EVALUATION OF SCIENCE AND TECHNOLOGY PROGRAMS: FROM THEORY TO PRACTICE AND PROPOSAL OF EVALUATION METHODS AND CRITERIA COMPATIBLE WITH VIETNAM'S CONDITIONS

Tran Hau Ngoc[1], Nguyen Ngoc Chien
Vietnam Center for Science and Technology Evaluation,
Ministry of Science and Technology

Nguyen Quoc Huy
Institute of Training and Science and Technology Application,
Hanoi University of Architecture

Abstract:

Evaluation is essential tool for effective management practice. Evaluation not only is a tool to measure the success of programs but also gives contributions to that success. Evaluation helps program managers plan, evaluate and indicate objectives to achieve, decide resources to allocate, modify, redesign and adjust programs to implement in next stages. Evaluation of science and technology (S&T) programs are usually conducted through 4 phases: (i) ***Appraisal:*** *it is the assessment carried out prior to program execution. This phase makes assessment of the feasibility and quality of program designing works; (ii)* ***Mid-term Evaluation:*** *it is the assessment carried out midway through program implementation to review performance and recommend necessary adjustments; (iii)* ***Final Evaluation:*** *it is the assessment carried out right after the end of the program. It is made to view the achieved results, summarize the entire implementation process and draw out the necessary conclusions as a basis for making the program acceptance report; (iv)* ***Impact Evaluation:*** *it is the assessment carried out at an appropriate time, since the time the program was put into operation, and used for clarification the effectiveness, sustainability and socio-economic impacts of the program. Therefore, depending on requirements, the purpose, process and method of evaluation works would be different between cases. This article provides a review of experiences from some countries in S&T program evaluation practice and a proposal of methods and criteria for S&T program evaluation compatible with Vietnam's conditions.*

Keywords*: Science and technology program; Science and technology program evaluation; Method; Condition.*

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1. Introduction

In Vietnam, S&T programs are S&T tasks which have the common goals to settle problems for S&T development and application activities in middle term or long term visions, and are conducted under various forms such as S&T

[1] Authors' contact email address: thngoc@most.gov.vn

research tasks, pilot projects and S&T projects[2]. The most specific features of S&T programs include their inter-sectorial nature, long lasting financial investments and mobilization of workforces from numerous S&T organizations for realization of large scale S&T objectives of the country. Therefore, the management and evaluation of programs play important roles in practice. The evaluation of S&T programs is the systematic and objective assessment of programs performance including designing works, implementation stages and achieved outcomes. The program evaluation would provide policy makers and managers with background to check the right course of program realization, right effects, remaining problems and required corrections (if any), evaluation of outcomes and assessment of success versus failure.

Evaluation practice gets increasing attentions in Vietnam. Law on S&T (2000), for the first time, deals with the selection of S&T tasks, evaluation works and rules for acceptance of realized results. These regulations remain in the amended Law (2013) (See Article 37). For purpose to enhance awareness and capabilities for evaluation of S&T programs and to give assistance to make S&T policies, the related units of Ministry of Science and Technology (MOST) were assigned to study methodologies of program evaluation and to conduct practical evaluation works of some national S&T programs. During the last 5 years MOST has assigned the Vietnam Center for Science and Technology Evaluation (the Institute) with tasks to give a global evaluation of S&T programs and their effects and impacts. These tasks provide the related units of MOST with numerous materials to serve management works of S&T programs in the next period. Also, the evaluation results are used by managing services of MOST to build up the program evaluation frame for re-structuring S&T programs for 2021-2025 period.

In this paper, we make a review of experiences of S&T program evaluation from some countries and give preliminary remarks on practice of S&T program evaluation works in Vietnam.

