

## The Establishment of Performance Evaluation System of NSFC & High-speed Railway Joint Fund

Yuan An<sup>1</sup>, Jing Chang<sup>1</sup>, Xueshan Li<sup>1</sup>, Yun Liu<sup>2</sup>, Yuhan Gao<sup>1</sup>

<sup>1</sup>China Academy of Railway Sciences, Beijing, China

<sup>2</sup>Beijing Institute of Technology, Beijing, China

**Abstract**—Highspeed Railway Joint Fund, jointly established by National Natural Science Foundation of China (NSFC) and China Railway Corporation (the former Ministry of Railways), aims to play the guiding and coordinating role of NSFC, to promote industry-university-research combination, and to upgrade the independent innovation capacity of railway industry in China. Based on the analysis of preliminary overview, use and management, and organization and implementation of the joint fund, this paper established the performance evaluation system in three aspects: the consistency between strategy and goal, the performance of organizational management and the efficiency of funded projects.

### I. INTRODUCTION

Since founded in 1986, National Natural Science Foundation of China (hereafter referred as NSFC), as the most significant Chinese funding channel in basic sciences, has played “an irreplaceable role” in promoting the development of basic sciences, the cultivation of scientific talents and the formation of scientific environment in China; and has been well and widely recognized by the science community.

In recent years, NSFC originates the cooperation model with provincial governments, industrial sectors and enterprises to implement joint funds, for the purposes of improving their basic science research and innovation capacity with NSFC’s advanced management mechanism and wide science and technology resources. NSFC & High-speed Railway Joint Fund (hereafter referred as the Joint Fund) was set up in 2011 by and between NSFC committee and China Railway (then Ministry of Railway), so as to attract and coordinate social scientific resources to participate in relevant basic sciences research under the background of development of high-speed railway; and to improve the independent innovative capacity of Chinese railway industry.

NSFC has kept increasing the funding amount and diversifying the program types, which generates the urgent demand for its performance evaluation. To improve the relative undeveloped performance evaluation system, NSFC adapts varied program performance evaluation methods posterior to its implement of international evaluation in 2010. The performance evaluation of the Joint Fund could expend the theory and the practices of NSFC performance evaluation system, and lay the foundation for future evaluations.

### II. CURRENT STATUS OF SCIENTIFIC AND TECHNICAL PROGRAM PERFORMANCE EVALUATION AT HOME AND ABROAD

#### A. USA NSF “Performance and Result” performance evaluation

In 1960s, several nations and organizations started to evaluate the government-funded research activities. In 1970s, United States National Science Foundation (NSF) and National Institutes of Health (NIH) set up an evaluation office to explore the performance evaluation method[9]. Under the framework of federal government performance evaluation system, NSF conducted a serial of exploration on research program performance evaluation since 1990s. In accordance with *Government Performance and Results Act* (GPRA) activated by federal government in 1993, NSF was required to formulate five-year strategic plan and annual performance plan, and to issue annual performance report. In 2001 and 2002, federal government issued *President Management Agenda* and *Program Assessment Rating Tool*. All these acts and documents forms an effective system of NSF performance evaluation.

The evaluation subjects are categorized as four levels by NSF: funded project, funded program, Sciences Division, and NSF as a whole. The evaluation commences with reviewing the funded project by comparative evaluation of project itself and relevant management; then raises to a high level to identify the consistency between project outputs with funding program; furthers to elevate the comprehensive strategy according to the above results by external experts from AC/GPA; and finally, to conclude the research activities’ influence on NSF, United States and the overall society[2].

#### B. JSPS performance evaluation

*Governmental Policy Evaluation Act* was activated by National Diet of Japan in 2001, demanding that all governmental institutions to formulate 3-5 years development aims, plans and relevant evaluation system, and to conduct internal review and third-party review. In 2003, Japan Society for Promotion of Science (JSPS) officially transferred from an affiliated institution of Ministry of Education, Science and Culture into Incorporated Administrative Agency (IAA). According to the Act, IAA are obligated to accept performance review based on mid-term development targets and plans by external committees. Under the reform background of independent administrative entities and the requirements of *Governmental Policy Evaluation Act*, JSPS implemented 10-month international review in 2002 by

external evaluation experts based on the materials supplied by JSPS.

Posterior to the international review, JSPS adapted the combination of annual evaluation and mid-term evaluation: to review funded program and issue evaluation report annually; and to conduct mid-term review every 3 to 5 years. In Feb. 2004, JSPS set up internal evaluation committee and external evaluation committee to perform annual evaluation, including internal evaluation and external evaluation[4]. In fact, external evaluation is the re-evaluation of internal evaluation. Ultimately, the external evaluation committee submits the annual performance evaluation report to JSPS Director and issues to the public, to demonstrate the funding performance and to accept public supervision.

C. Current status of NSFC performance evaluation

As the significant platform for independent innovation in China, NSFC’s performance draws attentions of the government and the public[8]. With a relative late start, NSFC keeps developing its management mechanism, expanding the funding scale, and emphasizing the performance evaluation. In 2010, NSFC implemented international performance evaluation for its 25 anniversary, whose results obtained widely positive feedbacks.

