Jianguo Hou: major reforms in China’s S&T funding mechanisms

By Mu-ming Poo and Ling Wang

In late June, the first batch of National Major R&D Projects was announced on the Public Service Platform of National Science and Technology Management Information System (http://service.most.gov.cn/index/). This signified a new round of major top-down reform of China’s S&T program management reform, a reform generally considered to be unprecedented in both scope and depth. In line with rapid economic growth, China now produces more research articles than any other country except the USA, boasting the world’s highest number of researchers (∼3.8 million). Yet, these impressive numbers are insufficient to meet the need for innovation in Chinese economy, which is still relying heavily on imported core technologies. The S&T program management has long been plagued by fragmentation, duplication and diffuseness, with widespread complaints by researchers on the lack of both openness and transparency in funding review processes. In a recent interview with NSR, the Vice Minister of Science and Technology Jianguo Hou elaborated upon the new reform of S&T program management that aims to address many of these problems, and new policies that impact on how research will be conducted in China.

INTEGRATION OF DIVERSE FUNDING CHANNELS

NSR: The current reform will integrate multiple funding mechanisms for special programs and grants, establish a unified platform and modify the grant application and review processes. Could you explain why such drastic changes were taking place?

Hou: In the past, S&T programs under central budget were funded by different ministries. For example, the Ministry of Science and Technology (MOST) was in charge of widely known S&T programs such as 973 Program, 863 Program and major S&T Enabling Program, whereas other ministries were also responsible for setting up S&T plans, reviewing grant applications, allocating funding, managing processes and summarizing the projects. Due to ineffective top-level design, coordination and categorized funding, similar projects were funded through different funding channels, leading to duplication, scattering, closeness and low efficiency of centrally funded S&T programs.

In the new system, we will categorize all S&T programs and projects into five types and manage them through one platform. The goal is to promote optimization and integration of various types of programs, achieve overall coordination of S&T resource distribution, build a uniform national S&T management information system and open it to the public.

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NSR: Why five categories? What are the differences and relationships among them?

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Hou: We have extensively examined ∼100 S&T programs (special projects and funds) in China, and considered the merit of funding mechanisms of advanced countries. Most importantly, this reform was called for by the government’s ‘innovation-driven’ development strategy. Each of the five categories of S&T programs has its unique features and specific management model, while all five systems are related and complementary. The national S&T Management Platform plays a critical role in coordinating these five programs, forming an integrated system and avoiding funding duplication.

The first funding category is projects supported by the National Natural Science Foundation of China (NSFC), which will continue its long-term mission of supporting researcher-initiated programs and fostering the source of scientific innovation. The second category is National Major Special Projects, which represents research projects defined by major national strategic S&T needs, in particular those ‘bottleneck’ scientific and technological problems. The third category of National Key R&D Programs intends to provide a broad spectrum of support to many S&T fields, with focuses on areas for economic and social needs. The fourth category of Special Project (Fund) for Technology Innovation aims to give play to the leveraging role of fiscal funding through risk compensation, post-allowances, venture capital fund, utilize market mechanism, support technology innovation activities and facilitate transfer and transformation, capital development and industrialization of S&T achievements. The fifth category is Research Base and Talent Projects, which emphasizes nurturing of S&T research talents and teams, and building ‘innovation highlands’ that are required for sustainable S&T development.

NSR: To be more specific, what is the relationship among projects funded by the first three categories?

Hou: NSFC is funding basic frontier research, supporting fostering of talent and teams, and strengthening source innovation capability. In line with the needs for economic and social development and priority areas for S&T development, the National Key R&D Program is innovatively designing and organizing the implementation of basic, frontier, common generic technologies and their demonstration through targeted and clearly defined major projects. The National S&T Major Special Projects focus on major strategic projects and industrialization needs, conduct coordinated research on difficult S&T problems by giving play to our strengths in rallying efforts nationwide.

In the national S&T Program Funding System, these three programs (special projects and funds) are clearly defined, interlined and mutually complementary. The NSFC projects will be further funded under the National Key R&D Program, once they prove to be fruitful and promising. And some of the projects under the National Key R&D Program could be selected to be National Major S&T projects if they turn out to show potential of major S&T breakthrough, with cumulated achievements and competitive research teams. A good example is the quantum communication and quantum computing project, which has made a series of discoveries in the cutting-edge field of quantum manipulation, and has been considered to be included in the new batch of national major S&T Projects in 2030.

NSR: Among the five new categories, why were National Key R&D Programs initiated first?