2. Experiences of S&T program evaluation practice from countries

2.1. Experiences of China

Since 1990s, the Chinese Government pays high attentions on evaluation of national S&T programs. Chinese Ministry of Science and Technology, by 1994, had set up National Centre for Science and Technology Evaluation (NCSTE) which plays important roles in provision of contents and objective evaluation for State agencies, businesses and investment organizations to make decisions related to S&T development. One of the main assignments of NCSTE is to give evaluation of S&T programs supported by the Chinese Government including

[2] Decree No. 08/2014/ND-CP on 27th January 2014 on stipulating detailed regulations and guidelines for some articles of Law on S&T (2013).

appraisal, mid-term evaluation and final evaluation. NCSTE had built the "Criteria for S&T evaluation" with 3 levels[3] which was promulgated by 2001. The first level includes basic aspects, namely: main principles, ethnic principles and technical terms for S&T evaluation. The second level includes technical standards, namely: processes, main duties and authorities of related sides in evaluation works. The third level includes commitments to standards and rules to keep independence, objectivity and fair treatment in evaluation practice.

NCSTE, by 2006, had conducted the evaluation for High Tech Development programs (Program 863) for 1986-2001 period[4] for fields: biotechnologies, information technologies, energy, advanced materials and oceanography. Identification and exploitation of information from different sources are important factors in evaluation practice. The collected information is divided into 3 groups:

- Group A: Internal information provided by program management offices;
- Group B: Information independently collected by evaluating teams including survey sheets, workshop presentations, on-site investigation and round table exchanges of related sides;
- Group C: Information and data are compatible with evaluation and study procedures.

The evaluation of Program 863 was conducted through round table sessions and public discussions to make unified and consensus views from different points and identification of discrepancies through direct dialogues. Main participants of round table exchanges are individuals charged with program management or related directly to it.

The main principles of the round table exchanges include: (i) Fairy dialogues between participating sides independently from positions and titles; (ii) Discussions made for problems prepared in advance; (iii) Exchanges conducted with encouraged approaches from different viewpoints; (iv) Discussion of results including pros and cons with the reports being well noted. All the meeting participants were informed with these principles in advance.

As shown by the evaluation outcomes, Program 863 was successful to mobilize strong potentials from Chinese scientist communities and then form teams for high tech development team at national level. The main sources of scientists, however, come from public sector universities and research institutes and a very low rate (5%) of scientists come from business sectors. Also, majority of scientists come from Beijing and Shanghai areas. It is important to note that Program 863 had trained a big volume of qualified scientists in high tech fields

[3] A Review of the Chinese National Center for Science and Technology Evaluation, Laura Pan Luo, Journal of MultiDisciplinary Evaluation

[4] http://ncste.org/memorabilia/index.html

which keep core positions for R&D activities, active cooperation and international exchanges for high tech development of China.

The Chinese Government, through the made evaluation work, also sees needs to move forwards improvement measures to extend participation of businesses in high tech development plans as well as fast high tech development in Middle and West parts of China.

NCSTE, in addition of Program 863, had conducted evaluation works for Fundamental Science Program 973, National Intellectual Property Strategies, National S&T Renovation Policies and etc.[5]

The Chinese Association of Research for Achievement Management and Science and Technology Evaluation issued two sets of standards: "Technical terms of S&T evaluation"[6] and "Criteria for S&T evaluation"[7]. They were developed under lead roles of NCSTE to extend standardization of S&T evaluation practice in China.

Activities implemented for evaluation practice in China not only impact much program planning and implementing works for following Government programs but also stimulate dialogues and information exchanges between Government agencies, industrial sectors and research communities.

2.2. Experiences of Korea

Since early 1990s, Korea started developing R&D programs not only in Korean Ministry of Science and Technology but also in other ministries and then, by mid 1990s, the evaluation works were started for R&D programs where ministries coordinate themselves implementation of R&D programs under their control.

The Korean Government, by May 1997, issued Law on Science and Technology Reform and started "survey, assessment and evaluation" works for national R&D programs under lights of the Law.

National Science and Technology Council was established by 1999 to conduct steering activities in S&T sectors, especially in the roles to supervise and govern activities related to assessment and pre-adjustment of State budgeted national R&D programs. Korean Institute for Science-Technology Evaluation and Planning (KISTEP) was established by 1998 with assigned functions to plan and organize survey, assessment and evaluation works of national R&D programs.

