

Basic Research in China's Scientific and Technological Development Plans, 1949-2020

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Basic research (*jichu yanjiu* 基础研究) can be defined as any experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without determining any particular or specific application or use for it.¹ Nevertheless, the definition of basic research in China has not been limited to such a scope. Rather, it has acquired unique characteristics in the process of the evolution of its implications and the development of the term. Concepts relating to basic research have already entered into the policy horizon since the beginning of China's scientific undertakings in 1949. In early policies, basic research was called theoretical research, and in other documents, basic research was divided into pure basic research and applied basic research. In the late 1980s, the concept of fundamental-oriented research (*jichuxing yanjiu* 基础性研究) came into being and sparked discussions.² In recent years, the term "basic research" has been used once again to refer to various policies and discourse systems.

As basic research has had a history of more than 70 years in China, scientific and technological authorities and related major institutions have reviewed their respective policies in different periods. As early as 1987, the State Science and Technology Commission (SSTC), i.e., the predecessor of the Ministry of Science and Technology (MOST), commissioned the Chinese Academy of Sciences (CAS) to perform a nationwide investigation of the status quo and the development strategy of basic research in natural sciences, and as a result, the CAS compiled a report entitled *Current*

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¹ "Manual for Statistics on Scientific and Technological Activities, ST-84/WS/12," UNESCO, <http://uis.unesco.org/sites/default/files/documents/manual-for-statistics-on-scientific-and-technological-activities-historical-1984-en.pdf>. (accessed on May 10, 2020).

² This term was actually coined in China without a corresponding term in English. The scope that the term covers will be further explained later in the article.

Status and Future of Chinese Natural Sciences (1990).³ The SSTC also assigned two other tasks: it presented a number of basic research policies and identified one hundred basic research cases in China. In reference to the general situation more than thirty years after the foundation of the People's Republic of China (PRC), the former task related to issues regarding basic research and development, and by selecting ninety-nine rather successful and influential cases in the basic research field at the time, the latter task showcased the achievements made in basic research since the foundation of the PRC.⁴ As the authority in charge, the MOST published books such as *Basic Research over Fifty Years in China* (1999) and *Thirty Years of the Scientific and Technological Reform in China* (2008), reviewing the developmental history of China's policies on basic research in various key points in time from an official perspective.⁵ In 2009, at the sixtieth anniversary of the foundation of the CAS, Zhan Wenlong, vice president of the CAS, reviewed the important role played and the key achievements made by the CAS in basic research and summarized the leading and driving effects made by the CAS in the planning and decision-making for basic research in China during different periods.⁶ In 2018, to commemorate the fortieth anniversary of the convention of the National Science Conference in 1978, Li Jinghai, president of the Council of the National Natural Science Foundation of China (NSFC Council), went through the history of the NSFC and presented the specific measures implemented and the results achieved by the Science Foundation in funding basic

³ Quanguo jichuxing yanjiu zhuangkuang diaoyanzu, Zhongguo kexueyuan keji zhengce ju 全国基础性研究状况调研组, 中国科学院科技政策局 ed., *Zhongguo ziran kexue de xianzhuang yu weilai* 中国自然科学的现状与未来 (Current Status and Future of Chinese Natural Sciences) (Chongqing: Chongqing chubanshe, 1990).

⁴ Zhongguo jichu yanjiu baili ketizu 中国基础研究百例课题组 ed., *Zhongguo jichu yanjiu baili* 中国基础研究百例 (One Hundred Cases of Basic Research in China) (Beijing: Nengyuan chubanshe, 1990), 1.

⁵ Zhonghua renmin gongheguo kexue jishu bu 中华人民共和国科学技术部 ed., *Zhongguo jichu yanjiu wushi nian 1949-1999* 中国基础研究五十年 1949-1999 (Basic Research over Fifty Years in China 1949-1999) (Beijing: Kexue chubanshe, 1999); Wang Gang 万钢 ed., *Zhongguo keji gaige kaifang sanshi nian* 中国科技改革开放三十年 (Thirty Years of the Scientific and Technological Reform in China) (Beijing: Kexue chubanshe, 2008).

⁶ Zhan Wenlong 詹文龙, "Zhongguo kexueyuan jichu kexue yanjiu liushi nian 中国科学院基础科学研究六十年 (Sixty Years of Research in Basic Science of the Chinese Academy of Sciences)," *Zhongguo kexueyuan yuankan* 中国科学院院刊 (Bulletin of Chinese Academy of Sciences) 24:3 (2009), 217-229.

research.⁷ In addition, a number of scholars have carried out multi-dimensional studies of basic research and its policies, covering aspects such as the concept of basic research, the funding system, and its effectiveness.⁸

As one of the traditional categories of scientific and technological activities, basic research not only exists in every plan for scientific and technological development in China, but has also formed diverse funding systems. This article aims to examine the descriptions and design of basic research in China's major plans for scientific and technological development and summarize the development process of China's basic research policies from the perspective of scientific and technological planning.

Evolution of Basic Research as a Concept in Science and Technology Policy

Basic research initially appeared as “basic science” and “theoretical research” in policy proposals on building a national scientific research system in China. In 1949, the newly established CAS was assigned the mission of serving as a national scientific research center and an institute for organizing scientific research endeavors nationwide. The Central Committee of the Communist Party of China (CPC) tried to prevent the scientific community from misunderstanding that “the government only focuses on applied science and does not pay attention to basic science or theoretical research.”⁹ For this reason, the CPC decided that the CAS intended “mainly to study theoretical issues in basic science and addressing essential scientific issues that play

⁷ Li Jinghai 李静海, “Guojia ziran kexue jijin zhichi woguo jichu yanjiu de huigu yu zhanwang 国家自然科学基金支持我国基础研究的回顾与展望 (Review and Prospect on National Natural Science Fund Supporting China's Basic Research),” *Zhongguo kexueyuan yuankan* 33:4 (2018), 390-395.

⁸ Zhang Jiuchen 张九辰, “Jichu kexue yanjiu: jiyu gainian de lishi fenxi 基础科学研究: 基于概念的历史分析 (Basic Science Research: Concept-based Historical Analysis),” *Ziran kexueshi yanjiu* 自然科学史研究 (Studies in the History of Natural Sciences) 38:2 (2019), 127-139; Gong Xu 龚旭 and Fang Xin 方新, “Zhongguo jichu yanjiu gaige yu fazhan sishi nian 中国基础研究改革与发展 40 年 (Reform and Development of Basic Research in China [1978-2018]),” *Kexuexue yanjiu* 科学学研究 (Studies in Science of Science) 36:12 (2018), 2125-2128; Wang Yanyu 王彦雨 and Cheng Zhibo 程志波, “Woguo jichu yanjiu zizhu tixi de lishi yange ji yanbian lujing fenxi 我国基础研究资助体系的历史沿革及演变路径分析 (Analysis on the Historical Change of China Basic Research Funding System and Evolution Path),” *Keji jinbu yu duice* 科技进步与对策 (Science & Technology Progress and Policy) 28:22 (2011), 94-99.

