

STATE POLICIES IN PROMOTING THE COMMERCIALIZATION OF GOVERNMENT FUNDED RESEARCH AND DEVELOPMENT RESULTS

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Abstract:

In recent years, the commercialization of scientific research and technological development (R&D) results (hereinafter referred to as commercialization) has received due attention of the Party and State. In reality, though it has achieved success, to some extent, in specific cases, commercialization or transfer of R&D results into production, life in our country in general is still a very difficult task. This study is to discuss some policy solutions to promote the commercialization of R&D results.

Keywords: *Commercialization of research results; Technology development; R&D; Policies; Mechanisms.*

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1. Commercialization of research and development results and experience of some countries in the world

In this paper, commercialization of R&D results is interpreted as the conversion of R&D results into production and life (Siegel *et al.*, 1995; Goyal, 2006). Commercialization is a complex process, undergone through many different stages from formation of the research idea to successful introduction of the research results in market. Figure 1 is a simulation of the commercialization process as such. For successful commercialization, all the stages involved in the process needs to be successful, failure at any stage could lead to failure of the whole process. For example, it is hard to imagine that a bad research idea could lead to successful commercialization.



Figure 1. The process of commercialization of R&D results

Source: Goyal, 2006

However, a good idea does not necessarily lead to successful commercialization. Dhewanto *et al.*, (2009), through their study on

Australia indicated that about 100 ideas would produce 10 development projects, out of which only one or two can be profitable. The idea which had been identified by the authors was an outcome of the study with a minimum cost. These authors also said that even in England and the US there was about half of the money that businesses spent on R&D projects never reached the market. This finding was consistent with many other studies (Figure 2). That is why Governments of many countries/ territories around the world have promulgated policies to support and promote the commercialization of R&D results.

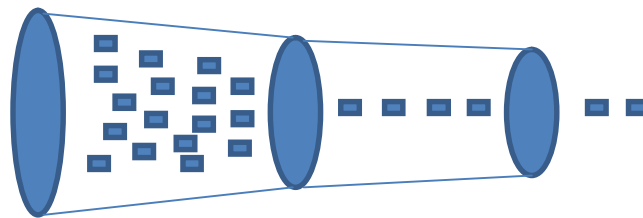


Figure 2. From ideas to successful commercialization projects

Source: Rourke, 1999; Hindle, 2004

The intervention of the State to commercialization has been mentioned by researchers at least for more than a half century back. To demonstrate the need for the State's intervention in commercialization, Arrow (1962) explained that the free market was not a favorable nature for technology transaction, especially technology was as the result of R&D. Without property rights protection, it would not be feasible to sell information in an open market, where any buyer can also reproduce and sell that information at negligible costs. This is one of the fundamental reasons for the State to be concerned of the market of R&D results.

To promote the transfer of R&D results from universities into enterprises, in 1980, the Government of the United States enacted the Bayh-Dole Act (*Bayh-Dole act 1980*). This Act gave universities and small businesses in the United States the ownership of inventions created from studies using the State budget. According to the report of the US Government Accounting Office submitted to US Congress on 07th May 1978, prior to the Bayh-Dole Act came into effect, the accumulated number of protected patents owned by US Government was 28,000 titles, but only less than 5% of these patents was commercialized. Since the promulgation of this Act, American universities had accelerated the establishment of institutions for service and technology transfer to commercialize their research results. Bayh-Dole Act was considered to be a far-reaching impact on the commercialization of R&D results of American universities. It was therefore indicated by Ashley

(2004) that "Bayh-Dole Act 1980 was the most inspiring act in the United States over the past half century" (p. 93).

Stevenson-Wydler Act 1980 of the United States on technology innovation required Federal laboratories be responsible for technology transfer activities; Federal laboratories must allocate a certain percentage of funding for technology transfer, establishment of Office of Research and Technology Applications (ORTA) and each ORTA must have at least one permanent full-time staff to be in charge of the coordination and promotion of technology transfer. The Stevenson-Wydler Act also requested that the head of the agency or laboratory pay initially for the author or co-author of the original patent US\$ 2,000 plus at least 15% royalty for a patent license, but it could not exceed US\$ 100,000 a year for a patent. This amount was increased to US\$ 150,000 under the National Technology Transfer and Advancement Act of 1995.