In 2012 and 2013, NSFC selects three major instruments design projects to evaluate the performance, In 2014 and 2015, NSFC conducted performance evaluations on surface program and Innovation group program, to explore the performance evaluation framework based on program category. With reference to the performance evaluation experiences of US NSF and JSPS, NSFC has set up the performance evaluation system on three levels as single project- program category - NSFC overall activities[7]. Under the system, single project performance evaluation is undertook as routine management; program category performance evaluation is applied as annual review and supervision; and NSFC overall activities performance evaluation is adapted as 5-year term evaluation.

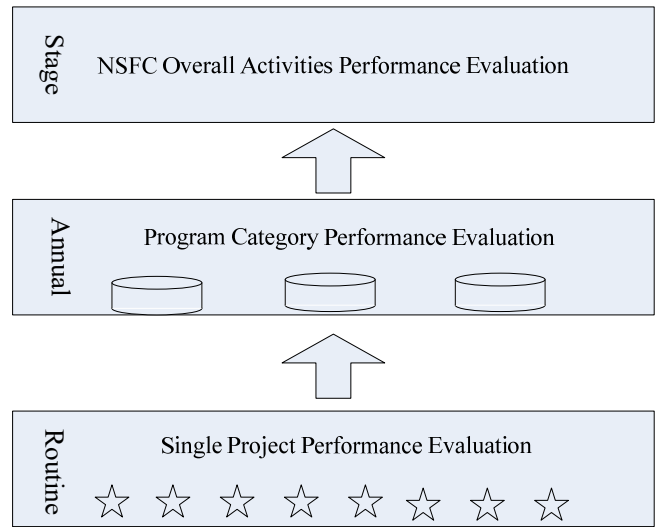


Fig. 1 Performance Evaluation System of NSFC

III. OVERVIEW OF THE JOINT FUND

A. The types and amount of funded program

The Joint Fund invested 120 million RMB from 2011 to 2014, with 30 million annually; funded 52 programs, of which 42 major supporting projects with 114 million RMB and 10 incubation projects with 6 million RMB.

B. Funded sectors

The Joint Fund funded six sectors including railway transportation, public works engineering, communication signals, power supply system of electric traction, high-speed railway train, and disaster prevention and mitigation. 14 programs from the sector of public works engineering was funded; 8 program from the sector of railway transportation. The distribution is as in Fig 2.

TABLE 1 THE TYPES AND AMOUNT OF FUNDED PROGRAM BY THE JOINT FUND

Year	Project Type	Project Number	Funded Amount	In Total
2011	major supporting program	9	2.6-2.7million RMB	30 million RMB
	incubation program	10	0.6 million RMB	
2012	major supporting program	11	2.7-2.8 million RMB	30 million RMB
2013	major supporting program	11	2.7-2.8 million RMB	30 million RMB
2014	major supporting program	11	2.7-2.8 million RMB	30 million RMB
In total	incubation program	10	6 million RMB	120 million RMB
	major supporting program	42	114 million RMB	

Data source: NSFC website <https://isisn.nsf.gov.cn/egrantindex/funcindex/prjsearch-list>

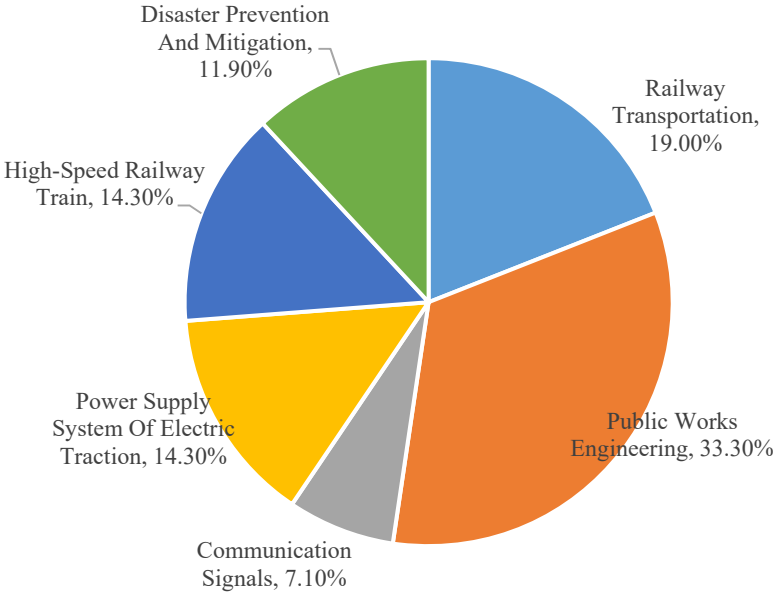


Fig. 2 Sector Distribution of the Joint Fund  
 Data Source: NSFC website <https://isisn.nsf.gov.cn/egrantindex/funcindex/prjsearch-list>

C. