EXCHANGE FOR POLICIES

CHINESE EXPERIENCE IN THE ORGANIZATION AND MANAGEMENT OF THE NATIONAL TECHNOLOGY INNOVATION PROGRAMME AND LESSONS LEARNT FOR VIETNAM

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Abstract:

System of science and technology (S&T) programs has existed in our country for over 30 years and became an important means in research and development management. Although a certain of results achieved, it has not yet met the requirement of the country's socio-economic development, and still exposed many problems, particularly bearing the imprint of the centrally planned economy period. Facing the current wave of increasingly deeper international integration of S&T, lessons learnt in management of S&T programs from advanced countries is necessary for improving the management of our S&T programs. This article focuses on the Chinese experience in the management of S&T programs, with particular emphasis on the national technology innovation program which mainly relied on the management experience of the ATP, TIP, and SBIR/STTR programs of the United States. The article then makes recommendations with a system of solutions for improvement of S&T management, in general and the system of S&T programs, in particular with the view to further enhancing the efficiency of S&T operation in our country.

Keywords: *S&T program; Management modality; Technology innovation.*

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1. Experience in management of system of science and technology programs of China

In the process of organization, development and implementation of system of national S&T programs, China paid due attention to adopt foreign

experience, especially the United States'. With respect to technology innovation promotion, China respectively studied, learned management methods of the Advanced Technology Program (ATP) in the period 1990 – 2006 and the Technology Innovation Program (TIP) in 2007 - 2017, and is now focusing on the study to learn experience of the program on innovation, technology transfer for small and medium enterprises (SBIR/STTR Program) of the United States. The system of Chinese national S&T programs was born and existed for 20-30 years, and it now still continues and expands with some other national S&T programs.

In general, the system of Chinese national S&T programs is quite stable. Except the high-tech research and development program approved by the government, the rest S&T programs are proactively proposed, organized for development and implementation by the Chinese Ministry of Science and Technology (MOST).

Following are the outstanding points worth to learn in respect of organization and management of the Chinese system of national S&T programs:

a) System of national S&T programs is proved and affirmed as an important means for organizing research and development, and application of S&T achievements into practice and production, and for periodical innovation of the program management.

Innovation process often takes place periodically in certain period of 5-10 years and most recently, in December 2014, the Chinese MOST launched a plan to strengthen the reform of the management of national S&T programs using the State budget, whereby it confirmed that S&T program was an important means to support the S&T reform effort of government. In fact, national S&T programs have played an important role in strengthening the national S&T capacity, enhancing its competitiveness, thus contributing to the country socio economic development.

b) Attention paid to provide guidance on socialist market orientated management of the system of S&T programs with focus on diversification and internationalization to link the resources in the country for technology innovation and enhance the competitiveness of Chinese enterprises.

In respective reform periods, depending on specific situations and objective requirements, and based on specific directives, it developed measures and regulations for a synchronized management.

The noteworthy point in thinking reform of 2014 was that more emphasis on support given to mechanisms and policies to encourage social investment in technology innovation, strengthen links between businesses,

universities and research institutions (enterprise-university-research institute) in proposing and implementing research topics/projects with stressed importance of technological innovation, while confirming the role of enterprise as a key player in technological innovation in the above mentioned linkage under the orientation of government policies; give due attention to the assessment of S&T performance by unified professional organizations, propose the modality of assigning management duty of S&T programs to a professional unit as done in some advanced industrialized countries, for example, Federal Republic of Germany which assigned banks to manage technology innovation programs for small and medium enterprises.

c) The implementation of scientific research, technology development and application of S&T achievement and creation of new professions from research results (industrialization of S&T results), is realized by two methods: (i) Though a system of Foundations financing from the State budget; (ii) Through a system of national S&T programs.

In order to implement S&T projects, like many other advanced industrialized countries in the world, China organized two parallel systems:

- System of Foundations: Foundation for national natural sciences (similar to the US National Sciences Foundation); Technology Innovation Fund for medium and small enterprises; Venture Capital Fund (this is not just an unique venture capital fund, but a system that involves many venture capital funds operating according to business-like modality);
- The system of national S&T programs (in China now there are about 10 programs) covering all steps of the research and development cycle until the results have been introduced into production, namely from application oriented basic research, high technology research and development, transfer and replication of successes, technology innovation support for businesses, research for public welfare, S&T decision making (soft science program), high-tech park development (Torch Program), rural industry development (Fire Sparks Program), etc.

