only surpassed its own target by more than 50 percent but nearly doubled since 2015. Internet penetration also vastly exceeded what was expected for 2020, and, since it is approaching 100 percent, is probably the reason this indicator was not included in the 14th FYP. S&T contract sums were also much higher than expected.
- Another significant milestone has been China's ascendance to the world's top spot in the number of patents filed, with Huawei the global leader in patent filing for individual firms for the fourth consecutive year
- China has also done very well in raising the number of citations of its publications in S&T. It is second overall, behind the United States by a narrow margin (31.4 to 32.9 percent), but it is first in eight disciplines, including engineering, chemistry, the environment, and ecology. Moreover, four Chinese universities are ranked in the top 10; the Chinese Academy of Sciences ranks number one.[8]

---

6 DARPA's budget was $3.56 billion and the NSF 2020 budget was $8.3 billion in 2020, see John Keller, "Pentagon Seeks $104.29 Billion Military Research Budget for 2020 -- An Increase of 8.7 Percent," Military+Aerospace Electronics, March 13, 2019, https://www.militaryaerospace.com/computers/article/16721966/pentagon-seeks-10429-billion-military-research-budget-for-2020-an-increase-of-87-percent; Mitch Ambrose, American Institute of Physics, "Final FY20 Appropriations: National Science Foundation," January 10, 2020, https://www.aip.org/fyi/2020/final-fy20-appropriations-national-science-foundation.

7 It is interesting to note that UNESCO estimates uses purchasing power parity for R&D spending for 2020, which puts China's R&D spending ($346 billion) much closer to U.S. spending ($476 billion). Mark Boroush, "U.S. R&D Increased by $51 Billion, to $606 Billion, in 2018; Estimate for 2019 Indicates a Further Rise to $656 Billion," National Center for Science and Engineering Statistics, April 13, 2021, https://ncses.nsf.gov/pubs/nsf21324; "How Much Does Your Country Invest in R&D?" UNESCO Institute for Statistics, http://uis.unesco.org/apps/visualisations/research-and-development-spending/.

8 "Last Year, China Ranked Second in the World in the Number of High-Quality International Papers and Ranked First in Eight Disciplines," Sina.com, December 20, 2020, https://news.sina.com.cn/c/2020-12-30/doc-iiznezxs9814893.shtml.

Table 1. Key Indicators of Success in the 13th S&T FYP[9]

	Indicator	Target (13th FYP)		Results in 2020		US
		Value 2015	**Target 2020**	**Value**	**Achieved?**	
1	World ranking in national comprehensive innovation capacity (rank)	29	15	14th[10] of 131 Economies	√	3
2	Contribution rate of scientific and technological progress to economic development (%)	55.3	60	60	√	Unique to China
3*	R&D investment intensity (%)	2.1	2.5	2.4	X	3.1
	Basic R&D (% total R&D)	5.1		6		16.6
4*	R&D personnel per 10,000 employed persons (person-year)	48.5	60	62	√	--
5	Operating revenue of high-tech enterprises (trillion RMB)	22.2	34	51	√	--
6	Value added in knowledge-intensive service	15.6	20	--	--	--

9 This table comes from the 13th S&T FYP. See, “Notice of the State Council on the Issuance of the 13th Five-Year Plan (国务院关于印发“十三五”国家科技创新规划的通知),” Central People’s Government of the People’s Republic of China (中华人民共和国中央人民政府). China Government Net (中国政府网), August 8, 2016, http://www.gov.cn/zhengce/content/2016-08/08/content_5098072.htm.

10 World Intellectual Property Organization, “Global Innovation Index,” https://www.wipo.int/global_innovation_index/en/.

	Indicator	Target (13th FYP)		Results in 2020		US
		Value 2015	**Target 2020**	**Value**	**Achieved?**	
	industries as a proportion of GDP (%)					
7	R&D expenditures by industrial enterprises above a certain size as a proportion of main business revenue (%)	0.9	1.1	1.32	√	--
8	World ranking by the number of international scientific and technological paper citations (rank)	4	2	2	√	--
9	Patent Cooperation Treaty (PCT) patent applications (10,000 applications)	3.05	Double	7.68	√	China- 1st U.S.- 2nd
10*	Invention patents held per 10,000 people (patents)	6.3	12	15.8	√	
11	National technology contract amount (100 million RMB)	9835	20000	28250	√	
12	Proportion of citizens with scientific capabilities (%)	6.2	10	10.56	√	

	Indicator	Target (13th FYP)		Results in 2020		US
		Value 2015	Target 2020	Value	Achieved?	
13^	Internet penetration (%)					
	Fixed broadband (households)		70	91	√	90
	Mobile broadband (households)		85	96	√	

*Indicators included in the national 13th FYP. All others are in the 13th S&T FYP.

Controversial Indicators

Many of the indicators identified in the 13th FYP are controversial to varying degrees. In the first place, the targets and categories are selected by Chinese leaders to ensure they are achievable.[11] A failure to reach publicly stated goals, as has happened in previous FYPs, is highly undesirable in the Chinese political context. This means that little is left to chance in setting targets, and some are chosen over others despite their questionable suitability. For instance, the "contribution rate of scientific and technological progress to economic development" is unique to China as a metric and prone to distortion.

Whether the GII ranking is the best indicator of China's level of innovation is also debatable. Other indexes, such as the Global Competitiveness Index, rank China somewhat lower while the Global Creativity Index ranks China substantially lower.[12] However, factoring in definitional differences, the indexes generally demonstrate how far and fast China has advanced technologically and narrowed the gap with advanced economies.

---

[11] For example, it could include facilities and real estate of research institutions. Scott Kennedy and Christopher Johnson, "Perfecting China Inc: The 13th Five-Year Plan," CSIS, May 2016, https://www.csis.org/programs/perfecting-china-inc.

[12] Scott Kennedy, "The Fat Tech Dragon, Benchmarking China's Innovation Drive," August 2017, https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170829_Kennedy_FatTechDragon_Web.pdf.

Another somewhat controversial indicator is the metric on patents. Critics argue that the majority of China's patent applications are graded utility patents not invention patents, suggesting that the quality of what is coming out is not as high.[13] Chinese scientists also point out that the structure of China's patents is unbalanced, incentivizing a narrower stream of innovation. In the field of metamaterials, for example, 80 percent of China's patents are in five major fields. By comparison, 80 percent of U.S. patents in this sector are distributed across 12 major fields. "In China, the results of the innovation system increase the attention and priority of specific fields as opposed to in the United States, where competition drives innovators to explore a wider range of niche markets and applications."[14] But here again, the shortcomings of China's patent quality and structure should not be overstated. In important categories of patent filings—such as R&D intensive products and high-tech services—China has made dramatic gains.[15]

S&T Output Performance of the 13th FYP

While S&T indicators are useful for assessing overall innovation, the 13th FYP is also highly ambitious in setting out to tackle numerous S&T achievements spread across a wide range of sectors. Within 21 single and cross-sector general initiatives—such as Made in China 2025, STI 2030, and SEI—the 13th FYP identified no less than 161 technology areas. The breathtaking ambition of this document makes any comprehensive assessment of China's success in all areas of S&T beyond the scope of this paper, but a selective review of a number of key projects and programs (see Table 2) provide clues to the victories and failures on which the 14th FYP builds upon.

---

13 For example, see, "Is China Really Leading in the Global War for Patents?" WION, March 3, 2021, https://www.wionews.com/world/is-china-really-leading-in-the-global-war-for-patents-367769.

14 Hu Zhijian, the party secretary of the Chinese Academy of S&T Development, a leading S&T think tank under the Ministry of Science and Technology, as quoted in Yu, Taoran (俞陶然), "Dean of the Chinese Academy of Science and Technology Strategy: The Government's S&T Plan Should be Open to Foreign Scientists (中国科技战略院院长：政府科技计划要向外国科学家开放)." Shanghai Municipal Science and Technology Commission (上海市科学技术委员会). Shangguan News (上观新闻), September 29, 2020, http://stcsm.sh.gov.cn/xwzx/mtjj/20200929/a7182fc9ad5e4dba99b0754beaa3265e.html.

15 "Main Science and Technology Indicators," OECD, https://www.oecd.org/sti/msti.htm.

Table 2. Major Technology Programs and Capabilities Targeted in the 13th FYP

13 Major National S&T Projects	Semiconductors, supercomputers, operating systems, cloud computing, big data, basic software, very large-scale integrated manufacturing equipment, broadband wireless mobile communication, 5G infrastructure, high-end computer numeric controlled machines, large oil and gas fields, gas-cooled nuclear reactors, water treatment, genetically modified organisms, pharmaceuticals, large aircraft, high-resolution earth observation system, manned and unmanned space
15 STI 2030 Megaprojects	Aerospace engines and gas turbines, deep-sea and space stations, quantum communication, brain science, cyberspace security, seed industry, renewable energy, smart grids, space-ground networks, big data, smart manufacturing, new materials, environmental protection, health tech
14 Modern Agricultural Technologies	Breeding, grain production, marine agriculture, livestock husbandry, forestry conservation, biocontrol, advanced farming machinery
9 Advanced Manufacturing Technologies	Network collaboration, green, intelligent equipment, robotics, additive manufacturing, laser equipment
10 New-Generation Information Technologies	Nano-electronics, optoelectronics, high-performance computing, cloud computing, AI, broadband communication, Internet of Things (IoT), virtual reality, smart cities
6 New Material Technologies	Basic, engineered, electronic, nano, structural, functional materials
5 Clean Energy Technologies	Clean coal, nuclear, hydrogen, smart grid system, energy-efficient construction
5 Transportation Technologies	Electric vehicles, rail, marine, air, intelligent transportation
6 Biotechnologies	Biomedical, bio-manufacturing, utilization tech, biosafety
5 Food Manufacturing Technologies	Processing, manufacturing, preserving, nutrition and safety

9 Environment Protection Technologies	Air, soil, water pollution, ecological restoration, reforestation, land reclamation, environmental risk, early warning systems, climate change response
5 Recycling Technologies	Water, coal, gas, metal utilization
10 Health Technologies	Disease, medicines, birth defects, diagnostics, drug quality, elderly care, TCM
3 Urbanization Technologies	Urban spatial planning, prefab construction, cultural protection
3 Public Safety Technologies	Emergency response, disaster risk assessment,
5 Marine Development Technologies	Deep-sea exploration, marine safety and sustainability, offshore engineering, seawater utilization
6 Aerospace Technologies	Satellites, deep-space exploration, Mars, earth observation and navigation, space craft, heavy lift launch
5 Polar Resource Technologies	Deep earth, polar observation, climate change, resource utilization
9 Basic Research National Strategic Tasks	Agricultural biological (genetic) development, clean energy, human-cyber-physical fusion, disaster effects, new materials, manufacturing under extreme environmental conditions, disaster prediction, aerospace, immunology
13 Strategic Scientific Issues	Nanotechnology, quantum regulation and quantum information, protein chemistry, stem cells, large scientific installations, global change and responses, developmental genetics, synthetic biology, gene editing, deep sea, deep ground, deep space, and deep blue, deep structure of matter and large-scale physics, mathematics and applied mathematics, nuclear fusion energy
5 International Science Projects	International Thermonuclear Experimental Reactor, Square Kilometer Array Program, Group on Earth Observations, International Ocean Discovery Program

In press releases and official statements, the following achievements are frequently cited as examples of China's successful performance in S&T innovation during the 13th FYP:

- Major advances in quantum technology, world's first quantum satellite
- "Wukong" dark matter particle detection satellite
- Iron-based superconductivity
- Stem cell breakthroughs
- Synthetic biology
- Five-hundred-meter aperture spherical telescope fully functional
- First test flight of C919 large-body passenger aircraft
- Successful nuclear fusion experiments
- 5G, AI, blockchain leading advances
- "Fuxing" high-speed rail
- New drugs, vaccines
- New energy and vehicles
- Acceleration of national lab building
- National high-tech zone output reached RMB 4 trillion, roughly double that of 2015
- Newly registered tech companies have grown exponentially

Measuring China's Performance Using Outside Data

China's self-described successes are usually laundry lists of technologies and increases in funding, infrastructure, and human capital, which make it hard to benchmark China's performance. It is useful therefore to view China's output from an external perspective. One large category of innovation that should be singled out as a clear success for China is what the United Nations Conference on Trade and Development (UNCTAD) calls Industry 4.0 sectors and frontier technologies. In a 2021 report, UNCTAD names China a leader or a close runner up in eleven such industries based on number of patents, publications, size of professional force, and market size.[16] These data come from the

[16] "Technology and Innovation Report 2021," UNCTAD, https://unctad.org/system/files/official-document/tir2020_en.pdf.

period coinciding with the 13th FYP and many of these technologies are embedded in the projects and initiatives in Table 3. In these emerging and frontier sectors, China has made impressive inroads.

Table 3. Leadership in Frontier Technologies

	Rank	
	China	U.S.
AI	2nd	1st
Internet of Things	1st	2nd
Big Data	1st	2nd
Blockchain	2nd	1st
5G	1st	2nd
3D Printing	2nd	1st
Robotics	2nd	1st
Drones	2nd	1st
Gene editing	2nd	1st
Nanotechnology	2nd	1st
Solar photovoltaic	1st	2nd

Space Program

One additional example of China's S&T innovation progress is China's space program. China has been making significant progresss in its space programs since the beginning of the 21st century, but the advances during the 13th FYP has been especially remarkable and demonstrate a prowess in a broad range of technologies and capabilities, to the point that China now is beginning to rival the United States.[17] These achievements include the following:

- China launched 256 satellites during the 13th FYP, according to the Union of Concerned Scientists satellite database. This almost doubled the number of Chinese satellites launched prior to the 13th FYP, putting China second only to

[17] Joshua P. Carlson, *Spacepower Ascendant: Space Development Theory and a New Space Strategy,* (Joshua Carlson, 2020); Steven Lee Myers, "The Moon, Mars and Beyond: China's Ambitious Plans in Space," *New York Times*, October 15, 2021, https://www.nytimes.com/article/china-mars-space.html.

the United States. China’s success with satellites rests on powerful applications in navigation positioning, remote sensing, space-based Internet and mobile telecommunications, as well as the world’s second largest manned space and space exploration programs.18

- The Tiangong 2 was launched as part of a broader plan to have a permanent manned space station in service around 2022.
- Chang’e lunar mission series, which saw the first landing on the far side of the moon by Chang’e 4 in 2019 and returned lunar soil samples at the end of 2020 with Chang’e 5.
- Initiation of China’s Mars program with the launch of an unmanned probe to Mars, followed by Tianwen-1, entering the orbit of the Red Planet in February of this year.
- Alongside these large-scale national undertakings, China’s private space industry has grown exponentially, with over 100 commercial space enterprises established over the last five years.19
- Major progress on China’s Long March 9 super-heavy lift launch vehicle to be commissioned by 2030.20
- The completion of the Beidou-3 navigation positioning network that provides global coverage with three Geostationary Earth Orbit satellites, three Inclined Geosynchronous Satellite Orbit satellites, and twenty-four Medium Earth Orbit satellites.
- Launched the world’s first quantum satellite.

---

[18] Union of Concerned Scientists, “UCS Satellite Database,” September 1, 2021, https://www.ucsusa.org/resources/satellite-database.

[19] Zhang, Jing (张静), “The Number of Chinese Private Space Enterprises Has Reached 123, Accounting for Nearly 90% of Domestic Commercial Space Companies (中国民营航天企业已达 123 家，占国内商业航天公司近九成),” Netease News (网易新闻). The Paper (澎湃新闻), May 15, 2019, https://c.m.163.com/news/a/EF73S4RO00097U81.html?spss=adap_pc&referFrom=&spssid=a12249a5eb82f60650cd3f00297c1fff&spsw=4&isFromH5Share=article.

[20] Andrew Jones, “China Moves to Next Stage of Super Heavy Rocket Development,” January 14, 2021, https://spacenews.com/china-moves-to-next-stage-of-super-heavy-rocket-development/.

Areas of Deficiency

Despite the results of China's S&T efforts in terms of outputs, there are a number of deeply rooted deficiencies in China's innovation ecosystem, which MOST minister Wang Zhigang alluded to in his speech on the 13th FYP report card. These are also problems that have been singled out directly and indirectly as priority areas for the 14th FYP. These shortcomings can be summarized in three general areas.

1. Technology Gaps

The first and most straightforward deficiency is China's continuing inability to fill in many important gaps in its supply and innovation chains. Given the U.S.-China trade war, and the dual-use nature of the industry, semiconductors have received the most attention. As a latecomer to this sector, China's wholly indigenous capabilities remain small, accounting for about 7.6 percent of global semiconductor sales. China produces primarily lower-end logic chips and analog chips for consumers and communications, while China's chip industry is notably absent in high-end logic, advanced analog, chip design, and leading-edge memory products. A wide variety of advanced semiconductors and integrated circuits are still imported from overseas suppliers, the cost of which exceeds China's entire oil importation bill.[21]

Another widely reported gap is the aviation sector, where the indigenous production and supply chains of commercial airliners have so far proven elusive to China, as has the design and manufacturing of turbofan jet engines[22] despite the consolidation of related enterprises and research institutes into the Aeroengine Corporation in 2016.[23]

But there are other areas of weakness too. Despite claiming the largest market for automobiles, the joint ventures retain the lead in component technologies, quality control, and branding. China is a large supplier of a wide range of pharmaceutical ingredients and generic drugs, but indigenous innovation in this field is modest.[24]

As the chapter on supply chains describes, the Ministry of Industry and Information Technology (MIIT) is undergoing a comprehensive review of China's supply chain vulnerabilities, but few specifics can be found in official reports. However, near the end of the 13th FYP and as the leadership was formulating the 14th FYP, various scientific organizations and industry associations in China published reports that identified numerous additional weak links in the supply and innovation chain. Computer numeric

---

21 "Taking Stock of China's Semiconductor Industry," *Semiconductor Industry Association*, July 13, 2021.

22 Although it may have finally resolved its problems as of late for some turbofan engines. Mike Yeo, "China Fields J-10 Jets Powered by Homemade Engine," *Defense News*, May 11, 2021.

23 Liu Zhen, "China Is Behind on Production of its Most Advanced Fighter Jet," *SCMP*, Jan 21, 2021.

24 "China's Biotechnology Development: The Role of US and Other Foreign Engagement," *Rhodium Group and Gryphon Scientific*, February 14, 2019.

control machines and other precision machinery was one of these weak links.[25] China reportedly spends roughly US$100 billion each year on equipment—from a wide range of medical devices to many types of scientific lab instruments such as cryo-electron microscopes. Foreign dependence in this sector is second only to semiconductors, with roughly 90 percent of high-end instrumentation monopolized by foreign companies.

A range of new materials is also one of China's short-term supply chain weaknesses, posing major risks to industrial security.[26] More than 90 percent of nearly 1,000 key materials in eight of the most important new materials categories required by the integrated circuit and display technology manufacturing industry depend on foreign sources.[27] In addition, high-performance carbon fiber and its composite materials, aramid fiber, and silicon carbide single crystal, are all well over 80 percent foreign dependent. A 95 percent market share of a wide range of sensors—which constitute the backbone of smart manufacturing, robotics, telemedicine, space situational awareness, and Airborne Warning And Control System systems—is in foreign hands according to this report.[28]

In sum, despite China's many notable accomplishments in S&T and unprecedented levels of R&D funding, the many extant weak or missing links in China's technology and innovation supply chain should be seen as a significant failure of the 13th FYP. This is reinforced both by the high degree of focus on basic R&D in the 14th FYP—from which many of these technology areas would benefit—and the way these S&T fields are securitized in the 14th FYP, being labeled as important to national security. Moreover, the role of the state in technology and innovation, already pronounced in the 13th FYP, is even more visible in the 14th FYP. The greater specificity and comprehensiveness of S&T goals and categories, alongside the more securitized tone of the 14th FYP, are strong signals that the government wants to remain in control of the country's attempt to fill these gaps in core technologies and innovation supply chain development.

---

[25] Zhang, "This Key Industry"**Error! Hyperlink reference not valid.**; "How to View China's Fruitful Scientific Research"; Zhang, "In the Field of Scientific Research."

[26] Tian, Jin (田进), "Gan Yong, an Academician of the Chinese Academy of Engineering: New Materials Have Become the Worst-Hit Area in China's 'Short Board' and Pose a Major Risk to Industrial Safety and Key Areas (中国工程院院士干勇：新材料成为中国"短板"中的重灾区，对产业安全和重点领域构成重大风险)," Sina Finance (新浪财经). Economic observation net (经济观察网), December 24, 2020, https://finance.sina.com.cn/stock/stockzmt/2020-12-24/doc-iiznctke8326882.shtml.

[27] Bai, Chunli (白春礼), "Academician Bai Chunli Analyzed the 'World Trend of Science and Technology Frontier Development Trend' (白春礼院士解析＂世界科技前沿发展态势＂)," Netease (网易). Chinese think tank (中制智库), January 21, 2021, https://www.163.com/dy/article/G0S2OBSC0538KQKE.html.

[28] "Where Is the 'Chokepoint' of Sensors?" Shanghai University of Science and Technology School of Management, November 2, 2020, https://mp.weixin.qq.com/s/9sSV5cfQRb9u5k-HI7ltxA.

2. R&D System

The unprecedented focus on reform of the R&D system in the 14th FYP is another indication of an area where the 13th FYP fell short. This is dramatically demonstrated by China's vastly different rank in inputs versus outputs in the GII 2020, which China vaunts as a sign of success. As outlined earlier, there is no questioning the progress China has made in many areas of S&T, which is reflected by its 6th place rank in "innovation outputs." But this is sharply contrasted by its 26th place in "innovation inputs," of which its poor performance in "innovation institutions" stands out, with China in the 62nd spot. Institutions include things like government effectiveness (45th place) and regulatory environment and research and redundancy, where China is near the bottom of the list at the 102nd spot (Table 4).

Table 4. Global Innovation Index 2020

	Overall GII Rank	Innovation Inputs	Innovation Outputs	Institutions	Government Effectiveness	Regulatory Environment
United States	3	4	5	9	15	11
China	14	26	6	62	45	102

The overhaul of the S&T system that roughly coincides with the 13th FYP period demonstrates that China's leaders recognize the deep-seated problems in the nation's R&D-related institutional regime. Both the focus of the R&D system in the 14th FYP and the high tempo of regulatory and reform initiatives leading up to it represent an acknowledgment that reform is far from complete and is a high priority for the next five years if China is to achieve its ambition to become an innovative nation.[29] One of the most pressing issues has been the reform of state R&D institutions. In early 2017, a pilot plan was initiated to convert 41 defense research institutes from wholly state-owned into mixed-ownership entities by allowing them to be listed on stock markets. This quickly stalled.[30] The 14th FYP will concentrate on bringing these changes about, with a timetable for completion.[31] Moreover, the document stresses the need to improve basic

29 Zhang, Mingxi (张明喜), "Innovation Incentives for Researchers Have Become Greater (对科研人员的创新激励力度更大了)," People's Net (人民网). Guangming Daily (光明日报), June 18, 2020, http://scitech.people.com.cn/n1/2020/0618/c1007-31751490.html.

30 "Reform to Classification of Defense Research Institutes Has Been Issued (军工科研院所分类改革方案已下发)," Sohu (搜狐), January 11, 2017, http://news.cnstock.com/news,bwkx-201701-4002072.htm.

31 "How to Lay Out the Military Industry in the 14th FYP? (军工行业深度报告：如何谋篇布局"十四五")," China Galaxy Securities (中国银河证券), September 23, 2020, http://pdf.dfcfw.com/pdf/H3_AP202009241416879860_1.pdf.

R&D—with a 10-year action plan soon to come[32]—and raise enterprise contribution to R&D, both clear indications that the national innovation ecosystem and the structure of R&D have so far seen limited progress.[33]

A number of regulatory and reform initiatives were announced at the end of the 13th FYP to transform R&D and signal these areas will come under much greater scrutiny during the 14th FYP:

- Greater apportionment of rights and rewards to individuals for scientific accomplishments within state and defense research defense institutes (RDIs).[34]
- Establishing extensive, third-party, blind evaluation systems for larger S&T projects.[35]
- Construction of a national platform for R&D and technology dissemination.[36]
- Clarifying confidentiality regulations and disclosure of information for sensitive areas, particularly for institutions looking to list on the stock market.[37]
- Doubling down on intellectual property rights (IPR) and patent protection mechanisms, including linking IPR to national security.[38]

---

32 Liu, Yin (刘垠), "The 2021 National Science and Technology Work Conference Was Held in Beijing (2021 年全国科技工作会议在京召开)," People's Net (人民网). Science and technology daily (科技日报), January 6, 2021, http://scitech.people.com.cn/n1/2021/0106/c1007-31990326.html.

33 Zhang, Chidong (张赤东), "Enterprises Should Become the 'Third Pole' in the National Basic Science Research System (企业应成为国家基础科学研究体系中的"第三极")," Guangming Daily (光明日报), December 31, 2020, https://news.gmw.cn/2020-12/31/content_34508461.htm.

34 "There Are 336 National Laboratories and National Key Laboratories, and 7 Are Unique to Tsinghua and Zhejiang University (国家实验室和国家重点实验室共计 336 个，清华浙大各独有 7 个)," Material ten (材料十). 114 Industry, university, research and development (114 产学研), June 22, 2020, https://www.ershicimi.com/p/4c3b7b6297c21e3e31a6ee600f4075e3.

35 Liu, "Letter on the Reply"; Feng, "Academician Feng Dengguo."

36 Guo, Jingjing (郭京京), "New Changes in the Transfer and Transformation of Scientific and Technological Achievements under the New Development Pattern (新发展格局下科技成果转移转化的新变化)," *Guangming Daily* (光明日报), December 31, 2021, https://news.gmw.cn/2020-12/31/content_34508459.htm.

37 For instance, "Interim Measures for Information Disclosure of External Financing of Defense Industry Enterprises Including the State Asset Supervision and Administration Commission, the State Administration for S&T, Industry for National Defense and the Ministry of Industry and Information Technology." See, "China Association of Listed Companies Holds Symposium on Listed Companies in National Defense," March 24, 2019, http://news.stcn.com/2019/0324/14947806.shtml.

38 "At the 25th Collective Study Session of the Political Bureau of the CPC Central Committee, Xi Stressed on Comprehensively Strengthening Intellectual Property Protection to Stimulate Innovation Vitality and Promote the Building of a New Development Pattern (习近平在中央政治局第二十五次集体学习时强调 全面加强知识产权保护工作 激发创新活力推动构建新发展格局)," Xinhua Net (新华网), December 1, 2020, http://www.xinhuanet.com/politics/leaders/2020-12/01/c_1126808128.htm; Huang, Can (黄灿), Ge Xu (徐戈), Lanhua Li (李兰花), and Huijun Shen (沈慧君), "The Implementation of the Law on Promoting the Transformation of Scientific and Technological Achievements Has Not Met Expectations, and the Institutional Reform Should Focus on Four Aspects (《促进科技成果转化法》实施未达预期，制度改革应着眼于四个方面)," Netease (网易), February 08, 2021, https://www.163.com/dy/article/G2AOIBAQ0511DV4H.html.

- Strengthening ethics, supervision, and a zero-tolerance culture for misconduct in S&T work.[39]
- Restructuring R&D institutions under the Chinese Academy of Sciences.
- Regulations to skew S&T awards to more basic and cutting-edge research.[40]

3. Productivity

Another factor that remains perhaps the most deeply entrenched problem for China's S&T innovation system is its apparent lack of contribution to raising productivity. The broadest metric for efficiency of the economy is total factor productivity (TFP), which differentiates growth achieved through technology, innovation, and the quality of human talent as opposed to just adding more capital and labor. At the heart of China's modern economic policies is the expectation that S&T innovation will eventually displace capital as the primary source of long-term growth. This issue has garnered increased attention because, despite official goals, unprecedented spending on R&D, and a rise in the output from the S&T innovation system, China has yet to see productivity gains through growth in TFP.[41]

China's drive for indigenous innovation was initiated in the MLP in 2006 and reinforced with subsequent plans such as Made in China 2025 and SEI (particularly for manufacturing), IDDS, and the 13th S&T FYP, which, as described earlier, is the most recent agenda for transforming China into an ever more innovative economy. However, despite the attention, TFP, a critical measure of the economic value of innovation, has been trending downward since the early 2000s. The World Bank and the State Council Development Research Center show TFP sinking from an average rate of just over 1 percent per annum during the 1997-2008 period to an average rate of under 1 percent between 2008 and 2017,[42] a level that persists today. Comparisons with advanced economies and even developing nations make these figures even more stark. While China's spending on R&D approaches that of the United States, the former's TFP has not budged from the equivalent of 40 percent of the United States' since the early 1980s.[43]

---

39 Liu, "The 2021 National Science and Technology."

40 Liu, Yin (刘垠), "What Is the New Idea of the Third Major Revision of the National Science and Technology Awards Regulations? The Authoritative Interpretation Is Here (《国家科学技术奖励条例》第三次大修新意何在？权威解读来了)," China News Net (中国新闻网), October 28, 2020, http://www.chinanews.com/gn/2020/10-28/9324606.shtml.