⁹ “Jianli renmin kexueyuan caoan 建立人民科学院草案 (A Draft for the Establishment of the People's Academy of Sciences),” *Zhongguo keji shiliao* 中国科技史料 (China Historical Materials of Science and Technology) 21:4 (2000), 333-338.

important roles in national economy,” and finally requested that the CAS take “developing basic science” as one of the six key tasks of the time.¹⁰ China’s first long-term plan for scientific and technological development, i.e., the *1956–1967 Long-term Plan for National Scientific and Technological Development (Twelve-year Plan)* (1956–1967 年全国科学技术发展远景规划), was released in 1956. While drafting the Twelve-year Plan, the Chinese and Soviet experts disputed over which of the two terms, “basic science” and “fundamental science” (*jiben kexue* 基本科学), should be used.¹¹ The ultimately released plan chose the term “basic science.” Since then, basic science and research in basic science have been included as key components in China’s scientific and technological policies.

The 1963–1972 Ten-year Plan for Sciences (1963–1972 年十年科学规划), developed in 1962, defined “basic science” as a concept corresponding to “technological science,” which became one of the key objectives of scientific and technological development in that stage. Although “basic research” appeared twice in the plan, during a certain period of time thereafter, basic research was often regarded only as part of the research contents in a specific discipline, not as an independent, core category in science and technology policies.

In 1985, the SSTC, the State Planning Commission, the National Bureau of Statistics (NBS), and the State Education Commission jointly organized and carried out the first National Science and Technology Census in China, which played an important role in understanding the general situation of science and technology in China and establishing a reporting system in the field of science and technology. Notably, they applied indicators that were made by taking account of definitions and classifications in the *Manual for Statistics on Scientific and Technological Activities* of the United Nations Educational, Scientific, and Cultural Organization (UNESCO).¹² From then on, basic research as a policy concept in China began to be defined and used in compliance with international standards. In the *Medium- and Long-term Guidelines to National Scientific and Technological Development (1986-*

¹⁰ “Zhonggong zhongyang dui Zhongguo kexueyuan dangzu <guanyu muqian kexueyuan gongzuo de jiben qingkuang he jinhou gongzuo renwu gei zhongyang de baogao> de pishi 中共中央对中国科学院党组《关于目前科学院工作的基本情况和今后工作任务给中央的报告》的批示 (Comments of the Central Committee of the Communist Party of China on “Report to the Central Committee on the General Situation of the Current Work and the Future Work and Tasks of the Chinese Academy of Sciences” made by the Leading Party Group of the Chinese Academy of Sciences),” in Hu Weijia 胡维佳 ed., *Zhongguo keji zhengce ziliao xuanji 1949–1955 shang* 中国科技政策资料选辑 1949–1955 上 (Jinan: Shandon jiaoyu chubanshe, 2006), 100–112.

¹¹ Zhang Jiuchen, “Jichu kexue yanjiu: jiyu gainian de lishi fenxi.”

¹² Liu Shumei 刘树梅, “Woguo keji tongji fazhan gaikuang 我国科技统计发展概况 (An Overview of the Development of Statistics of Science and Technology in China),” *Keji guanli yanjiu* 科技管理研究 (Science and Technology Management Research) 2 (2007), 1–3.

2000) (国家中长期科学技术发展纲领 [1986–2000]), “basic research” became an independent concept and was considered one of the five central sections of the “*Seventh Five-year Plan for National Scientific and Technological Development*” (“七五”全国科学技术发展计划).

The First National Basic Research and Applied Basic Research Work Meeting, which convened in 1989, exhibited that the importance of basic research had been reconsidered and that basic research was being promoted at the governmental level. The title of the meeting suggests that the two categories, “basic research” and “applied basic research,” gave birth to a new policy concept with more extensive implications. This concept was clearly defined as “fundamental-oriented research” in the speech delivered by Song Jian, then-director of the SSTC, in the opening ceremony.¹³ Specifically, fundamental-oriented research consisted of three types of work: (1) pure basic research that mainly aimed to explore the unknown and to understand nature and that had no apparent application backgrounds; (2) targeted research that had extensive application backgrounds or purpose but was aimed at acquiring new knowledge, revealing new rules, and discovering new principles and new methods; and (3) research that systemically gathered, identified, evaluated, accumulated, and comprehensively analyzed basic scientific data, materials, and information so as to explore basic rules.¹⁴ The introduction of the concept of fundamental-oriented research aimed largely at adapting to the political objectives and the developmental demand of the time. In 1985, the Chinese government started to reform its scientific and technological system, emphasizing that scientific and technological activities should fulfill the objective of boosting the economy. This guideline set the tone for later scientific and technological development in China. Meanwhile, both the political and scientific circles paid attention to the issue of how science and technology could boost economic and social development. Under these circumstances, the concept of fundamental-oriented research, which was full of Chinese characteristics, came into being. As renowned Chinese contemporary scientist Qian Xuesen 钱学森 (1911–2019) expressed, “modern basic research not only includes the pure basic research in different natural sciences, but also consists of the basic research in an extensive field of applied science and technology, i.e., fundamental applied research, which covers a broad scope.”¹⁵ Therefore, “fundamental-oriented research”

¹³ Guojia kexue jishu weiyuanhui 国家科学技术委员会 ed., *Zhongguo kexue jishu zhengce zhinan (kexue jishu baipishu disihao)* 中国科学技术政策指南 (科学技术白皮书 第四号) [A Guide to China's Science and Technology Policies (Science and Technology White Paper, Vol. 4)] (Beijing: Kexue jishu wenxian chubanshe, 1990), 285–295.

¹⁴ Zhongguo jichu yanjiu baili ketizu ed. 中国基础研究百例课题组 ed. *Zhongguo jichu yanjiu baili*, 1.

¹⁵ Gu jihuan 顾吉环 et al. ed., *Qian Xuesen wenji* 5 钱学森文集 5 (Collected Works of Qian Xuesen, Vol. 5) (Beijing: Guofang gongye chubanshe, 2012), 385–390.

is actually the combination of “pure basic research” and certain applied research, i.e., “fundamental applied research.”

