

UNITED STATE EXPERIENCE IN MANAGEMENT OF SCIENCE AND TECHNOLOGY ACTIVITIES FUNDED BY FOUNDATIONS AND SOME SUGGESTIONS FOR VIETNAM

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Abstract:

Scientific and technological (S&T) activities in the United States are not organized and managed by government administrative bodies, they are conducted and managed by research units in universities, R&D institutes and companies. The State just plays advisory and supportive role and not directly involved in S&T management. S&T activities and human resource development are always associated with each other. Research institutions not only create favorable conditions for scientists to generate innovations and creativity in a cooperative and competitive environment but also ensure the protection of rights and obligations of the research team by leading scientists. Lessons learnt from the USA show that beneficiaries of the foundations' support must be enterprises or research institutions operating as autonomy, self-reliance and self-financed entities. From the US experience in the organization of S&T system and establishment of mechanisms for S&T management, this paper provides a different approach in building S&T management capacity of the country in immediate and long-term perspective.

Keywords: S&T management; Foundation for Science and Technology Development.

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1. Introduction to the S&T organizations and S&T management system of the United States

The S&T organization system of the United States consists of the following components:

Universities: Universities in the United States are not only places to train high-quality human resources, but also the most important centers for research. US Universities mainly carry out basic research and spearhead technology development.

National research institutes such as: National Aviation and Universe Space Administration (NASA), National Institute of Health, Massachusetts Institute of Technology, California Institute of Technology, etc. (*in nature, these institutes have their own research and training activities*). The system of national research institutes primarily concentrates on in-depth research of priority and special areas.

Specialized Research institutions in a number of departments and sectors, namely: Department of Agriculture, Department of Nature and Environment (Department of Interior), Department of Energy, Department of Transport, The Museum of Nature, etc. These agencies are responsible for long-term researches, forecast, protection and conservation of natural resources and the environment.

Research organizations in business sector: large companies (*Silicon Valley, IBM,...*), which mainly focus on applied research and development.

Unlike many countries, the U.S does not have a specific department designated to S&T management, only the Department of Education. However, even the department at federal level, it does not directly involve in S&T and education management like the practice in Vietnam. Instead, universities and research institutions have full authority to determine their S&T activities. This means universities, research institutions have the right to self-organize their research system in a most cost-effective way, scientists have the freedom to secure funding for research projects, propose research ideas, organize studies, create ideas they think new and creative on the basis of law compliance and following the rules of the funding agency/foundation for research. In general, budget of the U.S Government for supporting research activities is primarily provided through funds.

In the U.S, at federal level, there are two organizations having influential and decisive role in financing S&T activities, such as the National Academy of Sciences (USNAS) and the National Science Foundation (USNSF). Both of these organizations are not administrative agencies, they are advisory funding bodies for S&T activities. USNAS has an Association of more than 2,000 leading scientists in the U.S and a number of international scientists. USNAS operates to discharge two basic functions: *First*, provide independent policy advice to federal government for S&T development; *Second*, participate in review and appraisal of research proposals for funding from the USNSF. Annually, the Congress approves about 6.9 billion dollars for USNSF, of which the majority is for scientific research, a small portion is for education.

Particularly, in the U.S, research is basically conducted in laboratories which are attached to specialized research units of research institutes, universities. Each such unit includes at least from 5-10, even 30 laboratories. Each lab is run by an independent research team headed by a prominent leading scientist. The head of the laboratory can be Associate Professor, Professor or Principal researcher, Senior Researcher. In the team, there are 2-3 researchers who have Ph.D. degree or Post-Doc, 3-5 research assistants who are usually Ph.D students. Only the head of the unit is a

regular staff of university/institute, the others have only a fix term contract depending on the duration of the research project (usually announced on the selection at national or international level). The laboratory is in good condition in terms of equipment and manpower for implementing an independent research.