S&T programs in Korea are classified into different categories on basis of socio-economic criteria (but not subject to technological fields), namely:

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[5] http://ncste.org/memorabilia/index.html

[6] http://ncste.org/standard/2698.html

[7] http://ncste.org/standard/2699.html

Table 1. Classification of S&T programs in Korea

Groups	Sub-groups
Programs oriented to platform technologies, technologies for public purpose and health care.	- Programs oriented to platform technologies; - Programs oriented to technologies for public purpose; - Programs oriented to health care.
Programs for industrial services	- Short term industrial technologies; - Middle and long term industrial technologies.
Programs for infrastructure development	- International cooperation; - Development of human resources; - Material infrastructure.
Programs to support research institutes	- National laboratories; - Fundamental research institutes; - Research institutes of industrial technologies; - Research institutes of technologies for public service purpose.

During the recent 10 years (2008-2018), the R&D expenditures of Korea keep increasing trends, from 2.99% GDP rate by 2008 (about USD46 billion) to 4.53% GDP rate by 2018 (about USD98 billion)[8]. With the increasing number of implemented programs and participating organizations, it is highly needed to ensure efficiency and transparency in allocation and use of Government budgets which lead to necessity to conduct evaluation works for implementation stages of R&D programs.

At this time point, KISTEP is the organization assigned to conduct program evaluation works in Korea. The legal background for these functions of KISTEP is recorded in Article 12 of Frame Law on S&T and Article 7 and Article 12 of Law on Evaluation and Management of National S&T Programs[9]. The evaluation works conducted by KISTEP are financially supported by the Government. The evaluation works are conducted through 3 groups of main criteria: (i) Authority coverage of programs; (ii) Effectiveness of programs; and (iii) Outcomes and efficiency of programs. Subject to nature and specific requirements of every program, the evaluation councils set up actual questions for the above noted criteria and give percentage scores. Finally, the programs under evaluation get ranked to levels by their gained scores, namely: Level A (> 90%); Level B (70-90%); Level C (30-70%); Level D (10-30%) and Level E (<10%) with the assignment of corresponding grades, namely: Excellent (>70%); Middle (30-70%); Low (<30%). The annual evaluation works of R&D programs in Korea are conducted through 3 stages: (i) Planning and inception; (ii) Assessment; and (iii) Adjustment and summary of evaluation results.

[8] https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm

[9] https://www.kistep.re.kr/en/c2/sub1_4.jsp

Among OECD countries, Korea is seen as keeping the solid steps in supervision of evaluation with application of integrated and consistent models for evaluation of S&T programs. *The Korean evaluation system of R&D programs is unique which is not similar to any system of any country in the world. Only in Korea, all the R&D programs get gathered together for evaluation process by the National Council.*

2.3. Experiences of Canada

Program evaluation works in Canada have especially high functions and important roles for activities of the Federal Government. The federal system of program evaluation of Canada has been implemented during the last 30 years. The Budget Committee is the organization of the Federal Government to set up policies for program evaluation. The first policy for program evaluation issued by 2007 calls to build evaluation capabilities in all the federal organizations and proposes the organizations to make periodical evaluation of their programs. The federal evaluation model is non-centralized. Every organization is responsible to make evaluation of its own initiatives under rules by the Budget Committee, independently from management organizations, and the evaluation results must be shared to external organizations which eventually are interested in, such as Budget Committee and other committees of the Congress. Globally, the evaluation frame was established immediately at the program inception stage.

The evaluation work, by regulations, requires provision of information in 3 basic aspects in relation to programs including R&D ones, namely:

- Compatibility of programs (to meet priorities of organizations, the Government and actual demands);
- Success of programs (to meet expected objectives and results of programs);
- Cost effectiveness (to gather the most effective designs and implementation approaches).