Until 2000, when the Second National Basic Research Work Meeting was held, the term “fundamental-oriented research” was gradually substituted with “basic research” again. Nevertheless, the *Opinions on Strengthening Basic Research Endeavors*, which was issued after the meeting, showed that, although the core concept changed to “basic research” in the policies, the ranges of the three corresponding types of work under “basic research” were still generally consistent with those under “fundamental-oriented research.” They were “(1) explorative research endeavors that mainly aim at understanding natural phenomena and revealing objective rules; (2) targeted research endeavors that aim to address key scientific issues presented by national economy, social development, and scientific development itself; and (3) fundamental work that systemically investigates, gathers, identifies, evaluates, and comprehensively analyzes basic scientific data, materials, and information so as to explore basic rules.”¹⁶ It is worth noting that the targeted research on “extensive application backgrounds or purpose” in “fundamental-oriented research” was explicitly replaced by targeted research on “national economy, social development, and scientific development itself.”

The *Opinions of the State Council on Comprehensively Strengthening Research in Basic Science* in 2018 mentioned “research in basic science” again and divided it into two categories: (1) “freely explorative basic research” that “focuses on scientific issues aiming at exploring the unknown” and (2) “targeted basic research” that “is closely connected with demands from economic and social development.”¹⁷ In fact, except for the exclusion of the “fundamental work” from the previous three types of work in basic research, this concept of “basic scientific research” generally continued to reflect the policy implications from 1989.

¹⁶ “Guanyu yinfa guanyu jiaqiang jichu yanjiu gongzuo de ruogan yijian de tongzhi 关于印发《关于加强基础研究工作的若干意见》的通知 (Concerning Issuing the ‘Opinions on Strengthening Basic Research Endeavors’),” Keji bu, Jiaoyu bu, Zhongkeyuan, Gongchengyuan, Guojia ziran kexue jijinwei 科技部、教育部、中科院、工程院、国家自然科学基金委 (the Ministry of Science and Technology, the Ministry of Education, the Chinese Academy of Sciences, the Chinese Academy of Engineering and the Council of the National Natural Science Foundation of China), http://www.moe.gov.cn/jyb_xxgk/gk_gbgg/moe_0/moe_7/moe_14/tnull_5824.html (accessed on May 10, 2020).

¹⁷ “Guowuyuan guanyu quanmian jiaqiang jichu kexue yanjiu de ruogan yijian 国务院关于全面加强基础科学研究的若干意见 (Opinions of the State Council on Comprehensively Strengthening Research in Basic Science),” Guowuyuan, http://www.gov.cn/zhengce/content/2018-01/31/content_5262539.htm (accessed on May 10, 2020).

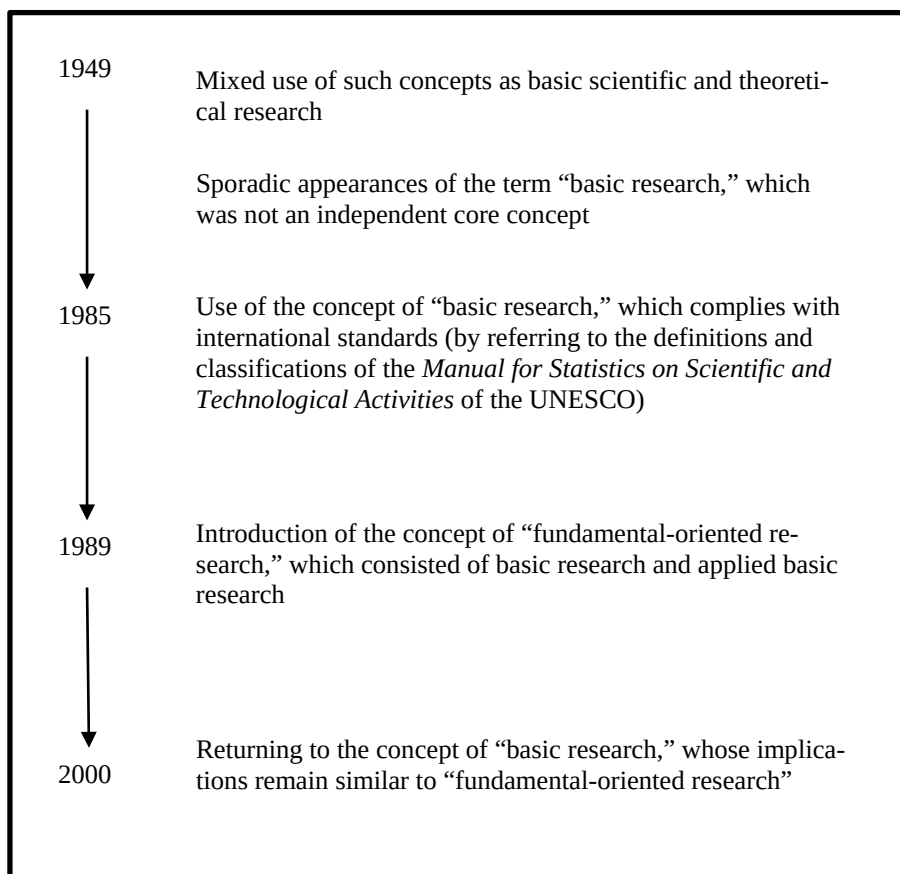


Figure 1. Evolution of Basic Research as a Policy Concept

Basic Research in Plans for Scientific and Technological Development in Different Periods

Scientific and technological development planning has served as one of the most important components in the Chinese scientific and technological system. A scientific and technological development plan served as a guideline in China's scientific and technological policies during a specific period. It exhibited the government's ideas and overall considerations concerning scientific and technological develop-

ment, consisting of various aspects of scientific and technological development, including strategic objectives, specific tasks, organization, and implementation. Since 1949, China has released 12 scientific and technological development plans, which consist of both the regular five-year plans and the medium- to long-term plans applicable for longer periods. The basic research in each of these plans, the use of the term, the implications of the concept, and the specific tasks assigned to it show characteristics typical to certain periods.

(1) Basic Research as Basic Science

After its foundation, the PRC gradually established a planned economic system. With reference to the Soviet experience, China started to implement its first national economic “five-year plan” in 1953. The country’s planning in the economic field also influenced its scientific and technological field. In the meeting on intellectuals’ issues held by the Central Committee of the CPC in early 1956, the premier Zhou Enlai 周恩来 (1898-1976) requested that a long-term plan for scientific and technological development be worked out within three months under the leadership of the SPC. Led and organized by the Science Planning Commission of the State Council,¹⁸ hundreds of senior scientists and experts from the fields of science and technology took part in the development of the plan. Furthermore, the Soviet government also sent 18 experts to assist China with the job.¹⁹ In December 1956, after undergoing studies, discussions, and modifications for nearly one year, the *Twelve-year Plan* was officially released. The *Twelve-year Plan* was the PRC’s first plan for science and technology, and it has had profound impacts on later scientific and technological planning. Although the term “basic research” did not directly appear in this plan, we can find explanations of related terms such as “scientific theory,” “basic science,” and “basic theoretical issue.” The plan not only set out fifty-seven essential scientific and technological tasks within thirteen aspects, most of which included “various scientific theoretical issues directly relating to national construction,” but also singled

¹⁸ The commission was previously called the Science Planning Group, which consisted of a total of ten members from the CAS and various ministries and commissions. In February 1956, the group was upgraded to the Science Planning Commission of the State Council. Vice premier Chen Yi was appointed as the director of the commission.