In US laboratories, the rate of royalties distributed to scientists was from 15%, as minimum, up to 40% of the value of the licensed technology (Table 2), depending on specific sectors. Most of the laboratories of the US Ministry of Defense operate under the guidance of this Ministry, i.e, paying for inventors US\$ 2,000 plus 20% royalties for technology license, but it could not exceed US\$ 150,000 a year for a patent.

Table 2: Share of royalties of some US laboratories

Laboratories	Proportion of royalties shared to inventors
Commander of the naval and space war systems	40%
National Laboratory of Lawrence Livermore	35%
National Laboratory of Lawrence Berkeley	35%
Agricultural Research Service Laboratory	25%
Air Force Research Laboratory	20%
Laboratory of Department of Health and Human Services	15 - 25%
National Northwest Pacific Laboratory	15%

Source: Hughes et al., 2011

In 1982, the US Congress passed the *Small Business Innovation Development Act* and the Program on *Small Business Innovation Research (SBIR)* was officially launched. The 1982 SBIR program specified that all departments and agencies of the US Government having research programs outside university with funding over US\$ 100 billion, must create SBIR program of their own with an allocation of fund of 0.2% of their total budget for research. In 1987, this fund allocation for SBIR increased to

1.25%. In 1992, the Small Business Innovation Development Act was replaced by the amended Act on Research programs for Small business innovation where the rate for SBIR rose to 1.5%. Since 1997, agencies must set aside 2.5% of their research funding for SBIR. With such a requirement of funding for R&D in businesses, SBIR program became the largest program of technological innovation in the United States.

The success of SBIR program in the United States has created spillover effects to many countries around the world such as Japan, Korea, Taiwan, Malaysia... For example, according to Branstetter and Sakakibara (1998), the *Japanese research consortia* in high-tech industries received an average of two thirds of the expenditure of research projects from the government of Japan. Some projects can be fully funded by the Government. The above authors also said that businesses involved in the research consortia had spent more money on R&D compared to those not involved in the consortia. It could be seen that the Japanese government's support contributed a lot to the promotion of business to make investment in technological innovation.

With respect to the case of Malaysia, Chandran (2010) mentioned that the Malaysian government had issued many incentive mechanisms and policies to encourage the participation of private sector in R&D. Financial incentives include the exemption of corporate income tax for those enterprises being recognized as pioneer business or the *double deduction for R&D expenditure* and some other favourable financial policies. Also according to Chandran (2010), the Government of Malaysia established the *Industrial Research and Development Grant Scheme (IGS)* with an initial budget of 100 million RM¹ to promote market oriented R&D projects. The Commercialization of Research and Development Fund (CRDF), *Technology Acquisition Fund (TAF)* were established in 1997 to accelerate and upgrade the domestic technological capability development. CRDF and TAF received initial government grant of RM 63 million and RM 118 million RM respectively. In the 7th, 8th and 9th five-year plan these figures were increased to RM 110 million and RM 250 million respectively for these two funds.

With the effort made by the Government of Malaysia, the commercialization of R&D results of this country has obtained a certain progress. Some S&T organizations have achieved success in commercializing their research results, namely University of Putra Malaysia, University of Sains Malaysia and a number of other S&T institutions. However, according to Chandran (2010), in general the level of

¹ 1 Malaysian Ringgit (RM) was about US\$ 0.32; RM 100 million was equivalent to 32 million US dollars.

commercialization of R&D results of the public research program in Malaysia was not high. A survey to 5,232 research projects in public research institutes and universities carried out during the 6th and 7th five-year plan of Malaysia showed that 14.1% of the research projects was considered as having potential commercialization and only 5.1% of the surveyed projects was successfully commercialized (*Chandran, 2010*). Also according to Chandran (2010), there existed many causes of the limited commercialization of R&D results in Malaysia, including shortage of seed money, lack of venture capital for commercialization, poor cohesion between universities, research institutes and enterprises, low capacity of enterprises to absorb new knowledge and technology.

2. An overview of the current status of commercialization of R&D results using State budget in Vietnam

Table 3: Summary of survey questionnaires

Field of research	Number of research themes	Survey questionnaire scale	Number of responses received
Machine manufacturing	427	97	14 + (12)
Chemical technology and chemical industry	113	55	7 + (14)
Agriculture and forestry	360	117	14 + (31)
Fisheries	135	31	4 + (11)
Total	1035	300	39 + (68)

Source: Results of the research theme: Number of responses collected

Nguyen Quang Tuan, 2013

To assess the status of commercialization of R&D results using the State budget, the author of this paper together with a research team has collected a list of all research projects at national, ministerial level completed in the period 2005 - 2010, archived at the National Agency of Science and Technology Information. Among applied research projects, the research team chose 04 fields to survey i.e., machine manufacturing, chemical technology and chemical industry, agriculture and forestry, and fisheries (Table 3).

