Evaluating government-sponsored science and technology projects in China

The Chinese Government has invested increasingly in science and technology (S&T) since the early 1980s. Evaluation of these activities began in the 1990s, especially at the national level. This paper introduces the process by which government-sponsored S&T programs are evaluated, investigates specific issues encountered during the process of evaluation, and recommends guidelines for future improvement of S&T evaluation practice.

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Introduction

During the past two decades, industrial innovation based on science and technology (S&T) has been regarded as a driving force for socioeconomic development. This has led government research policy-makers in both developed and developing countries to make efforts to find an appropriate approach to improving the effectiveness and efficiency of government-sponsored S&T projects. To legitimise the projects' goals and expenditures, evaluation has become standard practice for government-sponsored projects. This article reports on some recent experiences with evaluation methods, procedures and climates.

In the early 1980s, government-sponsored research institutes and universities were the main source of R&D in China. Since the late 1980s, the private sector has been encouraged to invest in S&T projects and could be compensated by government. Nowadays, many government-sponsored S&T programs are aimed at both public and private sectors, and the money invested has increased considerably each year. Although these projects have contributed to the development of S&T in China, their performance and outcomes have not always been satisfactory.

Confronted with this dissatisfaction, the Ministry of Science & Technology of China (MOSTC) set up a specialised agency with responsibility for the evaluation of government-sponsored S&T projects in 1994. This agency, the National Centre for Scientific and Technological Evaluation of China (NCSTEC), is the leading organisation in the field. NCSTEC plays an important role in providing objective and impartial evaluation to government departments, enterprises and other investment organisations for decision-making relating to S&T development. The activities conducted by the Centre are:

- evaluation of government-sponsored S&T projects, including ex-ante, ex-post and mid-term evaluations;
- evaluations of S&T policies;
- performance measurement for government-sponsored research institutes; providing services to enterprises and investment companies in the fields of S&T project evaluation;
- enhancing relationships with international organisations, government departments and other non-government agencies;

- helping to build the capacity of local S&T evaluation agencies.

Evaluation practice

Overview of projects evaluated

In China, every S&T project belongs to a specific program. Each program covers many projects. Different programs are initiated to meet different needs. Three major ones consume most of the government R&D fund and account for the majority of projects evaluated by NCSTEC:

Program 863

Program 863 was first proposed by several outstanding Chinese scientists in March 1986 and launched in 1987. It is also known as the High-Tech Research and Development Program. It is a program designed specifically to meet the needs of developing high-technology industries, with a major emphasis on cooperation between academia and high-tech enterprises. Projects funded under this program should play an important and directed role in the practical operation of enterprises and contribute to the solution of generic technological difficulties encountered by most enterprises. The target technologies include IT, biotechnology, new materials, energy, automation, aviation, environmental technology and lasers.

Program 973

Program 973, initiated in March 1997, is also referred to as the Key Basic Research Program. It emphasises important basic research projects that address technologies needed in the future. The program endeavours to provide a base for the strategic development of S&T in China, and concentrates on projects which will provide insights into developing trends and the capacity to strengthen core competitiveness.

Key Technological Difficulties Program (KTDP)

KTDP is a program specifically associated with the National Five-Year Development Plan. Whereas Program 973 covers basic research, KTDP funds applied research aimed at solving the practical technological difficulties met during the process of implementing every Five Year Plan. Most projects under KTDP are related to important large-scale projects under the Plan, for example the Three Gorges Project. Projects under KTDP are proposed by the industrial departments and carried out by a combined team drawn from industry and academia. The stress lies on cooperation between government-sponsored research institutes, universities and industry.

Evaluation types

S&T evaluation falls into three categories, ex-ante, mid-term, and ex-post. The three types differ significantly in purpose, criteria and timing:

- Ex-ante evaluation assesses (a) whether the research goals and scope are appropriate to the objectives of the program, (b) whether the research methods are suitable, and (c) whether the expected research outcomes are worthwhile.
- Mid-term evaluation checks (a) whether the outcome so far meets the research objectives up to this point, (b) whether any unexpected difficulties have emerged and if so, whether solutions are available, and (c) whether newer technologies have been invented to meet the project objectives, and whether there is still a need to continue the project.
- Ex-post evaluation reviews (a) whether the scientific and/or technological goals have been achieved, (b) the adequacy of the research methods, and (c) whether the project has had a significant impact on national socioeconomic development.