¹⁹ Zhang Jiuchun 张久春 and Zhang Baichun 张柏春, “Guihua kexue jishu: ‘1956-1967 nian kexue jishu fazhan yuanjing guihua’ de zhiding yu shishi 规划科学技术:《1956-1967 年科学技术发展远景规划》的制定与实施 (Planning Science and Technology: Working out and Implementing the Long-term Program for Developing Science and Technology from 1956 to 1967),” *Zhongguo kexueyuan yuankan* 中国科学院院刊 (Bulletin of Chinese Academy of Sciences) 34:9 (2019), 982-991.

out Task 56 as the “research on a number of basic theoretical issues in modern natural science.” Given inadequate human and material resources at the time, the plan also selected twelve tasks from the aforementioned fifty-seven tasks as top priorities, among which we still can find “a number of important basic theories in natural science.” In addition, the plan specifically pointed out that the first eleven key tasks consisted of their respective theoretical research, and that the twelfth key task was the research on “a number of theoretical issues with universal significance,” while a number of key areas in different natural sciences, including mathematics, physics, and chemistry, were specified. Furthermore, “basic science” and “essential scientific and technological tasks” were discussed as independent chapters. In the chapter, “Development direction of basic science,” eight disciplines in basic science were planned, namely mathematics, mechanics, astronomy, physics, chemistry, biology, geology, and geography. The *Twelve-year Plan* also structured China's scientific research system, emphasizing that the CAS should “focus on developing research in new scientific and technological fields and basic sciences and take on the responsibility for exploring new directions and looking for new ways.” It also stressed that universities should “attach importance to both basic theoretical research and research on issues that have great significance to production development.”

After the objectives set out in the *Twelve-year Plan* were basically accomplished ahead of schedule, the *Ten-year Plan* was released in 1963. In the development and implementation stages of the *Ten-year Plan*, China faced a harsh internal and external environment. On the one hand, due to political movements, scientific researchers' enthusiasm was impaired. On the other hand, along with the deterioration of its relationship with China, the Soviet Union annulled the treaty on China-Soviet scientific and technological cooperation and withdrew its experts from China. As such, the *Ten-year Plan* exhibited the resolution to re-establish the order of China's scientific and technological development. This plan listed “basic science” as one of the objectives for scientific and technological development, and assigned a separate chapter to it. Based on a summary of great significance and characteristics of basic science, the plan clearly drafted ten-year development objectives from three aspects, i.e., research results, scientific and technological talent, and the scientific and technological system. For the first time in China, it proposed forty-one key tasks and made detailed explanations of the development directions of each field in basic sciences. Unfortunately, because of factors including the Cultural Revolution, the *Ten-year Plan* was disrupted after being successfully implemented for only three years.

The National Science Conference was held in 1978; Deng Xiaoping 邓小平 (1904-1997), vice premier at the time, argued that “science and technology are productive forces” at the opening ceremony of the conference. From then on, the role and functions of science and technology in national construction began to receive attention. This unprecedented conference symbolized that China entered a “spring of science” after having been seriously disrupted and impaired during the Cultural

Revolution for a decade.²⁰ The *Outline of the 1978–1985 Plan for National Scientific and Technological Development (Tentative)* (“*Eight-year Plan Outline*”) (1978–1985 年全国科学技术发展规划纲要[草案]) was passed in the conference after being discussed, studied, and developed by more than 20,000 people, and it became the first plan for national scientific and technological development in China after the country’s Reform and Opening up. Disrupted by the Cultural Revolution, the gap in science and technology between China and the outside world was expanded again. Therefore, we can see contents in the *Outline* that encouraged hard work for catching up with the advanced international level. “Basic science” almost disappeared from the *Outline* except that, when scientific research institutes were planned, the document asserted that colleges and universities should have research in both basic and applied science and that state and local research institutes should also appropriately engage in research in basic science while focusing on research in applied science. In the core content of the plan, the term “basic science” was replaced by a relevant concept “natural science theory.” To bring China closer to the advanced level of the world in some key scientific and technological fields in the 1970s, the plan comprehensively arranged research tasks in such aspects as natural resources, agriculture, and industry and determined one hundred and eight key tasks therein. As a field amid five other key fields, namely agriculture, resources and natural conditions, energy, industry, and medicine and environmental protection, “natural science theories” involve twenty-seven key tasks ranging from Task 82 to Task 108. In particular, affected by the excessive optimism about the ongoing situation and the eagerness of catching up with the advanced international level, the objectives set forth by the *Outline* exceeded the realizable scope and were ultimately condensed to 38 state scientific and technological research projects, which achieved rather good results as a result of the condensation.²¹

²⁰ Guo Moruo 郭沫若 (1892–1978), then-president of the CAS, made a speech, entitled “The Spring of Science,” at the closing ceremony of the NSC in 1978. Later on, the term “spring of science” has been used to indicate the period of new opportunities in the development of China’s scientific endeavors.

²¹ Fan Chunliang 樊春良, “Xin Zhongguo 70 nian keji guihua de chuangli yu fazhan — butong shiqi keji guihua de bijiao 新中国 70 年科技规划的创立与发展 — 不同时期科技规划的比较 (Establishment and Development of New China 70-year Science and Technology Plan — A Comparative Study of Scientific and Technological Planning in Different Periods),” *Keji daobao* 科技导报 (Science & Technology Review) 37:18 (2019), 31–42.