With respect to working facilities, depending on particular study, each research unit includes 1-2 large laboratories (*area of 80-100m²*) to install research equipment and 01 space of over 20m² for the office of head of the Laboratory. Investment in equipment for 01 such laboratory is around 500,000 to US\$ 1 million (for biology lab, it can be double). In this laboratory model, the head plays the role as chief architect, she/he proposes research idea, applies for funding from various sources and directly recruits research team members to participate in research project. This is a very dynamic model. The lab is actually the birthplace of S&T research products for international publications, patents, Ph.D student training. Therefore, the construction of a system of standard research laboratories is of special importance for universities and research institutes. The identification of a system of research units and labs needs to be based on the requirement of S&T development, strengths and leading S&T manpower of each university, research institute. This should be done based on the recommendations of the Council of Professors. The head position (*Associate Professor, Senior Researcher and over*) is the soul of the laboratory, therefore she/he must be selected through a strict selection process of national and international candidates. This process enables to select truly leading experts in a narrow specialization, who not only having experience in research, but also experience in managing research project, especially having outstanding professional achievements/records (*on the basis of their international publication in the last 5 years*). Thus, for this position it is very important to have clear terms of reference, an open and competitive selection process at international standards.

Thus, it can be seen some big differences between the system of S&T research institutes in US and in most countries having developed science and technology and the present system of S&T organizations in our country, i.e:

First, system of S&T management and operations is not organized by administrative authority from central to local level but organized in universities, research institutes and companies.

Second, though the S&T system is organized in a diversified manner, the work division among research organizations is quite "natural" in respect of functions and responsibilities, each organization is self-adapted to the purpose of the system and the objective of their own organization.

Third, universities and research institutions, where S&T activities take place, are of high independence, the Government plays only advisory and supportive role, not directly involved in management of S&T activities.

Fourth, research always linked with human resources development.

Fifth, S&T organizations basically is a system of laboratories where it is not only allowing, promoting scientists to produce creativity in a collaborative and healthy competition environment, but also linking rights and responsibilities of leader scientists with those of their research team.

The most important thing is that U.S scientists are always aware of the use of scientific and technological results as the bridge connecting S&T activities with social-economic development. Through this connection, basic significance of S&T activities is materialized. In return, the use of S&T results also stimulates research activities to upgrade and improve existing technologies. Most U.S scientists always ask themselves questions: How can get results from advanced scientific research and how to effectively use these results in practice. In addition, in S&T activities, the United States is very concerned as how to support technology diffusion to acquire S&T knowledge from abroad via international trade, foreign direct investment, technology licensing, S&T manpower migration. These measures require certain conditions. The condition for technology transfer via international trade channel is having a system of standards, enough ability to identify and assess the technological level of machinery and equipment, capability to select appropriate technologies. The channel of foreign direct investment mobilization, on the other hand, requires a qualified workforce, quality infrastructure system, competitiveness of the market, and stability of the macro-economy. With technology licensing channel, it needs ability of technology pricing and evaluation, good negotiation skills. With S&T manpower movement, it requires an attractive environment for scientists to come to work... An important condition related to all the channels above is to ensure the protection of intellectual property rights. For example, in a study by the World Bank showed that the strength or weakness of the intellectual property protection regime had huge impact to the country's technology, particularly in the high-tech industry. The U.S always provides special incentive policies for highly qualified S&T personnel together with creating attractive working environment for them.

2. Management of S&T activities funded by the U.S National Science Foundation

In the U.S, research and training activities that can be funded by a number of foundations such as Fulbright Foundation, Education Foundation,

Foundation of companies and corporations,... but for S&T research is mostly funded by USNSF. USNSF is an independent federal agency established in 1950 with an annual budget of approximately US\$ 6.9 billion. This funding source is primarily for granting basic research carried out in universities and research institutes in the U.S in many areas such as mathematics, computer sciences and social sciences, USNSF is the main source of support throughout the federation.

For S&T research, the main concern of USNSF in appraisal of applications is placed on outputs rather than strict review of inputs. The most important criteria are that the proposed research ideas must be clear, sufficient scientific justifications and practical implication. To receive funding for scientific research, the research team leader needs to develop and submit research proposals to USNSF for review and appraisal.

Members of the USNSF's Review Panel must have the following qualifications and experience:

Criterion 1, having special knowledge on the field of science and technology that the proposal is concerned with a view to evaluating the performance capabilities, value of knowledge and the benefits of the research project.