Hou: National Key R&D Program will for social good conduct research concerning agriculture, energy resource, ecosystem and health, address strategic, basic and forward-looking scientific questions on industrial core competitiveness, overall independent innovation capacity and national security, develop common generic technologies and products, conduct international S&T cooperation. According to the guidelines, these projects should be structured with the emphasis on cross-institutional, cross-disciplinary and cross-regional collaboration, offering guidance and support functions in various research areas relevant to national economy and social development. The execution of these National Key R&D Program will also ‘pave the way’ for the other new categories of S&T Programs by testing the new reform efforts in achieving effective integration and optimal management of research projects.

NSR: Would the reform affect the total amount of government’s S&T funding?

Hou: That is a question of vital concern to researchers. Although the number of research projects might be reduced, the overall funding budget is expected to increase. In fact, China’s overall R&D input will rise from the present level of 2.1% of the GDP to 2.5% by 2020.

I should note that reform will enhance the stable support for basic research institutions, and improve the efficiency of funding allocation. The purpose of reform is to optimize the allocation of research funding resources by adopting integrated scientific research funding mechanism (whole R&D chain support from basic research to applied research) and discarding the previous R&D stage-based funding mechanism, with more focus on addressing national and society needs.

DECISION-MAKING IN S&T PROGRAM (PROJECT, FUND)

NSR: One of the highlights in the current reform is the establishment of a Joint Committee. Can you elaborate on the composition and function of this Joint Committee?

Hou: On 30 April 2015, the State Council approved the establishment of an interministerial Joint Committee for the management of national S&T programs (projects and funds), and clearly stipulated that the Joint Committee will be composed of leaders of 31 ministries and departments, with the MOST as the leading convener, heads of Ministry of Finance and National Development and Reform Commission as vice conveners and other ministries and departments as members of the Joint Committee. The Joint Committee works under the guidance of the State Council’s Leading Group of National S&T System Reform and Innovation System Building, the highest decision-making body for S&T development in China. The Joint Committee is in charge of executing the decisions of the Leading Group and implementing the five categories of programs (projects, funds) as described above.

In comparison with the S&T Program management approaches in the past, the Joint Committee has made the
following innovations. First, it resolved the segmentation of S&T resources and provided the mechanism for joint efforts from multiple ministries and departments. Some 100 programs (projects and funds) distributed in dozens of governmental departments will be managed under one platform of the Joint Committee. Shared interests on basic research, public welfare, common and key technologist will be discussed at the Joint Committee meetings before funding decisions will be made. Second, it established the mechanism for participation and decision-making: all members will be responsible for evaluating together the strategic plans for S&T development, the structure and distribution of specific targeted programs, the targeted goals and guidelines, the composition of ‘Strategic Consultation and Comprehensive Review Committee’ (SCCRC) and merit-based selection of specific research institutions responsible for various projects. It is on such bases that Ministry of Finance (MOF) will coordinate the budget allocation according to relevant regulations. Related departments will help rationalize the relationship between industry policies, planning, standards and research work. Third, it established a uniform procedure for decision-making in S&T programs (projects and funds). The first complete process in setting up projects of the National Key R&D Program has been accomplished under the decision-making platform. After the review of the Committee, the 13th Five-Year STI Plan, and the layout and major project arrangement under the National Key R&D Program have been submitted to the Leading Group, approved by the State Council according to related procedures, whereas major S&T decisions require further review and approval by top leaders of China.

NSR: What is the role of SCCRC?
Hou: The establishment of SCCRC signifies the principle of democratic decision-making of S&T programs (projects and funds) in the new system. The National S&T Leading Group will invite renowned leaders in scientific, industrial and economic communities to form the committee, which will suggest the list of members of SCCRC that is subjected to the approval of the Joint Committee.

The SCCRC members have the duty to follow the trend of international S&T development and industrial transformation, and to provide recommendations to Joint Committee on the national strategy in S&T development as well as major targets and directions for innovative R&D. Besides, the committee members will also provide opinions and evaluations on the new review rules for research projects, the establishment of national expert database of S&T project review and the formulation of a well-structured research project review procedure to be carried out by professional agencies that are charged with research grant management. Finally, upon request by the Joint Committee, SCCRC will carry out review of major S&T projects.