41 Zhu, Min, Zhang Longmei, and Peng Daoju, "China's Productivity Convergence and Growth Potential—A Stock-taking and Sectoral Approach," *IMF Working Paper*, November 2019.

42 Loren Brandt, John Litwack, Elitza Mileva, Luhang Wang, Yifan Zhang, Luan Zhao, "China's Productivity Slowdown and Future Growth Potential," *World Bank Group*, June 2020.

43 "Penn World Table," *University of Groningen*, https://www.rug.nl/ggdc/productivity/pwt/; "Innovative China: New Drivers of Growth," World Bank Group and DRC, 2019.

India, which spends a quarter of China's R&D budget in relative terms and one-tenth in absolute terms, has in the last 10 years begun to out-perform China in productivity.[44]

The implications for the 14th FYP are two-fold and contradictory. On the one hand, China does not seem daunted by these sobering figures in productivity and the S&T innovation system's failure to raise it. On the contrary, the 14th FYP is doubling down on its efforts to achieve indigenous innovation in order to fill technology gaps and secure supply chains, strongly indicating that GDP growth and efficiency in the economy have become secondary priorities to national security. On the other hand, the 14th FYP also tilts more toward manufacturing—including in traditional industries—than the 13th FYP, which focused more on cultivating the service sector. Again, the underlying objective is to secure supply chains as comprehensively as possible. However, it also signifies in part a concern that productivity will deteriorate if China moves too far toward a service-driven growth model.[45]

Techno-Industrial Policy

In retrospect, arguably China's most disastrous failings during the last five years have been both the expansiveness of China's industrial and technology policy and the way in which it was conceptualized. As outlined above, the 13th FYP demonstrates the enormous scope of China's goals in many areas of industry and technology. While Made in China 2025 predates the 13th FYP by a year it should be seen in concert with the 13th FYP and Xi's ambition to make China dominant in global high-tech manufacturing. Inspired by Germany's Industry 4.0 Development Plan, Made in China 2025 is China's first focused plan to rapidly upgrade the world's largest manufacturing base by integrating domestically developed technology from semiconductors to AI. The IDDS is similarly broad and sweeping in its objectives, setting a blueprint for China to become an innovative nation by 2020, an international innovation leader by 2030, and a major source of scientific and technological innovation by 2050.

However, it is not just the outsized ambition of Chinese techno-industrial policy that is problematic but also the approach: the determination to achieve it through a state-led model (funding, tax breaks, subsidies, the mobilization of state enterprises, and acquisition of intellectual property) and, perhaps more importantly, through a military-

---

44 "Research and Development: U.S. Trends and International Comparisons," in S*cience and Engineering Indicators 2018* (Alexandria, VA: National Science Foundation, 2018).

45 China's TFP as a driver of economic growth was highest in the 1980s and 1990s when lower- and medium-end manufacturing dominated the economy. This comports with other studies that show that there is little evidence of faster productivity growth after the late 1990s in industries that are intensive users or producers of IT. Alexander B. Hammer and Shahid Yusuf, "Is China in a High-tech, Low-productivity Trap?" U.S. International Trade Commission, 2020.

civil fusion (MCF) lens, particularly for the development of many technologies.[46] MCF was thoroughly embedded in these national plans. The IDDS places integration between civilian and military systems as one of its strategic pillars.[47] The deepening of MCF is also a fundamental means for achieving the goals set out in Made in China 2025.[48] And while the STI 2030 megaprojects plan that came out in 2016, and featured prominently in the 13th FYP, does not call for MCF specifically, ten of the 16 megaprojects in the plan are clearly dual-use in nature. Indeed, many of the institutions working in these fields have linkages across the civil-military divide, including all the projects in the electronics and information, advanced manufacturing, and maritime and space domains.[49] If these national plans were less than overtly forthright in identifying MCF goals, the 13th Five-Year Special Plan for S&T Military-Civil Fusion Development, published in 2017, made it abundantly clear. In short, the sweeping ambition, the boldness in which it was rolled out, and the linking of civilian and military aspects of technology in the 13th FYP and concurrent plans has had disastrous consequences for China and contributed to the international backlash and decoupling of supply chains that China is now witnessing. The question is what China has learned from this experience and how that is represented in the 14th FYP. The rhetoric and conceptual framing of national planning objectives in the current FYP is toned down in terms of previous outsized and conspicuous landmark policy programs like Made in China 2025 and MCF. But, as the following chapters in this report will show, the 14th FYP is not a retreat from industrial policy, MCF, or the state-led economic model. If anything, the Chinese leadership appears to be amplifying the state's role in guiding the economy and innovation development. The 14th FYP is an attempt to mobilize all social and productive forces in China to secure supply chains, and establish domestic demand and consumption as the primary driver of economic growth and S&T innovation. It places innovation over economic growth, and national security over international engagement.

---

46 Facial recognition, AI, 3-D printing, VA/VR systems, autonomous vehicles. See: "China Tech Investment Flying Under the Radar, Pentagon Warns," *New York Times*, April 7, 2017, https://www.nytimes.com/2017/04/07/business/china-defense-start-ups-pentagon-technology.html.

47 "Innovation Driven Development Strategy Outline (国家创新驱动发展战略纲要)," Xinhua News Agency (新华社), May 19, 2016, http://www.lcrc.org.cn/zhzsk/zcfg/gwgb/gwywj/201801/P020180110557547697363.pdf.

48 "Notice from the State Council on Issuing 'Made in China 2025 (国务院关于印发《中国制造 2025》的通知)," China Government Net (中国政府网), May 19, 2015, http://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm.

49 "Notice of the '13th Five-Year' National Science and Technology Innovation Plan."

Part Two: The 14th FYP and the Status of the 2021-2035 MLP

The release of the 14th FYP in March 2021 offers an important high-level window into the Xi regime's thinking, strategies, and plans for its development priorities to the mid-2020s. There was also guarded expectation that the Chinese authorities might issue the 2021-2035 MLP around the same time to provide a definitive roadmap to China's longer-term development goals, especially in science, technology, and innovation. However, only a very brief and vague outline of the country's 2035 vision was publicly provided. This section provides a critical analysis of the key contents, characteristics, and priorities of the 14th FYP, national security and defense issues contained in the 14th FYP, supply chain matters, and the status and prospects for the 2021-2035 MLP.

Assessing the Content and Context of the Chinese Leadership's Thinking on the 14th Five-Year Plan and 2035 Objectives

China's 14th FYP is a clarion call to "stay the course." The underlying assumption running through the document is that all of China's current policies are optimal and will be continued—perhaps even intensified. There is very little that is new in the 140-page document. Its 19 sections and 65 chapters echo the 13th FYP in organization and content. Yet it would be a mistake to think that the plan is trivial or insignificant. Current policies are full of tensions and contradictions, so even bland restatements can hold clues about shifting priorities and the way trade-offs among objectives are handled. Moreover, China is already on a road toward greater state control and a growing government push to control technology. By "staying the course," China is committing to traveling farther down that road, which will make the Chinese system even more unique and challenging and will inevitably increase international tensions.

The 14th FYP is a public relations document, but it is also a serious program that sends important messages to domestic constituencies and local power holders about what the government intends to do, and what, therefore, domestic constituencies will be expected to support. Government officials and Communist Party members are expected to follow its guidance, and businesses will study it in search of opportunities for government support and new markets. Moreover, the national FYP is just the capstone—the visible tip of a pyramid of plans, which are discussed below. Objectives are stated in vague and abstract fashion in the "capstone," and then implemented through more explicit instruments described in lower-level plans, which are often not publicly available.

What are the main messages from the 14th FYP? In order to assess something as grandiose as a FYP, we need to ask two big questions. First, what is the overall vision that the plan presents? Second, what are the specific policies proposed by the government to change economic outcomes during the plan period? Chinese FYPs frequently fall uncomfortably in between these two opposed aspects of planning: sometimes they predict future developments; sometimes they propose to change them.

With these caveats in mind, what does the 14th FYP say? There are three main messages:

1. China will press ahead with, and intensify, its program of government-developed science, technology, and infrastructure construction; this in turn will require the government to exercise more comprehensive planning.
2. China currently lacks a vision of overall structural change in the economy and will (temporarily) ease up its efforts to drive structural change.
3. China will continue to combine market-oriented institutions with stepped-up planning and will continue to have an open economy to the extent possible.

Clearly there is a tension among these three messages. It may be impossible to achieve all of them at the same time. However, as discussed in the final section of this report, Chinese policymakers believe they have found a way to combine their increased steerage of the economy with a market foundation, and they will seek to achieve their objectives in this environment. Regardless of whether they can resolve these contradictions, it is clear that the first of these three messages is the most important and the main objective of Chinese planners. They will likely push ahead with the first objective even if it comes at the expense of the others.

Government-Driven Technology and Infrastructure Strategy

China does not describe its strategy anywhere as government-driven, but the scope of China's ambitions and the type of instruments and interventions envisioned imply that it is, in fact, increasingly government-driven. This can be seen clearly in five dimensions laid out in the plan. First, the plan calls for intensified investment in basic science, including an altogether new commitment to self-reliance in S&T. Second, planners have laid out a strategic vision of "domestic circulation," in which the large and formidable domestic market plays an increasingly dominant role compared to international circulation. Third, China's ongoing industrial policies have all been reaffirmed and supplemented by an increasingly activist and transformative smart infrastructure investment program. Fourth, partly following the increased importance of infrastructure investment, regional land use and communications plans have much greater importance than ever before. Fifth, in order to coordinate the qualitatively different and inevitably overlapping plans, China is unveiling a new vision of the 14th FYP serving as a (compulsory) unifying vision for an entire system of specialized and local plans. These five dimensions inevitably add up to a sharply increased level of government intervention in the economy. I discuss each of them in turn.

1. Intensified Science and Technology Nationalism

In some respects, the 14th FYP really is an S&T plan. It puts even more emphasis than before on investment in technology, especially science. Section 2, the first following the overview, is all about S&T and is long and substantive. Clearly, China is responding to the U.S. challenge to its technology policies by moving "upstream" in the knowledge-production chain, putting more emphasis on basic research.

Probably the most significant, even shocking, declaration in the document is "make scientific and technological self-reliance (自立自强) the strategic prop of national development." Science is a global endeavor, and scientific knowledge is part of the world's commonwealth. For China to declare that it favors scientific self-reliance is to turn its back on centuries of experience and opens China up to tremendous unnecessary costs. Certainly, there are plenty of offsetting and qualifying statements in the FYP, but even so, it is an extraordinary statement.

Scientific research is also one of the few areas where the plan contains an explicit target, expressed as basic research reaching 8 percent of total S&T expenditures. This level is, of course, far below that of advanced economies like the United States (19 percent), Japan (13 percent), or South Korea (16 percent).[50] But China's basic research share, while low, has been inching upward for years, and reached 6 percent in 2019. Thus, an increase to 8 percent by 2025 is not a huge change, but it would mean that—if the projected 7 percent annual growth of total S&T outlays holds—basic research outlays will have nearly doubled by 2025. By comparison, China's total R&D outlays will have increased by around 40 percent.

In addition to these quantitative targets, the 14th FYP has a list of seven priority "cutting-edge science areas." First among the cutting-edge science areas is, not surprisingly, AI, followed by quantum computing and communications.[51] This research may be "basic," but it has obvious practical economic and defense applications.

---

[50] National Science Board, Science and Engineering Indicators 2012 (Arlington: National Science Foundation, 2012), Tables 4-20.

[51] The other areas are integrated circuits, brain science, genetic and biotechnology; clinical medicine; and earth & space exploration. This is the first of 19 lists in the plan containing mostly large-scale engineering and construction projects.

While increased investment by China is good in itself—since basic science knowledge tends to spread quickly beyond the original discoverers—the basic science emphasis in the 14th FYP could be a kind of feint, directing attention away from zero-sum technological competition and toward positive-sum knowledge creation. In any case, the increased stress on science surely reflects a recognition that China has increasingly gone off on its own. China needs to be prepared for cutoffs of core technologies from the United States and other advanced economies and to engage in earnest in "original innovation."

2. Domestic Market and "Dual Circulation"

"Dual circulation" was a concept officially endorsed by the Chinese Communist Party (CCP) Politburo in May 2020, and it is developed in the 14th FYP, making up the only unambiguously new section (compared to the 13th FYP). Section 4 states that China will "Form a formidable, large domestic market, [and] create a new development framework." While maintaining international links, domestic circulation will be enshrined as the predominant force driving China's growth. Importantly, this does not mean that domestic *consumption* will inherently become a bigger share of the economy (more on this in the next section).

Rather, "dual circulation" is a clever and ingenious attempt to reinterpret the challenges of international disruptions as a single opportunity. International disturbances—due to the United States, although this is not explicitly stated—impact both the demand and supply side of China's economy. Demand for China's exports is reduced by tariffs and technological protectionism in developed economies, and the supply of high-tech inputs to China's manufacturers is increasingly uncertain because of U.S. technology embargoes and the "entity list."

To meet these challenges, planners propose to combine supply-side policies (i.e., substituting for upstream inputs) with demand-side policies (i.e., creating demand for newish domestic products, ostensibly of higher quality than what could previously be produced). Putting these two sides together, planners will have many opportunities to remake and unblock domestic supply chains. It is an ingenious concept, but whether it makes practical sense is far from clear.

There is also a great deal in this section about "unblocking" (畅通) domestic circulation. This means continued investment in transportation and logistics and an effort to reduce trade and transport costs across the board. Even "cold chain" logistics are mentioned. At the same time, this section includes significant institutional content, calling for continued market reform of production factors "in order to unblock the domestic economy from the source" (Chapter 12). This includes nods toward a more effective credit system, better labor circulation (including between rural and urban areas), and a tax system that is more equitable and less slanted against consumption. There is even a sentence that calls for a gradual move toward uniform competition policies as opposed to targeted industrial policies. These points display the nature of the plan as a compromise, having a little something for everyone. They also show the effort to reconcile opposing approaches discussed in the final section of this report.

3. Industrial Policies

Section 3 of the plan is about industrial policies, and this is where the "stay the course" mentality is perhaps most evident. Explicit references to "Made in China 2025" and "Military-Civilian Fusion" have disappeared, but in both cases exactly equivalent expressions take their place. "Manufacturing Superpower (制造强国)" appears in exactly the same place, in the same section, as did "Made in China 2025" in the 13th FYP—and the section has been raised in priority, coming immediately after the section on S&T. Subsequently, an elaborate Chapter 57 describes "joint economic-military development" to replace "Military-Civilian Fusion."

The immediately following discussion is of SEIs, one of the organizing principles of China's industrial policies for the past ten years. SEIs were supposed to account for 15 percent of GDP in 2020, an ambitious goal that was almost certainly not achieved. We do not know the actual figure, because the National Bureau of Statistics has never published data on SEI output, and the 14th FYP passes over the target from the previous plan without comment and simply declares a new goal of 17 percent of GDP for SEIs in 2025. This section describes eight areas of focus for "upgrading the core competitiveness of the manufacturing sector," including materials industry, precision machinery and robotics, and electric vehicles (EVs), among others. The bedrock of China's approach to industrial policy, in other words, will not change.

The 14th FYP indicates that the intensity of industrial policy is growing, along with an intensified focus on overall management of production chains (or "value chains"). It is worth quoting one long sentence in full:

> "[We will] uphold the unity of economics and security, bringing up the laggard sectors and creating advanced sectors, and do sector-by-sector strategic design and precise arrangement of supply chains, in this way creating production chains and supply chains with higher-value-added activities and stronger innovation capacity that are safer and more reliable" (Chapter 8).

Wow. It is an ambitious objective, and one that is essentially indistinguishable from running a planned economy. This strategic conception of value chains closely aligns with the earlier discussion of "domestic circulation."

The biggest change in the discussion of industrial policy is that infrastructure investment is now included as a subset of industrial policy. This is understandable since infrastructure is increasingly seen as the literal concrete embodiment of new AI-based operating systems. 5G telecom is seen as an essential concomitant of this "smart infrastructure," as well as a key sector in its own right. What the Chinese like to call "new infrastructure" is thus increasingly the future of infrastructure everywhere, and China already invests a lot—far more as a share of its economy than any other economy. In the plan, China commits to becoming a "transportation superpower." The subsequent section discusses the digital economy and makes it clear that it is intimately linked to the application of AI to many new areas. Box 9 in the plan describes intelligent transport, energy, manufacturing, agriculture, education, medicine, and even intelligent tourism—all part of a drive to create smart cities and to manage rapidly expanding transport networks.

In all this, an increased focus on things the state does directly is evident. China will become a transportation superpower because the government will build the trains and highways and will therefore have to budget for them and develop better land-use plans. The supply chain audits to which the plan refers will have to be carried out by Chinese administrative agencies, such as the Ministries of Industry and Information Technology, of Science and Technology, and the National Development and Reform Commission. In contrast, to become a manufacturing superpower, China relies on the dynamism of the business sector, especially the private sector. No one should underestimate the dynamism of the Chinese private sector, but it does not always meekly follow the directions laid out by Beijing planners.

4. Aggressive Regional and Infrastructure Planning

Along with an increased emphasis on infrastructure, the 14th FYP displays a striking increase in the importance attached to land use and regional planning. The 13th FYP had four national maps, but they were essentially color illustrations for the text, with little useful information. By contrast, the 14th FYP has seven informative maps, three of which are detailed portrayals of the high-speed transport network envisioned in the urban mega-regions around Beijing, the Lower Yangtze, and the Guangzhou-Shenzhen-Hong Kong "Greater Bay Area." Each of these details an upgraded high-speed network that roughly doubles the transit intensity of each of these regions. China has already completed its national high-speed rail (HSR) network; this signals that rather than slowing down, China will embark on a new wave of HSR construction, focusing on the three major eastern metropolitan areas. This is a very important shift. For twenty years, China's regional planning has intended to push economic development west and away from the developed coastal regions. Of course, nothing in the plan proclaims the abandonment of the earlier strategy, but in practice the plan describes an unprecedented concentration of resources in the most developed part of the country.

Moreover, the emphasis on regional planning is part of an ambitious program to rebuild China's most important cities. Both Beijing and Shanghai now have population limits in place for their center cities and aggressive programs to channel population and economic activities into outlying new cities. "Urban clusters" are being vigorously promoted in the plan, with the explicit understanding that this is a consciously chosen alternative to the continued dominance of massive cities like Beijing and Shanghai. Expensive investment on transportation and communication infrastructure is seen as the cost of this shift to an urban cluster model. Three gigantic urban clusters are to lead China's development into the high-tech era of "smart cities" and a new digital civilization.

5. The Drive for Comprehensive Planning

The 14th FYP calls for increased industrial policy, enhanced scientific development policy, and much more transformational regional and infrastructure policy. How are all these policies to interact and be coordinated? Through more planning, of course. The final section of the 14th FYP lays out aspirations and explicitly calls for a unified system of long-run plans. Substantially longer and much more detailed than the similar section in the 13th FYP, this section explicitly states that every level of local government—province, city, prefecture, and county—should develop its own plan in line with the spirit of the national plan. The national plan will serve as the overall program, with "spatial plans as the foundation, specialized sectoral plans and local plans as the supports, and with local and national governments playing clearly defined roles" (Chapter 64). In this vision, the "strategic priorities and responsibilities set in this plan, including those in innovation, digital economy, environment, and social welfare, will be used to set up a batch of national keypoint specialized plans, and describe detailed timetables, roadmaps, and responsibilities." Local governments are to set up local plans in line with the development strategies, main objectives and responsibilities, and major projects of the central plan. Everyone's plans will thus fall in line with the center's priorities.

Can such a system work? There is much talk in the plan of the role of the Communist Party and government in supervising and monitoring local activity. There will be a set of plans approved by the national government and then a much larger set of local plans reported to the national government. The party and state supervision system will ensure they are in line with the policies, projects, and overall direction of the 14th FYP. The solution to the coordination problem created by multiple plans is to integrate them and have more planning. Stay the course, and damn the torpedoes.

Economic Structure and Structural Change

In sharp contrast to the ambitious technology, infrastructure, and regional plans, the portions of the plan that describe China's overall economic and structural changes is remarkably conservative. The plan is tepid, apparently marked by uncertainty and lack of conviction. China has reached the end of its "miracle growth" period. Most outside observers expect that GDP growth will fall below 6 percent annually during the course of the plan, but the plan itself makes no prediction about GDP growth. The labor force has already begun to shrink. Moreover, if China is like forerunner economies, the share of manufacturing will begin to decline, and growth will become increasingly driven by demand for services. What does the 14th FYP have to say about these fundamental changes? Not much.

The basic message of the plan is that China's economic structure should be maintained approximately as it is now. Nothing much should change, and the plan is designed to slow down structural change, not accelerate it. There are many examples: (a) the share of manufacturing in GDP should remain "basically stable" (instead of declining); (b) grain production, which has been at a plateau of 650 million metric tons for the last six years, should not drop significantly; (c) household income should grow "basically in step with GDP growth,"—that is, it should not increase as a share of GDP in order to drive domestic demand; and (d) China's exports should be "stable" as a share of the world market. In essence, the plan sets itself up to lean against the natural tendencies of structural change, which would in themselves tend to drive the economy toward a lower investment rate, higher consumption, and a "post-industrial" service economy.

It is worth emphasizing that the plan nowhere envisages a shift toward consumption as a share of domestic demand. China's investment rate has been extraordinarily high—well over 40 percent—since the 2009 global financial crisis. Many economists anticipated that China would shift toward household consumption as part of "rebalancing" the economy. There is no indication in the 14th FYP that this will happen or that it is a goal for China. The section on domestic demand treats consumption and investment as equally important drivers of growth, being careful not to display any explicit bias in favor of either. It is not just that there's no *statement* about increasing the domestic consumption share, they have also been careful not to create any *implication* that the domestic consumption share would increase. This even-handedness has occasionally comic effects. The consumption section includes astute, small-scale suggestions like promoting high-quality brands for cosmetics and establishing in-town duty-free shops. The investment section, by contrast, endorses hundreds of gigantic investment projects, including staircases of giant dams, transcontinental water transfer projects, and even interstellar exploration. The investment projects are the things the planners are really enthusiastic about. More important, they are the things that planners can directly control by approving projects and steering finance toward those projects. It is not the intention of these planners that resources should leak into the control of ordinary households.

The conservative approach extends to other areas as well. The plan was, with much hoopla, advertised as something that would go beyond a five-year outlook, because it would include goals for 2035. Now that it is public, it turns out that it contains only a single paragraph about 2035, which includes no meaningful goals, and only meaningless expressions like “new stage of development” and “completing new forms of industrialization, informatization, urbanization, and the modernization of agriculture.” The environmental aspects of the plan are also disappointing, given that Xi Jinping has declared that China will achieve carbon neutrality by 2060. The environmental targets are not completely empty, but they are essentially straight-line extrapolations of where China should be in 2025 in order to achieve previously announced objectives.

The timorous approach to structural change may be due in part to post-COVID anxiety. Another important element may be that the previous plan was not particularly successful in predicting the parameters of structural change. The 13th FYP said that services would increase as a share of GDP to 56 percent, and this was generally considered a modest, easily achievable target. In fact, the 2020 figure was only 54.5 percent, which could be blamed on COVID, except it was only 53.9 percent in 2019. A service sector target has disappeared from the current plan. The 13th FYP projected that R&D as a share of GDP would reach 2.5 percent, but it was actually 2.4 percent. Again, this target disappeared from the 14th FYP. This does not mean the targets were “bad,” just that they were not very accurate. It also suggests the possibility that the 14th FYP, as a public relations document, is only permitted to discuss targets that were fully achieved in the previous plan.[52]

An alternative explanation is that Chinese planners understand that they are pushing against the fundamental tendencies of the economy—and that they specifically intend to do this. In this reading, China’s planners are consciously trying to keep China focused on manufacturing, maintaining a minimal level of self-sufficiency in agriculture, all while moving toward self-reliance in S&T. Such a strategic orientation would be extremely costly, fundamentally threatening to other countries, and very difficult to change once adopted. There would be strong reasons for not explicitly avowing such a strategy.

---

[52] Similarly, one of the few productivity targets in the 14th FYP is the projection that overall labor productivity will grow faster than GDP. This sounds like a commitment to productivity growth, but it’s really just an acknowledgement that the labor force will shrink in absolute size. Apparently, planners would prefer not to mention this fact in case it would seem too depressing.

Combining Plan and Market

The 14th FYP is full of contradictions. At the core of the contradictions is the plan's clear advocacy for continuing market reforms and expanded international opening and simultaneously for greatly expanded state interference and steerage of the economy. While analyzing this contradiction is beyond the scope of this short briefing, it is essential to note one thing: Chinese policymakers appear to genuinely believe that they are developing a new type of market economy with state guidance and that there is no fundamental contradiction between these two things. Thus, while the 14th FYP is weak on specifics, it does repeatedly advocate a new round of market-oriented reforms and is careful to endorse continued economic opening. Perhaps the most explicit and interesting example of this is the section on foreign investment, which explicitly advocates for facilitating an increase in two-way investment flows. China, the plan says, should make it easier for foreign companies to invest in China and for its own companies to invest overseas (Chapters 13 and 40). This is one of the most unambiguous endorsements of this flavor of openness in China in recent years. Moreover, recent incremental policy changes seem to confirm this general policy direction.

Another explanation for the significant contradictions inherent in the 14th FYP, is that it is a compromise document that contains passages designed to appeal to different constituencies, not all of which must be consistent. Moreover, as a public relations document, the plan is designed to send messages to foreign parties that China is open for business and still committed to a market economy. This is a strategically important message: If China is to counter the U.S. threat, it will have to convince the majority of countries that they can trade with China and that its gigantic domestic market offers real economic opportunity. These factors may partially explain the mixed messages in the plan.

However, beyond the document itself, we know that Chinese policymakers really do believe in their model of government steerage. Numerous sources and actions indicate that they believe that their control of enormous resources, combined with powerful instruments of political control, allow them to direct the economy while still respecting the basic limits of a market economy. There are also some signs in the 14th FYP of the government adapting its own actions to conform to a more market-conforming vision of planning, even while that planning is becoming more ambitious.

The two most important shifts—to basic research and to infrastructure construction—are also shifts toward the type of activity that the government can control directly. If a country has the resources to pay for these things, it does no damage to a market economy to expand their scope. Yet there is no indication that China's industrial policy—already severely market-distorting—is being scaled back. The hand of the state is reaching into more and more sectors of the economy. Thus, the 14th FYP will severely test the belief of Chinese policymakers that their ambitions are compatible with the market economy that has brought them prosperity. By increasing the scale and scope of government guidance, keeping China on an investment-driven growth path, and restraining structural change, China will push against market forces to a degree unprecedented in the past thirty years.

Conclusions

The 14th FYP is China's "stay the course" program. However, this orientation has very different implications in different areas. In technology, science, infrastructure, and industrial policy, "staying the course" implies intensifying a state commitment that was already large, because it means continuing further down the path China is already on. Moreover, the effort to better connect these areas inevitably implies a greater commitment to comprehensive planning and government steerage than has been evident for years. In other respects, though, "staying the course" means a lukewarm commitment—for the present—to other goals that we would normally expect to see in a country at China's level of development: faster growth of consumption, rapid development of services for residents, and enhanced environmental progress.

Moreover, it puts China on a collision course with its vibrant market economy. In this sense, the 14th FYP is an extraordinary vision. China has achieved unprecedented success and prosperity by following the gradual but consistent marketization of the economy and by presiding over the withdrawal of the state from many areas of the economy. Now it seems prepared to turn its back on that achievement and launch an ambitious and perhaps risky program of rebuilding its cities, upgrading S&T by government fiat, and launching a new program of unified planning.

National Security and Defense Perspectives of the 14th Five-Year Plan

While the bulk of the 14th FYP is devoted to economic, social, and welfare issues, more than a quarter of its sixty-four chapters are concerned with matters related to technology, innovation, and security issues. The plan begins with a sober assessment of the "profound and complex changes" that China is facing in the international environment, which has not been witnessed in a century.[53] In other words, the external arena is more volatile and worrisome than at any time in the existence of the People's Republic of China, even during the Cold War days of bitter Sino-Soviet and Sino-U.S. rivalry.