Criterion 2, having extensive and general knowledge on the field of science and technology proposed in order to assess broader impacts of the project results. It is a requirement that the appraisal panelists must have broad expertise to review large scale and complex proposals containing widely specialized content or interdisciplinary or of national and international importance.

Criterion 3, having extensive knowledge on S&T infrastructure organization and education activities in order to review the contribution of research to achieve social goals, S&T human resources development objective, and the allocation of resources to research organizations and geographical regions.

In Vietnam, we also have the National Foundation for Science and Technology Development (NAFOSTED) but the mechanism of funding and management of scientific research activity is very different from that of USNSF, as follows:

a) Organization of the scientific review to appraise research proposals

A fundamental difference between the mechanism of USNSF and that of NAFOSTED is that for each science area, USNSF does not establish a permanent sector review panel to appraise all applications (*the Science Council of NAFOSTED is sectoral established each subject area by the*

Foundation's Board of Trustees with 3-year term of existence). USNSF will only select members of the review panel after a careful consideration of the proposals and make sure that no conflict of interest occurred to the member to be selected. This mechanism allows USNSF to select members of the appraisal panels in a flexible manner, depending on the nature/content of specific proposals.

As there is no general fixed panel, USNSF can have a lot of choices to invite both very specialized and general experts for different type of proposals, depending on the content and subject areas to be appraised. The selection criteria of USNSF to engage appraisal experts require them to not only have deep expertise in science and technology but should also have general knowledge so that they can be able to review interdisciplinary matters, and in case of need, be aware of the problems with comprehensive national and international implications. In addition, to the extent possible, USNSF takes into account different representations in the appraisal panel in order to achieve a balance of representation of various relevant authorities as well as ensure the diversity in age and composition of the experts.

When comparing with specific context of Vietnam where the scientific and technical level of the country is still not high, we found that the flexible model of USNSF would be a good lesson to learn in choosing the members for the appraisal Council. However, to do so NAFOSTED will need to enhance the database on a roster of local and international scientific experts so as to be able to quickly find out who is the right choice and have immediate contact with these people.

Perhaps due to not having a roster of such experts, the establishment of sectoral scientific council of NAFOSTED has many difficulties, so far it is merely a notice on the website of the Foundation regarding the requirement and then waiting for nomination by domestic research institutions or self-nomination of individual scientists for the position in the evaluation council before each term of appointment of the new permanent appraisal Council. Furthermore, it is also difficult to invite international experts or Vietnamese scientists living abroad although clear criteria have been set out to invite them to participate in the NAFOSTED's scientific review council.

Also, USNSF spends longer appraisal time by the Board or by independent scientists than NAFOSTED. While NAFOSTED usually spends 3 months for the appraisal of proposal and negotiation on financial matters, USNSF spends up to 6 months to make assessment or consider any matters arose and discussion with the proposer before making a final decision.

b) Fund's financial mechanism

USNSF has a fully active funding mechanism with the budget approved by the President and the National Congress for each year, USNSF also only reports to the President and the Congress once a year by year-end on the Foundation performance. USNSF directly receives these funds and transfers them to research projects in pursuant to prevailing financial regulations without going through any other agencies.

And in Vietnam, NAFOSTED just gets only a "semi-active" mechanism because the Foundation still has to get their plan of activity cleared by Ministry of Finance (MOF) before receiving operating funds. And these funds are not disbursed once right from the beginning of the year by MOF, it is divided into two installments and depending on the progress made. This means the MOF provides only an advance as first installment, the next disbursement depends on availability of the funds received and satisfactory report and future plan cleared by MOST and MOF. After the appraisal completed, the MOF will disburse the second installment within the total budget approved for the year.

Currently, basic research projects funded by NAFOSTED enjoy new funding modality, i.e lump-sum contract, applicable on pilot basis in accordance with Decision 14/2008/QĐ-BKHCHN issued on 22/12/2008 by the MOST. Accordingly, the payment for monthly salaries, remuneration for research team members need less supporting document. Each member just needs a working contract, liquidation of the contract, 2 reports on the assignment for 2 years. And the research team composed of a maximum of 7 persons, so the number of vouchers is not too many. When come to the final financial clearance, officials of NAFOSTED will go to the project to check original supporting documents, when project proposals are proven enough, then the research project will be financially cleared. In case NAFOSTED cannot send staff to check on the field, copy of all documents can be sent to NAFOSTED for checking and clearance.