In many organizations such as Natural Science and Technics Research Council, Resource Council and National Research Council of Canada, majority of resources are reserved for realization of R&D programs and then the capabilities for professional evaluation of S&T programs were developed. Assessment by experts from the same field was the method largely used for evaluation of R&D quality in these organizations since 1960s. In addition, some supplementary evaluation methods, such as surveys of clients, potential clients and staffs, were used together with methods for analysis of situations and cost-benefit problems.

During the recent 10 years, Canada implements evaluation works of some S&T programs such as Pilot program of application of digital techniques (implemented in 2013-2014), Program of access to renovation of businesses (implemented in 2015-2016), Program of incubators and acceleration

(implemented in2016-2017 and 2018-2019), and Program of support for agricultural research (implemented in 2016-2017). The evaluation works of these programs were realized by Canadian National Research Council. The objectives of evaluation works are to update managers with initial results of these programs and information for issuance of new policies and decisions of supports for related entities. The evaluation methods which were used are mainly surveys and collection of data, direct interviews, literature studies, cost-benefit analysis, assessment by experts of the same field and some others.

2.4. Lessons for Vietnam

We can see, through brief presentation of experiences from China, Korea and Canada on evaluation of S&T programs, these countries had issued a system of clear legal regulations for evaluation practice before starting evaluation works (Criteria of S&T Evaluation of China, Law on Evaluation and Management of National R&D Programs of Korea, Discussions on Evaluation of Canada, 1986). At the same time, these countries set up their organizations for realization of evaluation works (National Centre of S&T Evaluation of China, Korean Institute of S&T Evaluation and Planning of Korea and National Research Council of Canada). Evaluation works are financially supported by the Government. So, in the 3 countries, the evaluation works of S&T programs were built up, completed and developed on the pillars of regulatory documents, organization of implementation works and Government financial supports.

In Vietnam, with awareness of important roles of S&T sectors, the Party and the State issued numerous resolutions which confirm *"S&T development and application are the first rank national policy and one the most important driving forces for socio-economic development and national defence"*[10]. Implementing the resolution, the Government regularly provides increasing investments for S&T development during the last decade. In addition, the Government pays attentions to set-up and implementation of S&T programs. S&T programs were built up since 1980s. At the end of each implementation stage, Program Management Boards and Ministry of Science and Technology make final reports on basis of evaluation results for acceptance of research projects and pilot production programs under programs. In the final reports, at end of each stage of programs, the main contents are focused on conclusions for implementation works, financial use and listing-out of concrete results from projects. Even being noted with success and failure, the mentioned reports do not provide systematic analysis and evaluation but only qualitative remarks and recommendations. For better transparency in management works of S&T programs, MOST had set up Vietnam Institute of S&T Evaluation with functions of evaluation of S&T programs.

[10] Resolution of Central Committee Meeting 6, XI-th session on S&T development for industrialization and modernization in contexts of socialist oriented market economy and international integration.

So, as the above mentioned countries, Vietnam also set an organization in charge of conducting evaluation works, namely VISTEC which is financially supported by State budgets. The legal documents, however, are still not available to regulate program evaluation works in details (actually there exist only documents to regulate acceptance evaluation of projects of the programs).

3. Proposals for evaluation works of S&T programs in Vietnam

3.1. Brief view of the process of evaluation of S&T programs

Since 2001, MOST has conducted renovation activities for some contents of definition of State-level S&T tasks, set-up of S&T consulting councils, definition of tasks and projects in every program. Evaluation works are focused on the stages of input selection (detail definition of every task and selection of lead organizations and individuals for implementation of the task) and acceptance evaluation. The selection is conducted on basis of scoring works by the consulting council which processes also application files. The tasks, at end of realization, are evaluated for acceptance on basis of evaluation results by scientific councils. Even with considerable improvement for input selection and acceptance evaluation, the S&T evaluation practice remains still oriented mainly to concrete tasks. Efforts are still focused on evaluation of separate tasks while the organizational mechanism of scientific research and technological development already is upgraded to program level. Actually, MOST does not issue yet regulating documents and detailed guidelines for S&T program evaluation. However, realizing important roles of evaluation works in S&T management systems, particularly the evaluation of S&T programs, MOST has offered some tasks for enhancement of awareness and capabilities for S&T program evaluation as contributions to build S&T policies. Remarkably, some evaluation tasks were realized by VISTEC (which used to be Vietnam Centre for Science and Technology Evaluation).

So, during the last 10 years, the S&T program evaluation works have been implemented with gradual access to international standards. Being supported by MOST (through assignment of tasks), VISTEC conducts methodically evaluation works of S&T programs starting with studies of methods, a series of trial evaluation works, completion of methods and practical operation of evaluation works. This helps the Institute set up a global program evaluation procedure with the following concrete steps:

- Step 1: Collection of initial information about programs under evaluation (objectives, contents of implementation works, results, management documents and related aspects);
- Step 2: Designs of evaluation (subject to evaluation targets required by evaluation ordering sides to set up criteria and evaluation scores);

- Step 3: Investigations and collection of data in conformity to designed evaluation concepts;
- Step 4: In-depth investigations or additional ones (if needed);
- Step 5: Organization of evaluation works and preparation of evaluation reports.

3.2. Methods of preparation of evaluation data

a) *Studies of literature and files*: Studies are made for legal documents and regulations of S&T program evaluation of Vietnam with reference to foreign sources as well as ones in relation to the programs under evaluation such as: final reports of programs, results of scientific research and training activities, technological outcomes, commercial achievements, procedure of transfer of gained results and etc.

b) *Workshops and working meetings of teams*: They are organized with concerned sides such as Program Management Boards, program managers and members of program implementing actors.

c) *Investigations*: The works are conducted with 5 groups of actors:

- Lead organizations: for collection of information and data on implementation process, achieved results and modes to transfer gained results for practical application as well as program management works;
- Participating actors: for collection of information and data on objectives and contents of their works and impacts they get from their participation;
- Beneficiaries: for collection of information and data on final users and benefits they can get;
- Implementing staffs: for collection of information and data on impacts they get from their participation;
- Thesis preparing staffs: Some participating individuals are preparing their thesis for master or doctor degrees and information and data on the impacts they may get from participation are quite interesting.

d) On-site surveys and interviews of participating organizations and individuals as well as results using organizations.

e) Quantitative and qualitative evaluation of data.

f) Evaluation by experts from the same fields.

3.3. Criteria for evaluation of S&T programs

The evaluation is made on basis of 8 success indicators. The S&T programs fully completing the 8 indicators get classified as excellent. For that, they need

to gather maximal evaluating scores. Naturally, the scores would not be gained if the programs do not complete the corresponding criteria.

The 8 success indicators for a S&T program include:

(1) *Compatibility:* It is crucial to orient S&T programs to meet S&T needs and priorities for socio-economic development of Vietnam. Plans of the program have to be designed to produce outcomes for development of important S&T fields of Vietnam.

The actual compatibility gets evaluated through the following consideration:

a. S&T scopes supported by the program have to be important for strategies of S&T development and socio-economic development of Vietnam.

b. Necessity of State supports for S&T development in the related fields.

c. Orientations of the program to settle problems necessarily requiring knowledge and new technologies.

d. Objectives and priority fields of the program have to be defined clearly and feasible. The expected outcomes have to produce S&T progress necessary and applicable for socio-economic development.

(2) *Resources for implementation*: The programs under evaluation should have resources enough for successful implementation with expected results, namely:

a. Financial resources: The total finances for implementation works must be available and ready for achievement of all the defined objectives, the research activities being conducted with high quality;

b. Human resources: Researching staffs and key actors (e.g., enterprise-users of research results) are mobilized for participation.

(3) *Program management*: Management and supervision systems must be well organized to ensure effective implementation of research activities, namely:

a. Programs have to be planned clearly and scientifically;

b. Selection and acceptance procedures have to be conducted transparently and effectively;

c. Programs are implemented effectively;

d. Implementation schedules have to be well monitored and the defined tasks and outcomes have to be evaluated systematically when completed.