Xi provided further explanation in a speech to the World Economic Forum in January 2021 when he accused the United States in all but name of being an existential threat to China's rise and igniting an all-out confrontation. Xi said that "to build small circles or start a new Cold War, to reject, threaten or intimidate others, to willfully impose decoupling, supply disruption or sanctions, and to create isolation or estrangement will only push the world into division and even confrontation."[54] In internal remarks circulated among Communist Party officials to explain the geo-strategic reasoning behind the 14th FYP, Xi was more explicit by pointing out that "the biggest source of chaos in the world today is the United States" and "the United States is the biggest threat (最大的威胁, *Zuidade Weixie)* to China's development and security."[55]

The most noteworthy of these changes is a global S&T revolution happening alongside a deep-seated industrial transformation and a far-reaching adjustment in the balance of international forces. Although not explicitly stated, this likely refers to the power transition underway with China's rise that is challenging long-standing global dominance of the United States. This has made the existing international order increasingly complex, unstable, and uncertain, and brought in an era of "turbulent change, unilateralism, protectionism, and hegemonism that poses threats to world peace and development."[56]

---

53 14th Five-Year Plan , Section 1, Chapter 1.

54 Xi, Jinping (习近平), "Special Address by Chinese President Xi Jinping at the World Economic Forum Virtual Event of the Davos Agenda," *Xinhua News Agency*, January 25, 2021, http://www.xinhuanet.com/english/2021-01/25/c_139696610.htm.

55 He, Bin (何斌), "Speech at Special Seminar for County-Level Leading Cadre to Study and Implement the 5th Plenum of 19th Central Committee" (在县级领导干部学习贯彻党的十九届五中全会专题研讨班上的发言), *Qilian News (祁连新闻),* February 25, 2021, http://www.qiliannews.com/system/2021/02/25/013341147.shtml.

56 14th Five-Year Plan.

The developmental response has been to place science, technology, and innovation firmly at the commanding heights of the 14th FYP policy agenda. The plan points to the critical importance of "adhering to the core position of innovation in China's modernization drive" and to "take science and technology independence and self-reliance as the strategic support for national development."[57] National security has also received central billing in the 14th FYP compared to its cameo appearances in past five-year plans in the reform era. Nine chapters of the plan are devoted to national security-related topics matters covering domestic security, economic security, and defense modernization. National security and economic development are treated as of coequal importance and the plan emphasizes the need to closely integrate these two domains.

Key Themes: Techno-Nationalist Self-Reliance, Securitization of the Economy, Industrial Policy, Military Modernization

Several major themes emerge from the 14th FYP that offer important clues as to what the next stage of China's techno-security grand development strategy will entail. First is an urgent need to achieve techno-nationalist independence and self-reliance. The ease of access that China has had to foreign technology and knowledge over the past few decades has meant that self-reliance has been an aspirational long-term objective, but the rapid tightening of U.S.-led export controls since the mid-2010s has forced the Chinese authorities into concerted action to prevent technological "strangulation." Several types of effort are highlighted:

- **Resource allocations:** The plan calls for a significant boost in basic research spending from around 6 percent at the end of the 13th FYP to 8 percent by 2025. This is still around half of what advanced economies such as the United States (17 percent in 2017), France (21 percent in 2016), and Japan (13 percent in 2017) spend on basic research,58 but in absolute terms could see a doubling in the size of Chinese basic research outlays by the mid-2020s. Moreover, the plan calls for increasing annual R&D expenditures by 7 percent.
- **Structural reforms:** A long-awaited establishment of large-scale national laboratories is finally taking place with the plan calling for the setting up of these outfits in the areas of quantum information, photonics and micro-nanoelectronics, network communications, AI, biomedicine, and modern energy systems.

[57] 14th Five-Year Plan, Introduction to Part 2.

[58] "Research and Development: U.S. Trends and International Comparisons, 32.

- **Prioritization of select technology domains:** Seven areas are expressly identified in the plan, which are AI, quantum information, integrated circuits, genetics and biotechnology, neuroscience, advanced clinical medicine, and deep-space, deep-sea, and polar exploration. These areas have already been highlighted in other S&T development plans such as STI 2030.

A second theme is the securitization of and increased orientation toward the domestic bases of the Chinese economy to balance against excessive reliance of an increasingly treacherous international economy. This is set out in the "dual circulation" concept in which "China will form a formidably large domestic market and create a new development framework."[59] Using a combination of supply-side and demand-side policies, the intention is to reconfigure and unblock domestic supply chains so they are protected from international disruptions.

Third is the continuing emphasis on the pursuit of industrial policy, especially in the advanced manufacturing and techno-industrial domains. The plan talks about the need for China to become a manufacturing superpower, although it avoids the use of terms that have sparked international backlash such as Made in China 2025 and MCF. These initiatives are continuing to move ahead but have been relabeled or are no longer transparent. SEI is one industrial policy platform that has not been affected by external notoriety and so has not been brushed out of the 14th FYP. While a new goal has been placed on SEI to generate 17 percent of GDP by 2025, there is no mention whether the SEI Initiative met its 13th FYP target of 15 percent. Core manufacturing sectors constitute the prime areas of SEI, which include precision machinery, robotics, materials, and EVs.

Fourth, while MCF as a phrase has disappeared from the 14th FYP, the pursuit of the convergence between the civilian and defense economies remains a pressing priority.[60] The general objective outlined in the plan is to build an overarching integrated strategic system in which the civilian, defense, and national security sectors are closely aligned and coordinated. An extensive list of goals includes the following:

- Expand efforts to share resources, which means allowing the defense industrial sector to increase its access to the financial markets.
- Encourage the coordinated civil-military development of key regions. A top priority of the 14th FYP is regional and infrastructure development, especially the construction of high-speed transportation networks and the building of major urban clusters around the country. Military requirements will feature prominently in these projects.

59 14th Five-Year Plan, Chapter 4.

60 14th Five-Year Plan, Section 16, Chapter 57.

- Deepen civil-military R&D collaboration. The civilian S&T R&D system will be increasingly leveraged for defense requirements.61
- Strengthen military-civil joint development (军民统筹发展, Junmin Tongchou Fazhan) in maritime, space, cyber, biotechnology, new energy, AI, and quantum technology.
- Promote spin-on (civilian to military) and spin-off (military to civilian) applications in research, development, and production activities.
- Improve the development of the national defense mobilization system to ensure that the national economy can be rapidly and effectively repurposed for defense and national security uses in crisis and wartime conditions. The coronavirus pandemic in 2020 is a prime example of activating the defense mobilization system to deal with a health crisis.
- Guarantee the national security (安全保障, Anquan Baozhang) of critical economic capabilities and beef up of early warning, risk prevention, and control mechanisms of the economy. Sectors explicitly pointed out in the plan include the grain, food, infrastructure, energy, and financial industries.62

A fifth important theme is the need to accelerate the pace and scale of defense modernization, especially with the goal of "improving the strategic ability to defend national sovereignty, national security, and development interests" by the hundredth anniversary of the founding of the PLA in 2027.[63] This centennial target was first disclosed at the 5th Plenum meeting of the 19th Party Congress Central Committee in November 2020, which reviewed an earlier draft of the 14th FYP and was the first time that such a target date had been publicly disclosed. Neither the 14th FYP nor the 5th Plenum communiqué provided any specific details of what is meant by the 2027 target date, however. The *Global Times*, a nationalistic mainland Chinese newspaper affiliated with the party mouthpiece, *People's Daily*, reported that the 2027 centennial goal is to build a "fully modern" military force that will enable China to securely defend its sovereignty and national security interests in the Asia-Pacific region, especially

61 Liu, Xiaobing (刘小兵), "Promote the Simultaneous Improvement of National Defense Strength and Economic Strength" (促进国防实力和经济实力同步提升), *Guangming Daily*, March 14, 2021, https://news.gmw.cn/2021-03/14/content_34683946.htm.

62 14th Five-Year Plan, Chapter 53. See also Dong, Yu (董煜), "The Correct Way to Open the 'Outline' of the 14th Five-Year Plan" ("十四五"规划"纲要"的正确打开方式), *Diyi Caijing (第一财经),* March 15 2021, https://www.yicai.com/news/100986328.html.

63 14th Five-Year Plan, Section 16, Introduction.

concerning Taiwan, the South China Sea, and the Western Pacific.[64] The *South China Morning Post* also reported that the 2027 centennial objective referred to a modernization plan that calls for the PLA to "become a real combat-ready force with counter strategic capabilities," with the PLA Air Force, Navy, and Rocket Force being accorded higher priority under this plan in order to enable China to defend core interests, especially Taiwan and the South China Sea.[65] The 14th FYP emphasizes the need to "strengthen strategic forces and new combat forces in new domains as well as creating high-level strategic deterrence and joint combat systems."[66]

Several other military modernization objectives are detailed in the plan. One is accelerating the integration of mechanization, informatization, and intelligenization. Mechanization refers to industrial-age warfare that is predominantly fought by large-scale, low-tech, ground-based forces, which constitutes a large majority of PLA units. Informatization involves network-centric, highly mobile, and smaller-sized forces that are set up for information warfare. Intelligenization refers to future warfare in which emerging technologies such as AI, quantum information, big data, cloud computing, and the IoT will play a central role, which means a growing emphasis on autonomous and unmanned military capabilities.

The plan also calls for optimizing the layout of the defense industry. A top priority is promoting advanced high-end defense science, technology, and innovation along with high-quality defense production. Reforms are taking place to improve the structure and process of the defense innovation system and to reinvigorate the defense industrial base by allowing competition and addressing obstacles such as monopolies and corruption.

Last is the relationship between state planning and the market. In a demonstration of its inherently contradictory nature, the 14th FYP calls for the continuation of market reforms and opening up to international engagement as well as expanded state intervention and control of the economy. In techno-security-related issues such as basic research, technological self-reliance, industrial policy, and MCF, the state's reach is expanding. Finding a solution to forging a viable market-conforming approach to state planning will be crucial to the long-term development prospects for the country.

---

64 "China's Centennial Goal of Building a Modern Military by 2027 in Alignment with National Strength: Experts (中国的百年目标是在 2027 年之前建设一支与国家实力相符的现代化军队)," *Global Times*, October 31, 2020, https://www.globaltimes.cn/content/1205238.shtml.

65 Chan, Minnie and William Zheng, "Why Taiwan Maybe a Key Factor in China's Military Modernisation Plan," *South China Morning Post*, October 30, 2020, https://www.scmp.com/news/china/military/article/3107867/why-taiwan-may-be-key-factor-chinas-military-modernisation-plan.

66 14th Five-Year Plan, Chapter 56.

However, this goldilocks balance is absent in the 14th FYP and the broader techno-security grand development strategy.

The Turn Toward Securitization, Self-Reliance, and Domestic Resilience in China's Development Approach

The global context upon which the IDDS was originally drawn up was premised on the strategic determination by China's leaders that the country enjoys a generally favorable external environment and that deepening interdependence into the global economic and technology systems was essential for long-term development.[67] The IDDS stresses the importance of expanding China's global development engagement through greater openness, cooperation, and ensuring that the country become a global leader.

The IDDS does not explicitly raise any serious concerns about strategic threats to China's security or the possible curtailment of the country's access to global supply chains or technology access. But it does identify several externally related matters that pose major challenges and risks for China's development prospects. This includes the advent of commercial and military technological and industrial revolutions that are reshaping the global competitive landscape, along with the warning that critical core technologies that China is overly reliant upon is under foreign control.

As strategic, economic, and technology tensions began to intensify between China and the United States and its allies from the mid-2010s, Chinese policymakers began to rethink this pro-globalist engagement development posture. The first reported signs of this came at the Central Economic Work Conference in December 2017 when Xi put forward the idea that the country's advance into "high-quality development" (高质量发展, *Gao Zhiliang Fazhan*) depended upon having a smooth and unimpeded cycle (循环畅通, *Xunhuan Changtong*) of economic activity from production to distribution, circulation, and consumption.[68] What this referred to was how to ensure that China was able to mitigate the emergence of foreign efforts to impose obstacles to its economic development.

---

[67] This positive assessment of China's international situation came from the country's national security community and is detailed in outlets such as the defense white papers issued by the Ministry of National Defense.

[68] Qiushi commentator, "Compose a New Chapter in China's Economic Miracle by Accelerating the Construction of a New Development Pattern (在加快构建新发展格局中谱写中国经济奇迹新篇章)," *Qiushi*, no. 24, December 15, 2020, http://www.qstheory.cn/dukan/qs/2020-12/15/c_1126857440.htm; high-quality development refers to the pursuit of higher-end economic and technological activities, of which original advanced innovation is a cornerstone.

This concern that China's economic rise could be thwarted by foreign forces quickly gained currency from 2018 as the Trump administration undertook a concerted and expansive economic and technological campaign to impose costly sanctions, tariffs, and other restraints against China and its companies. The United States' imposition of crippling sanctions on ZTE Corporation, a Chinese technology national champion, in May 2018 was a major wake-up call for Beijing, which some Chinese analysts have likened to China's version of the Sputnik moment in which the Soviet Union's ability to launch the first person into space only galvanized the United States to engage in an all-out technology arms race with its arch-foe.[69] At a meeting of the Central Finance and Economic Commission shortly after the United States' actions against ZTE were announced in June 2018, Xi talked about the central importance of key and core technologies to China's economic and national security and the need for self-reliance.[70]

The Chinese strategic response to this increasingly hostile international environment and the growing threat that its long-standing unfettered access to the global economic and technology order might be significantly curtailed or even cut off began to crystallize in 2020 under the rubric of the dual circulation (双循环, *Shuang Xunhuan*) strategy. The dual circulation strategy approach was first publicly raised in a speech by Xi at a meeting of the Central Financial and Economic Commission in April 2020. Xi pointed out the need to establish a complete system of domestic demand (完整的内需体系, *Wanzhengde Neixu Tixi*) that would have a crucial bearing on China's long-term development and stability. Building up domestic economic resilience was essential, Xi explained, because the external environment was experiencing far-reaching changes, especially the accelerating trend of de-globalization.[71] At the Communist Party Central Committee's 5th Plenum in October 2020, more pointed negative factors were highlighted that included "unilateralism, protectionism, and hegemonism." While there was no explicit identification of who was to blame for these developments, there is little doubt that Beijing views the United States as the chief culprit aided by its close Western allies.

The Chinese leadership's rationales behind this strategic shift toward a more domestically based economy and stepped-up securitization was driven by a mix of economic, geo-economic, and geo-strategic factors. In a speech to a symposium of economic experts and social scientists in August 2020, Xi said that in recent years

---

69 Li, Yuan, "ZTE's Near-Collapse May Be China's Sputnik Moment," *New York Times*, June 10, 2018, https://www.nytimes.com/2018/06/10/technology/china-technology-zte-sputnik-moment.html.

70 "Xi Jinping Chairs Second Meeting of Central Financial and Economic Affairs Commission," *Xinhua News Agency*, July 13, 2018.

71 Xi, Jinping, "Several Major Issues in the National Medium and Long-term Economic and Social Development Strategy" (国家中长期经济社会发展战略若干重大问题), *Qiushi (求是),* October 31, 2020, http://www.qstheory.cn/dukan/qs/2020-10/31/c_1126680390.htm.

domestic markets had become the main engine of the country’s overall economic growth while access to international markets and resources had significantly weakened. Xi said that the downturn in the global economy was caused by noneconomic factors and that the headwinds were likely to worsen in coming years, and so “we must be prepared to deal with a series of new risks and challenges.”[72]

Vice-premier and economic czar Liu He said in a *People’s Daily* article in November 2020 that the principal economic reasons for this strategic shift included the fact that domestic demand was now adequate to sustain the country’s long-term economic development and that there were deepening problems in China’s access to the global supply of goods and services, especially the threat of having its neck choked (卡脖子, *Qiabozi*). This refers to the cutoff in exports by the United States of critical high-technology components such as semiconductors.[73] The central goal of the dual circulation strategy, according to Liu, was to “increase the autonomy, sustainability, and resilience of economic development.”

Constituencies advocating national security, protectionist, techno-nationalist, and mercantilist interests undoubtedly view the dual circulation strategy as a siren call to safeguard and promote the building up of a securitized and self-reliant domestic economic base, especially sectors deemed to be of critical and strategic importance, against the escalating risks posed by de-globalization and decoupling with the West. The security of supply chains has received special prominence. Xi talked about the importance of supply chains at the April 2020 Central Economic and Financial Commission meeting, pointing out that “in order to safeguard China’s industrial security and national security, we must focus on building production chains and supply chains that are independently controllable, secure and reliable, and strive for important products and supply channels to all have at least one alternative source, forming the necessary industrial backup system.”[74] This was reiterated in the communiqué from the 5th Plenum in October 2020 that detailed recommendations in the drafting of the 14th FYP and 2035 Vision that emphasized the need to securitize and exert sovereign control of supply chains.[75]

---

72 Xi, Jinping, “Correctly Understand and Grasp the Major Issues of Medium- and Long-Term Economic and Social Development (正确认识和把握中长期经济社会发展重大问题),” Xinhua Net (新华网). *Qiushi*, January 15, 2021, http://www.xinhuanet.com/politics/leaders/2021-01/15/c_1126987023.htm.

73 Liu, He, “Accelerate the Construction of a New Development Pattern with the Domestic Cycle as the Main Body and the Domestic and International Cycles Mutually Promoting Each Other,” *People’s Daily*, November 25, 2020, http://paper.people.com.cn/rmrb/html/2020-11/25/nw.D110000renmrb_20201125_1-06.htm.

74 Xi, Jinping, “Several Major Issues.”

75 “Recommendations of the Chinese Communist Party Central Committee on Formulating the 14th Five-Year Plan for National Economic and Social Development and Long-Term Goals for 2035” (中共中央关于制定国民经济和社会发展第十四个五年规划和二〇三五年远景目标的建议), *Xinhua News Agency*, November 3, 2020, http://www.xinhuanet.com/politics/zywj/2020-11/03/c_1126693293.htm.

The Chinese economy's rapid mobilized response to the COVID-19 pandemic is held up as a prime example of the importance of possessing a self-sufficient and comprehensive industrial supply chain for ensuring the country's national security. An article in *China National Defense News* argued that the battle against COVID-19 "fully demonstrates the significant advantages of the socialist system with Chinese characteristics and the national governance system as well as its strong social mobilizational and organizational power" that "provides a strong guarantee for fighting the pandemic and gaining control of the people's war."[76]

The Shifting Relationship Between Development and National Security and the Importance of Economic Security

With the Chinese leadership's reassessment at the end of the 2010s that the external strategic environment had turned hostile against China and a significant inward rebalancing of economic development was required, the shifting relationship between national security and development in national priorities that has gradually occurred since Xi came to power took a decisive step in favor of securitization. This latest readjustment will make the security-oriented components of the state far more entrenched and powerful and is also baked into China's medium- and long-term development goals and priorities into the 2030s and beyond.

In the making of the 14th FYP, Xi has stressed two prime considerations. First is how to "properly handle the relationship between development and national security," and second is how to "effectively prevent and respond to systemic risks that may affect the modernization process."[77] The 5th Plenum communiqué made clear that there was increasing awareness that "national security is the prerequisite for development and development is the guarantee of security," and risk factors are "increasing significantly." Consequently, the Chinese authorities "must persist in coordinating development and security, enhance the awareness of opportunities and risks, establish a bottom-line thinking, estimate difficulties more fully, think more deeply about risks, pay attention to plugging loopholes, strengths and weaknesses, and play first and play well."[78] This means adopting a more security-minded, risk-based, and preemptive mindset that will "effectively prevent and resolve various risks and challenges."

---

[76] Xue, Zhiliang, "Fight the 'Pandemic' and Refresh Thinking on National Defense Mobilization," *China National Defense News (中国国防报),* April 2, 2020, http://www.gfdy.gov.cn/topnews/2020-04/02/content_9783197.htm.

[77] Xi, Jinping, "Explanation of the 'Recommendations of the Chinese Communist Party Central Committee on Formulating the 14th Five-Year Plan for National Economic and Social Development and Long-Term Goals for 2035' (关于《中共中央关于制定国民经济和社会发展第十四个五年规划和二〇三五年远景目标的建议》的说明)," *Xinhua News Agency*, November 3, 2020, http://www.xinhuanet.com/politics/leaders/2020-11/03/c_1126693341.htm. A useful background assessment is Pei,Minxin, "China's Fateful Inward Turn: Beijing's New Economic Strategy as Spelled Out by the Resolution of the CCP Central Committee's 5th Plenum," *China Leadership Monitor* 66 (2020), https://www.prcleader.org/pei-3.

[78] "Recommendations of the Chinese Communist Party Central Committee."

A specific area in the intersection between development and national security is economic security. The recommendations of the 5th Plenum communiqué points out that to ensure economic security, there is a need to "strengthen the construction of economic risk early warning, prevention, and control mechanisms and capabilities, and achieve security and controllability in critical areas such as important industries, infrastructure, strategic resources, and major science and technology fields." The recommendations offer a detailed list of economic security measures to be carried out:

- Enhancing the industrial economy's ability to withstand shocks;
- Ensuring food security and the security of energy and strategic mineral resources;
- Safeguarding critical infrastructure facilities such as electric power, water supply, oil and gas, transportation, communications, Internet, and the financial system;
- Protecting ecological security, strengthening nuclear safety regulation, and maintaining security in new and emerging domains;
- Building up early warning and risk prevention capabilities to protect overseas interests.

This list covers much of the Chinese domestic economy and extends outward across the world. How far, deep, and rigorous this effort will be to securitize the Chinese economy and make it more self-reliant will depend on Chinese leadership assessments of the international strategic environment and the trajectory of its great power rivalry with the United States and its allies. While the prospects in the early 2020s suggest that a full-scale retreat to the militarized autarkic Maoist development model of the 1950s-1970s are low, there are updated and refined elements of that era that are being embraced, especially in the strategic, defense, dual-use, and advanced technology domains.

Supply Chain Issues in the 14th Five-Year Plan and 2035 Vision

The United States and much of the world are heavily dependent on China for a large range of end products and component or intermediate goods across a wide range of sectors from the pharmaceutical, to electronics, batteries, and automotive industries.[79] With the ongoing U.S.-China trade war that began in 2018, as well as the disruptions to the global economy resulting from COVID-19, supply chain management and resiliency has become a preoccupation of governments around the world. China is no exception. The centrality of supply chain security in the 14th FYP highlights the Chinese government's thinking about its own development strategy and its relationship with the world.

The 14th FYP is the first national-level planning document in which supply chains are discussed overtly and extensively. Previous FYPs mentioned supply chain issues but the 14th FYP is novel in that it devotes a whole section to the topic, as well as frequently discussing supply chains in many other sections.[80] Moreover, "modernization of the production chain" is cited as among the highest priorities for economic development in the 14th FYP (Main Goals, Section 2). In general, the 14th FYP's discourse on this subject has much of the standard language on securing critical supply chains in manufacturing, production, and technology, but there are a number of aspects of China's approach to supply chain resiliency that stand out.

- **Broader in concept:** Discussion of supply chains in the 14th FYP incorporates notions such as raw materials, manufacturing, and production, but also includes innovation, technology, R&D, design, and even marketing and services. This is a concept of supply chains that Chinese commentators describe as broader in scope and goes beyond traditional frameworks of supply chain management.[81]
- **Quality Upgrade:** There is also a concentrated focus on raising the quality of China's economic activities in supply chains. For instance, in its "strategic orientation," the 14th FYP emphatically states, "We must…lead and create new demand with innovation-driven and high-quality supply…." The document is

---

79 "US-China Trade War: Which Sectors are Most Vulnerable in the Global Value Chain," Rabobank Economic Research, August 19, 2019, https://economics.rabobank.com/publications/2019/august/us-china-trade-war-most-vulnerable-sectors/.

80 The 13th FYP mentioned supply, innovation, production and industry chains a dozen times. The 14th FYP uses the terminology over 50 times, includes a section devoted to it (Article VIII, Section 2) and discusses it in several others sections.

81 Li, Haiping (李海平), "Detailed Illustration of China's First Supply Chain: Three Pools of Industrial Supply Chain Collaborative Service Platform (中国供应链第一神图详解：产业供应链协同服务平台的三个池子)." Sohu (搜狐), August 26, 2019, https://www.sohu.com/a/336368810_99993532.

suffused with this language and represents a clear call for continued efforts to move China up the value chain within many sectors.

- **Whole Supply Chain:** Another unique attribute of the 14th FYP is how expansive it is in discussions of supply chains. The 14th FYP talks about securing entire supply chains in sectors where China has a lead or competitive advantage. "We will…consolidate and enhance the competitiveness of the entire production chains in high-speed rail, power equipment, new energy, shipping, and other fields, and build strategic and comprehensive production chains starting from complete machine products that conform to the direction of future industrial changes."
- **Increased Reliance on China as Deterrence:** The 14th FYP speaks of building "a strong domestic market and trade powerhouse to form a gravitational field to attract global resources and factors of production and accelerate the cultivation of new advantages to be used in international cooperation and competition." However, in a speech given in April 2020, Xi was much more explicit about the need to "forge dependence of the international industrial chain on my country as a powerful countermeasure and deterrent capability for any foreign party that cuts off supply."[82]
- **Domestic Focus:** Supply chain resiliency is also framed as a network that needs to remain within China. "We will optimize the layout of regional production chains, guide the key links of production chains to remain in the country…." The document does mention the need to maintain the stability of global production chains, but the overwhelming message is that supply chains should remain at home.
- **Under China's Control**: In its effort to solidify China's position as a manufacturing powerhouse, the 14th FYP calls for adherence to "independent controllability to promote advancement of the industrial foundation and modernization of the production chain…."[83] Again, the message is clear: China wants supply chains under its control and independent of outside influence.
- **Regional Development and Efficiency**: The 14th FYP also discusses "strengthening the abilities of central, western and northeastern regions to undertake industrial relocation" in the context of securing production and supply chains. These are China's less developed, less productive regions than

[82] Xi, Jinping (习近平), "Several Major Issues Concerning the Country's Medium-Term and Long-Term Economic and Social Development Strategy (国家中长期经济社会发展战略若干重大问题)," *Xinhua News Agency* (新华网), October 31, 2020, http://www.xinhuanet.com/politics/leaders/2020-10/31/c_1126681658.htm.

[83] 14th Five-Year Plan, Part 3, Article VIII.

the eastern coastal areas of the country. A focus on these regions implies a willingness to sacrifice a degree of economic efficiency for greater regional equality and a strategic depth in terms of supply chain development within the country

- **Role of State:** The 14th FYP speaks about "guiding enterprises," "leading enterprises," and "key enterprises"—many of them state-owned—to secure production and supply chains, "increase efforts to tackle key products and key and core technologies, and accelerate breakthroughs in engineering industrialization." Through state-owned enterprise, the role of the state in securing supply chains is paramount.
- **Securitized:** There is no direct reference to the role of supply chains in national security, but the 14th FYP is clear that all aspects of China's development, including supply chain management, will impact the nation's security. Part 15 opens with the following: "We must adhere to the overall national security concept…have national security permeate all national development fields and the entire process…." Given the centrality of supply and innovation chain discourse in the document as critical to China's development, the leadership clearly identifies it as a matter of national security.

In sum, the 14th FYP is not only the first time that China has articulated a supply chain strategy in a national-level planning document, it is the first time it has done so extensively and in a way that decisively shifts priorities from efficiency and global participation to self-reliance, comprehensive capture, and a securitization of its supply chain.

Connection Between Supply Chain Security and Other Planning Priorities

While supply chain security is explicitly identified as a prominent feature of China's development strategy, there are other important themes in the 14th FYP that dovetail with supply chain issues and provide a fuller picture of how China is formulating its economic strategy domestically and internationally.