With this mechanism, while NAFOSTED has to wait for the approval of the MOF for next disbursement, it may affect the operation of research projects, especially when the funds are not much available at project level. In addition, this mechanism repeats every year. It takes time and effort of so many agencies involved, especially of those people who are not so familiar with the project subject matters due to increased number of unnecessary administrative procedures.

Therefore, a financial mechanism to provide more pro-activity and full accountability to NAFOSTED in management and use of funds for S&T activities like the practice of USNSF should be taken into account by

Vietnamese authorities. One disbursement to NAFOSTED in a year shall shorten the process of submitting plans, reports and waiting for the approval of the MOF because all activities of NAFOSTED is under the control of MOST. The unspent fund accumulated at NAFOSTED's account may generate interests and this income can be used to further support scientific research activities.

c) Some other comments

USNSF have clear and specific rules enabling people to have the opportunity to discuss their proposals with the Program Office of USNSF to negotiate the level of funding support as the increase or decrease of fund may affect the research proposal, but NAFOSTED does not have specific regulations for this kind of financial negotiations between the Foundation and the applicants. The Program Office of USNSF can reduce the funding level proposed by applicants if they find specific activities not necessary or ineligible, especially when it coincides with the recommendation of the evaluation council on such budget cuts. In case the cost reduction of 10% or more compared to the estimated budget proposed by the applicant, the applicant is requested to resubmit a revised proposal with explanation on the impact of these cuts on the expected results and the scope of the proposed research project.

Among the selection criteria for research projects, USNSF tends to measure the community value by putting a criterion into the review process with a view to assessing the effect of the proposal on a large number of beneficiaries. It is therefore encouraged the involvement of other groups that have not been fully recognized by society (e.g gender issues, ethnic, disadvantaged groups, geographical factors, etc.) and the research results must take into account such issues as education and advocacy to improve understanding of society on science and technology. This is a new element and there not exist conditions to implement it in the present context of Vietnam but it should be considered to apply in future.

3. Some suggestions for Vietnam from the lessons learned of S&T management in the United States

The U.S has a diversified policy on financial support for R&D from the above mentioned foundations that we can apply. In order to gradually reform the R&D management mechanism, we need to implement a number of solutions of financial support for scientific research, as follows:

a) Establishment of a new technology recognition system

To ensure the accuracy of financial support for R&D, MOST needs to assign the Department of Technology Application and Development with the task of developing a new technology recognition system. This system will serve as the basis for scientific appraisal of proposals relating to new technology products under the marketing phase. Any new technology reached the standards set by the MOST, the technology owner will be supported by selling the products to state agencies as first customers; priority is given to secure funding from government development fund and technology development fund of commercial banks; priority right of sale promotion at communication campaigns or technology fair and exhibition. Support can also be provided by the NAFOSTED, the National Technological Innovation Fund for the completion, upgrading of new technologies developed by the technology owners.

b) Sponsored loans for R&D

In Vietnam, getting loans from financial institutions, especially commercial banks is not easy for small and medium-sized enterprises, especially for science and technology enterprises because these loans are always considered by the bank to be of high risk as small and medium-sized businesses are facing many uncertainties and so vulnerable to the market fluctuations and the economy, in general. So, in order to support small businesses to make investment in technology improvement, the national scientific and technological funds need to put into operation a mechanism so as to sponsor the loans by businesses for R&D. This mechanism should have a of flexible, accurate, strong and fully audited sponsorship approval process. Otherwise, it can create a “begging-giving” mechanism whereby corruption can occur. On the other side, if the mechanism is so rigid due to fear of accountability of competent authorities concerned, then R&D projects even are very promising they would not be sponsored, and cannot mobilize the necessary funds.

Therefore, sponsored credit should be provided by the Foundation for S&T Development or the National Technological Innovation Fund. Currently, the most appropriate channel should be the National Technological Innovation Fund. This kind of sponsorship may take many forms, but the common goal is to ensure that lending organizations can get back the loans in case the borrower is unable to repay. With the above sponsorship mechanism, it encourages financing institutions to lend money to small and medium-sized enterprises having promising technology, but not having enough mortgage property, or adequate credit record to prove the expected repayment.