(4) *Scientific results*: The tasks supported by programs have to produce valuable and measurable results, namely:

a. Produced scientific knowledge has to be new and valuable;

b. Outputs have to be measurable, e.g. the number of scientific publications, workshops, meetings and etc.

(5) *Technological results*: The tasks supported by programs have to produce valuable and measurable results, namely:

a. High applicability of produced technologies and solutions;

b. Intellectual property related records (e.g. inventions, utilities and etc.);

c. New products, services procedures and etc.

(6) *Transfer and commercialization of S&T results*: Results of scientific programs are considered successfully transferred and commercialized if they meet one of the following requirements:

a. Scientific knowledge and technologies produced from tasks are transferred to users, particularly businesses for successful application for making new products, services or better modifications;

b. Products and services produced by products from tasks are successfully developed and commercialized;

c. Researchers set up businesses (spin-offs) for successful commercialization of produced research results.

(7) *Impacts to S&T potential and capabilities:* Successful programs have to lead to impacts for S&T potentials and capabilities, namely:

a. Organizations participating in programs have to enhance their own S&T potentials and capabilities;

b. Research organizations have to develop or enhance cooperation links with: (i) Other research organizations and universities; and (ii) Users of research results, e.g. businesses;

c. Businesses taking part in programs or cooperate with research organizations under programs have to enhance their technological capabilities and competitiveness.

(8) *Socio-economic impacts*: Successful programs have to produce sustainable positive socio-economic impacts, namely:

a. Enhancement of productivity, innovation capabilities and competitiveness of businesses;

b. Contributions for economic growth, offers of new jobs;

c. Solutions for settlement of other important social problems (e.g. environment protection, energy development, urban infrastructure).

The evaluation of success indicators is summarized in the following table.

Table 2. Evaluation of success indicators

Success indicators	Excellent results *Highest scores*	Bad results *Lowest scores*
Compatibility	Programs support important S&T fields and other fields which need State supports to achieve necessary progress. Programs orient to settle research fields and improvement needs of Vietnam. Priority objectives and fields of programs are clearly defined and feasible. Programs achieve necessary S&T objectives and results as expected.	Programs carry out researches incompatible with Vietnam conditions. State supports are not needed for this type of S&T research activities. Research projects conducted in programs make no contributions to settlement of socio-economic problems. Priority objectives and fields are not clearly defined and not feasible. Tasks, even being considered as completed successfully, do not make contributions to socio-economic development.
Resources	Total financial expenditure volumes of programs are stable and ensure achievement of objectives. Finances for every task are enough to achieve well S&T objectives and results. Research staffs/teams and strategic teams are well available for selection. Most important research staffs are available for participation in programs.	Total financial expenditure volumes are not enough (too low) for achievement of objectives. Finances for every task are too low to achieve expected S&T objectives and results. Research staffs and important actors not available for selection.
Management and supervision	Plans are clearly and scientifically planned. Callings, selections and management of tasks are conducted effectively. Programs are implemented effectively. Supervision of schedules and evaluation of produced results are conducted systematically after completion.	No plans set up for implementation of programs. Times of callings and selections last too long. The selected tasks are not the best ones. Programs are not implemented effectively. No information available for schedules and no evaluation made for results of tasks.
Scientific results	Tasks under programs produce new and valuable knowledge. Research results made from S&T tasks are valuable and measurable.	Tasks under programs do not produce valuable and new scientific knowledge. No measurable results of scientific research produced.
Technological results	Tasks under programs produce new technologies and solutions highly useful for practical application. Tasks under programs produce enough inventions and technical utilities.	Tasks under programs do not produce new technologies and solutions useful for practical application. Tasks under programs do not produce any inventions and technical utilities.