Domestic Circulation: One of these is the new concept of "dual circulation" (i.e., international and domestic economies), which places priority on domestic economic resilience by creating "a complete domestic demand system that will have a crucial bearing on China's long-term development."[84] This is a reflection of China's past extensive participation in global supply chains. During the past 40 years, China has developed a sophisticated supply chain ecosystem that has allowed it to claim almost 30

[84] Xi, Jinping, "Several Major Issues in the National Medium- and Long-term Economic and Social Development Strategy," *Qiushi*, October 31, 2020, http://www.qstheory.cn/dukan/qs/2020-10/31/c_1126680390.htm.

percent of global manufacturing (in 2019) for a huge range of end products, components, and technology in many sectors of the economy.[85] This has made China the world's preeminent supplier in manufacturing. However, China has fared less well as a consumer of these goods. In the same year, consumption as a share of GDP accounted for only 55 percent compared to 70-80 percent in developed countries.[86] In other words, the demand that has fueled China's rise as a manufacturing powerhouse has to a significant extent been externally driven, leaving China vulnerable. Deepening problems in China's access to the global supply of goods and services, especially critical high-tech components, in a more complicated geopolitical and geo-economic environment, means a dependence on international markets is now seen as a liability for maintaining the integrity of its own supply chains. The shift toward a more domestically based economy is predicated on China's view that domestic demand is now adequate to sustain the country's long-term economic development and the supply chains that underpin it.[87]

Innovation: A second theme of the 14th FYP—innovation-driven development—ties in closely to supply chain resiliency and the structure of China's domestic demand system. In similar fashion to the previous discussion, the problem with China's ascendance as a global manufacturing power substantially dependent on foreign markets is that it was focused on efficiency and economic growth. Many countries moved large swathes of commercial and industrial production to China because of its cheap, large, and skilled labor pool and the ability to build highly efficient supply chains. While China has steadily risen in the global innovation rankings, most of its manufacturing ecosystem has required low- to medium-level technology. And until recently, China was able to purchase equipment and technology it could not develop itself—from advanced chips to new materials, specialized sensors, precision machinery, operating software, and aeroengines. The rise of the U.S.-China trade war and the end of China's access to core technology missing in China's supply chain are now the overriding concern. This was made clear by Xi in April 2020 in his speech at the Central Economic and Financial Working Group when he talked about the importance of supply chains, saying that they should be "independent and controllable." Here and in the 14th FYP, indigenous technological innovation has eclipsed GDP as a priority for China's development path ahead.[88]

---

[85] This figure is for 2019, "China Is the World's Manufacturing Superpower," United Nations Statistics Division, May 2021, https://www.statista.com/chart/20858/top-10-countries-by-share-of-global-manufacturing-output/.

[86] Kevin Yao, "Reform Hopes Rise as China Focuses on Inward Economic Shift," *Reuters,* September 15, 2020, https://www.reuters.com/article/china-economy-transformation/reform-hopes-rise-as-china-focuses-on-inward-economic-shift-idUSKBN2610G5.

[87] Liu, He, "Accelerate the Construction."

[88] Amitendu Palit, "'Dual Circulation' and the 14th Five-Year Plan*," China Daily*, September 7, 2020, https://www.chinadailyasia.com/article/a/142439.

Supply Chain Goals and Strategies

The 14th FYP articulates a number of ideas that offer insights into what China's objectives are with regard to supply chain resiliency and how to best accomplish those goals. These discussions are also outside of the direct passages on supply chains but have direct relevance to the topic.

Maximum Capture: Perhaps most remarkably, the 14th FYP lays out a plan to capture the fullest range possible of both national and global supply chains, from traditional manufacturing to high-tech goods and services.[89] There are several elements to this discussion. First, the document has a clear understanding that securing supply chains is closely linked to demand and that moving China up the innovation ladder will require a society and economy that demands innovative goods and high-tech services. It is assumed that increased demand will drive the supply of innovation, making it a self-perpetuating system. The 14th FYP states, "We will rely on the strong domestic market, running through all the links from production and distribution to circulation and consumption, and form a higher-level dynamic balance in which demand drives supply and supply creates demand, and promote a virtuous cycle in the national economy." However, this new development pattern poses a dilemma for China's leaders if they want to maintain control and independence of supply chains in the more traditional industries of the economy, a goal that is expressed clearly and repeatedly in the 14th FYP. These include sectors like automobiles, consumer electronics, textiles, energy, infrastructure, construction, equipment manufacturing, chemicals industry, and the production of raw materials. Throughout the document, there are numerous refences to consolidating and maintaining these traditional areas of economic activity and keeping the key links of the production chain in the country. "We will transform and upgrade traditional strong industries such as equipment manufacturing… promote the optimization and structural adjustment of raw material industries such as petrochemicals, steel, nonferrous metals, and building materials, expand the supply of high-quality products in sectors such as light industry and textiles, speed up the transformation and upgrading of enterprises in key industries such as the chemical industry…."

The dilemma, as noted earlier, is whether China can hold on to its success as a traditional manufacturing power that has depended on foreign markets, while at the same time decisively shifting its economy into sectors demanding higher levels of innovation and technology, such as advanced manufacturing, robotics, AI, aerospace, aviation, new energy, biotechnology, service industry, and numerous high-tech products and design.

---

[89] Here, supply chain is used in a singular sense that incorporates all the individuals, organizations, resources, activities, and technology involved in the creation and sale of a product or service in all sectors.

International Circulation: The most prominent component of China's international strategy in the 14th FYP is the Belt and Road Initiative (BRI). Its lengthy devotion to the BRI demonstrates that it is the centerpiece to pursuing China's supply chain strategy and will "rely on China's ultra-large-scale market advantage." BRI is an umbrella initiative that spans a multitude of projects and promotes the flow of trade and investment to over 80 countries from East Asia to Western Europe, though predominantly to low- and middle-income nations. BRI is relevant here because the target countries have a combined GDP of US$29 trillion and infrastructure needs through 2030 estimated at $26 trillion.[90] China has already pledged US$1 trillion to BRI infrastructure investment. BRI's infrastructure-led investment helps in the export of many capital goods in transportation, energy, communication, machinery and construction—although this benefits China's state-owned sector more than its private one.[91] Moreover, trade with BRI nations—valued at $6 trillion between 2014 and 2017—offers a huge opportunity to maintain and relocate its low-cost manufacturing to other low-cost countries, allowing China to upgrade its own production to high value-added products.

Digital China: Another widely discussed strategy for modernizing China's supply and production chains is digitization. The promotion of digital technologies was evident in the previous FYP, but the 14th FYP places it at the very heart of China's development plans, especially its drive for innovation and raising productivity.[92] There is a long section devoted to "constructing a digital China" (Part 5), with implications for the economy, technology, society, and even governance. Chinese commentators on the 14th FYP have noted that one of the main lines of investment in the plan is devoted to "data elements" of the economy—data production, collection, storage, and analytics. Data and the digital technology are the "economic oil" of the new era.[93]

More specifically, the 14th FYP emphasizes digital systems as the primary enabler of "transformations of entire production chains." Digitization will help build smart manufacturing that will "promote equipment networking, coordinate supply chain response, production data connectivity, manufacturing flexibility, product customization, and intelligent management." China has already witnessed a remarkable change in the form of digitization. The application of robotics in logistics and

---

90 China Power Team. "How Will the Belt and Road Initiative Advance China's Interests?" China Power, May 8, 2017. Updated August 26, 2020, https://chinapower.csis.org/china-belt-and-road-initiative/.

91 Holger Görg, and Haiou Mao, "Does the Belt and Road Initiative Stimulate Chinese Exports? The Role of State-Owned Enterprises," KCG Working Paper, No. 21, Kiel Centre for Globalization (KCG), Kiel, 2020, https://www.econstor.eu/bitstream/10419/213420/1/1688460241.pdf.

92 The added value of digital economy industries as a proportion of GDP is one of the three main innovation drivers in the 14th FYP. See Table 1.

93 Cicc research (中金研究), "CICC: From the 14th Five-Year Plan, the Three Main Lines of the Technology Industry Investment in the Next 15 Years (中金：从十四五规划看未来十五年科技行业投资的三大主线)," Zhitong Finance (智通财经). The gold dot eyeball (中金点睛), November 17, 2020, https://www.zhitongcaijing.com/content/detail/363679.html.

warehousing have already made supply chains in the country highly efficient. China now has 800,000 robots related to manufacturing, roughly one-third of the world's total.[94] But the list of key digital industries in the 14th FYP, many of which China already leads,[95] aims to push the country's automation to new heights by streamlining its production processes, deeply connecting all elements of the supply chain within and outside of China's borders, and greatly improving supply chain resiliency.

The trend has now shifted from a sequential, linear supply chain network to an open, interconnected chain of operations and digitalization is the key to ensuring that. There are several key technological elements of this digitization strategy.

- **Artificial Intelligence and Big Data:** At the heart of China's digitization strategy is the pursuit of AI. The Chinese Academy of Sciences calls it the new Industrial Revolution fueling globalization.[96] China issued a national action plan for AI in 2017, but now more than ever Chinese firms are embracing digital technologies to transform supply chains. In combination with AI, the use of big data takes on a whole new angle. Applications of these technologies will provide insights related to all areas of supply chain performance and analyze huge amounts of data to provide real-time holistic monitoring of the entire supply chain ecosystem.
- **Cloud Computing:** Cloud computing allows for far greater efficiency in the distribution and storage of information with benefits for systems integration in the complex processes of advanced manufacturing. It also provides effective data security.
- **Internet of Things (IoT):** Real-time tracking using GPS monitors can track everything in the supply chain, while automation and sensors allow for highly accurate quality control. This will enable immediate on-site data collection, supply forecasting, and inventory control.[97]

---

[94] "China's Future Economic Potential Hinges on its Productivity," *The Economist*, August 14, 2021, https://www.economist.com/briefing/2021/08/14/chinas-future-economic-potential-hinges-on-its-productivity.

[95] China now has a significant lead over the rest of the world in AI, including the United States in AI research publications and journal citations. Kai-Fu Lee, "China Is Still the World's Factory—And it's Designing the Future with AI," Time, August 11, 2021; Also, Derek Grossman,Christian Curriden, Logan Ma, Lindsey Polley, J.D. Williams, and Cortez A. Cooper III, *Chinese Views of Big Data Analytics* (Santa Monica, CA: RAND Corporation, 2020), https://www.rand.org/content/dam/rand/pubs/research_reports/RRA100/RRA176-1/RAND_RRA176-1.pdf, and regarding blockchain technology, Wharton's "China's Blockchain Dominance: Can the U.S. Catch-up?" April 23, 2019, https://knowledge.wharton.upenn.edu/article/can-u-s-catch-chinas-blockchain-dominance/.

[96] Hong, Zhisheng, Qin Peiheng, and Zhou Chengxiong. "Analysis of Talents Demand for Building National S&T Power under Fourth Industrial Revolution," *Bulletin of Chinese Academy of Sciences* 34, no. 5: 522-531.

[97] Sean Galea-Pace, "Five Benefits of an IoT-enhanced Supply Chain," SupplyChain, August 27, 2020, https://supplychaindigital.com/supply-chain-2/five-benefits-iot-enhanced-supply-chain.

- **Industrial Internet:** Information barriers have long plagued coordination between sectors and even individual firms. Industrial Internet is a broader goal of creating a standardized system of data analytics and software to reduce information asymmetries and create a more intelligent industrial ecosystem.
- **Blockchain:** This technology, initially created for cryptocurrencies, holds great promise for supply chain management by making highly complex transactions between an unlimited number of anonymous parties efficient and secure.[98]
- **Virtual Reality (VR) and Augmented Reality (AR):** Although a relatively established technology, 3D modeling and design using VR and AR have powerful applications for traditional supply chain models. The use of digital prototypes eliminates the need for physical samples.

China's embrace of digitization has gained urgency during the COVID-19 pandemic, as a virtual, digital supply chain from design to end-user production obviates the need for physical contact between anyone or anything. China's advantage in this realm was stark: As other economies struggled with the effects of the pandemic, and tensions in the U.S.-China trade relationship intensified, China's manufacturing output and its proportion of the global market rose in 2020 from the previous year.[99]

Implementation of Supply Chain Strategy

Supply chain security is relatively new as a rallying concept for Chinese national planning. High-level attention was first given to the subject in 2017, when the General Office of the State Council published guiding opinions on "Actively Promoting Supply Chain Innovation and Application."[100] This likely formed the basis of national planning for supply and production chain modernization, as many of the themes in this document are reflected in the 14th FYP. However, these opinions were relatively vague and general; they called for securing and upgrading supply chains by participating in the formulation of global supply chain rules; creating a good supply chain policy environment; and preventing financial risks in the supply chain. Given that these opinions predate the U.S.-China trade war, they are largely bereft of the securitized language that is pervasive in the 14th FYP and the government documents and party

98 Gaur Vishal and Abhinav Gaiha, "Building a Transparent Supply Chain," *Harvard Business Review*, May-June (2020), https://hbr.org/2020/05/building-a-transparent-supply-chain.

99 "China Manufacturing Output 1960-2022." Macrotrends, https://www.macrotrends.net/countries/CHN/china/manufacturing-output.

100 "Guidance of the General Office of the State Council on Actively Promoting Supply Chain Innovation and Application (国务院办公厅关于积极推进供应链创新与应用的指导意见)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政). China Government Net (中国政府网), October 13, 2017, http://www.gov.cn/zhengce/content/2017-10/13/content_5231524.htm.

meeting minutes leading up to it. One notable exception, however, is its call for an "early warning system for global supply chain risk."

The document also recommended a supply chain expert committee under the State Council, with a dedicated research institute to explore supply chain security issues. That expert committee was formed and convened its first meeting in mid-2019 under the auspices of the Ministry of Commerce (MOFCOM).[101] It was the first time that "global supply chains under the conditions of a changing international situation"—a vague reference to mounting trade and technology tensions with the United States—was one of the key topics of discussion.

Given its purview over trade, foreign direct investment, market competition, and import/exports, it is surprising that MOFCOM led an expert committee for supply chains, which would presumably fit better with an agency managing the broader domestic economy such as the National Development and Reform Commission (NDRC) or one in charge of industry and manufacturing such as the MIIT. The best explanation is that MOFCOM was best positioned to understand the affects arising from international trade tensions and their impact on imports/exports and global supply chains. Notably, in 2018, MOFCOM was also a lead agency in formulating a pilot program to coordinate with provincial governments on the creation of demonstration zones for testing models for supply chain modernization and application. The program included a work plan to evaluate the pilot zones.[102]

In March 2021, the NDRC released the "Opinions on Accelerating the Promotion of High-quality Development of the Manufacturing Service Industry," which is the most comprehensive road map for implementing supply chain resilience to date.[103] It contains a long list of actions that can roughly be broken down into three major tasks.[104]

---

[101] "List of Experts of the Modern Supply Chain Expert Committee of the Ministry of Commerce (商务部现代供应链专家委员会专家名单)," The Ministry of Commerce of the People's Republic of China (中华人民共和国商务部). Department of Market System Construction, Ministry of Commerce (商务部市场体系建设司), May 16, 2019. http://www.mofcom.gov.cn/article/tongjiziliao/sjtj/jcktj/201905/20190502863585.shtml.

[102] "Notice of 8 Units Including the Ministry of Commerce on the Creation of National Supply Chain Innovation and Application Demonstrations (商务部等 8 单位关于开展全国供应链创新与应用示范创建工作的通知)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府). Ministry of Commerce (商务部), March 30, 2021, http://www.gov.cn/zhengce/zhengceku/2021-04/01/content_5597349.htm.

[103] "The National Development and Reform Commission and Other 13 Departments: To Study the National Manufacturing Supply Chain Security Plan (发改委等 13 部门：研究国家制造业供应链安全计划)," China Building Materials Federation (中国建筑材料联合会). National Development and Reform Commission (国家发改委), March 24, 2021, http://www.cbmf.org/cbmf/xydt/zfxx/7062903/index.html.

[104] "Enhancing Independence and Control of the Industrial and Supply Chain—Interview with Xiao Yaqing, Head of the Ministry of Industry and Information Technology," People's Daily, January 5, 2021, http://www.xinhuanet.com/fortune/2021-01/05/c_1126949432.htm.

First and most urgent, is to "make up for the shortcomings of the supply chain." In other words, China must address critical missing links in the country's supply and innovation chains in which it remains dependent on the United States or other countries. While China has the world's most complete manufacturing supply chain ecosystem, there are a number of "choke points" in products and technologies that need to be resolved.[105] Semiconductors and aeroengines are commonly listed as China's principal weak links, but there is an extensive mapping by MIIT of its supply chains in all sectors to identify categories that are moderately or severely deficient.[106] One report identifies over 50 new materials for which China is substantially dependent on foreign producers and that affect sectors like aviation, high-performance medical equipment, biological materials, and precision machines. Moreover, it is an area hit hardest by the Export Control Reform Act issued by the United States in 2018. Another key missing link is high-end sensors, for which China is reportedly 95 percent dependent on foreign sources.[107] Xiao Yaqing, the Minister of MIIT, called for a high degree of focus on these "core product and technology gaps" by increasing the construction of national innovation centers, and "accelerat[ing] the transformation and industrialization of S&T achievements."[108]

A second basket of tasks involves "forging the long board" in supply chains. This refers to a recognition that while addressing weak links is critical, China should be careful not to neglect its existing strengths in traditional industries and manufacturing. Instead, China should consolidate and strengthen these industries through upgrading, digitizing, and making current areas of strength in the supply chain more intelligent and green.[109] To obtain a detailed picture of the strengths and weaknesses of the industrial economy's supply chain situation, MIIT has been conducting a strategic assessment of all 41 major industrial categories as well as a detailed analysis of 666 subcategories.[110]

---

105 China has 41 major industry categories, 207 medium industrial categories, and 666 industrial subcategories, see, Wu, Yang (吴阳), "Ministry of Industry and Information Technology: China Has 41 Industrial Categories, 666 Industrial Subcategories, the Only One in the World! (工信部：我国已有 41 个工业大类、666 个工业小类，全球唯一！)," Sohu (搜狐), October 23, 2020, https://www.sohu.com/a/426789846_116237.

106 "The State Council Information Office Held a Press Conference on the Development of Industry and Information Technology (国务院新闻办就工业和信息化发展情况举行发布会)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府), March 3, 2021, http://www.gov.cn/xinwen/2021-03/03/content_5589875.htm.

107 "Where is the 'Chokepoint' of Sensors?"

108 "Enhancing Independence and Control."

109 "The State Council Information Office Held a Press Conference."

110 Categories based on the U.N. index. "The State Council Information Office Held a Press Conference" and Wu, "Ministry of Industry and Information Technology."

On the other hand, this set of tasks demands that China's "strong supply chain" be "longer and longer." This entails seeking new areas in emerging technologies and industries where China has a "new competitive advantage," and can compete to capture novel supply chains, such as new energy vehicles, and 5G and 6G construction. To this end, MIIT issued draft regulations on rare earth management and the State Council has issued the New Energy Automobile Industry Development Plan (2021-2035).

A third basket of priorities for action in addressing supply chain resiliency is to focus on the structure and role of enterprises. Liu He, vice-premier and head of the state-owned enterprise (SOE) Reform Leading Small Group (LSG), underscored the importance of SOE reform during the LSG's first meeting in early 2021 by pressing for the rapid implementation of the "SOE Reform Three-Year Action Plan (2020-2022)."[111] In a seminar for local enterprises in Beijing, Hao Peng, party secretary of the State-owned Assets Supervision and Administration Commission, emphasized the necessity of "optimizing the layout and structure of SOEs in order to stabilize and modernize the industrial supply chain."[112] This reinforces a theme in the 14th FYP: reform of SOEs does not intend to diminish them but rather to strengthen them into "backbone" entities in the economy around which other firms—the "small giants and single product champions" (small- and medium-sized enterprises)—can cluster and fill in the rest of the supply chain.[113] An interview with the head of MIIT reinforces this approach: "We will implement policies that benefit and stabilize key enterprises…make them stronger and better."[114] This difference of direction regarding China's SOEs—size and strength over efficiency and retrenchment—which revolves around supply chain security, suggests a possible clash between pro-SOE reformers and big industry agencies such as the MIIT.

111 "Liu He Presided over a Meeting of the State Council State-Owned Enterprise Reform Leading Group (刘鹤主持召开国务院国有企业改革领导小组会议)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府), January 27, 2021, http://www.gov.cn/xinwen/2021-01/27/content_5583086.htm.

112 "Securities Daily: SASAC Promotes Restructuring and Integration with the Guidance of Improving the Security and Stability of the Industrial Chain and Supply Chain (证券日报：国资委以提升产业链供应链安全性稳定性为导向推进重组整合)," The State-owned Assets Supervision and Administration Commission under the State Council (国务院国有资产监督管理委员会). Securities Daily (证券日报), July 21, 2021, http://www.sasac.gov.cn/n2588025/n2588139/c19812372/content.html.

113 "The Ministry of Industry and Information Technology the Third Batch of Specialized Special New 'Little Giant' Enterprises List Public, Shanghai CA Glorious List (工信部第三批专精特新"小巨人"企业名单公示，上海 CA 光荣登榜)," Shanghai legal person one certificate pass (上海市法人一证通), July 21, 2021, https://www.962600.com/news/2150a90064a2421b988fabc803931cb8.

114 Xiao, Yaqing (肖亚庆), "We Will Enhance the Ability to Independently and Control Industrial Chains and Supply Chains (增强产业链供应链自主可控能力——访工业和信息化部部长肖亚庆)." *Xinhua News Agency* (新华网). People's Daily (人民日报), January 5, 2021, http://www.xinhuanet.com/fortune/2021-01/05/c_1126949432.htm.

Military-Civil Fusion in the 14th Five-Year Plan

The 14th FYP reveals much about China's national strategy for MCF. Since 2018, in the early stages of U.S.-China trade tensions, overt reference to China's MCF strategy was rapidly toned down to the point it was difficult to know whether MCF remained a viable national program enjoying the highest level of political support that it had up to that point. Though not specifically mentioned in the 14th FYP, MCF is alive and well, and it is also perhaps even more central to China's development planning for the next 5-15 years. MCF in the 14th FYP is nuanced and obfuscated, but it is highly relevant in many of the development priorities articulated therein. China is aiming to construct an economic system in which MCF is more organic and systematically embedded within the basic principles and mechanisms on which China's economy will operate.

Downplaying the MCF Strategy

The objectives of building an MCF system in the national industrial and technological base was a highly visible feature of the 13th FYP. It is mentioned numerous times and explicitly discussed under a lengthy section entitled "Promoting the Deep Integration of Military and Civilian Development," employing the usual jargon of resource sharing, pursuing dual-use agendas, collaboration on S&T projects, and opening the defense industry and military procurement up to greater civilian and commercial participation.[115] But it also touched on more sensitive issues like "guiding superior private enterprises to enter the field of military research, production, and maintenance," a point that is of particular concern to the United States. It also talked about guaranteed funding and projects to establish "mechanisms for military-civilian integration," another worrying issue as it signified a heightened financial support for MCF through government funds and capital markets, both of which materialized during the 13th FYP timeframe. The section on mobilization was also open in its ambitions to build reserve forces, maritime forces, a modern armed police force, border defense forces, and civil air defenses. Perhaps even more importantly, the period of the 13th FYP, 2006-2020 saw a plethora of spin-off and supplemental plans that reinforced and fleshed out many aspects of the MCF national strategy.[116] Perhaps the most important one being the "13th Five-Year Special Plan for S&T Military-Civil Fusion Development," released in 2017, which laid out the centrality of MCF in China's national development ambitions.

---

[115] The 13th FYP mentions MCF 14 times.

[116] For instance, the "Outline of the National Innovation-Driven Development Strategy," "Opinions of the CPC Central Committee, State Council, and Central Military Commission on the Integrated Development of Economic Construction and National Defense Construction," "13th Five-Year National S&T Innovation Plan," the "State Council and Central Military Commission's 13th FYP for Integrated Development of Economic Construction and National Defense Construction," and the "Outline of the 13th Five-Year Plan for Military Construction and Development."

In contrast, the relevant section in the 14th FYP leads with the more benign heading, "Promote the Simultaneous Upgrading of National Defense Strength and Economic Strength." There is no mention of MCF in the document. The closest it comes is a call for civil-military unity (军民一体), but that is in the context of their relations politically and in society. It contains some of the same language regarding resource sharing and S&T collaboration. For instance, it says, "Deepen the military-civilian scientific and technological collaboration innovation and strengthen the military-civilian coordinated development of marine, aerospace, cyberspace, biology, new energy, artificial intelligence, quantum technology, and other fields." However, it is briefer and more watered down overall and is shorn of the more alarming directives in the 13th FYP. The discussion of mobilization is also far less pronounced. It is difficult to predict at this early time of the 14th FYP period the nature of the many follow-on supplemental plans to come, but China's leaders will unlikely repeat the mistake of publicly brandishing such a controversial policy strategy. The upcoming 2021-2035 Science, Technology, and Innovation Development Plan will be an important bellwether for China's approach to MCF.

A Shifting Approach to MCF

While the 14th FYP is devoid of the labels previously used for MCF, a closer reading of the document offers strong clues that MCF remains an important national strategy, in essence if not in name. MCF is certainly more nuanced and obfuscated in this FYP, but the goal to "build an integrated national strategic system" by uniting the capabilities in the defense and civilian technological and industrial base is clear. There are a number of items in the 14th FYP that will crucially affect China's MCF strategy.

Key Projects and Tasks: The most obvious place to start is comparing the development priorities listed in the section on building national defense with the rest of the 14th FYP. It is no surprise that each of the areas specifically listed are high priorities in both the military and civilian spheres (Table 5).

Table 5. Military and National Priorities of the 14th FYP

Military/Defense Priorities	National Priorities
Maritime	Construct a maritime powerhouse
Aerospace	Increase core competitiveness
Cyberspace	Digitization and cybersecurity
Biotechnology	1 of the 7 listed cutting-edge S&T fields
New energy	New pillar of the modern industrial system
AI	1 of 7 key industries of the digital economy
Quantum technology	1 of 7 of cutting-edge S&T fields

In addition to those listed in Table 5, there are many other areas of focus in the 14th FYP that have clear dual-use potential, with military applications, and have been identified in other supplemental documents on MCF.[117] Virtually all of the projects and technologies listed under "Research in Cutting-Edge S&T," "Major National S&T Infrastructure Fields," "Manufacturing Core Competitiveness," "Transportation Powerhouse Construction Projects," "Modern Energy System Construction Projects," "Key Industries of the Digital Economy," and "Applications of the Digital Economy," fall under this rubric of MCF.

But the following themes in the 14th FYP are less apparent in their relevance yet will nonetheless substantially impact MCF.

R&D System: Possibly the most important of these themes is the focus on the R&D system. The first aspect of this is a call for investing more money into R&D. The 14th FYP sets substantially higher targets for overall R&D spending, now 2.4 percent of GDP, and could amount to almost $600 billion in 2025 (at greater than 7 percent annually over the next five years, this would be roughly equal to the United States' current level of 3 percent of GDP or $606 billion[118]). Perhaps more importantly, however, is the 14th FYP's goal of improving the structure of R&D in the country. It sets higher targets for basic R&D in particular (set to rise by 10 percent in the first year of the 14th FYP alone).[119]

117 The "13th Five-Year Special Plan for S&T Military-Civil Fusion Development," and associated documents demonstrate this.

118 China's roughly $378 billion on R&D spending in 2020 is still substantially below the United States' $606 billion in the same year but given the projected rise in GDP and R&D spending in China, the latter will amount to $590 billion in 2025.

119 Hua, Yunan, "Interpretation of the Scientific and Technological Innovation Content of the '14th Five-Year Plan' ("十四五规划"科技创新内容解读)," Zhihu (知乎), March 16, 2021, https://zhuanlan.zhihu.com/p/357531281.

Basic R&D as a share of total R&D spending is currently 6 percent and is targeted to rise to at least 8 percent. This is significant, but still lower than that of the United States, albeit the world's leader, at 17 percent.[120] A ten-year Basic R&D Action Plan is in the works and will likely come out with the aforementioned S&T MLP 2021-2035.[121]

This focus on basic R&D is significant for MCF in several ways. It is unknown whether these figures include purely defense R&D, but the majority of basic R&D occurs within national labs, government research institutes, and universities where many of the dual-use programs operate. Estimates put 80 percent of this R&D as applicable to defense work, therefore a structural shift in R&D directly benefits dual-use utility.[122] Moreover, a greater focus on basic R&D shifts China's research efforts further upstream on the S&T/R&D spectrum where the potential for disruptive, original innovation is greater and also offers more flexibility for dual-use planning.

A second importance of this focus on R&D is reform of the system. R&D institutional reform has been possibly the most nettlesome issue in China's S&T ecosystem and a high priority in the 14th FYP.[123] In the lead up to the FYP, this area saw lots of activity: regulations coming out on a variety of problems from oversight of S&T projects to fair evaluation, better IPR protection, greater rewards to individuals for their achievements, and even regulations on maintaining the integrity of scientific activity.[124] There has also

---

120 Smriti Mallapaty, "China's Five-Year Plan Focuses on Scientific Self-Reliance," *Nature*, March 11, 2021, https://www.nature.com/articles/d41586-021-00638-3.

121 "Report on the Implementation of the 2020 Plan for National Economic and Social Development and on the 2021 Draft Plan for National Economic and Social Development," National Development and Reform Commission, March 5, 2021.

122 See, "Layout of the Defense Industry under the 14th FYP," China Galaxy Securities, September 23, 2020.

123 "The Incentive for Researchers to Innovate Is Even Greater (对科研人员的创新激励力度更大了)," Renmin Net (人民网). *Guangming Daily* (光明日报), June 18, 2020, http://scitech.people.com.cn/n1/2020/0618/c1007-31751490.html; Li, Liang (李良), Wen Zhaodong (温肇东), and Zhou Yi (周义), "How to Lay Out the Military Industry in the 14th FYP? (军工行业深度报告：如何谋篇布局"十四五")," Snow Ball (雪球). China Galaxy Securities (中国银河证券), September 23, 2020, https://xueqiu.com/9508834377/160158742.

124 "Opinions on Deepening Project Review, Talent Evaluation, and Institutional Evaluation Reform" and the "Central Fiscal Science and Technology Plan (Special Projects, Funds, etc.) Performance Evaluation Specification (Trial)" in 2020. "Letter on the Reply to Proposal No. 2415 (No. 130, Science and Technology Category) of the Third Session of the 13th CPPCC National Committee of the CPPCC (关于政协十三届全国委员会第三次会议第 2415 号（科学技术类 130 号）提案答复的函)," Research Institute of Science and Technology Development, Tianjin University (天津大学科学技术发展研究院). Ministry of Science and Technology (科技部), September 29, 2020, http://kj.tju.edu.cn/info/1031/2514.htm; "Ministry of Science and Technology: Reply Letter on the Proposal on Science and Technology at the Third Meeting of the 13th National Committee of the Chinese People's Political Consultative Conference (科技部：关于政协十三届全国委员会第三次会议科学技术类提案的答复函)," Blue Ocean Evergreen Think Tank (蓝海长青智库). Ministry of Science and Technology (科技部), September 29, 2020, https://wemp.app/posts/c7aa80fc-2a45-46b4-a19d-b32ce70d626b.

been calls for deep changes to the academician system.[125] None of this is new, but there appears to be a greater sense of urgency and a realization that "securing China's tech supply chain" will necessarily entail reconfiguring the R&D system. While China's national planning document never distinguishes between civilian and defense RDIs, other government documents, and industry reports, defense RDIs are clearly targeted with very specific timetable for restructuring.[126]

Last, not only does the 14th FYP call for strengthening basic research, but it also entices all enterprises to play a greater role here.[127] The Chinese corporate sector has significant potential to contribute to China's innovation capacity, including in the realm of MCF. Enterprises account for roughly 77 percent of China's spending on R&D, a percentage that continues to climb each year.[128] But only a miniscule amount goes to basic R&D.[129] Even a relatively small shift of that enterprise R&D spending toward basic R&D would have a significant impact on China's innovative capabilities. Again, the undertones of MCF are clear here because many of the "supply chain vulnerabilities" that China is identifying as it rolls out the 14th FYP are areas enterprises are prominent players, including sectors with deeply dual-use and even overtly defense-related sectors (military-grade chips, rapid-response space capabilities, new materials, AI, robotics, etc.).

Defense SOEs: Defense enterprises are not specifically mentioned in the 14th FYP but they are an important part of China's SOE landscape with net assets over RMB 4 trillion.[130] As some of the most closed and monopolistic firms in China's economy, they are an important part of SOE reform, of which a push for mixed ownership and an enhancement of stock incentives are two that get most coverage in the 14th FYP and could have a big impact on the vitality of the defense industry.

---

125 The Chinese Academies of Science and Engineering, "Why Is it so Difficult to Be Elected as an Academician of the Two Academies? (当选两院院士为什么这么难？)," Sohu (搜狐). Xinhua Net (新华网), February 25, 2021, https://www.sohu.com/a/452671914_419916; "The Time Has Come for the Academician Co-Optation Process to Be Reformed! (院士增选流程到了必须进行改革的时候了！)," What to see today (今天看啥). Science Prize Center (科奖中心), February 23, 2021, http://www.jintiankansha.me/t/DKsCwN4eNU.

126 See, "Layout of the Defense Industry under the 14th FYP."

127 For instance, preferential tax treatment will be granted to encourage enterprises to increase R&D spending and China will continue to implement the policy of granting 75 percent extra tax deductions on enterprise's R&D costs while introducing a 100 percent deduction for manufacturing enterprises ("Layout of the Defense Industry under the 14th FYP").

128 China Power Team, "Is China a Global Leader in Research and Development?" China Power, January 31, 2018. Updated January 28, 2021, https://chinapower.csis.org/china-research-and-development-rnd/.

129 In Shenzhen, a center of corporate innovation, only 2 percent of R&D is spent on basic and applied research, the rest is spent on developmental R&D. *China Science and Technology Yearbook* (2018), (Beijing: China National Bureau of Statistics, 2018).

130 Total asset levels and profits can be drawn from company yearbooks as well as Fortune (财富), www.fortunechina.com/.

A continued push for mixed-ownership reform, as highlighted in Three-Year Action Plan for SOE Reform, drafted in late 2020, is meant to streamline the defense SOEs, improve efficiency and management, and reduce duplication. But it is also a means to consolidate and strengthen the sector, allow greater leverage of financial markets, and develop them into large, world-class firms.[131] Reform of the defense industrial base is about positioning its SOEs to be the leading pillars of China's new development model. The 14th FYP continues and even enhances a state-led approach, particularly regarding strategic emerging industry and S&T innovation progress, of which the defense SOEs comprise an important part.

A consolidation of the defense industry began in earnest during the 13th FYP with the formation of the China Aeroengine Corporation in 2016—spun off from Aviation Industry Corporation of China—followed by the merger of China's two nuclear industrial enterprises,[132] and in 2019, with the consolidation of the country's two state-owned shipbuilding conglomerates.[133] This shake-up of the defense sector is likely to continue into the 14th FYP. The country's two principal aerospace corporations—China Aerospace Science and Technology Corporation (CASC) and China Aerospace Science and Industry Corporation (CASIC)—signed a strategic cooperation agreement in August 2020[134] that could signal the first steps toward a merger of this industry. The agreement between CASC and CASIC calls for much closer cooperation in research, development, and production in emerging areas such as AI, big data utilization, environmental protection, energy conservation, and numerous civilian applications for the space sector.[135]

Another important measure that will propel reform in the Chinese defense industry is the expanded use of stock options for defense enterprise employees.[136] These measures allow the offering of stock incentives to a greater number of people in an enterprise and

131 "Report on the Implementation of the 2020 Plan."

132 "The Reorganization of Central Enterprises Adds Another Example of CNNC (央企重组再添一例 中核建划入中核)," Xinhua Net (新华网). Beijing News (新京报), February 01, 2018, http://www.xinhuanet.com/2018-02/01/c_1122350616.htm.

133 "The 'North and South Ship' Officially Merged with China Shipping Group and Set Sail ("南北船"正式合并 中国船舶集团启航)," Xinhua Net (新华网). Shanghai Securities News (上海证券报), October 26, 2019, http://www.xinhuanet.com/2019-10/26/c_1125154616.htm.

134 Chen, Li (陈立), "The Two Major Chinese Aerospace Groups Have Signed an Agreement on Deepening Strategic Cooperation (中国航天两大集团签署深化战略合作协议)," China Aerospace Science and Technology Corporation (中国航天科技集团有限公司). China Aerospace News (中国航天报), August 31, 2020, http://www.spacechina.com/n25/n2014789/n2414549/c2998607/content.html.

135 Chen, "The Two Major Chinese Aerospace Groups."

136 Li, Taoyang (黎韬扬), "AVIC Optoelectronics Has Carried out the Second Phase of Equity Incentive, and the Authorization List Has Loosened Policy Restrictions (中航光电开展二期股权激励，授权放权清单已松绑政策限制)," Citic Construction Investment Securities (中信建投证券), November 24, 2019, http://pdf.dfcfw.com/pdf/H3_AP201911251371064635_1.pdf.

at a higher amount. The State Council issued the "List of Authorized Decentralized State-Owned Assets Supervision and Administration Commission (2019 Edition)" in June 2019, which clarified the loosening of previous restrictions.[137]

Digitization: The pursuit of a wide array of digital technologies is seen as crucial in the 14th FYP to modernize China's traditional and new areas of manufacturing and industry. The list of key industries in the digital economy without exception have direct and potential dual-use application, and most of them are described as such in China's defense white paper.[138] These are described as technologies that are central to the "evolution toward informationized warfare and intelligent warfare." China's progress in digital and information platforms will have real impact on military capability from data storage, transmission, and analytics to situational awareness, encryption, sensors, simulation, war-gaming, and unmanned vehicles, to name a few.

But there is another less obvious aspect of the digital economy that is relevant to MCF, particularly regarding the defense industry and how digitization may play a role in how it operates in the Chinese economy. The recently published "Industry Internet Innovation and Development Action Plan (2021-2023)" (Industry Internet) fleshes out China's thinking.[139] In brief, this is a plan to build and apply a wide range of Internet and communications technologies and infrastructure to all of industry and manufacturing in order deeply integrate data across the entire supply ecosystem, secure information, interconnect supply and demand networks, and institute standards across sectors. This is a platform to make information flowing through industries and firms rapid and seamless. It has import implications for the defense sector because issues such as industry standards, market information asymmetry, procurement networks, and data management systems, have been central problems for MCF. Interestingly, some of the first pilot efforts for industrial Internet have come from the defense sphere.[140]

Domestic Circulation: Another important concept in the 14th FYP, is 'dual circulation,' or domestic and international markets, which places the former as central to China's

---

137 For instance, the China Great Wall Industry Corporation announced it would increase its total stock options to 1,000 employees (out of a workforce of 20,000)—the equivalent of 4.5 percent of the company's total capital (estimated at over RMB 51 billion). See, "Introduction of China Great Wall Asset Management Company (中国长城资产公司简介)," China Great Wall Asset Management Company (中国长城资产公司), http://www.gwamcc.com/ComProfile.aspx.

138 "…cutting-edge technologies such as artificial intelligence (AI), quantum information, big data, cloud computing, and the Internet of Things is gathering pace in the military field" ("China's National Defense in the New Era," The State Council Information Office of the People's Republic of China, July 2019).

139 "Interpretation of 'Industrial Internet Innovation and Development Action Plan' (2021-2023) （(《工业互联网创新发展行动计划（2021-2023 年）》解读)," Ministry of Industry and Information Technology, February 18, 2021, http://www.gov.cn/zhengce/2021-02/18/content_5587565.htm.

140 CASIC leads one such project: "Yuan Jie: Give Full Play to the Important Role of the Industrial Internet in Building a New Development Pattern (袁洁：着力发挥工业互联网在构建新发展格局中的重要作用)," *Pengpai News*, March 27, 2021, https://www.thepaper.cn/newsDetail_forward_11933228.

development strategy going forward and dovetails with MCF strategies. Prioritizing China's internal market to drive consumption and demand in goods and services, especially those of higher added value and higher technology, not only has implications for sustaining economic growth but is an important driver of innovation. Demand of high technology propels the supply of high technology. The 14th FYP is pinning its hopes on this virtuous cycle:

> We will rely on the strong domestic market, running through all the links from production and distribution to circulation and consumption, and form a higher-level dynamic balance in which demand drives supply and supply creates demand, and promote a virtuous cycle in the national economy.[141]

As important suppliers of many of many high-tech products in the Chinese economy, the defense industry—particularly in the fields of aviation, aerospace, and information communication technology sectors—has understood the opportunity for rapid development and innovation when these products have a huge domestic civilian market.[142] This has always been the case, but there seems to be a more conscious linkage between the economy, national development priorities, markets, and financial resources to drive dual-use sectors that will deliver clear dividends to China's military capabilities.[143] Sectors like commercial aviation, satellite-based Internet, navigation positioning, commercial space launch, and autonomous vehicles are all key dual-use programs the defense industry is lobbying. This demonstrates an important lesson: To make MCF take hold in terms of drawing broader civilian participation, the allure of a large, lucrative market is essential.[144]

---

141 14th Five-Year Plan, Article XII.

142 ICT sector: "Basic Electronic Components Industry Development Action Plan (2021-2023)"; aerospace: "The Beidou Navigation Industry in 2021: The Military and Civil Markets Will Blossom (北斗导航产业的 2021 年：军用、民用市场两开花)," Today Beidou (今日北斗). Northeast Securities (东北证券), January 04, 2021, http://jinribeidou.com/news/detail/f2576ef076c989610176cccd776a0369; Ren, Yueming (任悦鸣), "At the End of the 12th Meeting of the 2020 Strategic Work Conference, High-Quality Development Is the Top Priority to Enhance the Implementation of the Development Strategy (中国航天科工 2020 年战略工作会暨战略管理委员会第十二次会议闭幕 始终把高质量发展作为第一要务 持续增强发展战略执行力)," China Aerospace Science and Industry Company (中国航天科工), September 30, 2020, http://www.casic.com.cn/n12377419/n12378166/c17931566/content.html; aviation: https://www.hotbak.net/key/中国民用飞机制造行业发展现状及十四五规划报告 2020～2026 年.html; aeroengine: https://www.hotbak.net/key/中国航空发动机行业发展前景及十四五规划研.html; *Military Industry Report: The Logic of Military Industry Companies with Large Market Capitalization*, AVIC Securities, January 17, 2021.

143 Zhang, Chao (张超) and Dong Junye (董俊业), "Military Industry in the '14th Five-Year Plan' and Prospects for 2035" (军工"十四五"规划及 2035 年展望)," Netease (网易). Zhongguancun Blue Ocean Military-Civilian Integration Industry Promotion Association (中关村蓝海军民融合产业促进会), February 05, 2021, https://www.163.com/dy/article/G22F1TRM0514HGHU.html.

144 For instance, this report says there are now 123 private aerospace companies in China, making up 90 percent of aerospace firms domestically (no comment on size and capability), and 14 of the 20 satellite constellations planned

Mobilization: While the 14th FYP has little to say on national defense mobilization, it is important to view this issue in light of the revised National Defense Law, which took effect in January 2022.[145] With regard to technology and innovation, the National Defense Law is important because it emphasizes national coordination to mobilize both state-owned and private enterprises for the research, development, and production of conventional weapons, cybersecurity, space, and the electromagnetic spectrum.[146] But the more important result is that it significantly weakens the State Council in favor of the Central Military Commission, led by Chairman Xi, which now has full power to mobilize military and civilian assets to defend national interests both within China and abroad.[147] In the context of MCF as national strategy, we see a pattern of creating the institutions and legal underpinnings of a socioeconomic mobilization for greater military preparedness, and in general to better translate economic power into greater hard power.

Supply Chain Security: Supply chain security, while relatively new in China's five-year national development blueprint, is clearly articulated in the 14th FYP as a rallying concept for China's "new development pattern." The features of China's approach to securing industrial and innovation supply chains make it highly relevant to MCF. In the first place, China's notion of supply chains is highly expansive, with aims to capture the entire supply chain—from inputs of raw materials to goods, services, and technologies—in as many sectors as possible, both domestically and internationally. Moreover, its framing of supply chains is highly securitized. Not only does China desire supply chains that are independent and controllable, but it also wants to maintain them within China to the highest degree possible where they are most secure from outside influence. The focus on indigenous development of S&T is widely interpreted in China as a strong desire to address critical vulnerabilities in the supply chain.[148] Xi called for the nation to use countermeasures against foreign parties that cut off supply.[149] Lastly, the 14th FYP is

during the 14th FYP have been initiated by these private firms. Zhang, Jing (张静), "The Number of Chinese Private Space Enterprises."

145 The amendment makes significant changes, with a total of 54 articles revised, six added, and three deleted from the older version. Wang, Xinjuan, ed., "Revised National Defense Law to Take Effect in China on January 1, 2021," China Military Online, December 29, 2020, http://eng.mod.gov.cn/news/2020-12/29/content_4876134.htm.

146 Minnie Chan, "China's Military Takes Charge of War Powers with New Defence Law," *South China Morning Post*, January 3, 2021.

147 "Chinese President Xi Jinping Wrests Greater Control over China's Military; Revises National Defense Law." Free Press Journal, January 5, 2021. https://www.freepressjournal.in/world/chinese-president-xi-jinping-wrests-greater-control-over-chinas-military-revises-national-defense-law.

148 Amitendu Palit, "'Dual Circulation.'"

149 Xi, Jinping (习近平). "Several Major Issues Concerning the Country's Medium-Term and Long-Term Economic and Social Development Strategy (国家中长期经济社会发展战略若干重大问题)." Xinhua Net (新华网), October 31, 2020, http://www.xinhuanet.com/politics/leaders/2020-10/31/c_1126681658.htm.

a document that calls for the state and the entities under the state to play a central role in achieving a fuller capture and control of supply chains.[150]

The breadth and tone of the 14th FYP as a comprehensive mobilization of national resources to capture supply chains for economic and national security purposes is in essence a reformulation of MCF. When the drive for semiconductor development[151] or the push for commercial space launch[152] evokes the spirit of the "Two Bombs, One Satellite" program of the 1950s and 1960s, the line between military and civilian objectives is blurred as commercial and private enterprises are heavily engaged in these sectors.[153] Also, a homegrown, comprehensively captured and controlled supply chain fits in very well with the MCF strategy because many of the gaps or missing links in the supply chain are products and technologies of both civilian and military application.[154] Moreover, a higher level of autonomy in critical and sensitive technologies and a greater dependence on domestic markets as a driver of innovation make MCF easier to implement as the fear of international blowback for Chinese companies becomes less of a concern.

Hub-Centered Development: The 14th FYP contains a regional hub-centered approach to development for industry, but especially for China's S&T innovation economy. Several chapters go into detail about focusing China's economic energy on three regions: the Beijing-Tianjin-Hebei Corridor; the Lower Yangtze River Basin (Shanghai and surrounding cities); and the Greater Bay Region around Pearl River Delta (Guangzhou, Shenzhen, and Hong Kong).[155] The stated goals are to concentrate resources, improve sharing of technology and infrastructure, improve efficiency, and promote agglomeration effects. Previous FYPs placed far more emphasis on balancing development between the already

---

150 "We will give full play to the strategic supporting role of the state-owned sector, encourage the state-owned sector to further focus on functions such as strategic security, industry leadership, and the national economy…" 14th Five-Year Plan, Article XIX.

151 Cheng, Yue (诚阅), "US Media: China Is Betting on the Third Generation of Semiconductor, Reshaping Two Bombs and One Star Miracle! Lead U.S. Stocks to Plunge! (美媒：中国全力押注第三代半导体，重塑两弹一星奇迹！引美股暴跌！)," YouTube, September 05, 2020, https://www.youtube.com/watch?v=xmY4sosGwDM.

152 Cao, Xiuying (操秀英), "The Rocket Production Base Has Landed in Nansha, Guangzhou, Aiming to Build an Aviation Industrial Park (火箭生产基地落地广州南沙，旨在打造航天航空产业园)," China S&T Net (中国科技网). *S&T Daily* (科技日报), October 9, 2020, http://www.stdaily.com/index/kejixinwen/2020-10/09/content_1025911.shtml.

153 The "Two Bombs, One Satellite" program was China's drive to develop its own nuclear and space missile capabilities, recruiting China's top scientists, research institutions, and universities without military or civilian distinction.

154 One article by the Zhongguancun Blue Ocean Military-Civil Fusion Industry Promotion Association (中关村蓝海 军民融合产业促进会) points to 62 core technologies that are not "controlled" by China. See, "List of 62 Core Technologies That China Has yet to Control! (中国尚未掌控的 62 项核心技术清单！)," Netease (网易). Zhongguancun Blue Ocean Military-civilian Integration Industry Promotion Association (中关村蓝海军民融合产业促进会), September 16, 2020, https://www.163.com/dy/article/FMKD5TJK0514HGHU.html.

155 Chapters 30-32 and 61 all discuss regional concentration in these areas.

highly developed eastern coastal centers and the west and interior. Thus, this is a departure from past plans and may prove to have a mixed impact on MCF.

Given that these areas are China's most innovative centers—whether in terms of national labs, government RDIs, China's tech giants, or defense industrial base assets—the implications for MCF of a regional concentration of resources are broadly positive, particularly regarding leveraging the private sector to meet increasing military modernization demands. However, a substantial portion of the defense economy remains in the western and interior provinces—especially defense industry enterprises and the national MCF demonstration bases—a deliberate policy approach adopted since the early 2000s as an effort to leverage the defense industrial base for local development.[156] Thus, a reorientation to the coastal centers will come at some cost to MCF development in lesser developed western and interior portions of the national innovation system.

Conclusion

While the 14th FYP is mute on the express terminology of MCF used in the past, this document should not be read as a retreat from its goals. Rather, it is an acceleration of the national strategy. As this section describes, many of the specific themes in the plan are relevant to or are linked to MCF and defense modernization strategies. The wording is less direct to be sure, yet the approach weaves many of the nation's development goals holistically into a framework that is highly salient to MCF—upgrading basic R&D, security of supply chains, domestic demand, digitization, SOE and research institute reform, homegrown S&T, and greater capital market participation. Moreover, there is a more muscular tone to this FYP than previous ones. The 14th FYP talks of China aspiring to become a powerhouse in R&D, maritime domain, cyberspace, networks, sports, transportation, intellectual property, manufacturing, quality control, trade, talent and education, and culture. This is most pronounced in the concept of innovation, especially S&T innovation. Innovation has eclipsed economic growth as the central rallying concept of China's five-year planning. "We will adhere to the core position of innovation in China's overall modernization." With power and security, the defining themes of this FYP, a full mobilization of Chinese society's resources for economic, social, and security goals is at the very heart of MCF strategy.

[156] Initiatives to "develop the west" began in the early 2000s. See, Ceng, Xiaochun and Yun Ying, "Models of Joint Development of Defense Enterprises and Municipal and Township Economies in Western China—The Case Study of Shaanxi Province," Research on Development 3 (2005); Wan, Difang and Ceng Xiaochun, *Defense Technology Resource Utilization and Urbanization in China's Western Regions* (Beijing: Science Publishing House, 2009).

The Status of the 2021-2035 Medium- and Long-Term Science and Technology Development Plan

Preparatory work to support the drafting of the 2021-2035 MLP formally commenced in the fall of 2018. At the end of August 2018, the Chinese Academy of Sciences established eight specialized committees to examine key areas covering the MLP. On September 5, the central government launched its MLP planning efforts when the National Leading Group on Science and Technology System Reform and Innovation System Construction (国家科技体制改革和创新体系建设领导小组) convened its first meeting. Chaired by Vice-Premier Liu He, a report by MOST on proposals for the MLP was discussed and a decision was made that state agencies should "urgently study the preparatory work related to the development of the MLP".[157] On September 14, MOST held a seminar on "Research on the Thinking of the MLP" (国家中长期科技发展规划思路研究) that marked the official start of the MLP drafting process.

Numerous meetings and conferences were convened in subsequent months to ensure that the drafting of the MLP would be completed by the end of 2020 so it would be ready for adoption. On October 11, 2018, the National Science and Technology Management Systems Party Building Work Exchange Forum (全国科技管理系统党建工作交流座谈会) was held and MOST minister Wang Zhigang stressed the importance of preparing the MLP.[158] At the National Science and Technology Work Conference (全国科技工作会议) on January 9, 2019, Wang listed the preparation of the MLP as one of the top ten most important annual S&T tasks for the country.[159]

The formal drafting process for the MLP officially began on June 24, 2019 with the launch meeting (启动会) of the 2021-2035 Medium- and Long-Term S&T Development Plan. Xu Qiong, Director of the Strategic Planning Division of MOST, introduced the background, key tasks, and strategic research selection of the plan.[160] On July 12, MOST

---

157 "Liu, He: To Study the Development of National Medium- and Long-Term Science and Technology Development Plan Related to the Preparatory Work" (刘鹤：抓紧研究制定国家中长期科技发展规划的有关准备工作), *Chinese Government Net*, September 5, 2018, https://www.guancha.cn/politics/2018_09_05_470946.shtml.

158 "The Ministry of Science and Technology Held the 2018 National Science and Technology Management System Party Building Work Exchange Forum" (科技部召开 2018 年全国科技管理系统党建工作交流座谈会), *China Hunan Provincial S&T Department*, October 30, 2018, http://kjt.hunan.gov.cn/xxgk/gzdt/kjzx/201810/t20181030_5151638.html.

159 "2019 National Science and Technology Work Conference Held in Beijing" (2019 年全国科技工作会议在京召开), *National Science and Technology Innovation Center*, January 9, 2019, http://www.yidianzixun.com/article/0L3C3Fi5.

160 "The 2021-2035 National Medium- and Long-Term Science and Technology Development Plan Meeting Was Held" (2021—2035 年国家中长期科技发展规划研究编制工作启动会召开), Rui Dongyuan, June 25, 2019, http://www.yidianzixun.com/article/0MP9oX2J.

held a symposium with foreign experts to listen to their suggestions on China's future S&T development.[161]

A major week-long planning seminar under the auspices of the administrative office of the leading group responsible for the formulation of the MLP was held in July 2019. The seminar covered more than 30 major research topics and thousands of experts participated in the event.[162] In late September 2019, the Department of Strategic Planning at MOST released the "Research Catalogue of Major Issues in the MLP" and solicited public input. In November 2019, MOST selected 21 work units to conduct 20 research tasks in 15 research directions.

In January 2020, the annual National Science and Technology Work Conference was held and the preparation and release of the MLP was listed among the top ten annual tasks of MOST.[163] But with the outbreak and massive political, economic, and social upheavals caused by COVID-19 from January 2020 onwards, this led to significant disruption to the MLP drafting process, which is reflected in a sharp downturn in news reporting about MLP-related activities. There was little reporting about major MLP meetings and events until June 2020 when Wang Zhigang hosted a symposium on national medium- and long-term S&T development planning for veteran S&T workers. At the meeting, invited experts had the opportunity to provide their opinions and suggestions on the new MLP.[164]

Following the 5th Plenum at the end of October 2020, Wang Zhigang chaired a MOST party group meeting and stressed the need to strengthen the S&T planning system and continue with the urgent preparations of the MLP and 14th FYP for S&T Innovation.[165] This review of the numerous meetings, seminars, workshops, and other events between 2018 and 2020 offers a general overview of the different stages in the MLP formulation

161 "The Ministry of Science and Technology Held a Symposium on Foreign Experts in the Preparation of Scientific and Technology Planning" (科技部召开科技规划研究编制工作外国专家座谈会), Rui Keji, July 22, 2019, https://www.toutiao.com/i6716417833544188419/.

162 "In 2021-2035, Major Medium- And Long-Term Science and Technology Development Plans Were Held in Beijing" (2021—2035 年国家中长期科技发展规划重大专题集中研讨交流在京举行), Rui Keji, August 1, 2019, https://www.sohu.com/a/330878928_390536.

163 "The 2020 National Science and Technology Work Conference Was Held in Beijing" (2020 年全国科技工作会议在京召开), *Chinese Technology Net*, January 11, 2020, https://baijiahao.baidu.com/s?id=1655435952905164499&wfr=spider&for=pc.

164 "Wang Zhigang, Minister of Science and Technology, Presided over a Symposium for Old Scientific and Technology Workers" (科技部部长王志刚主持召开老科技工作者座谈会), *Department of Science and Technology*, July 1, 2020, http://www.most.gov.cn/kjbgz/202007/t20200701_157584.html.

165 "The Ministry of Science and Technology: We Will Promptly Formulate the Medium- and Long-Term Science and Technology Development Plan and the 14th Five-Year Science and Innovation Plan" (科技部：抓紧编制中长期科技发展规划和"十四五"科创规划), *Department of Science and Technology*, November 14, 2020, https://www.thepaper.cn/newsDetail_forward_9846670.

process. The initial launch phase to mobilize the scores of institutions and thousands of scientists, engineers, and bureaucrats to work on the MLP occurred from September 2018 to February 2019. This was followed by the strategic research phase from March to December 2019, which then turned into the text drafting, demonstration support, and approval phase between October 2019 to the end of 2020. While there is no official indication of when the MLP was approved by the Chinese government, it is very likely to have occurred in the first half of 2021, especially around the same time that the 14th FYP was officially adopted in March 2021.

There was little substantive news about the status of the MLP in the first half of 2021. On June 3, 2021, Xie Min, director of the Department of Policy, Regulations and Innovation System Construction at MOST, said at the 2021 Pujiang Innovation Forum that China would soon release a new MLP to further improve the national innovation system.[166] A month later, Wan Jinbo, a researcher at the CAS Institute for Strategic Consulting in Science and Technology, published an article in the *People's Daily* entitled "The Wisdom of the Great Party in Leading the Construction of a Strong State in Science and Technology (引领科技强国建设的大党智慧)" where he mentioned that a new MLP would be shortly released and implemented.[167] News reporting on the MLP once again dried up thereafter.

MLP Research Topics

The coverage of topics investigated for possible inclusion in the MLP was wide-ranging. The *Economic Information Daily* reported that an inter-agency leading group had be formed to oversee the preparatory research that was led by MOST with participation from 27 ministries, state commissions, and the State Council General Office.[168] At the start of the MLP preparatory process, a wide net was cast across 50 strategic research directions. This was subsequently reduced to 30 key topics that were sorted into seven major sections of the intended plan. These topics included nuclear power and reactor safety research, information technology and network security, complex service computing and AI, energy research, advanced manufacturing, material science, space technology, biotechnology, public security, urbanization and urban development, and oceanography (see Table 6).

[166] "China's Innovation Index Continues to Improve, and the Yangtze River Delta Has Built a Strategic Node of the Innovation System" (中国创新指数持续提升，长三角打造创新体系战略节点), *Tencent*, June 3, 2021, https://new.qq.com/omn/20210603/20210603A0DOFX00.html.

[167] "The Wisdom of the Great Party in Building a Strong Country in Science and Technology" (引领科技强国建设的大党智慧), *People's Daily,* July 5, 2021, http://www.xinhuanet.com/2021-07/05/c_1127622082.htm.

[168] "The National Mid- and Long-Term Science and Technology Development Plan Is Stepped up (国家中长期科技发展规划加紧编制)," People's Network (人民网), December 5, 2019, http://finance.people.com.cn/GB/n1/2019/1205/c1004-31491031.html.

Table 6. Selection of Thirty Research Topics Contained in the MLP Preparatory Research Agenda

Topics	Participants
Basic research on innate immunity and inflammation and application of tumor immunotherapy（天然免疫与炎症的基础研究、肿瘤免疫治疗应用研究）	Cao Xuetao (曹雪涛), Leader of Strategic Expert Group and Nankai University professor, and Academician of the Chinese Academy of Engineering [169]
Nuclear power, reactor safety research (核电、反应堆安全研究）	Zheng Mingguang (郑明光), Leader of Strategic Expert Group and Chief Engineer of Nuclear Energy, National Power Investment Group [170]
Information technology and network security（信息技术与网络安全）	Wu Jiangxing (邬江兴), Academician of the Chinese Academy of Engineering, expert in communication and information systems, Director of the China National Research Center for Digital Exchange Systems Engineering, Chairman of the China Network Information and Military Integration Alliance
Complex Service Computing & Artificial Intelligence（复杂服务计算&人工智能）	Wu Chaohui (吴朝晖) Expert in computer applications, Academician, Chinese Academy of Sciences[171]
Energy（能源）	Xia Dehong (夏德宏) Expert on Energy Saving and Environmental Protection New Technology, Clean Energy Development and Clean Energy Utilization[172]

169 "Cao Xuetao（曹雪涛)," Graduate School of Nankai University（南开大学研究生院), Accessed April 20, 2020, http://graduate.nankai.edu.cn/cxt/list.htm.

170 "China Nuclear Industry Engineering Design Master-Zheng Mingguang（中国核工业工程设计大师--郑明光)," China Nuclear Industry Survey and Design Association（中国核工业勘察设计协会), December 3, 2018, http://www.cnida.cn/a/dashifengcai/252.html.

171 "Wu Chaohui (吴朝晖)," Zhejiang University Teacher Homepage (浙江大学教师个人主页). Accessed April 20, 2020, https://person.zju.edu.cn/wuzhaohui.

172 "Xia Dehong (夏德宏)," School of Energy and Environmental Engineering, University of Science and Technology Beijing (北京科技大学能源与环境工程学院). Accessed April 20, 2020, http://seee.ustb.edu.cn/shiziduiwu/quantijiaoshi/2018-10-24/111.html.

Topics	Participants
Advanced Manufacturing （先进制造）	
Material science （材料科学）	
Space technology （空天技术）	
Modern services （现代服务业）	
Life and Health （生命与健康）	Chen Kaixian (陈凯先), Pharmaceutical chemist specializing in drug design and new drug research[173]
Biology (生物学): 7 sub-areas of frontier biotechnology, biomedical technology, bio-agriculture technology, bio-manufacturing technology, bio-resource technology, bio-information technology, and biosafety technology[174]	Zhan Qimin (詹启敏), Expert in molecular biology and cancer transformation medicine[175])
Population Health （人口健康）	
Public Security （公共安全） [176]	
Urbanization and urban development （城镇化与城市发展） [177]	
Oceanography （海洋学） [178]	

[173] "Chen Kaixian (陈凯先)," Hong Kong Baptist University (香港浸会大学). Accessed April 20, 2020, http://www.hkbu.edu.hk/sch/about/honlist/2013_hondoc_ChenKaixian.jsp.

[174] "The National Medium- and Long-Term Scientific and Technological Development Plan Biological Strategic Research Work Conference Held in Beijing (国家中长期科技发展规划生物领域战略研究工作会议在京召开)." China Biotechnology Development Center (中国生物技术发展中心), May 28, 2019. http://www.cncbd.org.cn/News/Detail/8444.

[175] "Zhan Qimin (詹启敏)," Peking University School of Medicine (北京大学医学部). Accessed April 20, 2020, http://www.bjmu.edu.cn/xbgk/xrld/dcc61ea3227844fe843a38ad808948ee.htm.

[176] "2021-2035 The National Medium- and Long-Term Science and Technology Development Planning Strategy Research Social Development Sector Kick-off Meeting Was Held in Beijing (2021-2035 年国家中长期科技发展规划战略研究社会发展板块启动会在北京召开)," Ministry of Science and Technology (科技部), April 18, 2019, http://www.most.gov.cn/kjbgz/201904/t20190418_146116.htm.

[177] "2021-2035 The National Medium- and Long-Term Science and Technology Development Planning Strategy Research."

[178] "2021-2035 The National Medium and Long-Term Science and Technology Development Planning Strategy Research."

The Strategic Planning Department at MOST issued a 2021-2035 MLP Major Topics Research Catalogue in September 2019 that solicited bids for 20 research tasks to universities and think tanks. Many of the research topics put forward addressed policy and social science issues rather than technical issues (see Table 7).

Table 7. MLP-Awared Research Topics Conducted By Universities and Research Institutes[179]

Research on the Vision of China's Economic and Social Development in 2035 (面向 2035 年我国经济社会发展愿景及科技需求研究)	National Information Center （国家信息中心） and Nankai University （南开大学）
Research on Global Science, Technology, and Innovation Trends and Changes to Global Competition Facing 2035 (面向 2035 年全球科技创新趋势与竞争格局变化研究)	Shanghai Institute of Science （上海市科学学研究所）
Research on Global Innovation Paradigm Change Toward 2035 (面向 2035 年的全球科技创新范式变革研究)	Tongji University （同济大学）
Study on Measures to Improve the National Innovation Ecosystem in 2035 (面向 2035 年完善国家创新生态体系的措施研究)	Huazhong University of Science and Technology （华中科技大学）
Research on Measures to Improve the National Innovation System in 2035 (面向 2035 年完善国家创新体系的措施研究)	China Institute of Engineering Physics Strategic Research Center （中国工程物理研究院战略研究中心）
Research on Modern Economic System for Science and Technology Innovation Support in 2035 (面向 2035 年科技创新支撑现代化经济体系研究)	Institute of Science and Technology Strategic Consulting, Chinese Academy of Sciences （中国科学院科技战略咨询研究院）
Strengthening Basic Research and Original Innovation for Enterprises From	Beijing University of Chemical Technology （北京化工大学）

179 "2021-2035 National Mid- and Long-Term Science and Technology Development Plan Announcement on Major Issues for Social Collection Research Units (2021—2035 年国家中长期科技发展规划面向社会征集研究单位开展重大问题研究公告)," Ministry of Science and Technology (科技部), September 30, 2019, http://www.most.gov.cn/tztg/201909/t20190930_149075.htm.

0 to 1 by 2035 (面向 2035 年加强企业从 0 到 1 基础研究和原始创新的措施研究)	
Research on Measures to Promote Innovation and Development of Small- and Medium-Sized Technological Enterprises in 2035 (面向 2035 年促进科技型中小企业创新发展措施研究)	Capital University of Economics and Trade （首都经济贸易大学）
Research on Precision-Effective-Continuous Investment Mechanism for Scientific and Technological Innovation Diversification in 2035 (面向 2035 年科技创新多元化的精准-有效-持续投入机制研究)	Wuhan University of Technology （武汉理工大学）
Research on the Incentive Mechanism for Young Scientific and Technological Talents in China in 2035 (面向 2035 年我国青年科技人才激励机制研究)	Shanghai Research and Development Public Service Platform Management Center （上海研发公共服务平台管理中心）
Research on the Incentive Mechanism for Young Scientific and Technological Talents in China in 2035 (面向 2035 年我国青年科技人才激励机制研究)	Shanghai Jiao Tong University （上海交通大学）
Research on the Trends and Measures of Regional Science and Technology Development and Collaborative Innovation in 2035 (面向 2035 年区域科技发展与协同创新趋势及措施研究)	Tianjin Institute of S&T, China Association for S&T Policy Research Regional Innovation Committee （天津市科学学研究所、中国科学学与科技政策研究会区域创新专业委员会）
Research on the Measures of Science, Technology, and Innovation for Regional Coordinated Development in 2035 (面向 2035 年科技创新促进区域协调发展的措施研究)	Beijing Great Wall Strategic Institute （北京市长城战略研究所）
Research on Intellectual Property System for Stimulating Science and Technology Innovation in 2035 (面向 2035 年激励科技创新的知识产权制度研究)	University of Chinese Academy of Sciences （中国科学院大学）
Research on the Social Influence and Countermeasures of Scientific and	Southeast China University （东南大学）

Technological Innovation in 2035 (面向 2035 年科技创新对社会的影响及对策研究)	
Research on Ethical Issues and Countermeasures for Scientific Research in 2035 (面向 2035 年的科研伦理问题与应对措施研究)	Beijing Center for Scientific Research （北京科学学研究中心）
Strengthening Research on Ethics Construction of Scientific Research in 2035 (面向 2035 年加强科研伦理建设研究)	Southwest University of S&T （西南科技大学）
Research on the Governance System of Scientific and Technological Innovation and the Modernization of Governance Ability Facing 2035 (面向 2035 年科技创新治理体系和治理能力现代化研究)	Institute of S&T Strategic Consulting, Chinese Academy of Sciences （中国科学院科技战略咨询研究院）
Research on Building a Community of Science and Technology Innovation for Human Destiny in 2035 (面向 2035 年科技创新促进人类命运共同体构建研究)	Institute of Technology of South China （华南理工大学）

A number of special MLP study groups were also established to organize and conduct research in key areas. A selection of these groups is listed in Table 8 and cover basic science, investment and management mechanisms for S&T funds, agricultural development, public security, intellectual property and technical standards development, cross frontier and disruptive innovation research, and industrial synthetic biology.

Table 8. Special MLP Study Groups

Date of Establishment	Study Group Name or Area of Study
April 2019	Social Development Sector (社会发展板块)[180]
April 2019	Research on the investment and management mechanism of S&T funds to 2035 (面向 2035 年科技资金投入与管理机制研究)[181]
April 2019	Special topics on the strategic development of basic science (基础科学发展战略研究专题)[182]
April 2019	Agriculture and the countryside (农业农村)[183]
April 2019	Food (食品)[184]
May 2019	Layout and Conditions for National Innovation Platform Construction to 2035 (面向 2035 年的国家创新平台布局及条件建设专题)[185]
May 2019	Population and health (人口健康)[186]

180 "2021-2035 Social Development Launch Meeting of National Medium- and Long-term Science and Technology Development Planning was held in Beijing" (2021-2035 年国家中长期科技发展规划战略研究社会发展板块启动会在北京召开), Rui Keji, April 17, 2019, http://www.yidianzixun.com/article/0LlyMhiQ.

181 "The 2035 Science and Technology Capital Investment and Management Mechanism Research Launch Meeting Was Successfully Held" (面向 2035 年科技资金投入与管理机制研究启动会顺利召开), Strategy and Policy Forum, April 24, 2019, http://www.yidianzixun.com/article/0LpYguRl.

182 "The Research on Basic Science Development Strategy of National Science and Technology Development Plan from 2021-2035 Was Launched in Beijing" (2021-2035 年国家中长期科技发展规划基础科学发展战略研究专题在京启动), Rui Keji, April 30, 2019, https://www.163.com/dy/article/EE150KPP051494VN.html.

183 "In 2021-2035, the National Medium- and Long-Term Science and Technology Development Planning Strategic Research on Agriculture and Food Was Held in Beijing" (2021-2035 年国家中长期科技发展规划战略研究农业农村、食品两个专题启动会议在京召开), *Department of Science and Technology,* April 28, 2019, http://news.foodmate.net/2019/04/516096.html.

184 "In 2021-2035, the National Medium- and Long-Term Science and Technology Development."

185 "The 2035 Special Strategic Launch Conference on the Layout and Conditions Construction of the National Innovation Platform Was Held" (面向 2035 年的国家创新平台布局及条件建设专题战略研究启动会召开), China Hunan Provincial S&T Department, May 22, 2019, http://kjt.hunan.gov.cn/xxgk/gzdt/kjzx/201905/t20190522_5340047.html.

186 "China Biotechnology Development Center Held a Seminar on the Strategy of Health Promotion (Including Disability) in National Medium- and Long-Term Science and Technology Development Plans" (中国生物技术发展中心召开国家中长期科技发展规划健康促进（包括残疾）领域战略研讨会), China Biotechnology Development Center, May 20, 2019, http://www.cncbd.org.cn/News/Detail/8418.

May 2019	Public security (公共安全)[187]
May 2019	Intellectual Property and Technical Standards strategy (知识产权和技术标准战略)[188]
May 2019	Cross Frontier and Disruptive Innovation Research Topics (交叉前沿与颠覆性创新研究专题)[189]
May 2019	Industrial synthetic biology (工业合成生物学)[190]
July 2019	Strategic development topics in material S&T for 2035 (面向 2035 年的材料领域科技发展战略专题)[191]

Media Coverage of the MLP Drafting Process

Media coverage of MLP-related issues by mainland-based news organizations began to gain momentum in the first quarter of 2019 with more than 1,100 articles published (see Figure 1), although many of them are likely to be reprints from news reports issued by Xinhua News Agency or media releases from government agencies. News coverage peaked in the second quarter of 2020 with more than 4,000 MLP-related news articles, although there was also considerable media attention in the fourth quarter of 2020 with more than 3,300 news items. Media coverage fell significantly in 2021, dropping to below 800 in the third quarter of 2021.

187 "Academician Yuan Liang Attended the Special Research Conference on the National Medium- and Long-term Science and Technology Development Planning Strategy in the Field of Public Security" (袁亮院士出席公共安全领域国家中长期科技发展规划战略专题研究会), Anqing Net, May 16, 2019, http://www.ahyouth.com/news/20190516/1380781.shtml.

188 "The First Plenary Expert Group Meeting Was Held on the Topic of 'Intellectual Property and Technical Standards Strategy' of the National Medium- and Long-term Science and Technology Development Plan in 2035" (面向 2035 年国家中长期科技发展规划战略研究"知识产权和技术标准战略"专题第一次全体专家组会议召开), Tonghuashun Finance, May 15, 2019, https://www.toutiao.com/i6691200400445407757/?wid=1629094239836.

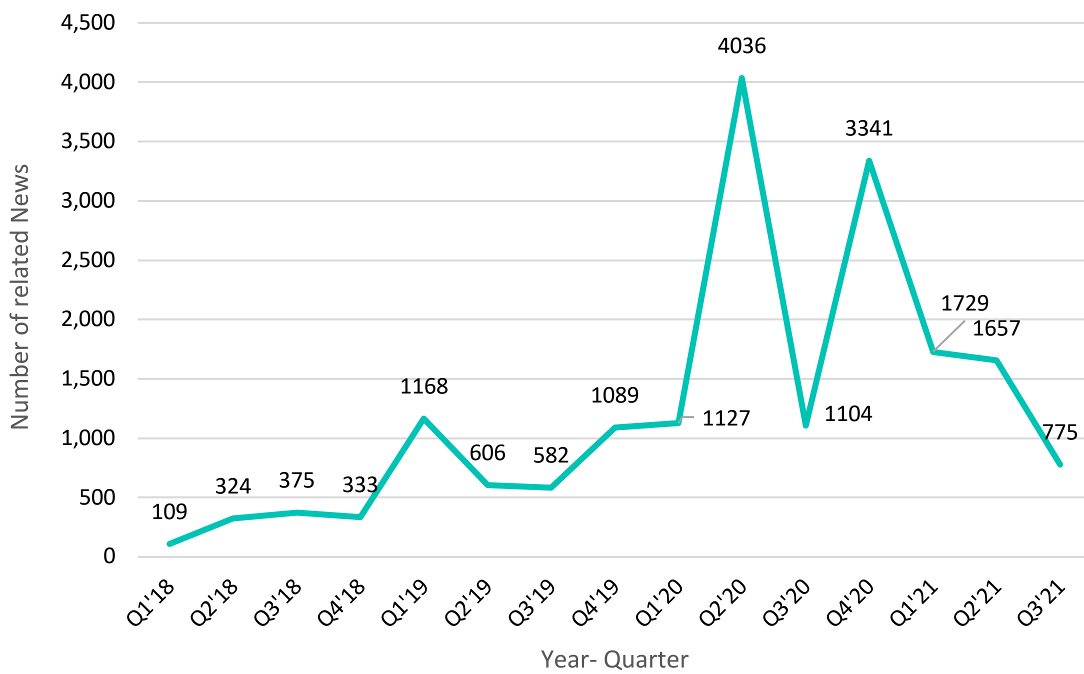
189 "The Biological Center held an expert seminar in the field of stem cell and transformation research in the national medium- and long-term science and technology development planning" (生物中心召开国家中长期科技发展规划干细胞及转化研究子领域专家研讨会), Department of Science and Technology, July 5, 2019, https://kjt.shaanxi.gov.cn/kjzx/kjyw/87293.html.

190 "2021-2035 National Medium- and Long-term Science and Technology Development Planning was held in Jiangnan University" (2021-2035 国家中长期科技发展规划工业合成生物学领域战略研究研讨会在江南大学召开), Jiangnan University, 29 May 2019, https://www.toutiao.com/i6696370025751642632/.

191 "The 2035 Science and Technology Development Strategy in the Field of Materials Was Held in Beijing" (面向 2035 年的材料领域科技发展战略专题研究开题会在京召开), Electronic information industry, July 16, 2019, https://www.163.com/dy/article/EK7N5RPQ05348BNH.html.

These trends indicate that the Chinese authorities were keen to publicize MLP drafting work during 2020 as the plan was nearing its conclusion, but sought to dampen public interest in 2021 as it appeared that the open release of the plan was under review. The fact that there is still media coverage of the MLP in 2021, albeit at reduced levels, suggests that the authorities have not sought to impose a complete information blackout on the plan, which means that there is still a possibility that the MLP may eventually be publicly issued.

Figure 1. Trends in News Coverate of MLP over Time from 2018 to 2021



Date range: 2018-01-01 to 2021-08-16
Data Source: Wisesearch

14^{th} Five-Year Plan for National Informatization and 2022 National S&T Conference

The National Informatization 14^{th} Five-Year Plan (NI 14^{th} FYP; 十四五"国家信息化规划) was issued by the Central Cyberspace Affairs Commission (中共中央网络安全和信息化委员会) in December 2021 and provides top-level guidance for China's digital development to the mid-2020s. The overarching goal of the plan is to have made "decisive progress" in the implementation of the "Digital China" initiative by 2025, which is spelled out in six areas: 1) the level of informatization will have been "elevated significantly"; 2) digital infrastructure will have been "comprehensively consolidated"; 3) digital technology innovation capabilities will have been significantly enhanced; 4) the value of data will have been fully utilized; 5) the high-quality development of digital economy will have been achieved; and 6) the overall efficiency of digital governance will have been greatly improved."

Numeric goals were also outlined in the NI 14^{th} FYP, but it was pointed out that these goals are "anticipated" (预期性) and not "binding" (约束性). The numeric goals are focused in four areas: digital infrastructure, innovation capability, industrial transformation, and government services.

The plan also calls for the pursuit of ten major tasks:

1. Building a ubiquitous intelligent connected digital infrastructure system featuring 5G applications and R&D of next generation 6G.
2. Establishing an efficient data element resource system.
3. Building an innovative development system for digital productivity.
4. Cultivating an advanced and secure digital industrial system.
5. Building an industrial digital transformation development system.
6. Building a digital social governance system.
7. Creating a collaborative and efficient digital government service system.
8. Building an inclusive and convenient digital livelihood support system.
9. Expanding a mutually beneficial and win-win international cooperation system in the digital domain.
10. Establishing and improving a standardized and orderly digital development governance regime.

To achieve these major tasks, the plan lists 17 key projects that will be undertaken over the next five years:[192]

1. 5G Innovative Applications Project
2. "Intelligent Networking" Facility Construction and Applications Promotion Project
3. National Integrated Big Data Center System Construction Project
4. Construction and Application of Multi-Dimensional Space, Earth, and Oceans Network Demonstration Project
5. Data Element Market Cultivation Project
6. Big Data Application Improvement Project
7. Core Information Technology Breakthrough Project
8. Information Technology Intellectual Property and Standardization Innovation Project
9. Information Technology Industrial Ecology Cultivation Project
10. Manufacturing Digital Transformation Project
11. Information Consumption Expansion and Quality Improvement Project
12. Smart Public Security Construction and Improvement Project
13. Artificial Intelligence Social Governance Experimental Project
14. Emergency Management Modernization Improvement Project
15. National Integrated Government Service Improvement Project
16. Digital Public Service Optimization and Upgrading Project
17. "Digital Silk Road" Joint Construction and Sharing Project

When the NI 14th FYP was released, Central Cyberspace Affairs Commission officials held a press conference and provided background to the drafting process. They pointed out the plan was drawn up under external and domestic circumstances that were "complex and undergoing profound changes." They noted that the global economy was going through accelerating digital transformation that meant that competition in the digital domain was increasingly fierce. Domestically, China was entering a stage of high-quality

---

[192] Central People's Government of the People's Republic of China (中华人民共和国中央人民政府) and Cyberspace Administration of China General Office (中央网络安全和信息化委员会办公室), *National Informatization 14th Five Year Plan* (十四五"国家信息化规划), December 28, 2021, http://www.gov.cn/xinwen/2021-12/28/content_5664873.htm.

development, but the level of informatization development was still viewed as unbalanced and insufficient to meet actual needs and the digital governance regime was urgently in need of upgrading.[193]

Besides the NI 14th FYP, the central authorities have also drawn up two other 14th five-year sub-plans addressing the development of China's digital and informatization capabilities. They are the Digital Economy 14th FYP (DE 14th FYP) and New Infrastructure Construction 14th FYP (NIC 14th FYP). In addition, the "Internet Plus" initiative is another key component of the medium- and long-term planning approach for digital and informatization development. An article in the *Economic Information Daily* (经济参考报) in March 2021 pointed out that the NI 14th FYP was intended to support the implementation of the DE 14th FYP and NIC 14th FYP.[194] Key priorities of the NIC 14th FYP include the construction of a national integrated big data center collaborative innovation system, facilitating the large-scale deployment of 5G networks, and promoting the mass deployment of IPv6 applications.[195]

National Science and Technology Work Conference

The National Science and Technology Work Conference was held in Beijing on January 6, 2022. S&T minister Wang Zhigang (王志刚) delivered the working report and newly promoted MOST vice-minister Zhang Yudong (张雨东) chaired the meeting.[196] Zhang, an optics expert, is regarded as a candidate to take over from Wang as MOST minister.[197]

Wang highlighted a number of major achievements in 2021: [198]

1. The short-, medium-, and long-term strategic planning layout for China's science, technology, and innovation development has been accomplished with

---

[193] "Relevant Officials from the Cyberspace Administration of the CPC Central Committee Answered Reporters' Questions on the 14th Five-Year National Information Plan (中央网信办有关负责同志就《"十四五"国家信息化规划》答记者问)," Cyberspace Administration of China (中央网络安全和信息化委员会办公室). Cyberspace Administration Net (中国网信网), December 27, 2021, http://www.cac.gov.cn/2021-12/27/c_1642205312620820.htm.

[194] Guo, Qian (郭倩), "A Number of Heavy Policies Are Landing in the Digital Economy Exceeds 60 Trillion Yuan of Market Space to Start (多项重磅政策落地在即 数字经济超 60 万亿市场空间待启)," China Financial Net (中国财经网). Economic Information Daily (经济参考报), March 30, 2021, http://finance.china.com.cn/news/20210330/5533547.shtml.

[195] Guo, Qian (郭倩), "A Number of Heavy Policies."

[196] "The 2022 National Science and Technology Work Conference Was Held in Beijing (2022 年全国科技工作会议在京召开)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府). Ministry of Science and Technology (MOST), January 7, 2022, http://www.gov.cn/xinwen/2022-01/07/content_5666813.htm.

[197] "Up-to-Date! Zhang Yudong, an Optical Expert, Served as Vice Minister of Science and Technology (最新！光学专家张雨东出任科技部副部长)," Science Net (科学网), August 9, 2021, https://news.sciencenet.cn/htmlnews/2021/8/462887.shtm.

[198] "The 2022 National Science and Technology Work Conference Was Held."

the formulation of the 2021-2035 MLP and the 14th FYP for S&T as well as associated plans.

2. The capabilities of the S&T system have been significantly expanded with the accelerated construction of the national laboratory system and the completion of plans to reorganize the state key laboratory system.
3. Major progress has been made in basic research and critical core technology research, including the formulation of a Ten-Year Plan for Basic Research (基础研究十年规划) and the start of work on the implementation of more than 70 critical special projects (重点专项) (see Table 9).
4. Efforts to integrate S&T development with broader socioeconomic development have made important advancements, which include rollout of 5G networks and the development of the AI industry.
5. Beijing, Shanghai, and the Guangdong-Hong Kong greater bay area rank among the country's top ten S&T clusters.
6. Major momentum in S&T reform efforts took place in 2021 with the issuance of a three-year plan for S&T system reform (科技体制改革三年攻坚方案), the adoption of new mechanisms for S&T project management, and the continuing reform of S&T research fund management.
7. International S&T cooperation continued to move forward.

The S&T work conference pointed out that the Central Economic Annual Work Conference, which is the country's top-level economic meeting, had stressed the importance of implementing S&T priorities when it convened in December 2021.[199] The S&T work conference identified a number of key work priorities for 2022: [200]

1. Comprehensively promote the implementation of S&T planning tasks and better promote the role of strategic guidance.
2. Implement Ten-Year Plan for Basic Research and undertake critical core technology research.
3. Promote effective operationalization of the national laboratory system and play a leading role in strategic S&T development and complete reorganization of national key laboratories.

---

[199] Note: Xi adjusted the positioning of S&T management from "focusing on strategy, planning, policy, and service" to "focusing on strategy, reform, planning, and service." See also Chen, Jin (陈劲) and Chen Yuanzhi (陈元志), "We Will Improve the Management Level of Scientific and Technological Innovation in the New Era with the 'New Four Efforts' (以"新四抓"提升新时代科技创新管理水平)," *S&T Daily* (科技日报), August 23, 2021.

[200] "The 2022 National Science and Technology Work Conference Was Held."

4. Strengthen the dominant position of enterprises in the innovation process.
5. Accelerate S&T research and the application of its results.
6. Facilitate S&T to support reaching carbon neutrality and accelerate the transition to green low-carbon technologies.
7. Accelerate the construction of international and regional science, technology, and innovation centers.
8. Implement the Three-Year S&T System Reform Plan, focusing on the promotion of reform measures in the "new whole of national team" platform and project funding management.
9. Focus on accumulating strategic human talent power, promoting the training and use of strategic scientists, cultivating young S&T talents, and constructing high-level innovation teams.
10. Explore ways to enhance S&T cooperation and actively participate in global S&T governance.[201]

An article in the *S&T Daily* on January 6, 2022, stressed that 2022 is a crucial year in beginning the implementation of the 2021-2035 MLP and the 14th FYP for S&T Innovation. The article pointed out that the Central Economic Work Conference had made S&T policy one of the country's seven major policy priorities for the first time.[202]

A key task for MOST in 2022 is to strengthen the building of national strategic S&T capabilities, especially scientific and engineering teams. A key priority is the construction of a "national laboratory system with Chinese characteristics." Select national laboratories will constitute the core and national key laboratories will provide a crucial supporting role. A second task is to promote the development of universities and research institutes.