(2) Basic Research Compatible with International Standards

For the purposes of further accelerating scientific and technological development and shortening the gap with developed countries in the world and while the *Eight-year Plan Outline* was still being implemented, the Chinese government started to make preparations to draft a new long-term plan for scientific and technological development. Engaging a great number of people, the *1986–2000 Plan for National Scientific and Technological Development* (1986–2000 年全国科学技术发展规划) was developed stage by stage and was completed at the end of 1984. The plan was divided into a medium-term plan, i.e., “*Seventh Five-year Plan for National Scientific and Technological Development (Tentative)*”; a long-term plan, i.e., *Framework Design Outline of the 1986–2000 Plan for National of Scientific and Technological Development (Tentative)* (1986–2000 年全国科学技术发展规划轮廓设想纲要[草案]); and the *Outline of the 1986–1990 Plan for National Scientific and Technological Development (Tentative)*, which covered all major traditional industries and six emerging technological areas.²²

This fifteen-year plan expressly outlined principles including that “science and technology must be dedicated to economic construction,” “full coverage is not pursued,” and “a scientific and technological system with Chinese features should be developed.” As an independent core concept, “basic research” reappeared in the key chapters of the plan. The tasks set forth by the plan for basic research mainly consisted of two aspects: (1) sticking to long-term development and arranging basic research projects, and (2) complying with the rules of scientific and technological development and strengthening fundamental endeavors. As such, forty-three key projects in basic research were proposed in the detailed “*Seventh Five-year Plan for National Scientific and Technological Development (Tentative)*.” More importantly, this fifteen-year plan initiated the basic research foundation and project-funding system in China: Generally coordinated under the plan, a number of national key laboratories in universities and scientific and technological research institutes were funded and equipped under such entities as the State Education Commission (the predecessor of the Ministry of Education), the CAS, the Ministry of Agriculture, and the Ministry of Health in 1984. Furthermore, the CAS Science Foundation was upgraded into the NSFC Council to guide, coordinate, and fund basic research nationwide in 1986.

²² Zhonghua renmin gongheguo kexue jishu bu fazhan jihua si 中华人民共和国科学技术部发展计划司 ed., *Zhonghua renmin gongheguo kexue jishu fazhan guihua he jihua 1945–2005 nian* 中华人民共和国科学技术发展规划和计划 1949–2005 年 (Planning and Plans of Scientific and Technological Development of the People's Republic of China [1949–2005]) (Beijing: Kexue jishu wenxian chubanshe, 2008), 77.

When the plan was released, China was carrying out its first National Science and Technology Census, which adopted the standards (including indicators, definitions, and categorization) developed by such international organizations like UNESCO. Over a certain period of time later on, terminologies in China's scientific and technological policy began to be compatible with international standards. Therefore, when the plan was implemented, the concepts relating to basic research also complied with such standards.

(3) Fundamental-oriented Research in Line with National Condition

The National Basic Research and Applied Basic Research Work Meeting, which convened in 1989, introduced the concept of “fundamental-oriented research” into China's policy-making circle. The concept included the existing term “basic research” and the newly added “applied basic research.” This concept was used in both the Eighth and the Ninth Five-year Plan periods.

The *Outline of the National Medium- and Long-term Plan for Scientific and Technological Development* (国家中长期科学技术发展纲要) projected the prospects of scientific and technological development in China from 1990 to 2000 and then to 2020. In the *Outline*, basic research and applied basic research were regarded as one of the six development focuses, together with (1) agricultural science and technology, (2) industrial science and technology, (3) science and technology in respect of social development, (4) high and new technology and technological industry, and (5) science and technology for national defense. In addition, the *Outline* also stated that basic research and applied basic research should “aim at exploring science and obtaining macro socioeconomic benefits” and that funding should mainly come from the continuous and steady fiscal support from the state.

Officially released in 1992, the *1991–2000 Ten-year Plan and the Outline of the Eighth Five-year Plan for Scientific and Technological Development* (1991-2000 年科学技术发展十年规划和“八五”计划纲要) continued the mindset of previous plans. Especially the doctrine that “science and technology must be dedicated to economic construction; and economic construction must depend on science and technology” was taken as the overall guideline for China's scientific and technological development. The document set out the objectives of China's fundamental-oriented research in ten years regarding three macro aspects: disciplines, talent teams, and organizations. It expressly laid out for the first time the objectives of quantitative development of fundamental-oriented research as below: (1) during the Eighth Five-year Plan period, the number of scientists' voluntary projects in fundamental-oriented research should be maintained around 20,000; (2) with reference to the demand of national economy and social development, 200 to 300 key projects should be chosen among the aforementioned voluntary projects; and (3) separate plans should be developed for the basic research projects that might help China make breakthroughs

by the end of the twentieth century. In terms of funding, this plan was consistent with the *Outline of the National Medium- and Long-term Plan for Scientific and Technological Development*. Fundamental-oriented research should continue receiving support from diversified sources, and inputs to fundamental-oriented research should be “adjusted to an appropriate proportion.” According to the specific requirements of the plan, by the end of the twentieth century, the proportion of the fundamental-oriented research funding in the total research and development funding should exceed 10%.

Although the *Ninth Five-year Plan and the 2010 Outline of the Long-term Plan for National Scientific and Technological Development* (全国科技发展“九五”计划和2010年长期规划纲要) was drafted in 1994, the State Science and Education Leading Group, after discussions, decided not to officially release the plan in 1998. Despite the fact that the plan had been designed to remain valid until 2010, the period in which the plan was actually effective was from 1996 to 2000, the last five years of the twentieth century. By then, China had already promoted the strategy of “invigorating China through science and education,” in which science, technology, and education were placed in an essential position in economic and social development. We can see that the *Ninth Five-year Plan and the 2010 Outline of the Long-term Plan for National Scientific and Technological Development (for report only)*, which is in place today, was in line with its preceding plan with regard for its mindset for basic research development during the period. The development direction of the plan was still to focus on the country's strong basic science areas and to strive for making breakthroughs while taking account three factors: national economic construction, the demand of social development, and the trend of scientific development. Furthermore, the plan also specifically mentioned the construction of national key laboratories, major scientific projects and facilities, and state-level funding and support plans for basic science from entities such as the natural science foundation system.

Although China addressed fundamental-oriented research to meet the demand of its development after the reform and opening up in 1978, the use of “applied basic research” can be traced back to the 1960s,²³ when the design of fundamental-oriented research in policy plans fully exhibited philosophies of the Chinese government, such that “science and technology are primary productive forces” and that science and technology should serve economy and society. Led by the plan, China began to implement the *National Key Fundamental-oriented Research Plan* (“Climbing Plan”) (国家重大基础性研究计划[攀登计划]) in 1992; in 1997, the *National Development Plan for Key Basic Research* (国家重点基础研究发展规划) was developed, while the *National Development program for Key Basic Research* (“973

²³ Liu Li 刘立, “Jichu yanjiu jiujing shi shenme? 基础研究究竟是什么? (What Exactly Is Basic Research?),” *Keji Zhongguo* 科技中国 (Science and Technology in China) 2 (2002), 97-99.

program”) (国家重点基础研究发展计划[973 计划]) was implemented.²⁴ Together with the NSFC, the two plans formed the basic research funding system at the state level.