	Tasks under programs produce enough new products, services and procedures, applicable or commercializable.	Tasks under programs do not produce any new products, services and procedures, applicable or commercializable.
Transfer and commercialization of research results	New knowledge or technologies are successfully transferred to users. New products and services on basis of research results are successfully developed and commercialized. Research staffs use research results to set up new businesses (spin-offs) for commercialization purpose.	No new knowledge or technologies transferred to users. No new products and services on basis of research results successfully developed and commercialized. No business set up.
Impacts to S&T potentials and capabilities	Research organizations taking part in programs enhance their S&T potentials and capabilities. Research staffs taking part in programs enhance their research potentials and S&T cooperation links. Businesses taking part in programs enhance their research potentials and competitiveness.	Programs do not produce impacts in terms of S&T potentials and capabilities of participants. Programs do not produce impacts in terms of S&T potentials and competitiveness for participating businesses.
Socio-economic impacts	Outcomes of programs make contributions to enhancement of productivity, innovation capabilities and competitiveness for businesses. Outcomes of programs make contributions to economic growth and offers of new jobs. Outcomes of programs make contributions for issuance of solutions for settlement of important social problems.	Outcomes of programs do not make contributions enhancement of productivity, innovation capabilities and competitiveness for businesses. Outcomes of programs do not make contributions economic growth and offers of new jobs, and do not issue solutions for settlement of important social problems.

3.4. Methods of evaluation

Every success indicator is measured by certain evaluating criteria. Every evaluating criterion gets a score in range from 1 (very bad results) to 5 (excellent results). The scoring for evaluation is explained in the following table.

Table 3. Scores for evaluating criteria

Scores	Explanations
1	Very bad results: Programs are incapable of defining objectives, the implementation is completely ineffective without achieving any valuable results.
2	Incomplete results: Programs achieve only a few objectives, the implementation is not yet effective and achieves only a few desired results.

3	Medium results: Programs achieve some objectives with results acceptable according to Vietnam standards. Programs complete contents, but management and implementation works have to be improved.
4	Good results: Programs achieve almost all the objectives, the implementation works conducted well with results assessed as good in comparison to other programs in Vietnam.
5	Excellent results: Programs achieve all the objectives, the implementation is conducted very effectively, even comparable to the world leading S&T programs.

In addition to scoring, the evaluating experts are required to give remarks on strong points, weak points and needs of improvement for every criterion.

The total scores for evaluation of programs are summed up from the 8 success indicators. Evaluating experts when computing the total scores of the 8 success indicators have to sum up the average scores of individual indicators.

3.5. Practice of evaluation works of S&T programs during recent time

VISTEC implemented methodically evaluation works for S&T programs, from studies of methodologies to trial evaluation works for completion of methodology and practical operation of evaluation works.

- Trial evaluation works: They were conducted for completion of methodology through the following two tasks:

- Task 1: Evaluation of effective application of research results of the project "Research for improvement of seedlings for better productivity and quality of some leading plant species". The task was completed by 2013. The results of the tasks are the successful building of methodology and the initial formation of the set of skills for evaluation of impacts of the project with the following trial application for evaluation of impacts from research results to various components of the project. It is the first time, VISTEC makes deeper extensions of methodology for evaluation of programs and tasks to evaluation of their impacts.
- Task 2: Research for completion of methodology of evaluation of S&T programs through a pilot work for evaluation of a State-level S&T program. The task was completed by December 2015. On basis of application of previous research results for a global evaluation of a S&T program during 2006-2010, it is required to complete the effective methodology for evaluation of S&T programs. Experiences gained from realization of this task show difficulties in evaluation of impacts. The most difficult segment of works is the collection of information and data used for evaluation works. It is needed to note that evaluating experts have to follow up every propagation of impacts of the program to catch necessary information. Then the evaluation of impacts requires high use of financial resources and massive involvement of qualified and experienced staffs.

- Practical operation of evaluation works: VISTEC conducted evaluation works for some State-level key S&T programs, namely Programs KC.01, KC.02, KC.03, KC.04, KC.05, KC.06, KC.07, KC.10 and KX.01with some details briefed as follows:

- By 2015-2016, VISTEC completed evaluation works of two State-level key S&T programs (Program KC.04 for biotechnologies and Program KX.01 for economics through 3 stages from 2001 to 2015). The evaluation works were implemented on basis of 3 large criteria: compatibility, effectiveness and efficiency. The reports for these two programs clearly did not give the evaluation of impacts due to certain problems of financial resources and personnel matters. The produced results of evaluation works were highly appreciated by the Ministerial Acceptance Council and the provided information was considered by experts as reliable and meaningful which policy makers need.