The following 10 national S&T programs are under implementation by China:

(1) National Hi-Tech Research and Development Program (Programme 863), starting from 1986;

(2) Key Tech Research and Development Program (Key Program), starting from 1982;

(3) National Key Basic Research Program (Program 973), starting from 1998;

(4) National Program for dissemination and multiplication of S&T results, starting from 1990;

(5) Fire sparks Program, starting from 1986;

(6) Torch Program, starting from 1988;

(7) National program on new and key products, starting from 1988;

(8) National program on technology innovation, starting from 2002;

(9) Soft Science Program (related to S&T management);

(10) Public Welfare Program, starting from 2012.

4. Attention was given to fund management of research topics/projects in the principle that budgeting step be strengthened (detailed inputs for the task assigned), transparent and simplified administrative procedures, better monitoring, mid-term review and post project evaluation.

It should be noted that like a number of advanced industrialized countries in the world, China focused on strengthening budget management of research topics/projects, by strengthening the inspection on the process of budget development rather than giving a entire lump-sum budget for implementation. It also applied method of public procurement for the purchase of S&T results of topics/projects, but with limited application in some areas of priority such as those related to environmental protection, energy saving, green production, the State does not buy the results of topics/projects in the not promoted areas in their early stages (Another example, the German government bought 1,000 first series hybrid cars, because there was the need to encourage environmental protection).

5. Attention was paid to technology innovation and industrialization of S&T achievements, whereby support was provided for technology upgrading and innovation and creation of new industries, high-tech parks, technology incubators through Program of replication of S&T achievements, Torch Program, Program on New products, technology innovation Program,... In recent years, China has focused on encouraging self-created technologies, i.e technologies using patents generated in the country, paying attention to management of intellectual property rights in research and development.

A typical example relating to introduction of technology into production, China has maintained the national technology innovation program for 13 years. This program was supported by financial incentive policies and used funding from the State budget to guide and attract the investment of society, promote technological innovation to enhance the technological innovation

capability and improve the market competitiveness of enterprises. The Program has focused on general requirements of the national socio-economic development, aimed at the unexpected problems raised in restructure of national programs and products, through the development of technology innovations, addressed leading key source technologies and promote efficiently the transformation of S&T achievements into real productive forces, upgrading, industrial optimization, to ensure fast, continuous, healthy development of national economy.

It should be noted that the program had clear objective to serve socio-economic development, it took enterprises as target audience with market-oriented approach to promote technology innovation from three stakeholders: Government, business and society, contributing to economic institutional change and economic growth, promote the development of fast, healthy and sustainable national economic development. Clearly, the directive philosophy of the program is quite right: clear definition of the role of each stakeholder in the linkage chain between business - university - research institute - State. The program involved many activities such as research and development, production and commercialization of goods and benefits. It was a program which required multidisciplinary cooperation in many aspects. In management of the program, it studied and learned European experience, especially experience of the "Programme for financing research and innovation of medium and small enterprises (SBIR program)" and "Grant Program for technology transfer for medium and small enterprises (STTR Program)" of the United States.

Results of the implementation of the system of S&T programs have contributed significantly to economic development, enhanced the competitiveness of Chinese enterprises, constantly expanding market share in the tough competitive market in the world.

2. Observations and the lessons learnt

2.1. Observations

a) The National system of S&T programs of the China was an important modality of promoting effective research and development, application of S&T achievements and technological innovation.

The system of Chinese national S&T programs was quite stable, early established from the beginning of 1980, many national S&T programs have established for 20-30 years now, it is a long-term system of S&T programs. All the National S&T Programs of China were lead in the implementation by the MOST, except the program 863 Decision was made by the

government, for every 5 years, the Government conducts a review to decide whether or not to continue each specific program. The procedure was always timely to ensure timely and continuous execution of the program.

The system of national S&T programs of China relatively covers all the stages in the cycle from research to production, for each stage there are adequate forms of organization of programs. Each S&T program had clearly prioritized objectives for the period of 5 years with specific guidance and priority targets for annual implementation. The S&T programs are continuously carried out with annual and five-year review conducted based on the evaluation of results obtained against the objectives set out.

b) The management of S&T programs was basically similar to that realized in developed countries, but it was modified to fit the conditions of developing countries in transition to socialist market-oriented economy.