In line with the above field study, the researchers used Excel to randomly select 300 research projects and sent questionnaires by post to host agencies/institutions in charge of scientific research themes. The number of randomly selected research themes of each field is shown in Table 3. After sending questionnaires to host agencies/institutions, the research group continued to contact them to confirm that the questionnaires was sent to

correct addresses. During the 03 month period, representative members of the team regularly contacted by phone with the agencies/institutions with a view to increasing the number of responses. Finally, there were 39 written responses officially received by the research group.

After receiving 39 responses, the researchers continued to contact with the agencies/institutions by phone and email to collect additional information regarding the actual status of commercialization of the results of research projects. Apart from 39 written responses received, 68 personal interviews were implemented at institutions in charge of research projects, bringing the total number of surveyed research projects up to 107. The number of host research institutions answered the questions by phone and email was shown in parentheses in Table 3. However, the quality of responses to the questionnaire by phone was not as expected. Anticipated the difficulty in studying the current situation of commercialization of R&D results in Vietnam, the research team, while collecting additional information over the phone, just concentrated on one question, i.e., “Could you tell us the form in which the results of your research project have been transferred?”.

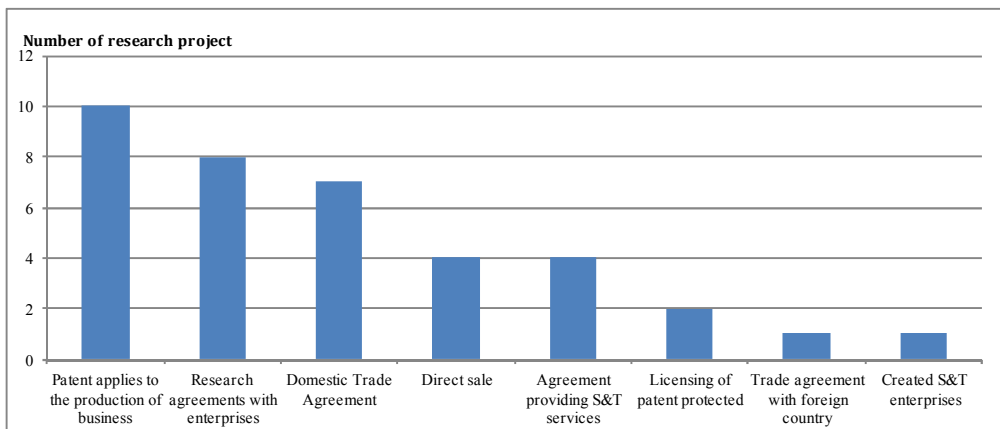


Figure 3: Some modalities of commercialization of R&D results

Source: Nguyen Quang Tuan, 2013

There were 193 research projects, in total, not sending response in any form (neither directly by post nor by phone or email) for many different reasons: some agencies did not provide phone numbers of the project leaders, some others said that they did not know the project leader’s address and phone number as it was not the requirement because the agency was just interested in receiving the research results; in some cases it was said that project leaders had retired or moved to other assignment for a long time, that why the agency could not contact them for information of concern, in some

extreme cases, agencies said they were no longer interested in the research project as it had been evaluated, satisfactorily accepted by the acceptance panel and it was now considered completed and closed, no more to say about the project.

Regarding the transfer of research results directly to the production, out of 107 research projects (Figure 3), 10 said that there were inventions/utility solutions created by their research project been applied in production and business. A surprising thing was that 6 out of 10 projects did not remember or could not specify the destination of their research results when were asked about the business address where the research results had been applied. It was noted that out of the 04 projects having patent or solution applied in production, two failed to reach the market and other two could not determine their economic efficiency after being introduced into practice. Some project leaders said that based on the results of their research, they had reached agreement with businesses so as to conduct further research or provide advisory services to them in order to further improve the technology transferred. Results of direct transfer of technology into production showed that the rate of successful commercialization in the surveyed fields was not high. Out of the 107 accepted research projects, only 01 project was commercialized in the form of establishment of a start-up S&T enterprise. Unfortunately, during the survey the researchers failed to collect relevant information on the status of this enterprise.