- By 2017, VISTEC completed the task "Evaluation of effectiveness and activities of Program KC.02 for material technologies through stages from 2006 to 2015". Accordingly, it was targeted to identify that the impacts of the Program can be evaluated by comparison of achieved outcomes to initially defined objectives. The task implementation also enhanced capabilities of evaluating staffs of VISTEC as well as assisted MOST units in management works of Program KC.02 in next stages.

- By 2018, VISTEC completed the task "Evaluation of impacts of State-level key S&T programs KC.01, KC.03, KC.06 and KC.07, 2011-2015 period". Also, by 2019, VISTEC completed evaluation works for Program KC.05 and Program KC.10, 2011-2015 period. These two tasks had been finished and passed grass-level acceptance formalities and now await the one of ministerial level. The realization of these two tasks provides the evaluating team with precious experiences in terms of theoretical knowledge and practical skills. The results gained from these tasks make contributions to the re-structuring works for S&T programs of MOST.

4. Difficulties from realization of S&T program evaluation

As shown by practical experiences from evaluation works realized for some S&T programs, the two most difficult groups of works relate to data matters and evaluation tools.

- Difficulties related to data collection and survey works, namely:

- *First*, scientists involved into S&T programs are not aware enough of the roles of evaluation works in supporting policy making works where the right information is necessary for set-up and adjustment of management systems.

This low awareness level leads to less cooperation in provision of related information;

- *Second*, on-site survey trips, as shown by implementation practice, very highly consume time, finances and workforce. Particularly, the finances allocated for these mission trips are usually limited;
- *Third*, some tasks, with their specific nature, do not store data after 5 years since ending. This leads to high shortages of crucially needed information and data;
- *Fourth*, the evaluation works for S&T programs were developed for the first time as ministerial level projects and then do not get high attentions from concerned sides, particularly with survey works for collection of information and data.

➢ Difficulties related to evaluation tools and availability of evaluating experts, namely:

- *Evaluation tools*: the collection and processing of data were conducted with use of Excel software which leads to low development and non-professional practice. As shown by practical operation of evaluation works developed by VISTEC, it is highly needed to get special software for collection, synthesis and processing of data;
- *Evaluating experts*: the evaluation works for S&T programs are implemented by VISTEC with use of assessment by experts from the same fields. Even with existing database from thousands experts from numerous sectors, the actual selection of experts for evaluation works faces high difficulties. The main cause comes from the respect of rules for transparency and avoidance of interest conflicts as required by this type of works. Almost all the S&T programs involve leading experts of Vietnam and then the number of experts availably mobilized for evaluation works is low. Also, the evaluating units do not have finances to invite evaluating experts from advanced countries for joint participation.

5. Experience lessons and recommendations for S&T programs evaluation practice

For methodical and right practice of S&T program evaluation activities, as shown by experiences from many countries, Vietnam needs to set up fully the following three main platforms.

- *First*, issuance of documents governing S&T program evaluation activities;
- *Second*, set-up of an organization assigned for S&T evaluation works;
- *Third*, financial supports from the State for S&T program evaluation activities.

In Vietnam practically two platforms are already available: an entity assigned for evaluation works and provision of finances (even still limited). The shortage of documents to govern this type of works leads to difficulties for realization of works. With purpose to turn the S&T program evaluation to a really useful tool for administration of S&T program evaluation activities, the following recommendations are proposed.

- Awareness should be raised higher for the roles of evaluation activities among scientific communities and administration agencies;
- Legal regulation systems need to be completed sooner for evaluation of S&T activities in general and S&T programs in particular;
- Database should be set up for service of evaluation activities;
- Results gained from evaluation works have to be used for management services through program frames for the following stages, completion of management mechanisms of S&T programs and consideration of budget allocation for priority fields and organizations with enriched potentials for realization of S&T tasks./.

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