All the national S&T programs were managed by a specific Program Office. The statistics, monitoring data on the implementation of the project were closely updated for timely annual report of inputs/outputs. The system of legal documents guiding the implementation of the subject/project/ program was complete, appropriate for each separate type of national S&T program.

The management of expenditure of each topic/project was very strictly, from the budget development to the budget approval, evaluation and auditing stage. Application of whole lump-sum package was absolutely forbidden. However, it was allowed to apply partly lump-sum expenditure in implementation of some parts of the project, which were for the benefit of the project owner (for example, the use of the facilities of the host institution for the project, the expenditure involved were still to be settled). Besides, there were very strict regulations which absolutely avoid the abuse of funds for improper purposes.

The selection, bidding of topics/projects was done openly and transparently. The list of scientific evaluation panel's members was publicly announced on the electronic web page of the Program Office. Like other industrialized developed countries', China is very concerned on evaluation of research topics/projects and tends to improve the evaluation process by using professional evaluation organization of high prestige.

c) Attention was given to study/learn foreign experiences. China attaches great importance to the learning of experience in organizing and managing the national S&T programs from developed countries, typically experiences of the United States,...

Although China pays attention to support for medium and small enterprises in technological innovation, the measures and methods are still unclear. Currently, using experiences learnt from ATP, TIP and SBIR/STTR programs of the United States, China began to pay more attention to strengthen the support for technology innovation projects proposed and invested by enterprises, especially encourage the linkage of business with universities and research institutes while the State provides financial support no more than 50% of the project budget for technology innovation.

d) Focus on management of intellectual property rights in the management of programs/projects.

After the period of technology import, absorption of imported technology, China now enters a re-innovation stage, i.e creation of products and technologies with their own right of intellectual property, China starts to pay attention to encourage the registration of patents for research results, this made China become the first country in the world in terms of number of patent applications in 2013, followed by the United States, Japan (China (SIPO) with more than 825,000 applications, United States (USPTO) more than 571,600 applications and Japan (JPO) with more than 328,400 applications).

Learning US experience in 1980 on granting ownership of S&T achievements funded by the Government for laboratories (Stevenson-Wydler Technology Innovation Act of 1980), starting from 1985, China had applied a mechanism to grant: ownership of scientific research results despite the research had used the State budget, for staff leading the research project and the project lead agency. In fact, this was a catalyst to encourage scientists to be better off by directly benefiting from their righteous effort. This also explains why Chinese S&T personnel earns a lot and has high income resulting from their high value S&T results.

2.2. Lesson learnt

a) The state should further appreciate the role of S&T, placing the National Council for S&T Policy in higher position. The Council should play an important advisory role in the decision of the Government on S&T. The Council should regularly listen to the opinion of independent S&T evaluating agency on the matters relating to S&T, and on that basis, it may provide correctly advisory opinion for S&T policy decisions.

MOST should propose a reformed management mechanism for national S&T programs in line with internationalization trend, ie more respect given

to scientific freedom in basic research, proactiveness in applied research and development in priority areas, because the actors responsible for transforming S&T achievements are enterprises, universities and research institutes. However, for those subject/projects under orientation of technology priorities that should be promoted for development, and not yet market established in the field, for example: new energy, climate change, environmental protection, green production, etc. the State should have special policies in government procurement to support early series of S&T achievement of such national S&T projects.

b) In the selection of priority S&T direction, it should carefully consider the actual conditions and capacity in the country, it should not run after the development priorities in the world which are not relevant with our country. For example, according to experience of Thailand, Indonesia, Malaysia,... our country should pay more attention to development of high-tech agriculture, development of our agricultural strengths by learning and application of technology of Israel, Japan, Taiwan; attention also should be placed on wind energy, climate change, environmental protection technologies. In addition, it should further strengthen the implementation of information technology, advanced manufacturing technologies, biotechnologies for agriculture, health, health care, food safety, not just applying stereotypical development model of industrialized countries such as information technology, advanced manufacturing technology, energy technology, new materials, nanotechnology, space technology,...