Some previous studies also showed the rate of research results that could be potentially commercialized. For instance, Nguyen Lan Anh (2003) commented that in the agricultural sector "only 10% of the research budget was effectively used" (p.12). Meanwhile, Ho Duc Viet (2006) believed that the rate of commercialized R&D results in our country could be from 12-15%. This study showed that the rate of commercialization of 107 projects did not likely exceed 10%. It was observed that this figure was constant in recent years.

The status of commercialization described above was due to many different causes. The most notable causes mentioned by project leaders were: (1) lack of funding for experimental research and perfection of technology; (2) Lack of State policy to promote the commercialization of R&D results; (3) lack of investment by venture capital; (4) lack of support from the host organization; and (5) the technological need of enterprises is low (Figure 4).

The commercialization rate of research projects in the surveyed fields, especially the rate of successful commercialization was very low. In the world, it was very popular that commercialization was undertaken in the form of technology licensing and creation of S&T enterprises, but it was

not the case for our country because the majority of research projects could not create new technologies with breakthrough character. So it was hard to find out a typical commercialized project to replicate for the economy as a whole.

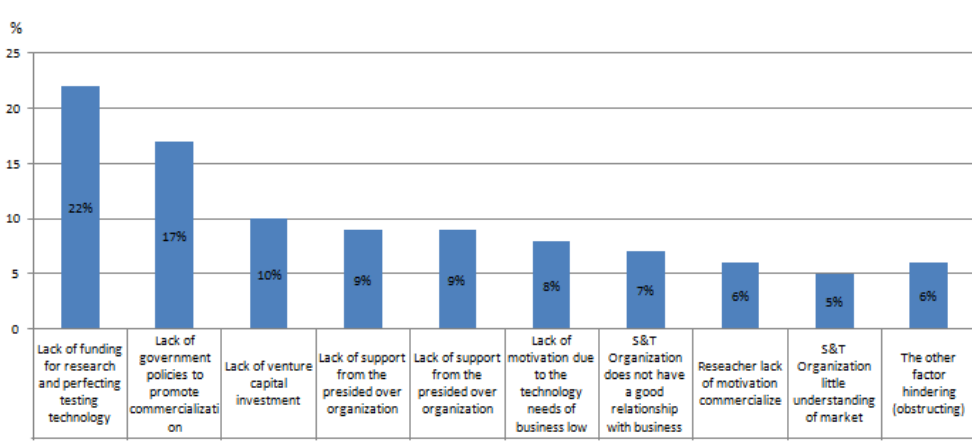


Figure 4: Factors hindering the commercialization of research results

Source: Nguyen Quang Tuan, 2013

3. Current status of incentive policies to promote the commercialization of R&D results in Vietnam

In respect of the ownership of R&D results, it was clearly stipulated in the Law on Technology Transfer in 2006: "The State gives the technology ownership to R&D institutions which have produced R&D results obtained by using the State budget, unless otherwise stipulated by laws" (Article 40). However, the Law on Science and Technology in 2013 stipulated that "Minister of Science and Technology (MOST) is the representative owner over the results of scientific and technological tasks at national level. Line ministers, heads of ministerial-level agencies, agencies of the government, other central state agencies, Chairpersons of provincial people's committee are representative owners of the results coming from S&T tasks at ministerial, provincial level, and approved by themselves" (Article 41).

Thus, there is difference between the two laws developed by the MOST. In this respect, it is very necessary to make adjustment of these two laws for consistency and synchronization. In view of commercialization, it was noted that no one who directly involved in commercialization could be representative owner of R&D results funded by State Budget as stipulated in the Law on Science and Technology. In order for commercialization, representative owners will have to further delegate the ownership to S&T institutions concerned just like the Bayh-Dole Act of the United States or Law on Technology Transfer of Vietnam. For that reason, the Law on

Science and Technology 2013 has provision that representative of state ownership “has full jurisdiction to hand over all or part of the ownership or right to use of the R&D results created using the State budget in line with the Government's regulations applied to institutions performing S&T tasks”.

Law on Science and Technology 2013 defines the responsibility for application of R&D results (Article 44), which says: “Organizations and individuals in charge of performing S&T tasks shall have direct responsibility for or participation in the application of R&D results in production, life under R&D contracts following the requirement and instruction of the demand side, except in force majeure cases”. Responsibility of organizations and individuals in the application of S&T achievements stated in the Law on Science and Technology 2013 is similar to the provision of the Stevenson-Wydler Act 1980 of the United States applied to Federal Laboratories. The difference here is that Vietnam has not had a specific policy to enforce the provision of their Law on Science and Technology.

To promote the commercialization of R&D results using the State budget, the Law on Technology Transfer allows enterprises to use assets owned by the State as mortgage for technology transfer transaction (Article 41). Organizations and individuals have the right to transfer technology, use technology as capital contribution to technology investment projects (Article 43).

With regard to distribution of income gained from technology transfer which was supported by the State budget, Article 42 of the Law on Technology Transfer specified: (1) Collectives and individuals creating technology shall be entitled with a percentage of the selling price of the products produced by the technology within a maximum of ten years, if the host organization of R&D by itself uses the technology in production; (2) Collectives and individuals creating technology shall be entitled with 20% to 35% of the revenue earned from the transfer of technology contract; and (3) After paying remuneration to collectives and individuals creating technology, the technology owner shall use the remaining 50% of income for further investment in scientific research and technological development, 50% for infringe benefits or bonuses. The Law on Science and Technology 2013 also stipulates that profit from the application of R&D results can be considered as a shared capital in investment, quote “Profits obtained from the use or transfer of right to use, transfer or shared capital earned by the application of R&D results using State budget shall give to the technology

authors at least 30%”. Once again, these two laws above should be adjusted to become consistent to each other.

In addition to the state regulations related to commercialization of R&D results as mentioned above, the government has also issued a number of mechanisms and policies such as Decree No. 115/2005/ND-CP on the autonomy, self-responsibility mechanism applied in public S&T institutions, i.e “S&T organizations shall be granted with business registration permit; be allowed to realize joint-venture production with organizations and individuals at home and abroad; direct export, import technologies and products in the fields of competence of S&T institutions in pursuance with law provisions; be allowed to participate in bidding to perform contract of manufacturing and supply of goods and services consistent with their fields of competence" (Article 6).

The government has also promulgated incentive policies to support S&T enterprises. For example, S&T enterprises are granted with the use of IP right or the State-own S&T results; are exempt of tax or enjoy reduction of corporate income tax; eligible costs are applied when calculating taxable income for R&D activities as well as production, service activities involved under the competence of the R&D institution and in line with the prevailing provisions of law; be exempt from the registration fee applied for land use rights, house ownership; and can enjoy preferential policies for getting investment credit of the Development Bank of Vietnam, the Fund for Science and Technology Development and other funds as prescribed by law to implement investment projects in production... (*Decree No. 115/2005/ND-CP and Decree No. 80/2007/ND-CP*).

In general, the state agencies have recently made constant efforts to promulgate mechanisms and policies to promote the commercialization of R&D results. The provisions of laws already touched upon various important aspects such as responsibilities of organizations and individuals in the commercialization process, measures to ensure the transfer of intellectual property, distribution of benefits gained from the commercialization of intellectual property. However, there were still many difficulties when applying these provisions in practice due to some provision were too general, in the meantime specific policies needed for the deployment of provisions of law had not been issued. Some regulations are not positively encouraging commercialization activities (for example, provisions on benefit sharing in the Joint Circular No. 93/2006/TTLT/BTC-BKHCN, Article 17 of the Law on Corporate Income Tax regarding the establishment of funds for S&T development in enterprises, etc.)

4. Some policy recommendations to promote the commercialization of R&D results

The system of legal documents related to commercialization of R&D results should be consistent and synchronized.

At least it should revise some related provisions of the Law on Science and Technology and the Law on Technology Transfer for early amendments. After harmonization and synchronization of the laws of concern, it should urgently promulgate policies to specify the obligations and rights of organizations and individuals in charge of S&T tasks. In this context, the State may have to apply some strong measures to place pressure on scientists who lead government funded research projects. For example, if a researcher held the position of leader of 03 consecutive research subjects without any of these can have their results applied in production, she/he shall not be considered as project leader again for at least 05 years since the end of last unsuccessful project. Research project leaders must be obliged to pursue his research results until these can be transferred into production (whether the commercialization is a success or a failure). In case research results are adopted by enterprises to realize pilot production, the research project leader has the responsibility to take part in, make clear of technical details and give guidance for enterprises to apply the results of their research project.

For public S&T organizations doing applied research, their supervising government agency should determine the rate of commercialization of R&D results of such organizations. It should be noted that the rate of commercialization will depend on specific field of scientific research. This rate can be very low for those research institutes whose outcomes primarily serve public purposes or for the poor. To determine the rate of commercialization, S&T institutions have responsibility to report objectively the status of application of their research results in production and life, for instance, number of projects has successful application; number of projects has potential application due to some limited conditions beyond the capacity of the S&T organization; and number of projects could not reach to the production stage, together with analysis of causes that hinder the application in reality.