In basic research, MOST will focus on four issues: 1) finalize the layout of a national S&T basic research system; 2) train and cultivate a world-class basic research talent team; 3) increase investment in basic research; and 4) create an optimal ecosystem for basic research.

---

[201] "The 2022 National Science and Technology Work Conference Was Held."

[202] Commentator of S&T Daily (科技日报评论员), "We Will Ensure the Solid Implementation of Science and Technology Policies, and Accelerate the Realization of High-Level Independence and Self-Improvement in Science and Technology (确保科技政策扎实落地，加快实现高水平科技自立自强)," Chinese S&T Net (中国科技网). *S&T Daily* (科技日报), January 6, 2022, http://www.stdaily.com/index/kejixinwen/2022-01/06/content_1244574.shtml.

MOST is also looking to strengthen the role played by enterprise innovation, especially focusing on three areas: 1) improving the regulatory and policy environment; 2) playing a leading role in developing national and high-tech innovation zones; and 3) improving the R&D capabilities of major enterprises.[203]

Table. 9. List of 73 Critical Special Research Projects

	Critical Special Projects
20 Projects Listed in 13th FYP National Key Research and Development Program 2021 Annual Project Declaration Guide[204]	1. Chinese medicine modernization research
	2. Green bio-manufacturing
	3. High quality and high yield of major economic crops and industrial quality and efficiency of science and technology innovation
	4. Major natural disaster monitoring and early warning and prevention (cultural heritage protection and utilization tasks)
	5. Public security risk prevention and control and emergency technology and equipment
	6. Strategic science and technology innovation cooperation
	7. Intergovernmental international science and technology innovation cooperation
	8. Key scientific issues of transformative technologies
	9. Solid waste resourcing
	10. Causes of site soil contamination and treatment technologies

[203] Zhao, Yongxin (赵永新) and Gu Yekai (谷业凯), "We Will Make Solid Implementation of Science and Technology Policies - Visiting the Party Secretary of the MOST (推进科技政策扎实落地——访科技部党组书记、部长王志刚)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府). *People's Daily* (人民日报), December 23, 2021, http://www.gov.cn/xinwen/2021-12/23/content_5664089.htm.

[204] "Summary of the 2021 Annual Project Application Guidelines for Key Projects of the 13th Five-Year National Key R&D Program (十三五国家重点研发计划重点专项 2021 年度项目申报指南汇总)," June 17, 2021, https://www.sciping.com/36090.html.

	11. Reproductive health and prevention and control of major birth defects
	12. Manufacturing basic technologies and key components
	13. Network collaborative manufacturing and smart factory
	14. Comprehensive transportation and intelligent transportation
	15. Gravitational wave detection
	16. Synthetic biology
	17. Developmental programming and its metabolic regulation
	18. S&T Winter Olympics
	19. Green and livable village and town technology innovation
53 Projects Listed in 14th FYP National Key Research and Development Program 2021	1. Chinese medicine modernization research
	2. Green bio-manufacturing
	3. High quality and high yield of major economic crops and industrial quality and efficiency of science and technology innovation
Annual Project Declaration Guide[205]	4. Basic research on the formation of important traits and environmental adaptability of agricultural organisms
	5. Agricultural biological germplasm resources mining and innovative utilization
	6. S&T innovation for improving the capacity of low- and middle-yielding fields in the arid and semi-arid north and southern red and yellow soils
	7. S&T innovation of black land protection and utilization

[205] "Summary of the 2021 Annual Project Application Guidelines for Key Special Projects of the 14th Five-Year Plan (十四五国家重点研发计划重点专项 2021 年度项目申报指南汇总)," May 15, 2021, https://www.sciping.com/35879.html.

	8. Agricultural surface source, heavy metal pollution prevention and control, and green input research and development
	9. Research, development, and demonstration of integrated technology for prevention and control of major pests and diseases
	10. New breeds of livestock and poultry breeding and modern pasture science and technology innovation
	11. Animal disease prevention and control key technology research and development and application
	12. Forestry germplasm resources cultivation and quality improvement
	13. Key technology for factory agriculture and intelligent agricultural machinery and equipment
	14. Food manufacturing and agricultural logistics science and technology support
	15. Rural industry common key technology research and development and integrated application
	16. Research on pathogenesis and epidemic prevention technology system
	17. Integrated management of water resources and water environment in key basins such as Yangtze River and Yellow River
	18. Biosafety key technology research
	19. Reproductive health and women's and children's health protection
	20. Strategic mineral resources development and utilization
	21. Medical treatment equipment and biomedical materials
	22. Biological and information integration (BT and IT integration)

	23. Research on the prevention and treatment of common multi-morbidity
	24. Social governance and intelligent social science and technology support
	25. Prevention and control of major natural disasters and public security
	26. National quality infrastructure system
	27. Basic scientific research conditions and major scientific instruments and equipment research and development
	28. New display and strategic electronic materials
	29. Rare earth new materials
	30. Advanced structure and composite materials
	31. High-end functional and intelligent materials
	32. Cyberspace security governance
	33. Intelligent sensors
	34. High-performance manufacturing technology and major equipment
	35. Industrial software
	36. Earth observation and navigation
	37. Culture, technology, and modern service industry
	38. Information photonics technology
	39. High performance computing
	40. Multimodal networks and communications
	41. Blockchain
	42. Hydrogen energy technology
	43. Energy storage and smart grid technology
	44. Transportation infrastructure

	45. New energy vehicles
	46. Mathematics and applied research
	47. Stem cell research and organ repair
	48. Nano-frontiers
	49. Biomolecules and microbiomes
	50. Regulation of physical state
	51. Catalysis science
	52. Engineering science and integrated intersection
	53. Frontiers of large scientific devices

Part Three: Important Related Plans and Strategies

This section conducts a detailed examination of three case studies of important Chinese industrial policy and innovation initiatives. They are the Strategic Emerging Industries (SEI) Initiative, industrial policy efforts to support the development of the semiconductor sector since the late 2010s, and the Science, Technology, and Innovation 2030 (STI 2030) plan.

Strategic Emerging Industries: From Opportunism to Central Planning

The SEI Initiative is the work horse of Chinese industrial policy. Other initiatives have come and gone, but SEIs have endured and have been arguably the major focus of China's industrial policy for more than a decade. The first coherent SEI program was elaborated in 2010-2011 and rolled into China's 12th FYP (2011-2015). Today, SEIs still have pride of place and were given their own section (Section 9) in the 14th FYP.

In order to maintain this central role, SEIs have been continuously adapted as new ideas seize the imagination of Chinese policymakers. In its first incarnation, the SEIs were a response to perceived opportunity in sectors newly emerging on a global scale. The SEIs were then reshaped in 2016 to conform with the IDDS. This second incarnation was more coherent and internally consistent, but also more government-dominated than the initial version. Finally, in 2020, a third incarnation of the SEIs program was rolled out, incorporating still more government direction that was designed to respond to the technological challenge from American sanctions.

The successive incarnations of the SEI program reveal a great deal about the changing strategic rationale for Chinese industrial policy and the increasing role of direct government intervention in the economy. This case study describes the three incarnations of SEI policy—including the broad targets and changing definitions of that policy—and analyzes the role of firms and local governments as key actors in the program.

Three Incarnations of SEIs

Phase 1

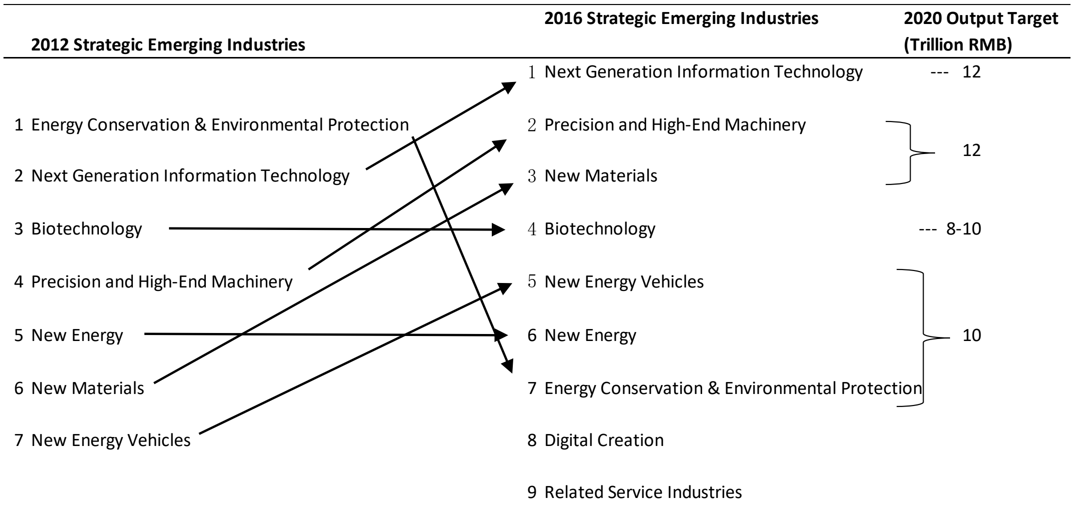
SEIs grew out of the "megaprojects" initiative, which initiated Chinese industrial policy in 2006. Many megaprojects were ramping up when the global financial crisis (2008-2009) hit China. As part of its crisis response, China rolled out a short-term industrial policy designed to shore up crisis-hit industries, especially traditional industrial sectors such as steel and automotive. As the crisis moderated, Chinese policymakers quickly saw the necessity—and opportunity—of shifting support toward high-technology, potentially high-growth sectors. During 2010, an intensive effort was made to bring together a coherent program, the SEI Initiative. The official program coalesced into seven large SEIs, and the detailed first "edition" of the SEI Initiative was formalized in 2012, as shown in Figure 2 (left panel).

The initial SEI sectors were chosen opportunistically. To the extent that there was any consistent rationale, sectors were selected largely as industries in which future growth was expected and in which there were no strong entrenched incumbents. Accepting, for instance, that it would always be difficult for China to compete with Toyota or Volkswagen in internal combustion engine automobiles, planners saw an opportunity for China to establish an early position in EVs (recall that the first Tesla had just been produced in 2009). SEI strategy thus echoed an insight in the innovation literature that new industries present latecomers an opportunity for leapfrog development.[206] The SEI program was alert to technological opportunity and confident that ongoing manufacturing cost advantages would allow China to build and defend globally competitive industries. Along with these opportunistic calculations, SEIs also included many recognized "strategic" sectors such as semiconductors and display panels, which were seen as fundamental to military and economic modernization.

---

[206] C. Perez and L. Soete, "Catching-up in Technology: Entry Barriers and Windows of Opportunity," in *Technical Change and Economic Theory*, ed. Giovanni Dosi (London: Pinter, 1988).

Figure 2. Reformulation of the Strategic Emerging Industries Program, 2012-2016



Phase 2

The pragmatism of the initial SEI program was soon felt to be outmoded, and an effort was made during the planning cycle for the 13th FYP (2016-2020) to bring SEIs up to date with the new thinking. In November 2016, the SEI plan for the 13th FYP period (2016-2020) was issued.[207] The new classification—the right panel of Figure 2—kept the same basic industries but reshuffled them into more coherent groupings. The number of large sectors grew from seven to nine, and the first seven were grouped into four super-sectors: IT and electronics; machinery and new materials; biotechnology and pharmaceuticals; and electric vehicles/clean energy/environmental protection. Each of these super-sectors was expected to produce around RMB 10 trillion of output by 2020, with the rough targets shown in the far-right column.

Even more striking than the broad-based, high-tech nature of the 2016 strategy are the two sectors that were quietly added. What the Chinese call "digital creation" is a very large sector focused on digital media. It includes most Internet services, television and movies, and all digital design services. Needless to say, this is a huge sector and one that, in China, is dominated by state and Communist Party organs. The addition of this sector to SEIs is the CCP's belated acknowledgment that "content is king." As Bill Gates proclaimed in 1996, "Content is where I expect much of the real money will be made on the Internet, just as it was in broadcasting."[208] The final added sector, "related service

[207] State Council, "Development Plan for Strategic Emerging Industries in the 13th Five-Year Plan Period," [in Chinese]. November 29, 2016, http://www.gov.cn/zhengce/content/2016-12/19/content_5150090.htm. For the SEI 12th Five-Year Plan, adopted July 9, 2012, see http://www.gov.cn/zwgk/2012-07/20/content_2187770.htm.

208 Bill Gates, "Content Is King," Microsoft, 1996, https://medium.com/@HeathEvans/content-is-king-essay-by-bill-gates-1996-df74552f80d9.

sectors," includes a grab-bag of related items: R&D, science and scientific services, IPR protection (and litigation, presumably), air transport, and "modern" financial services. "Digital creation" was projected to have produced RMB 10 trillion worth of output in 2020. No target was given for "related service sectors," but it is clear that in the 2016 reboot, the definition of SEIs was expanded by at least a fifth and perhaps even a quarter. This re-definition will not help SEIs achieve 20 percent growth rates in any comparable sense), but it might help SEIs reach somewhere near 15 percent of GDP in the current economy.

Besides containing more sectors than the original list, the 2016 version is far more detailed.[209] The number of industrial sectors specified more than doubled—going from 240 to 405. The digital media and related service sectors account for only about 10 percent of the new sectors; most of the added sectors are actually detailed sector specifications that reflect ways in which thinking about issues has evolved in recent years. For example, intelligent manufacturing is given more prominence, and AI is developed as a separate item. A particularly striking change occurs in the section on new materials, which has been moved up in priority, and in which the degree of specification has increased dramatically—from 59 categories in the 2012 categorization to 223, almost quadruple.[210] Nanomaterials manufacturing, for example, has been disaggregated into five sub-types of nanomaterials.

The proliferation of sector specifications, particularly in the new materials category, reflects the enormous emphasis China puts on material science as part of its broader high-tech push. In December 2016, China set up a national "Leadership Small Group for the Development of the New Materials Sector" under the leadership of Vice-Premier Ma Kai, one of the top five officials in the Chinese government. China regularly creates these small groups when a priority policy issue calls for coordination across bureaucracies and sectors. However, it is extremely unusual for China to set up a leadership group of such high bureaucratic rank for a single industrial sector. This group stands out, then, as an exception from ordinary procedures, reflecting both the high priority given to new materials and, likely, the need to coordinate military and civilian actors in different bureaucratic sectors. Subsequently, the MOST promulgated a "Specialized Plan for Technological Innovation in the Materials Sector in the 13th Five-Year Plan," and, jointly with three other ministries, a "Guide for Development of the Materials Industry," to coordinate development in that sector with the national 13th FYP

---

209 The detailed list was finally published in 2018 and is available at "Classification of Strategic Emerging Industries (2018) (BS Order No.23) (战略性新兴产业分类（2018）（国家统计局令第 23 号）)," Central People's Government of the People's Republic of China (中华人民共和国中央人民政府). State Statistical Bureau (国家统计局), November 26, 2018, http://www.gov.cn/zhengce/zhengceku/2018-12/31/content_5433037.htm.

210 In statisticians' parlance, new materials industries have now been specified to the four-digit level from the previous three-digit classification, while the other sectors are now specified at the three-digit level (from the previous two-digit).

(2016-2020) and the "Made in China 2025" initiative. China's interest in the material sector stems from China's limited natural resources, the sector's importance in national defense, and a recognition that China is far behind advanced economies like Japan and the United States in material research.

The 2016 SEI reshuffling was an effort to bring the SEIs into compliance with the technological vision outlined in the IDDS, which was formally issued in May 2016 and reflects a more coherent and overarching vision of technological change, including a new wave of general purpose technologies that are "intelligent, green, and ubiquitous." This reconceptualization was accompanied by a promotion in the significance of SEIs: It was now expected that by 2030, "the SEIs will become the main force driving the sustained healthy development of our economy."[211] SEIs were now expected to coordinate closely with the Made in China 2025 and Internet Plus plans, as well as with MCF.

Phase 3

A third incarnation of the SEIs emerged in September 2020. The high priority of the SEI program was reaffirmed, but the guiding spirit shifted again, changing the emphasis and content of the SEI program.[212] Now, the SEIs were to be fully incorporated into the global tech and trade war, in part as a defensive response to U.S. initiatives to embargo Chinese firms on the entity list. For the first time, the Chinese government targeted the full value chains of each of the SEIs. Weak links had to be strengthened across the board to ensure the survivability of the full value chain. National and local governments were to step up investment in the building of industrial clusters, grouping together related firms within a specific industrial sector. Although these measures had their roots in those initiated five years earlier, the 2020 SEI incarnation dramatically stepped them up, and marks another step in subordination of the SEIs to a full-blown program of government planning and government-directed development. Chinese policymakers seem blind to the irony that in this process, the SEIs—intended to promote unoccupied sectors that provide global opportunities—have now become a tool for planners to build self-sufficient value chains that duplicate sectors that are already developed elsewhere in the world.

211 SEI 13th Five-Year Plan, Section 1.4.

212 National Development and Reform Commission, "Guiding Opinions on Expanding Investment in Strategic Emerging Industries, Cultivating and Growing New Growth Point Growth Pole (NDRC High Technology (2020) No. 1409)" (关于扩大战略性新兴产业投资培育壮大新增长点增长极的指导意见(发改高技〔2020〕1409 号)), September 25, 2020, https://www.ndrc.gov.cn/xwdt/tzgg/202009/t20200925_1239583.html; English translation available at www.newamerica.org/cybersecurity-initiative/digichina/blog/new-chinese-ambitions-strategic-emerging-industries-translated/.

SEI Targets and Ambitions: A Dearth of Data Leaves Questions about China's Performance

From the beginning, the SEI program has been accompanied by extremely ambitious targets. However, China does not publish consistent or coherent figures on the SEIs or their main components. There appear to be three reasons for this. First, when the SEIs were first announced, it was unclear where the boundaries were, and it took a long time to demarcate the scope of industrial priorities. Second, many subsectors are defense-related, and China wanted to avoid inadvertently disclosing information about them by publishing consistent information about aggregates. Third, and perhaps most telling, Chinese authorities set out bold targets for SEIs when they were initially promulgated and have almost certainly failed to meet these targets. Clear data released on the SEIs would publicize this failure.

From the beginning, it was stated that SEI value added was about 4 percent of GDP in 2010; would grow to 8 percent of GDP in 2015; and then 15 percent of GDP in 2020. To achieve this, assuming a GDP growth rate of 6 percent per year, SEIs would have to grow more than 20 percent per year. These targets have never been changed or abandoned, but neither has China ever released any data that would show whether they have been achieved. If the 2020 target had been achieved, it would imply that SEIs are worth two-thirds of total manufacturing value added, which is scarcely plausible since the majority of Chinese manufacturing consists of light and textile industries plus heavy material industries (dominated by steel, cement, and refining). However, as discussed earlier, some large service sectors were quietly added to the SEIs in the 2016 revision. Therefore, while the original, predominantly manufacturing, SEIs could not possibly be 15 percent of GDP in 2020, the expanded SEIs, with big service sectors tacked on, could begin to come close.

Little reporting of SEI output was done in early years, in part because there simply was not a clear definition of what counted as an SEI.[213] For three years beginning in 2017, the National Statistics Bureau published growth rates only for the SEIs, reporting that they grew 11 percent, 8.9 percent, and 8.4 percent in 2017, 2018, and 2019 respectively. This was slightly above the roughly 6 percent growth rate of large-scale industry but nowhere near the 20 percent growth rate needed to meet the targets. In 2020, this SEI growth rate disappeared from the statistical report.

[213] Annual SEI Yearbooks were published, but these scrupulously avoided publishing any sectoral or aggregate value-added or output data.

The 14th FYP briefly reviewed achievements through 2020 but did not mention SEIs, only saying that they were projected to be 17 percent of GDP in 2025. In other words, China's data releases on the SEIs are carefully chosen to avoid disclosing any actual information on SEI output or growth. The pattern of data release strongly indicates that SEIs have significantly under-performed relative to planner's expectations. (A subsequent analysis by the UC Institute on Global Conflict and Cooperation will perform the data breakdown necessary to provide a detailed assessment of output data and performance of SEI sectors.)

Actors and Execution: Firms and Local Governments

The successive incarnations of the SEI program have moved steadily in the direction of government control. Initially, the SEIs were a market-based program in which the government simply "made the market," sweetening the pot so that entrepreneurial firms could survive their start-up phases. Direct government funding was to account for only 5-15 percent of the total funding effort.[214] Today, China does not limit itself to such a modest government role. Nonetheless, the primary actors in the SEI are still expected to be dynamic firms—including private firms—with local governments playing a powerful facilitating role. Firms are charged with developing new sectors, with the objective of nurturing as many globally competitive firms as possible, projecting China's economic influence and power across a global market.

SEI National Champions

The ultimate purpose of the SEI program has always been to create national champion firms. For the last few years, China has published lists of champion SEI firms, ranked by their "SEI output revenue." The top 30 from these lists are shown in Table 10.[215] Comparison with other lists of firms allows us to compare "SEI output" with total output; this ratio is shown in the right-hand column. The results reveal some familiar faces and some surprising outcomes.

Huawei is the clear SEI champion, far above the others. What stands out, however, is the variety of ways in which government intervention builds the firms on this list. First, huge state firms with protected markets are big players. Three of the top five are state telecom firms that benefit from a regulated and protected market. One government monopoly, State Grid, is so gigantic that it comes in as the 18th largest SEI firm, even

214 Fang, Jiaxi and Yang Shen, "The Country's Financial Strategy for Emerging Industries (in Chinese)," Economic Information Daily (经济参考报), September 9, 2011, http://finance.sina.com.cn/roll/20110909/013110456623.shtml.

215 "The 2019 List of the Leading SEI Firms Has Been Released! (2019 中国战略性新兴产业领军企业 100 强榜单)," Sina Finance (新浪财经), http://finance.sina.com.cn/zt_d/2019_zgzlxxxcyljqy100qbd/.

though only 3 percent of its output falls into SEI categories. At the local level, a number of government-sponsored conglomerates are important actors in SEI space, including Beijing Electronics (11), Shenzhen Investment Holdings (19), and Chengdu Xingcheng Investments (25). Finally, several firms of mixed ownership have moved up the list rapidly in recent years as the government has intervened to aid and restructure promising firms. This includes two battery firms, Tianneng Battery Group (8) and Chilwee Batteries (16). Absent from the list are the state giants that produce largely for the military. These are big firms whose output places them securely in the top SEI firms, but they are kept off the list for security reasons. There are certainly a few dynamic, specialized firms on the list, including server maker Langchao (12), but these are relatively few.

Table 10. Top 30 Chinese Enterprises by SEI Revenue

Rank	English Name	Chinese Name	2019 SEI Revenue (billion RMB)	2018 SEI as Share of Total Revenues
1	Huawei (Telecom Equipment)	华为投资控股有限公司	859	100%
2	China Mobile (Telecom)	中国移动通信集团	558	72%
3	Suning (Retail)	苏宁控股集团	269	13%
4	China Telecom (Telecom)	中国电信集团有限公司	264	56%
5	China Unicom (Telecom)	中国联合网络通信集团	245	84%
6	CRRC Group (Railroad Equipment)	中国中车集团有限公司	236	99%
7	China Electronics Company	中国电子信息产业集团	157	69%
8	Tianneng Battery Group	天能电池集团有限公司	140	N.A.
9	Geely Automotive	浙江吉利控股集团有限公司	136	50%
10	Guangzhou Pharmaceuticals	广州医药集团有限公司	133	N.A.
11	Beijing Electronics	北京电子控股有限责任公司	126	98%
12	Langchao (Computers)	浪潮集团有限公司	112	100%
13	China General Nuclear Power	中国广核集团有限公司	105	N.A.
14	China Minmetals	中国五矿集团有限公司	95	16%
15	Baowu Steel Company	中国宝武钢铁集团有限公司	95	11%
16	Chaowei (Chilwee) Batteries	超威集团	91	N.A.
17	Baotou Steel	包头钢铁（集团）	89	N.A.
18	State Grid (Electric Power)	国家电网有限公司	84	3%
19	Shenzhen Investment Holdings	深圳市投资控股有限公司	83	N.A.
20	Hisense (Consumer Electronics)	海信集团有限公司	81	66%
21	CITIC (Diversified Conglomerate)	中国中信集团有限公司	77	16%
22	Zall (Diversified Commerce, Logistics)	卓尔控股有限公司	72	68%
23	Shaanxi Non-ferrous Metals	陕西有色金属控股集团	71	55%
24	GCL Power (Renewables)	协鑫集团有限公司	66	69%
25	Chengdu Xingcheng Investment	成都兴城投资集团有限公司	63	N.A.
26	China National Building Materials	中国建材集团有限公司	62	23%
27	China Railway Engineering Corp	中国铁路工程集团有限公司	62	N.A.
28	Shenzhen Neptunus (Pharmaceuticals)	深圳海王集团股份有限公司	61	100%
29	Hai'er (Consumer Durables)	海尔集团公司	59	14%
30	Chinalco (Aluminum)	中国铝业集团有限公司	58	14%

Local Actors in a National Plan

The importance of local governments in SEIs has grown in recent years. At the same time the 2016 restructuring of SEIs took place, the Chinese government put forward some new development concepts that were designed to guide policies for SEIs.[216] These new ideas were based on the idea of productive clusters—that is, the concept that clusters of related firms are the most likely to foster an innovative environment. The concepts are based on well-established ideas in the Western innovation and business literatures that emphasize spillovers of knowledge among firms and the importance of supporting institutions—including universities and venture capital firms. In China, these ideas ended up reinforcing the importance of local governments, which were encouraged to intervene repeatedly, at multiple stages of the development process.

Local governments have engaged in a few important ways. First, they play the traditional role of creating "zones" in which basic infrastructure is provided and subsidized. Second, they are expected to actively intervene to bring related firms together and give "themes" to the zones they support. This is a significant departure from the traditional "special economic zones," which were designed to be attractive to investors, but were generally agnostic about which type of industries were to develop. Third, local governments provide supporting institutions and finance to ensure favorable conditions for successful entrepreneurial firms.

The importance of productive clusters was introduced in the 2016 version of SEIs, and it became much more prominent in the 2020 incarnation and a focus of the more activist government approach adopted in 2020. Indeed, the title of the 2020 document refers to "New Growth Points and Growth Poles," which are terms from the economic geography literature, referring to productive clusters of activities.

In addition to the productive clusters policy, the 2020 document places a much stronger emphasis on strengthening the weak links in high-tech value chains. "Bottleneck sectors"—often described as "choke points" in the Chinese literature—receive special attention as a way to reduce vulnerabilities to supply cutoffs. Bottleneck sectors, almost by definition, tend to relate to existing Chinese production facilities that depend on high-tech value chains and high-tech imports, especially component imports. The government's preference for building industry clusters has thus tilted toward building alternative suppliers near to existing Chinese factories and firms. Thus, although this was a central government document, released jointly by the four most powerful ministries (planning; S&T; industry; and finance), it places the most important responsibility on local governments.

216 State Council, "Development Plan for Strategic Emerging Industries."

SEI development goals are as ambitious as ever, but they have now been recast in a geographic framework, calling for the expansion of innovative regional clusters. An official "expert interpretation" published by the NDRC immediately after the 2020 "Guiding Opinions" document was released underlines the importance of building SEI clusters. The primary goal is the 10/100/1000 program, designed to create a graduated ladder of regional clusters: 10 SEI clusters with global influence, 100 SEI clusters that are internationally competitive; and 1,000 specialized local SEI clusters, each with their own distinctive characteristics. To foster this objective, the central government is to support four pilot programs on innovation capacity enhancement; industrial city integration; applied infrastructure scenarios; and public service capacity enhancement.[217] The national government only provides the framework and pilot projects: The actual activity takes place at the local level.