c) Regarding the system of national S&T programs, it should consider to develop long term and continuous programs for 10-15 years, not just be limited to 5 year timeframe (as used to be during the period of centrally planned economy, first to develop 5 year plan and then the next to be set up after review for further consideration. In fact, the implementation of a 5-year plan was carried out in 3-3.5 years because it took 1.5-2 years waiting for approval of Prime Minister, which lost the momentum of the plan, as a result, reduced effectiveness of implementation of the program objectives. Furthermore, Prime Minister shall only consider those major S&T policy matters decisions, including the decision to form S&T programs of important strategic nature, the other S&T program and the management of the system of S&T programs should be authorized directly to the MOST.

d) As far as the support to enterprises for technological innovation is concerned, MOST should pay more attention to the major role of business in technological innovation for economic competitiveness and growth. Therefore, there is a need to develop specific policies to support S&T start-up businesses (eg preferential policies for start-up enterprises in terms of

credit, taxation, infrastructure investment...), support for enterprises in implementing S&T topics/projects (eg support of less than 50% of funding required on condition that advance would be made by enterprises and refund shall be done after the completion of topics/projects); priority would be given to topics/projects with strong linkage of Enterprise - University - Research Institute lead by enterprises; support for businesses in staff training, realization creative innovation, marketing, paying special attention to support the deployment of emerging strategic technologies that our country possesses the potential.

e) With respect to financial management of S&T topics/projects, it is proposed that it should strengthen the development of instructions and assessment of budget estimates; it should not apply lump-sum package funding for project implementation, because according to theory, scientific research is a creativity work, creating new knowledge, new features, bearing risky factors and the outputs of topic/project are often only premature, initial, it needs further efforts to transform 100% the results into commercial products/services, and then provide immediate economic effect. Economic commercial contracts in actual reality come from businesses already stable, with low risks, normally using LC modality, and lump sum payment after termination of contracts, but for scientific research, on the other hand, it poses a higher degree of risk, therefore, it is not appreciate to apply the full lump-sum package.

f) Regarding measures to promote commercialization of S&T results, it should learn experience of the United States (China also fully exploits this experience), as the purpose of research and development is to create new technologies from 2 directions: (i) To organize the development of a common technology innovation program with priorities to create markets oriented results, with breakthrough nature (mainly by/from universities, institutes research) that play a guiding role in the development of a industry, even create possibly a new industry; (ii) To organize 2 special assistance programs for medium and small enterprise, namely: first, technology innovation program for medium and small enterprise, with State support not exceeding 50% of total funding to implement the project, the enterprise must invest at least 50% of the funding, enterprise is the host entity of the topic/project to link with universities or research institutes; and second, technology transfer program for medium and small enterprise using the formula that host project owner is universities or research institutes and enterprises is the recipient in technology transfer with also contribute a certain percentage of financial contribution.

At the same time, the ownership of S&T results should be given to the research team who has implemented the project using funding from the state budget (in fact, if the ownership of S&T results is not granted, it could not be manageable by the State, though it can de-facto happen in reality)./.

REFERENCES

1. *Stevenson-Wydler Technology Innovation Act of 1980*; Pub. L. No. 96-480;
2. *Public Law 102-564-Small Business Act of 1992*. Research and Development Enhancement Act of 1992;
3. *Proposal for strengthening the management reform of S&T programs using State budget*, 2014; http://www.most.gov.cn/tpxw/201501/t20150106_117285.htm;
4. *Some ideas on the management reform of S&T Programs at State-level*, 2006; http://www.most.gov.cn/fggw/zfwj/zfwj2006/200601/t20060127_55445.htm;
5. *Management measures for National Technology Innovation Program*, 2002; http://www.people.com.cn/GB/shehui/212/3572/3574/20021128/877096.html;
6. *Small Business technology Innovation Research Program (SBIR) and the Technology Transfer Program (STTR)*, http://science.energy.gov/sbir/;
7. ATP Proposal Preparation Kit, 2/2004, NIST; http://www.atp.nist.gov/atp/kit-04/final-kit.pdf;
8. *TIP Proposal Preparation Kit*, 2010, NIST;

   http://www.nist.gov/tip/cur_comp/upload/tip_preparation_kit_2010_complete_a.pdf;
9. *About SBIR/STTR*, https://sbir.nih.gov/about;
10. *Small Business Innovation Research (SBIR) Program*, http://ies.ed.gov/sbir/.