(4) Basic Research Returning to a Comprehensive Concept

Since the beginning of the twenty-first century, five scientific and technological development plans have been released in China, including four regular five-year plans and one medium- and long-term plan. Except for the Tenth Five-year plan issued in 2001, the remaining three five-year plans were formulated under the framework of the medium- and long-term plan. The term “basic research” has come back and been used as a comprehensive concept in those plans. Different representations of basic research in the five plans reflect the changing attitudes of the Chinese government toward basic research.

Released in 2001, the *Tenth Five-year Plan for National Economy and Social Development: Special Plan for Scientific, Technological, and Educational Development (Scientific and Technological Development Plan)* (国民经济和社会发展第十个五年计划科技教育发展专项规划[科技发展规划]) was China’s first scientific and technological development plan in the twenty-first century, and it furthered the country’s mindset of implementing the strategy of “invigorating China through science and education,” and used “innovation and industrialization” as its guideline. The plan expressly stated that China had to catch up to the world frontier level in a number of scientific areas. The plan considered basic research as part of the efforts by which China should strengthen its scientific and technological innovation capacity, and placed it side by side with high-tech research and development. Regarding specific tasks, basic research focused on three areas: (1) research on major scientific issues, which involved six areas: agriculture, energy, information, materials, resources and environment, and population and health; (2) disciplinary construction: supporting humanities and social science in addition to traditional natural science, and developing emerging disciplines, peripheral disciplines, and inter-disciplines; and (3) explorative research: encouraging scientists to explore freely and supporting steadily outstanding talents to engage in research. We can see that the promotion of

²⁴ In March 1997, CPC and state leaders such as Li Peng (1928-2019), Li Lanqing (1932-), and Song Jian (1931-) attended the Joint Meeting of Science and Technology Organizations and the China Association for Science and Technology during the Fifth Session of the Eighth National Committee of the Chinese People’s Political Consultative Conference (“CPPCC”). During the meeting, the leaders listened to the speeches made by scientist representatives and proposed to develop the “national development plan for key basic research.” The plan was later called the “973 program” for short.

basic research was comprehensively reflected in this plan, while the “basic research” mentioned in the plan was still a comprehensive concept covering both basic research and applied basic research.

After a certain period of accumulations, China's overall scientific and technological level improved rather significantly especially in terms of the number of theses and patents. However, there still existed considerable problems in aspects such as the lower level of scientific and technological talent, and the limited capacity of scientific and technological management and governance. To participate in the worldwide scientific and technological competition more actively, China strived to clear obstacles in scientific and technological development. In addition to the five-year scientific and technological plans, the country organized again large-scale studies to produce the *Outline of the State Medium- and Long-term Plan for Scientific and Technological Development (2006–2020)* (国家中长期科学和技术发展规划纲要[2006–2020年]). The *Outline* has been the most comprehensive and influential plan for scientific and technological development since the beginning of the twenty-first century in China. The plan highlights “independent innovation,” and plans China's scientific and technological development over the fifteen years from 2006 to 2020. As one of the special chapters therein, basic research involves four tasks. The first task concerns disciplinary development planning. In addition to such traditional basic disciplines as mathematics, physics, chemistry, astronomy, geography, and biology, the task also includes inter-disciplines and emerging disciplines that have come into being based on overlapping and integration between existing disciplines in science and technology and between natural science and humanities and social science. The mindset and contents of the disciplinary development plan is basically consistent with the previous plan, except that references to inter-disciplines and emerging disciplines are more specific. The remaining three tasks consist of eight frontier scientific issues, ten basic research projects addressing the demand of major national strategies, and four major scientific research programs. These tasks are the first specific jobs ever set out in such plans after basic research is further categorized.

Within the framework of the above-mentioned medium- and long-term plan, China released three five-year plans for scientific and technological development in 2006, 2011, and 2016. With reference to the status and demands of scientific and technological development at the time, the three plans made adjustments to the design of basic research. The *National Eleventh Five-year Plan for Scientific and Technological Development* (“*Eleventh Five-year Plan*”) (国家“十一五”科学技术发展规划) was released in 2006 directly after the medium- and long-term plan, and, therefore, was highly consistent with the latter in terms of both structure and content. The plan started to place basic research side by side with frontier technologies and dedicated special sections to the current major frontier issues that needed to be addressed in the basic research, the basic research areas needed by major national strategies, and the major scientific research plans. The plan was basically consistent with

the medium- and long-term plans in its content module and had only slight differences in the specific requirements for the issues and areas. After years of implementation and the management of scientific and technological programs, the *Eleventh Five-year Plan* expressly stated that the management of scientific and technological programs should be reformed and that China's scientific and technological programs should be divided into major special programs and basic scientific and technological programs. Basic research programs were put into the category of basic scientific and technological programs and consisted of freely explorative basic research and national objectives-oriented strategic basic research.

The *National Twelfth Five-year Plan for Scientific and Technological Development* ("Twelfth Five-year Plan") (国家“十二五”科学和技术发展规划) introduced the philosophy of coordinated development of basic disciplines, which emphasizes support of the development of the disciplines in which China had strength, increasing support to weak disciplines, and lifting the overall level of disciplines by strengthening the integration among different disciplines and by actively supporting emerging disciplines. The plan briefly presented the “major scientific issues at the frontier of science” that needed to be addressed at the time and only listed the major research directions without giving any detailed descriptions. In “the area of studying demand-oriented major scientific issues” section, the *Twelfth Five-year Plan* added the “manufacturing and engineering science area” and deleted the content relating to “major scientific frontiers” from the *Eleventh Five-year Plan*. Based on the four major scientific research programs in the *Eleventh Five-year Plan*, namely protein research, quantum control research, nanotech research and development, and reproduction research, the *Twelfth Five-year Plan* added global change research and stem cell research and began to shift the direction of nuclear fusion power research with the help of China's participation in building facilities for the International Thermonuclear Experimental Reactor (ITER). Furthermore, the plan stated again that China should strengthen fundamental scientific and technological endeavors, including carrying out scientific investigations; compiling and studying important scientific and technological literature, local annals, classics, and drawings; and building and sharing scientific databases, to be specific.