NSR: Taking National Key R&D Program as an example, how do Joint Committee and SCCRC work together?
Hou: First, on behalf of the Joint Committee, MOST will adopt a bottom-up approach to solicit the major needs for S&T support from various departments, professions and localities. It is on such bases that various departments will come up with the layout and implementation of major national strategies like the Belt and Road Initiative and Made in China 2025. Second, SCCRC will be entrusted by the Joint Committee to review layout of major tasks and implementation plans, and suggestions and opinions for launching of major projects. Third, the Joint Committee will hold a plenary session to discuss the consultation of the SCCRC. Formal recommendations will be submitted to the State Council for approval. Lastly, in line with the implementation plan approved by the State Council, various ministries and departments will work together to organize expert committees to develop project application guidelines, and launch the application and review of projects. In the whole process of managing Major R&D Program, the oversight and review mechanisms will be established so that various ministries and departments will jointly oversee the setting up, review and implementation of the projects, and evaluate the management and operation of third-party professional agencies.

THIRD-PARTY REVIEW: OPEN AND TRANSPARENT

NSR: In the new system, the review of proposals for research grants is managed by third-party professional agencies.
Hou: Yes. In the past, the review of proposals was generally organized by the government. Now the government no longer directly manages specific projects, rather professional agencies undertake the task. The government determines what projects to pursue, and professional agencies determine who will be funded to undertake the project.

Hou: Currently, each project of the National Key R&D Program is targeted at major scientific and technological issue or socio-economic progress. No technology roadmap or research plan could be included in the guideline. Therefore, it is not possible for the guideline to be tailored to specific applicants or research units. The guideline drafted by expert committees also needs to be reviewed prior to the announcement by the third-party assessment agency, in order to ensure that the guideline fits the original tasks of the project delineated by the Joint Commission. The assessment agency will also review whether the guideline is targeted at specific applicants. Under the premise that clearly defined project goals could be evaluated, there should be no constraint on the technical approaches and research plans of the proposal.
NSR: What are these ‘third-party professional agencies’?
Hou: The Joint Commission has chosen the first seven agencies: four are affiliated with MOST and three others with Ministry of Industry and Information Technology (MIIT), Ministry of Agriculture (MOA) and National Health and Family Planning Commission (NHFPC), respectively. We are initiating the first batch of 36 projects this year, and each agency will review proposals for three to five projects, based on the expertise of the agencies.
NSR: How can one be sure that these agencies perform the task properly?
Hou: There are constraints and rule of operations defined for the agencies. For example, reviewers should be randomly drawn from a database of relevant experts, who are not themselves among the applicants of related projects or involved in formulating the project guidelines; that is judges could not be players at the same time. We also introduce strict rules to avoid conflict of interest during the review process.

Some measures are also taken to improve the transparency of the review process. For example, when the project guideline is announced, we also release review criteria, the list of experts that draft the guideline and the management staff responsible for eligibility checks. In addition, each step of reviewing process is recorded in detail for future reference.

STRENGTHENING SELF-DISCIPLINE OF RESEARCHERS

NSR: When most qualified scientists in a particular field are all applying for funding of the same project, how could the third-party professional agency find sufficient qualified reviewers?
Hou: After years of accumulation, China has formed a large expert database, with over 80,000 high-level researchers capable of conducting project review. These experts cover a wide spectrum of areas, from basic research to applied research and technology transfer. Thus, based on the principle of avoidance, experts are selected from the database randomly to reduce ‘conflicts of interest’. While most experts are selected from the database by computer, professional agencies are also allowed to invite a certain number of experts to be part of the review team if needed. The agency-invited special review experts need to be marked on the experts’ list and have to sign conflict of interest statement certified by their institution.

NSR: Why not include non-Chinese scientists as review experts?
Hou: This year marks the beginning of the reform of R&D programs. Reform measures need to be explored and improved in practices. This year, no overseas experts have been invited to participate in the review of National Key R&D Program. In the future, we will invite high-level overseas scientists if needed. Basic research projects are more likely to be suitable for assessment by non-Chinese scientists; applied research projects like agriculture, regional development, resources and environment would be more difficult because most projects seek to solve local problems that require knowledge on domestic background.

The key to the grant review is the fairness and transparency of the review process. For the new reform of S&T funding system, we have set many rules and regulations and made much effort in improving the transparency of project-related information. Nevertheless, self-discipline of the scientists participating in the review process is critical.

NSR: A recent online poll has indicated that the lack of self-discipline on the part of the scientists is considered to be a significant cause of the problems in the grant review system.
Hou: Indeed. We have requested all management personnel and scientists involved in the review to abide strictly to the rules and regulations. In the new system, all persons involved in the projects are required to obey professional norms and scientific ethics, and sign integrity agreements. Those found to violate the agreements will be recorded into the system or even be ‘blacklisted’.