Generic evaluation procedures

Although the three types of evaluation serve different purposes, they do not necessarily follow entirely different procedures. In fact, the basic procedures for all three are almost identical, albeit with minor differences according to the evaluation type.

Five stages are included in the generic procedure as outlined on the following page.

Though it has yet to be established whether this multi-stage approach is effective in terms of precision and impartiality, it reflects the strong commitment of the Chinese government to ensuring fairness in the assessment of government-sponsored S&T projects and to using public resources more efficiently.

Evaluation methods

Both qualitative or quantitative methods can be used, including peer review, case studies and cost–benefit analysis. There are standards for selecting the evaluation methods, based on the project characteristics. For instance, if the project to be evaluated is commercial one, which means attention should be paid on its potential profitability, methods such as market research and financial analysis should be used, and the panel should include members drawn from business, especially marketing.

The three main techniques, invariably used in combination, are peer review, case studies and performance indicators.

Peer review

Peer review is the most widely used form of assessment, and is generally used to evaluate the quality of the science associated with basic and strategic research. This particular method is based on the view that scientists agree to some extent on the definition of 'good science', and therefore can make objective judgements concerning the merits of individual projects. Peer review is always used for ex-ante evaluation.

The five stages of the generic evaluation procedures

1

Stage 1
Project applicants self-assess their proposals or outputs according to guidelines issued by the Ministry. To discourage arbitrariness, an internal committee is requested to provide basic information and initial comments.

2

Stage 2
Application documents, including the project proposals, are mailed to an anonymous program director in NCSTEC. After receiving these documents, the program director first checks that the proposed project is not already being supported by another branch of government and has not already been undertaken elsewhere, and that the objectives of the proposed project are consistent with those of the program. The director then nominates an evaluation panel of six members, drawn from universities, industries and research institutes. Copies of the application documents are posted to the evaluators or tabled at a meeting of the panel, together with a set of instructions designed by NCSTEC to provide guidance on how to assess the proposals.

3

Stage 3
In the third stage, the program director integrates the results of the first and second stages and draws up an opinion. In the cases of project selection and mid-term evaluation, the program director first checks the panel's ratings on the requirements set out in the pro-forma. For project selection, four of these items are related to feasibility of the project, two to qualifications of the applicant researchers, and two to expected impediments to carrying out the project. For mid-term evaluation, four items are related to changes in the R&D environment, and four to the likelihood of goal achievement if the project is continued. In the case of midterm evaluation, if a specific prerequisite item for a project is indicated to be inappropriate by more than one panel member, or the number of items indicated to be inappropriate is more than three, then the project is rejected.

4

Stage 4
The fourth stage, a site visit, occurs only in ex-post evaluations. The visitors compare the outputs of the project with the written report. They also gather detailed information about the project through open communication with the researchers.

5

Stage 5
The last stage is for the panels to critically investigate, modify, and approve the project, aided by the director's opinion and the site-visit report.

stages of generic evaluation procedures

Our practice has developed a form of modified peer review which involves a combination of socioeconomic impact assessment and traditional peer review. This method is used predominantly for evaluating strategic and applied areas of science, where the criteria go beyond the quality of science and include issues concerning the social and economic impacts of research, and/or the potential for the commercial utilisation. Panels include non-peer members such as economists, finance experts, marketing management and future users. Modified peer review is used in both ex-ante and ex-post evaluation, in combination with other methods such as site visits, interviews and questionnaires.

Case studies

Case studies are mostly used in ex-post evaluation, especially of long-term projects such as those funded under Program 973. The advantage of case studies is that, if based on sufficiently detailed data and records, they offer probably the best chance of fully identifying the relationships between the S&T projects and their outputs. The problem lies in gathering adequate data. A networked computer-based information system has been set up in NCSTEC to support this process, although its function is not perfect and it contains insufficient data. Another way to solve this problem is by cooperation with the administrative departments that hold the raw data. However, this is an ongoing task that will need to continue for some time.