The *National Thirteenth Five-year Plan for Scientific and Technological Innovation* ("Thirteenth Five-year Plan") (“十三五”国家科技创新规划) designs the development of basic disciplines from the viewpoint of building a disciplinary system. While it changes from “demand-oriented” to “objective-oriented,” basic research covers three areas: (1) the basic research dedicated to the emphatic deployment of major national strategic tasks becomes more specific compared to the previously specified areas, “manufacturing and engineering sciences” is divided into “manufacturing in extreme environmental conditions” and “formation and forecast of catastrophes of sophisticated systems in key projects,” and “key mechanical issues in aerospace and aviation” is added; (2) based on the previous plan, thirteen strategic issues in science are put forward; and (3) basic research and advanced exploration in “gene

editing, plainification of materials, neural chips, metamaterials, and accurate mesoscopic measurement” are stated so as to provide scientific reserves for industrial transformation and sustainable economic and social development. Given that it keeps improving its comprehensive national strength and scientific and technological competitiveness, China is expected to actively participate in and even initiate international big science projects. Therefore, the plan proposes that China join the ITER project, the Square Kilometer Array (SKA) project, the Group on Earth Observations (GEO), and the International Ocean Discovery Program (IODP); the plan also urges China to initiate and implement international big science projects in the upcoming five to ten years. The construction of major scientific and technological facilities and the implementation of scientific investigations and surveys are also separately listed. Furthermore, the *Thirteenth Five-year Plan* also proposes for the first time the coordination of supports for basic research and covers all aspects that have significant impacts on basic research, e.g., the input system, the management layout, integration between science and education, and the evaluation mechanism.

In most of the recent five plans, basic research emerged as a comprehensive concept, while the five plans were consistent with one another in terms of their basic philosophy of development; all of them reflected the characteristic features specific to the development of basic science and highlighted the position and needs of China's governmental funding for science. In these plans, there were both forward-looking layouts in a number of areas and specific schemes targeting strategic demands. With reference to the requests of these scientific and technological plans, five-year plans for “basic research” were released in 2006, 2012, and 2017, respectively, in China.

Conclusion

As guidelines for scientific and technological development in specific periods, China's scientific and technological development plans have played an essential role in the country's scientific and technological policy system. Since basic research appeared on the scientific and technological policy horizon, its concept, implications, development direction, organization, and implementation in scientific and technological development plans have been modified continuously and have exhibited evident Chinese characteristics.

The changes in basic research as a concept in scientific and technological development plans reflect the Chinese government's understanding of and attitude toward basic research during different periods. In the three scientific and technological development plans before the reform and opening up, “basic research” was used for terms such as “scientific theory,” “basic science,” and “basic theoretical issues.” In terms of people's understanding of the concept, basic research was limited to the range of theoretical research, and greater focus from the policies was placed on the

planning of specific disciplines such as mathematics, physics, and chemistry. After the First National Science and Technology Census in 1985, with reference to the UNESCO indicators, “basic research” as a concept was involved in the *1986–2000 Plan for National of Scientific and Technological Development*, and its supporting policies tilted toward pure basic research. Under the strategic guideline that “economic construction must depend on science and technology while scientific and technological work must be dedicated to economic construction,” China’s policy-making circle introduced the concept of “fundamental-oriented research,” which was further divided into basic research and applied basic research. In the later policies, the implications of “fundamental-oriented research” and those of “basic research” were generally consistent with one another. The “principle of sticking to integrating the state’s objectives with free explorations” set out by the *Eleventh Five-year Plan* accurately indicated the Chinese government’s expectation for basic research.

The basic research tasks proposed according to different scientific and technological plans have reflected the status and trend of scientific and technological development in China and revealed the Chinese government’s demand for basic research. “A number of important basic theories in natural science” and the plan of the development directions of eight disciplines set out in the *Twelve-year Plan* aimed at accumulating the country’s scientific reserves, given that, after the foundation of the PRC, the country’s scientific and technological strength was poor, while the level of disciplinary development was also low. The plans during a certain period after the *Twelve-year Plan* mainly set out a number of major tasks and projects for basic research in different fields, and in terms of specific contents, it still focused on science itself. Starting from the plans that specified “fundamental-oriented research” as their core concept, planners also introduced criteria of applicability while taking account of the scientific value of tasks in basic research. The *Outline of the State Medium- and Long-term Plan for Scientific and Technological Development (2006–2020)* and the three following five-year plans went into further detail regarding the categorization of basic research. In addition to disciplinary construction and free exploration, they mentioned frontier scientific issues, major scientific research plans, and basic scientific research work. Moreover, along with the gradual improvement of its scientific and technological strength, one of the major tasks of basic research during the Thirteenth Five-year period, i.e., from 2016 to 2020, is to increasingly participate in international scientific and technological activities and to organize international big science projects.

According to the deployment of its planning, China has gradually formulated its basic research program and funding system at the state level. For example, universities and research institutes attached to ministries and commissions invested in and equipped a number of state laboratories in 1984; in 1986, the CAS Science Foundation was upgraded into the NSFC Council; in 1992, China began to implement the *Climbing Plan*; and in 1997, the *National Development Plan for Key Basic Research*

was developed, while the 973 *program* was implemented. The reform on the management of scientific and technological program set forth in the *Eleventh Five-year Plan* divided China's scientific and technological programs into two categories: major special programs and basic scientific and technological programs. As one type of basic scientific and technological programs, basic research programs highlighted original innovation and focused on free explorative research and national objectives-oriented strategic basic research. In 2015, China started a new wave of reforms on scientific and technological programs, consolidating the scientific and technological programs, special projects, and funds that had been managed by central authorities into five types of scientific and technological programs, special projects, and funds. Among them, we can still find the NSF, which is dedicated to funding basic research and frontier scientific exploration.

As we can see from those plans during different periods, the financial support from the Chinese government to basic research has been generally made in a steady fashion. In the plans from different periods, the government has repeatedly stated that inputs to basic research should "be adjusted to an appropriate proportion," or stressed that inputs to basic research should be increased. The *1991–2000 Ten-year Plan and the Outline of the Eighth Five-year Plan for Scientific and Technological Development* even expressly proposed that, by the end of the twentieth century, the proportion of China's basic research funding in the country's total research and development funding should exceed 10%. Nevertheless, this proportion in China has stood steadily around 5%. By 2018, this proportion had only reached 5.5%.²⁵ At present, China is working on the formulation of the *2021–2035 State Medium- and Long-term Plan for Scientific and Technological Development* (2021–2035 年国家中长期科技发展规划). Both the position of basic research in the plan and the release and implementation of follow-up supporting these policies can be expected.

²⁵ "2018nian quanguo keji jingfei touru tongji gongbao 2018 年全国科技经费投入统计公报 (Statistical Bulletin on National Scientific and Technological Funding 2018)," Guojia tongji ju 国家统计局 (National Bureau of Statistics of China), http://www.stats.gov.cn/tjsj/tjgb/rdpcgb/qgkjfft/rjgb/201908/t20190830_1694754.html (accessed on May 10, 2020).