In addition, it can enjoy incentives applicable in government financial support policy for R&D investment, namely:

Salary payment: Support of 80% annual salary for each expert, maximum of US\$ 30,000 in the first 2 years.

Tax refund: Refund of 15% of the total investment for R&D and manpower training cost in each taxed year; Or refund of 40% of average annual expenditure for R&D investment and human resource training in 4 recent years.

Reduced import tax: Reduction of 80% tax for imported research materials: equipment, chemicals, semi-processed goods, raw materials, and samples.

VAT exemption, duty free for homes and lands used for R&D purposes.

Personal income tax exemption for foreign engineers: Personal income tax exempted in 5 years for experts with service in R&D of technology intensive industrial areas specified by the State.

c) Funding Support to reduce the lag-behind in science and technology

In the trend of S&T development today, the State should provide funding support for businesses and S&T organizations to overcome the lag-behind in science and technology through three stages:

Phase 1: Shorten the gap in the use of S&T results.

Phase 2: Shorten the gap in conducting applied research and technology development.

Phase 3: Shorten the gap in basic research.

The most noticeable feature of successful countries in the catch-up process is "simulative creativity". Simulative and innovative technologies are combined together quite smoothly and naturally. Imitation and creativity has the same objective that is for the market competitiveness. In this respect, the role of application of imported technology, research and development, basic research is set out at the right time, in right place. They should be complementary with each other in a most effective manner. The highlight of this lesson is to answer the question: can we dare to set up breakthrough objectives with clear catch-up stages; persistent implementation of drastic measures toward achieving the objective, and have ability to identify opportunities to transform from lower to higher stage; go straight into hi-tech world is indispensable to "short-cut" and "catch-up" the world's development.

To shorten the gap in applied research and technology development, it must first develop the national applied research capacity, strengthen the participation in international applied research network. It should form a cadre of S&T manpower strong enough with corresponding R&D organization system, information system for research, funding sources for research and new technology perfection in line with the national R&D development strategy. Clearly, narrowing the gap is a more difficult task with higher level of effort than shortening the lag-behind in application of S&T results. To overcome difficulties caused by the fact that much scientific knowledge has not yet been encrypted, research institutes in our country have to enhance their participation and effective participation in international research programs with developed industrialized countries, or attract scientists from advanced industrialized countries. According to world experience, there are many diverse forms to choose such as: inviting foreign scientists to do teaching and research; establishing research institutes abroad and hiring foreign researchers; coordination with research activities of transnational companies, etc.

In order to acquire advanced S&T achievements from abroad, research institutes in our country should be ready in terms of deeply understanding principles of science and technology, mastering research results and successful transfer them to business sector.

To overcome the problem of research results kept on file as secret against competitors, research institutes in our country must have enough S&T capacity to "decode" the technology hidden in uncontrolled commodities in the market.

d) Establishment of a national database on S&T specialists

There should be flexibility in the selection of members for the evaluation Council of research proposals. To do so, the MOST needs to build up a database on S&T experts/scientists both national and international for a quick assess to the candidate when needed. When building the database, focus should be put on qualifications and experience of scientists/ experts, not merely rely on diploma degree, academic titles, but most importantly on the merits in S&T activities during the last 5 years, international awards/prizes obtained in the relevant fields, etc.

Particularly, the establishment of scientific advisory council to appraise S&T research projects, the Council's members must satisfy the following criteria as USNSF.

Conclusion

There are 03 key points in the management mechanism of funding scientific research by U.S. foundations, as follows:

1. Greater independence and autonomy in financial matters.
2. Flexible procedures of funding in selecting candidates for the appraisal panel, interactive dialogue with applicants in negotiation of financial support level for research project.
3. Attention of the Foundations is given to spillover effect of the research, including basic research, not only within the specialized but also in interdisciplinary fields, and not only on scientific but also on social community.

For our country, when considering the financial support for science and technology tasks, it is necessary to pay attention to the outputs and give concern in spillover effect of research project on S&T and social communities, within not only the specialized area itself but in interdisciplinary areas. Only doing so then would the investment policies for of S&T activities be truly effective./.

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