Performance indicators

Performance indicators are the core of many evaluation methods such as peer review. The approach generally used is weighted multiple criteria analysis, or the 'scoring approach'. This provides a means of incorporating and ranking a wide variety of quantitative and qualitative factors that influence or are deemed relevant to the evaluation on the project options.

Improving our evaluation practice

Since we know that evaluation is both a science and an art, it is necessary to incorporate our experiences and lessons into future practice. Improving evaluation technique is a long-term task that needs a systematic approach to guarantee continuous work on it. NCSTEC requires every evaluation director to spend part of their working hours on research and discussions on the improvement of evaluation. This work takes the form of proposals and research projects.

Another measure used by the Centre is to

strengthen cooperation with professors from the universities. Some professors whose fields are concerned with S&T evaluation are nominated as part-time researchers with NCSTEC, and they are the main resource used for research work on the improvement of evaluation methods. Methodological innovations are subjected to field-testing before being put into general use. This is the responsibility of a special group within the NCSTEC.

International cooperation and communication also play an important role in improving evaluation practice in China. The NCSTEC makes an effort to take part in international conferences held by APEC, the World Bank and some evaluation societies such as AES.

Implementation of findings

NCSTEC evaluation findings are a major input to decision-making on the projects concerned. The Ministry has final power to make the decision on whether or not to sponsor a project. However, if its decision goes against the recommendation of the evaluation, a special committee will make the final judgement. For both project and policy reviews, NCSTEC presents a formal evaluation report to the Ministry after internal discussion.

Problems and solutions

In this part, we will discuss the problems met during evaluation and offer solutions based on our practical experience.

Enlarge the pool of evaluators

The success of evaluations depends on their objectivity and credibility. In our experience, if the pool of qualified scientists/engineers is small, or experts in a particular field are not easily found, then as a result it is nearly impossible to guarantee the objectivity and credibility of evaluation. It is necessary to build a large pool of evaluators with outstanding academic achievements, comprehensive practical experience and distinguished expertise. The following are two of the measures NCSTEC is taking:

Share qualified human resources for selecting evaluators

In China, different government departments know the qualified experts of their own fields very well and hold detailed, frequently updated personal information on them. For instance, the Ministry of Information Industries has set up a network of experts available for work in IT projects. The NCSTEC aims to strengthen its cooperation with such government departments and share their human resources.

Seek international assistance

The very small pool of qualified evaluators in China means that we need to seek international assistance. Of course, this will cost more, but the cost is justified for important projects with major impacts on national development strategy.

Select appropriate evaluators

Selecting appropriate evaluators is another key factor determining the success of evaluation. To make the selection reasonable and fair, the Centre has developed a database with details on more than 3000 experts. The system allows rapid identification of the most relevant experts using an index based on specialty. The program director can select among them by using a random function provided by the system, though this can be overridden by the director. The director can also use this information to screen out any evaluators with links to the project applicant.

A second database system holds records of individual evaluators' rated performance. The ratings, covering expertise, morality and personality, are drawn on by a special committee in NCSTEC.

Make evaluators follow the same rules as much as possible

Before beginning their work, evaluators receive a set of instructions from the program director to accompany the project application documents. There are three parts to this set. The first part is a detailed description of the generic evaluation procedure. The second introduces the weighted scoring method, together with an illustration of the relevant indicator system. The third part consists of tables to be filled out by evaluators. This is intended to ensure that evaluators understand the method and follow the same rules when they evaluate. However, in practice, this has proved inadequate to ensure consistency; in fact, it is impossible to do so, whatever measures are taken. All we can do is try to make evaluators follow the same rules as far as possible.

Training in how to evaluate plays an important role in this. Since there are too many evaluators to make it always possible to run formal training programs, the main resource is informal training delivered through seminars, short-term workshops and distribution of course materials.

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Conclusion

The inherent uncertainty and complexity of S&T projects and the subjective nature of evaluation imply that S&T evaluation cannot always produce definite and accurate results. It utilises methods similar to those of science, but the conduct of an evaluation and the utilisation of evaluation results are governed by principles characteristic of administration, and also affected by the cultural characteristics, such as reluctance to criticise others in oriental cultures. Achieving a perfect evaluation system will require a combination of science and art.