Appendix. Basic Science in China's Scientific and Technological Development Planning, 1949-2020

Concept	Plan	Release Time	Applicable Time Period	Key Points Concerning Basic Science
Basic research as basic science	National Plan for Scientific and Technological Development Prospects (1956 – 1967) (“Twelve-year Plan”)	1956	1956-1967	(1) “Research on a number of basic theoretical issues in modern natural science” as Task 56 of 57 tasks in 13 areas; “a number of important basic theories in natural science” as Task 12 of 12 priority tasks. (2) A special chapter on “Development direction of basic science,” with plans for eight disciplines: mathematics, mechanics, astronomy, physics, chemistry, biology, geology, and geography.
	1963 – 1972 Ten-year Plan for Sciences (“Ten-year Plan”)	1963	1963-1972	Independent Chapter: “Basic sciences” (1) Summarizing the three characteristics of modern basic science (2) Proposing three goals for the 10-year development of basic sciences (3) Proposing 41 key tasks and detailing the development directions of eight basic disciplines, respectively
	Outline of the 1978 – 1985 Plan for National Scientific and Technological Development (Tentative) (“Eight-year Plan Outline”)	1978	1978-1985	One of the major scientific and technological research projects: aspects of natural science theory Replacing “basic sciences” with “natural science theory” and proposing 27 key tasks
Basic research compatible with international standards	1986 – 2000 Plan for National Scientific and Technological Development	1984	1986-2000	(1) Sticking to long-term development and arranging basic research projects (2) Complying with the rules of scientific and technological development itself and strengthening fundamental endeavors (3) Proposing forty-three key basic research projects (4) Establishing national key laboratories and NSFC Council

Fundamental-oriented research in line with national condition	Outline of the National Medium- and Long-term Plan for Scientific and Technological Development	1991	1990-2020	One of the six development focuses: “Basic research and applied basic research” (1) Basic research and applied basic research should “aim at exploring science and obtaining macro socioeconomic benefits” (2) Research priorities in six fields (condensed matter physics, molecular biology, chemistry, oceanography, ecology, and information science) (3) Continuous and stable financial support from the state (4) Funding should mainly come from the continuous and steady fiscal support from the state
	1991 – 2000 Ten-year Plan and the Outline of the Eighth Five-year Plan for Scientific and Technological Development	1992	1991-2000	One of the key tasks: “Fundamental-oriented research” (1) Setting out the objectives of China’s fundamental-oriented research in ten years from three macro aspects: disciplines, talent teams, and organization (2) Main research content and directions during the Eighth Five-year Plan period (20,000 scientists’ voluntary projects, 200 to 300 key projects, separate plans for the basic research projects that might help China make breakthroughs by the end of the twentieth century) (3) The proportion of the fundamental-oriented research funding in the total research and development funding should exceed 10% by the end of the twentieth century
	Ninth Five-year Plan and the 2010 Outline of the Long-term Plan for National Scientific and Technological Development	1998	1996-2010	Independent Chapter: “Fundamental-oriented research” (1) Further adjusting and optimizing the layout of academic disciplines (2) Improving the natural science fund system (3) Continuing to organize and implement a number of key basic research projects with great scientific value or application prospects (4) Enhancing the construction of scientific research infrastructures, with emphasis on large-scale scientific facility.

				(5) Carrying out scientific research on management and decision-making
Basic research returning to a comprehensive concept	Tenth Five-year Plan for National Economy and Social Development – Special Plan for Scientific, Technological, and Educational Development (Scientific and Technological Development Plan)	2001	2001-2005	One of the priorities: “Basic science” (1) 6 major scientific issues (2) Construct basic research discipline system (3) Explorative research
	Outline of the State Medium- and Long-term Plans for Scientific and Technological Development (2006 – 2020)	2006	2006-2020	Independent Chapter: “Basic science research” (1) Disciplinary development planning (2) 8 frontier scientific issues (3) 10 basic research projects addressing the demand of major national strategies (4) 4 major scientific research programs
	National Eleventh Five-year Plan for Scientific and Technological Development (“Eleventh Five-year Plan”)	2006	2006-2010	One of the key tasks: “Seizing the future and deploying frontier technologies and basic research ahead of time” (1) Adhering to the principle of combining service to national goals with encouragement of free exploration (2) 8 major issues of scientific development and scientific frontiers (3) 8 basic research areas of major national strategic needs (4) 4 major scientific research programs

	National Twelfth Five-year Plan for Scientific and Technological Development (“Twelfth Five-year Plan”)	2011	2011-2015	Independent Chapter: “Deploying frontier technologies and basic research ahead of time” (1) Promoting the coordinated and balanced development of basic disciplines and strengthening the overlapping and integration among different disciplines. (2) Exploring the frontiers of science and deploying research on several major scientific issues ahead of time (3) Adhering to a demand-oriented approach and focusing on breakthroughs in 8 major scientific issues that constrain economic and social development (4) Promoting the implementation of 6 major scientific research programs and 1 special research program by concentrating on strengths (5) Strengthening fundamental scientific and technological work and continuous enhancement of the accumulation of scientific research
	National Thirteenth Five-year Plan for Scientific and Technological Innovation (“Thirteenth Five-year Plan”)	2016	2016-2020	Independent Chapter: “Continued strengthening of basic research” (1) Strengthening free exploration and disciplinary systems (2) Strengthening objective-oriented basic research and frontier technology research (9 basic research programs dedicated to emphatic deployment of major national strategic tasks and 13 strategically forward-looking and major scientific issues (3) Organizing and implementing 5 international big science programs and big science projects (4) Strengthening the construction of major national science and technology facilities (5) Conducting major scientific expeditions and investigations (6) Strengthening coordinated support to basic research

Abstract

Since the early years of scientific and technological development in the People's Republic of China (PRC), concepts relating to basic research have been applied within the scientific and technological policy field. At times, basic research has been called theoretical research, and other times it has been divided into pure basic research and applied basic research. In recent years, basic research as an independent comprehensive concept has been employed in various policies. Developmental mind-sets and policy essentials of basic research have been reflected most fully and systematically in scientific and technological development plans during different periods. This article outlines the descriptions and designs of basic research as applied through twelve scientific and technological development plans since the foundation of the People's Republic of China and summarizes the evolution of basic research in the PRC from the perspective of scientific and technological plans. This article argues that the changing concept and tasks of basic research in scientific and technological development plans show the Chinese government's understanding of and attitudes toward basic research at different times. China has gradually formed its national-level basic research plan and funding system. However, the future of basic research and basic research policy in China still has significant room for improvement.

Keywords: basic research, scientific and technological development planning, scientific and technological policy, People's Republic of China (PRC)