NATIONAL LABORATORIES ARE COMING

NSR: In the past decade, China’s research capacity is rapidly growing, but the overall strength in S&T is not in the same league as advanced countries. What is the prospect for China to become an S&T superpower?
Hou: China is transforming itself from a big country of science and technology to a strong one. Examining the country’s S&T system with a magnifying glass will reveal many imperfections. It is our ardent wish that the S&T system could be improved and national strategic goals could be realized through facilitating the reform and implementing the innovation-driven development strategy.

NSR: In three top-level S&T conferences this year, President Xi has set the national goals for S&T development—China should join the rank of innovative countries by 2020, reach the frontline innovative countries by 2030 and become an innovation superpower by 2049, when People’s Republic of China ushers its 100th birthday. What are the criteria for reaching these goals?
Hou: Innovative countries are those countries in which S&T progress contributed to over 60% of economic growth, with active R&D; frontline countries are the top five countries, and superpower means China will have mastered the core technologies and become a leader in some critical areas. In other words, China will be ‘on a par’ with other S&T superpowers.
NSR: The establishment of National laboratories was also announced recently by President Xi. Is this on the agenda? Will this affect existing National Laboratories?
Hou: Yes, several new national laboratories will be established, guiding the development of some major S&T areas. While the exact organization model and operating mechanism of the new national laboratories are still under discussion, it is clear that these labs must have very clearly defined S&T goals.

IMPROVING EXISTING RESEARCH ENVIRONMENT VS. RECRUITMENT OF TALENTS

NSR: S&T innovation ultimately rests upon scientists, who should be the direct beneficiaries of the S&T reform.
Hou: Indeed. The current reform aims to eliminate many problems scientists have complained about in the past, especially the time-consuming procedures of grant application and the perceived requirement of making personal efforts in ‘socializing’ with grant administrators and expert reviewers in order to get the proposal funded. Take the example of projects under the National Key R&D Program, the new procedure does not require a full proposal at first. The applicant only needs to write a preliminary application of \( \sim 3000 \) words in length. After going through the first round of review by expert reviewers in the field, about three to four times of final number of awarded applicants will be asked to submit formal proposals and undergo the oral presentation and defense. This procedure has saved substantial efforts on the part of the applicants. Furthermore, the new format of the guidelines for proposals has integrated research projects based on different R&D stages of the ‘innovation chain’, so as to avoid duplicative efforts in project management by different government sectors.

In the budget management, the new funding system offers more flexibility in order to facilitate the research effort, including the required details of proposed budget and review of the budget, the scope of expenditure, and the researcher’s authority in managing the funds.
NSR: Young scientists are most innovative, is there a new measure for nurturing this particular group?
Hou: Yes. For scientists under 35, we have established ‘young scientist projects’ in the new system. Each project will be supported by 3–5 million RMB for young scientists to pursue their research interest as principal investigators and to play a leading role in innovation.
NSR: In recent years, the government has established several ‘talent programs’ that specifically aim to attract young scientists from abroad. Those young scientists who had chosen to pursue research career in China found themselves in a rather disadvantaged position, in terms of research funding, salary and other benefits. This is a policy difficult to comprehend.
Hou: We definitely should pay attention to this problem. Many scientists who had no overseas experience have done fabulous research in China. In my view, government bodies should not just play the role of talent scouts, but also the role of farmers who irrigate and enrich the soils for cultivating our own talents, who will bear fruit here in our own country. In the current reform, we need to establish new rules and programs that young talents, regardless whether they are trained abroad or domestically, will be treated equally and provided with equal opportunity of career development.
NSR: Hopefully, the government will pay similar attention to this problem. In the area of biological sciences, there are many domestically trained young scientists performing better than the ‘Thousand Young Talents’, but receive much lower research support, salary and benefits. This problem must be resolved soon.
Hou: Yes. We have created many special recruitment programs for the recruitment of overseas talents and have ignored the potential adverse effects of these programs in retaining young talents in our own institutions, many of which are now ‘on a par’ with those in advanced countries. We should establish more attractive programs for cultivating domestic young talents, especially for postdoctoral fellows and junior researchers.
NSR: You had served as a university president before being appointed as the vice minister of MOST, and for many years you have also been a professor and an active physicist. Which role do you enjoy most?
Hou: I enjoyed the most my life as a professor. I am also keenly aware that each generation of scientists and professors has their special duties to fulfill. When I was entrusted to perform the duty of administrative affairs, I would fulfill it wholeheartedly and do my best.
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