Leadership of public S&T organizations should commit themselves to the State with regard to enhanced commercialization of R&D results. For example, prior to being appointed as head of S&T organization, the appointed person should have had a written commitment to the appointing authority to enhance the commercialization of R&D results. Superior S&T state management agency should also consider the successful (or

unsuccessful) achievement of R&D commercialization as an important criterion in the appointment (or dismissal) of heads of public S&T organizations.

It should encourage public S&T organizations specialized in applied research to set up a Department responsible for the introduction of research results into production and life.

For some public S&T organizations the establishment of a technology transfer unit is a mandatory requirement. These public S&T organizations must assign at least one permanent staff to carry out the task of coordination, promotion of technology transfer (according to the experience of the United States). Public R&D organizations have responsibility in monitoring the results of their R&D projects after being accepted; periodically make report to the State S&T management agency of concern regarding the actual state of commercialization of their R&D projects after acceptance.

The State should have appropriate policies to promote enterprises to use R&D results generated in the country.

Government should issue some provisions for socio-economic development projects using State budget. For example, development projects using the State budget are not allowed to import technology from abroad if this technology was available in local S&T institutions. It can only import foreign technologies into Vietnam if these prove that the technology generated in the country cannot satisfy the requirement of the development project, economic and technologically. So, it is recommended that some points in the current Law on Technology Transfer be reviewed, amended in its upcoming revision, including: (1) priority policies should be given to the use of domestically created technology. The government should set up a set of priority criteria for domestically created technology in tendering, appointed bidding of socio-economic development projects using the State budget; (2) Prohibit all acts of discrimination and price dumping in selecting locally created technologies in tendering, appointed bidding of socio-economic development projects invested in the territory of Vietnam. Support for S&T institutions in the country to transfer their R&D results to production, life. This is also the policy of many countries with more advanced economy and scientific and technological development than Vietnam.

It should improve the perception and attitude of enterprises towards application of R&D results generated in the country.

In fact, it is not easy to change the attitude of "foreign fond" of Vietnamese in general and Vietnamese businesses in particular. Building the trust

between business community and S&T institutions may take time to consolidate mutual trust between the parties. To build this kind of trust, firstly S&T institutions have to create quality and reliable products. In this respect, the State has a large role in building trust between businesses and S&T organizations. State management agencies may use their prestige to influence, for example, giving opportunity for enterprises and S&T institutions to use public mass media for advertisement of their products resulting from S&T outcomes. They may also make periodic reports, newsletters to compare locally created technologies with technologies imported from abroad by enterprises.

The State should have policies to promote the development of venture capital market in the country.

For immediate period, the State should invest by their own fund (or in combination with private investment) to develop a mechanism for operating pilot venture capital funds. On that basis, more venture capital funds will be set up whereby encouraging all economic sectors to participate in the market of venture capital. The State should also issue regulations to minimize the criminalization of economic relations in the operation of venture capital funds with participation of the State.

It should strengthen the management of S&T tasks after acceptance.

Over many years, the management of S&T tasks of Vietnam mainly focuses on linear process, namely, from the formulation of S&T task outline, monitoring the implementation process, to assessment and acceptance of the results of the S&T task performance. After the acceptance, there is a "gap" that is not yet given proper attention by state S&T management agencies. It should therefore, first of all, establish an unit in charge of commercialization R&D results within the S&T management agency of State in the ministries and localities where there is high concentration of the R&D activities, or assign additional functions and responsibilities for existing S&T departments of these highly demand ministries, provinces. The task of management of commercialization of R&D results in MOST should be clear between the Department of Technology Application and Development and the Department of S&T Market and Enterprise Development.

It is necessary to add on criteria and develop a mechanism for the state S&T management agencies to assess the commercialization of R&D results.

Commercialization is a process from forming research ideas to introducing research results into production and life. So, right from the development of research proposal, state S&T management agencies should pay attention to

the possibility of commercialization of the research tasks. General assessment of the potential market of the expected research output is one of the essential criteria during the formation of research proposal.

Research project proposals should indicate the possible destinations of the research results. Here, the address of technology application is not simply a "signature" or a "seal" of the interested enterprise. It requires a real strong commitment of the leader of research project to pursue the R&D tasks in experimental, pilot production until the results are applied whether the application is a success or a failure./.

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