Vigorous local government responses are evident throughout China. They are supported by the establishment of special funds for SEIs, which again primarily help localities with related SEI projects.[218] In Wuhan, an RMB 10 billion Yangtze River Zall Industrial Investment Fund was established, focusing on five SEIs: smart manufacturing, health, commerce and logistics, new infrastructure construction, and the airport economy (to help accelerate the post-epidemic recovery of Wuhan). In the northeast, Changchun, which has been struggling economically, has expanded its Economic and Technological Development Zone to support SEIs such as intelligent manufacturing, biomedicine, optoelectronic information, new materials, and big data. Changchun's efforts to support industrial clusters are focused on incubating high-tech "mighty midgets" to complement the existing large firm base.[219] It goes without saying that local governments in the most advanced areas of the country—Shanghai, Shenzhen, Nanjing, Wuxi—are even more fully invested in building out clusters of SEIs with increased survivability.

Finally, local governments are in charge of rolling out ambitious new "smart infrastructure" programs, which are conceived of as being closely related to SEI development. In the most optimistic interpretations, this new infrastructure construction will transform investment in the physical world into a stronger infrastructure for the digital world. Next generation information infrastructure, integrated transport and logistics infrastructure, and innovation infrastructure will

---

[217] National Development and Reform Commission, "Promote the High-Quality Development of Strategic Emerging Industries—Expert Interpretation 2," September 25, 2020, https://www.ndrc.gov.cn/xxgk/jd/jd/202009/t20200925_1239581.html.

[218] He, Daixin, "Strategic Emerging Industries Will Benefit from the Spring-Like Development of 5G, Chips, etc." *Economic Daily*, September 24, 2020, http://www.ce.cn/cysc/tech/gd2012/202009/24/t20200924_35806681.shtml.

[219] "Highlight Innovation Driven, Support Project Development, Focus on Planning and Layout of Strategic Emerging Industries in Changchun Economic Development Zone." August 27, 2020, https://www.thepaper.cn/newsDetail_forward_8901722.

improve industrial competitiveness and further promote the development of SEIs.[220] A new wave of state-led development is being unleashed based on the priority construction of local "smart infrastructure."

Conclusion

What started as a purely opportunistic venture, launched as part of China's response to the global financial crisis, China's SEI Initiative has become part of an expanded vision of global technological and political change. The global financial crisis was the beginning of a particular Chinese belief that a new technological revolution was being accompanied by dramatic changes in global power relations. Then-Premier Wen Jiabao said that throughout history major crises like the global financial crisis were followed by major technological breakthroughs, and countries that mastered these revolutionary new technologies transformed their economies and became the successful—and dominant—economies of the post-crisis eras. Since developed countries were redoubling their support for emerging industries during the crisis, China should seize this opportunity.[221] This apocalyptic interpretation of technological change only deepened under Xi and was incorporated into his IDDS, with which the reformulated SEI Initiative is aligned.

The reformulation of SEIs was an excellent opportunity to obscure the fact that SEIs have fallen far short of their original targets. Now, as the attention given to the "strategic" component of SEIs has increased and been reinterpreted, the government's role has expanded. China is now dramatically increasing its resource commitment to SEIs, even though it is widely agreed that the program thus far has not been particularly successful. An initially market-based program has turned into a program that is predominantly government guided. A program initially targeted at vacant spaces and opportunities in the global landscape has turned into one focused on replicating existing production links and insulating China from the outside world. SEIs have survived and maintained their centrality but only by being redefined into something quite different from their initial form.

---

[220] Liu, C. and Wang P. "The Development of Emerging Industries during the '14th Five-Year Plan' Period: Problems, Trends and Policy Recommendations," *Economic Aspect （经济纵横）*, no. 7 (2020): 77-83.

[221] Wen, Jiabao, "Let Science and Technology Lead Sustainable Development in China," Speech on the 60th Anniversary of the Chinese Academy of Sciences, November 3, 2009, http://www.gov.cn/ldhd/2009-11/23/content 1471208.htm.

Adapting Chinese Industrial Policy: The Case of Semiconductors

The Setting

Chinese policymakers were first alerted to the potential threat from restrictions in the supply of U.S. semiconductors and equipment in April 2018, when the United States sanctioned Chinese telecom firm ZTE. It quickly became clear that ZTE faced collapse without access to U.S. semiconductors, and ZTE promptly resolved the complaints against it, thereby regaining access to U.S. semiconductors in July 2018. Then on August 18, 2019, the United States followed through on earlier warnings and placed Huawei on the entity list. Thus, from mid-2018 through 2019, Chinese policymakers received repeated indications of their vulnerability in semiconductors and have been signaling to a range of actors, including local governments, the need to prepare responses.

Chinese sources and friendly commentators repeatedly argued that U.S. actions would force China to redouble its efforts in the semiconductor space—that is, that the United States was forcing China to embark on a program of self-sufficiency. The reality, however, is that Chinese efforts in this sector were already enormous, and "redoubling" such efforts in a short period of time was never likely to do China any good. Events in 2019 and 2020 have confirmed that prediction. A hasty increase in incentives induced massive new entry into the sector. However, most new firms were unqualified, and the result was massive waste and little, if any, improvement in China's developmental effort. Nevertheless, the episode is instructive about the ways in which China's industrial policy functions.

Signs of Financial Distress

Signs of financial distress in parts of China's semiconductor industry have proliferated in the second half of 2020. Large projects, given priority by local governments, were acknowledged as failures or allowed to go bankrupt. In Nanjing, Dekema (德科码) established to produce contact image censors, failed after almost RMB 10 billion had been invested. In Hebei province, the Soaring Company (昂扬公司), set up by an engineer who returned to China after 18 years of education and professional experience in the United States, collapsed.[222] These failures are representative of scores of local projects that have run into serious difficulties.

---

[222] "Nanjing's 10 Billion RMB Dekema Semiconductor Project Bankrupt after 5 Years, Awaiting Resolution," China Management Web *[Zhongguo Jingyingwang]*, July 19, 2020, http://finance.eastmoney.com/a/202007191561023020.html; Man Tianxin (pseud.), "Another 'Star' Chip Project Left Unfinished; Core Manufacturing Cannot Be Created Overnight." October 16, 2020, https://ee.ofweek.com/2020-10/ART-8500-2801-30464542.html. Soaring aspired to produce IGBTs (insulated gate bipolar transistors).

To be sure, many of these projects were destined to fail regardless, some being little more than houses of cards erected by ambitious local governments. However, some of the troubled projects and firms were important and once carried high hopes and had reasonable chances of success. For example, in Hubei, local officials had placed enormous hopes on the Wuhan Hongxin (弘芯) Company. The company began construction on a RMB 128 billion ($18.4 billion) project to produce 14-nanometer chips by 2022. More important, Hongxin had a realistic and aggressive strategy to offer extremely generous compensation packages to attract experienced engineers from outside China. This is a plausible model, and it is also being tried by the YMC, also in Wuhan. While YMC has mainly hired engineers from South Korea (offering generous packages and, in many cases, the option to work from Seoul), Wuhan Hongxin was focused on hiring engineers from Taiwan. More than 50 engineers were lured away from the world's leading chip fabricator, Taiwan Semiconductor Manufacturing Company (TSMC). Chief among them was 72-year-old Chiang Shang-yi, who had previously served as the co-chief operating officer of TSMC and had personally led important technological breakthroughs that had played a crucial role in TSMC's ascent to the global frontier. Despite these significant opportunities, the project collapsed. Chiang Shang-yi resigned, calling the experience "a nightmare," and the project site is deserted, awaiting final wrap-up.[223] In a parallel process of comparable size, in Chengdu, a massive semiconductor fabrication facility planned jointly by the local government and international giant Global Foundries in 2017, originally set to invest $9 billion, has also collapsed.[224]

Perhaps the most surprising of all these cases is the recent series of defaults by the majority state-owned Tsinghua Unigroup (紫光集团). Tsinghua Unigroup is a huge player in the mainland semiconductor industry. It is the primary investor in the previously mentioned YMC, one of China's national champions. In 2013 and 2014, it purchased China's two most dynamic private chip design companies—Spreadtrum and RDA—and consolidated them into a single, state-owned firm, Unisoc (紫光展锐). Overall, it serves as a major conduit for government financing in the semiconductor sector. However, it is also something of a rogue operator, with its Chairman Zhao Weiguo—viewed as a visionary by some, and a charlatan by others—exercising effective control. The company sent shockwaves through the Chinese corporate bond market on November 15, when it announced it would be unable to make payments on one of its bonds. Since then, the

---

223 Sidney Leng, "China's Semiconductor Dream Takes a Hit as Local Authority Takes over 'Nightmare' Wuhan Factory," *South China Morning Post*, November 18, 2020, https://www.scmp.com/economy/china-economy/article/3110368/chinas-semiconductor-dream-takes-hit-local-authority-takes; Ting-fang Cheng, "China Hires over 100 TSMC Engineers in Push for Chip Leadership," *Nikkei Asia*, August 12, 2020, https://asia.nikkei.com/Business/China-tech/China-hires-over-100-TSMC-engineers-in-push-for-chip-leadership; Ting-fang Cheng and Lauly Li, "Beijing-Backed Tsinghua Unigroup's Chip Projects Hit by Delays," *Nikkei Asia*, November 30, 2020, https://asia.nikkei.com/Business/China-tech/Beijing-backed-Tsinghua-Unigroup-s-chip-projects-hit-by-delays.

224 Tianxin "Another 'Star.'"

company has further defaulted on $2.5 billion in offshore dollar-denominated bonds, and has had an additional onshore issue.225 Though an eventual restructuring is likely (with most bondholders ultimately getting paid off), the case raises serious questions. If even Tsinghua Unigroup cannot meet its financial obligations, what is going on more broadly with industrial policy financing?

Local Government Finances

In the final analysis, Chinese local governments bear much of the financial burden for these semiconductor projects and will be responsible for sorting out the current financial difficulties. Yet Chinese local governments face significant financial challenges. Although they have enormous leeway to engage in a range of deal-making and fundraising, financing from these sources is limited. Local governments can tap various kinds of funding platforms, land development deals, and government investment funds. However, they bear heavy expenditure responsibilities, since they must provide virtually all government services, including education, rudimentary health insurance, and public utilities. Recent indications suggest that local governments are under broad financial pressure, exacerbated by the costs of controlling the novel coronavirus and its impact on the economy.226

The most important funding vehicle for industrial policy used in recent years to circumvent these limits is also showing signs of diminishing returns. Government Industrial Guidance Funds (IGFs) have been a major innovation in recent years. Intended to raise money, IGFs also bring a set of market-friendly principles to the finance of industrial policy. As Table 11 shows, IGFs grew enormously after 2015. Most of these funds are run by local governments, although the central government IGFs are much larger and account in aggregate for 19 percent of total IGF fundraising.227 However, establishment of new IGFs peaked in 2017 and declined thereafter. In 2019, even before the novel coronavirus hit Wuhan, new IGF creation had already dropped to a fraction of its previous high.

---

[225] Kenji Kawase, “China’s Tsinghua Unigroup Bond Crisis Deepens with Second Default,” *Nikkei Asia*, December 10, 2020, https://asia.nikkei.com/Business/Markets/China-debt-crunch/China-s-Tsinghua-Unigroup-bond-crisis-deepens-with-second-default.

[226] Yu, Hairong, “Local Government Debt is Approaching the Warning Line; How Should Risk Be Controlled? (in Chinese),” *Caixin*, December 9, 2020, http://economy.caixin.com/2020-12-09/101637199.html.

[227] The data in Table 11 are calculated by the author from the commercial database maintained by Zero2IPO (清科研究中心), https://www.pedata.cn/. Some data may be behind paywalls.

Table 11. New Chinese Government Guidance Funds
(Designated Fundraising: Billion RMB)

2014H1	55
2014H2	205
2015H1	304
2015H2	1,086
2016H1	1,401
2016H2	1,832
2017H1	999
2017H2	2,322
2018H1	961
2018H2	813
2019H1	267
2019H2	622
2020H1	144

Clearly local governments can no longer turn to IGFs, large as they are, as a seemingly unlimited source of funding for activist industrial policies. The slowdown in establishing new IGFs should be considered in tandem with increasing evidence that many IGFs are struggling to raise the amounts specified in their fundraising quotas. The most common estimates suggest that total funds actually raised amount to about 60 percent of designated fundraising scope (still an enormous amount, surpassing $1 trillion in cumulative contributions). Thus, while local governments are certainly not running out of money, there is evidence that local government financial resources are not unlimited, and increased attention is being given to limiting the demands on local resources.

Proliferation of Semiconductor Projects

The most important change in the semiconductor sector has not been the amount of funding available, but the increase in the number of projects competing for funds. The challenge that emerged from the United States in 2019 resulted in a proliferation of semiconductor projects in targeted sectors. Surprisingly, the response of the Chinese government was not incorporated into a formal document until July 2020, when the State Council released Document No. 8 on the promotion of the integrated circuit and software industries.[228] This document includes many detailed operational and policy details, including an emphasis on new tax breaks and tax holidays for firms in the two priority sectors. Local governments are urged to arrange funding, set up technology parks, arrange stock listings and stock options, and encourage local universities to set up companies. Fundamentally, the document is an impassioned plea for local governments to do everything in their power to promote these two sectors and should be seen as the culmination of at least a year of increasingly heightened concern.

[228] State Council, "Several Policies on Accelerating the High-Quality Development of the Integrated Circuit and Software Sectors in the New Era," *Guofa [2020],* no. 8, July 27, 2020, http://www.gov.cn/zhengce/content/2020-08/04/content_5532370.htm.

Local governments, astute entrepreneurs, and not a few con men, were in fact already responding and scarcely needed more stimulus. One Chinese source reported that as of October 27, 2020, there were a total of 270,000 firms in the broadly defined integrated circuit sector, of which 58,000 were newly registered since January 1, increasing the total by 27 percent. Of these, 13,000 were existing firms that had simply shifted their business scope by adding "integrated circuits, processers, or semiconductors" to their business licenses during 2020. Among existing firms, 43 percent were in Guangdong province, and almost two-thirds were in technology services, software, and consulting—relatively "soft" activities relating to integrated circuits.[229] According to a different calculation with a narrower definition, in the first nine months of 2020, over 13,000 new semiconductor firms were established—about 50 new firms a day—twice the pace of 2019.[230] The proliferation of preferential policies had created a gold rush.

The Backlash

In late October, the central government, in response to increasing reports of failing semiconductor projects and excess proliferation of semiconductor-related projects, began a campaign to tighten up oversight and control. On October 20, 2020, the spokesperson for the main planning agency, the NDRC, denounced projects with "no experience, no technology, and no skilled personnel," and scolded those localities that had "blindly" rushed into new projects and industrial parks without adequate planning or expertise. The spokesperson then informally laid out a four-point program of monitoring and control: increased geographic concentration; better implementation of Document No. 8; early identification and feedback on projects; and the principle that investors take full responsibility and bear the costs of failed projects.[231]

It is remarkable that only three months after an authoritative central government document essentially advocated unlimited support for semiconductor projects, the government was forced to damp down on that support. But though the timing is bizarre, the basic sequence is entirely in line with how Chinese industrial policy is generally conceived and executed. Planners recognize that they operate with incomplete and inadequate information. They announce priorities knowing they will trigger waves of activity and entry and with the conscious expectation that they will later have to cull many projects, clearing away the rubble (the "chicken feathers" in one Chinese

---

[229] Song, Jie and Guo Fang, "The 'Great Leap Forward' in Chips Has Been Told to Stop; the Star Projects of Many Regions Are Now Unfinished (in Chinese)," *China Economic Weekly*, November 2, 2020, https://m.us.sina.com/gb/finance/sinacn/2020-11-02/detail-ihacmqme8754792.shtml.

[230] Man Tianxin, "Another 'Star.'"

[231] Meng, Wei, "Record of the October News Conference of the National Development and Reform Commission," October 20, 2020, https://www.ndrc.gov.cn/xwdt/xwfb/202010/t20201020_1248457.html; See also Song and Guo, The Great Leap Forward.

expression). The hope is that this process will reveal which of the surviving projects will be viable for the long term. It is an inherently wasteful process, but one that Chinese planners defend with reference to venture capital investors in the United States: that is, you fund 10 projects, knowing that nine will fail—but you do not know which nine—in the hope that the tenth project is a huge success. Chinese planners are comfortable with this process, particularly since they are spending other people's money. They have no difficulty falling in behind an already successful firm and retrospectively declaring them to be a "national champion."

What makes the current semiconductor case unique is simply the speed of the cycle and the amount of waste. Semiconductor projects are inherently demanding, knowledge- and capital-intensive projects with long lead and development times. The idea that the development of the industry could be accelerated by powerful short-term incentives was always illusory, given the fact that China was already spending enormous amounts on semiconductor projects. "Redoubling" the effort probably just increased the waste of money and time.

Concentration on the "Winners"

While the most recent cycle has probably done China little or no good, it has not done much to harm the semiconductor push, either. In the first place, with the advent of the NASDAQ-like Shanghai Star Market, many of the leaders in China's semiconductor effort have been listed with government support. This has attracted speculative private investors to go along with government listings: While the bulk of the funds (and ownership share) come from government entities, the sign of government support attracts additional private funds and has led to healthy valuations. There is some indication that government hopes have been shifting from the IGFs to the opportunities provided by China's currently booming equity markets. In the semiconductor space, this opportunity has been used to insulate the national champions from any danger of financial shortage.

The key "stars" of China's semiconductor push have been part of this new listing push, including SMIC (Semiconductor Manufacturing International Corporation; 中芯国际); Cambricon (寒武纪; a new AI chip firm); as well as Verisilicon (芯原微) and Amec (中微). Moreover, other national champions have been provided with substantial financial insulation from the problems sweeping the industry. To take the three most important cases, HiSilicon, the chip division of Huawei (华为海思), is protected by Huawei's non-public status and obvious national priority; while the two largest semiconductor firms in which Tsinghua Unigroup has a stake, SMIC and YMC (长江存储), both have a healthy independent capital base and have been insulated from the financial problems of their parent. Their survival is not in question.

Most fundamentally, the recent changes in policy—including the drive to clean up excess entry in the semiconductor industry—portend a shift to more direct centralized control over a smaller number of national champions. This is already implicit in the brief comments of the NDRC spokesperson in November 2021, cited earlier. However, the details of this control have not been released and will only gradually become clear in the course of implementation. For hints of the direction in which policy is moving, we must turn to recent authoritative policy statements.

The CCP "Recommendations" for the 14th FYP

The party's "Recommendations" for the 14th FYP (2021-2025) were released on November 3.[232] These "Recommendations" serve as guidelines for the government planners who write the FYP, which appeared in March 2021.[233] In the "Recommendations," proposals are couched in abstract and general language, with few details and no specific targets. Overall, the approach described is similar to that espoused five years ago in the 2015 "Recommendations" for the previous 13th FYP, with some sections repeated verbatim. Nevertheless, the document provides insight into the thinking of the most authoritative policymakers at the top of the Communist Party hierarchy. Specifically, some modest new sections and slogans provide insight into new directions and programs, some of which relate directly to the semiconductor sector.

Not all revisions are substantively important, of course. In this new "Recommendations" two programs that figured prominently in the 2015 "Recommendations" have disappeared: Made in China 2025 and MCF. These two programs have not, of course, been dropped in practice; indeed, careful reading uncovers oblique references to these programs that have not been completely purged from the document. Rather, their removal demonstrates that Chinese policy has, since 2019, begun to systematically minimize even vague references to certain core programs that had previously been openly discussed, but which elicited the most international controversy. With heightened secrecy, the analyst's task becomes more challenging, but even more essential.

Two sections of the "Recommendations" bear directly on the future of industrial policy in the semiconductor sector. The first, in Section 7, refers to the "new type of national champions policy under socialist market conditions." This is an important new slogan, which is beginning to appear widely in the Chinese press. The term that is translated as

---

[232] Chinese Communist Party Center, "Recommendations on Drafting the 14th Five-Year Plan for Economic and Social Development and the Long-Run Targets for 2035 (in Chinese)," *Xinhua News Agency*, November 3, 2020, http://www.xinhuanet.com/2020-11/03/c_1126693293.htm.

[233] Even then, the publication of the overall national plan is merely an umbrella for the drawing up of 80 to 100 regional and sectoral plans, which proceeds simultaneously but one step behind the comprehensive national plan.

“national champions” is *juguo tizhi* (举国体制), which is frequently mistranslated. Its meaning is clear from its history: It has been applied both to the historical effort to develop nuclear weapons and ballistic missiles and to the training of elite athletes for China’s Olympic teams. It refers to the process of assembling all the nation’s most elite talent into one “national team.” The use of the term in the industrial policy context means that an effort is being made to concentrate resources on the best firms (regardless of ownership) and to coordinate their development for national aims.

The second important innovation is the increased emphasis on supply chains. China’s industrial policy has always been supply chain conscious—focused on both strong and weak points in a single industrial value chain. The “Recommendations” indicate that a new supply chain initiative is now being ramped up. Section 11 refers to “strategic design and precise measures, sectorally differentiated, to maintain independently controllable, secure, and efficient supply chains (自主可控、安全高效，分行业做好供应链战略设计和精准施策).” Local sources confirm that this is not just an abstract wish but rather a new program to audit supply chains and establish their independent and controllable identities, safe from the disruption of international supplies. This is a new program that needs to be monitored as it is rolled out. However, it is easy to see that the rectification of the semiconductor industry will likely be combined with this program of supply chain audit to drive new phases of semiconductor industrial policy.

Conclusion

Rectifying the unsustainable “leap forward” in the semiconductor sector will give the central government more control than ever. Evidence of financial distress in the semiconductor sector turns out not to show that available resources are being constrained but rather that the generous incentives on offer in this sector elicited an unsustainable entry and profusion of projects. The resulting correction was inevitable, but the means by which it is being carried out provide useful indications of current changes and likely future policy orientations. China’s semiconductor industrial policy in the past two years has been extraordinarily wasteful. However, Chinese policymakers seem prepared to accept these levels of waste—and more. Moreover, if current policy succeeds in subjecting more projects to market discipline, it will end up making China’s industrial policy relatively less wasteful and thus potentially more sustainable and disruptive to the world.

Science, Technology, and Innovation 2030 Plan

The Party Central Committee at its 5th Plenum in October 2015 decided to launch a new long-term initiative on mastering core technologies.[234] The "Science, Technology, and Innovation 2030 Major Projects" (STI 2030; 科技创新 2030 重大项目, *Keji Chuangxin 2030 Zhongda Xiangmu*) plan initially covered fifteen science and engineering megaprojects, although this was subsequently increased to sixteen projects. They include aircraft engines and combustion turbines, technologies for deep-sea exploration and deep-sea stations, quantum communications and quantum computing, neuroscience and brain-related research, cybersecurity, deep-space exploration and in-orbit spacecraft, clean and efficient use of coal, smart power grids, space-earth integrated information network, intelligent manufacturing and robotics, and key new materials research and applications. Xi stressed that it was "necessary to speed up implementation centering around the needs of important national strategies, focus efforts on mastering key and core technologies, and capture science and technology strategic commanding heights that have a bearing on the future and the overall situation."

The principal role of the National Major Science and Technology Projects is to manage the portfolio of megaprojects contained in the 2006-2020 MLP and the STI 2030 program (see Table 12). The implementation of STI 2030 even before the completion of the MLP megaprojects is based on the principle of "as a project matures, another project begins" (成熟一项, 启动一项, *Chengshu Yixiang, Qidong Yixiang*), which is enshrined in the regulations guiding the management of these projects.[235]

Each of these megaproject programs covers five domains:

- **Electronics and information:** The MLP has three projects on new-generation broadband wireless mobile communication networks; core electronic devices, high-end universal chips, and basic software products; and very-large-scale integrated circuit manufacturing equipment and turnkey techniques. STI 2030 has five projects: quantum communications and quantum computers; cyberspace security; big data; AI; and earth-space integrated information networks.

---

234 "Recommendations of the Chinese Communist Party Central Committee."

235 "Provisions on the Administration of Major National Science and Technology Projects (Civilian Projects) (国家科技重大专项（民口）管理规定)," *Ministry of Science and Technology, National Development and Reform Commission, and Ministry of Finance* (科技部，发改委和财政部). Document No. 145, January 6, 2019, http://www.most.gov.cn/mostinfo/xinxifenlei/fgzc/gfxwj/gfxwj2017/201706/t20170627_133757.htm.

- **Advanced manufacturing:** The MLP has two projects on large passenger aircraft and high-grade numerical control machinery and basic manufacturing equipment. STI 2030 has three projects: aircraft engines and combustion turbines; smart manufacturing and robotics; and key new materials.
- **Energy and environment:** The MLP has three projects on large-scale oil and gas fields and coalbed methane; large-scale, advanced nuclear power plants with pressurized water reactors and high-temperature gas-cooled reactors, and water pollution control and treatment. STI 2030 also has three projects: clean and efficient utilization of coal; smart power grids; and comprehensive environmental governance of Beijing, Tianjin, and Hebei.
- **Biosciences and health:** The MLP has three projects on new varieties of genetically modified organisms; formulation and manufacturing of major new medicines; and the prevention and treatment of AIDS, viral hepatitis, and other major contagious diseases. STI 2030 also has three projects: brain science research; health care; and innovation of the seed industry.
- **Maritime and space:** The MLP has two projects on a high-resolution earth observation system, and manned spaceflight and lunar exploration programs. STI 2030 also has two projects: deep-sea stations and in-orbit services and maintenance systems for deep-space exploration and spacecraft.

The 13th FYP for S&T Innovation stressed that STI 2030 was targeted for the next fifteen years to 2030 and that projects selected "embody China's strategic intentions to… strive to take the lead on breakthroughs on important directions."[236]

Table 12. The Sixteen Megaprojects of the Science, Technology, and Innovation 2030 Major Projects Program

Project	Description
Aircraft engines and combustion turbines	Research on general basic technologies such as materials, manufacturing techniques, experimentation and testing, and interdisciplinary studies to tackle design and other key technologies
Deep-sea stations	Research on deep-sea exploration and universal, specialized, mobile, and fixed deep-sea stations

[236] "13th Five-Year National Science and Technology Innovation Plan."

Quantum communications and quantum computers	In-city, intercity, and open-space quantum communication technologies; universal quantum computer prototype and functional quantum simulator will be developed and manufactured
Cerebrology and brain-inspired research	Brain cognition is the main focus along with brain-inspired computing, brain-computer intelligence, and the diagnosis and treatment of major brain diseases
Cyberspace security	Cyberspace security technologies and systems encompassing information and networks will be developed
In-orbit services and maintenance systems for deep-space exploration and spacecraft	Improving China's efficiency in space resource utilization and ensuring in-orbit safety and reliable operations for spacecraft
Independent innovation in the seed industry	Agricultural plants, animals, forests, and microorganisms are key areas of focus to apply heterosis and molecular design breeding and provide support for national grain security strategies
Clean and efficient utilization of coal	R&D on green coal exploitation, high-efficiency coal power generation, clean coal conversion, coal pollution control, and coal capture, utilization, and sealing; demonstrate and popularize advanced applicable technologies, achieve lead in coal-fired power generation and ultra-low-emission technology, and make breakthroughs on modern coal chemical engineering and poly-generation technology
Smart power grids	Regulation and control of large-scale renewable energy grids, flexible interconnection of large-scale power grids, interaction of supply and demand in power consumption by diversified users, and basic supporting technology for smart power grids, to achieve domestic production of technical equipment and systems for smart power grids and improve the share of electric power equipment in the global market

Earth-space integrated information networks	Comprehensive fusion of space-based information networks, the Internet of the future, and mobile communication networks, forming earth-space integrated information networks with global coverage
Big data	Research common key technologies for big data, construct standard system and exchange platforms for open data sharing throughout China, form common knowledge application model and technical plan oriented toward typical application, and form big data industry clusters
Smart manufacturing and robotics	Construct a network of cooperative manufacturing platforms and research, and develop smart robots, high-end turnkey equipment, and 3D printing and other equipment to solidify basic support capabilities for manufacturing
Key new materials	Research and production of carbon fiber and composite materials, high-temperature alloys, advanced semiconductor materials, new displays and their materials, high-end equipment using special alloys, rare earth new materials, and new materials for military use
Comprehensive environmental governance of Beijing, Tianjin, and Hebei	Building of core technologies, industrial equipment, standards and policy systems for coordinated governance of water-earth-air, coordinated resource cycling for labor-agriculture-city, and coordinated regional environment management and control; establishing a batch of comprehensive demonstration projects
Health care	Research of precision medicine, prevention and control of chronic noninfectious diseases and frequently occurring diseases, and research of reproductive health and birth defect prevention and control
Artificial intelligence	R&D of new-generation AI basic theory, core key technologies, and smart chips and systems

STI 2030 does not make reference to any projects of a primarily defense or national security purpose, but ten of its sixteen projects have dual-use applications. They include all the projects in the electronics and information, advanced manufacturing, and maritime and space domains.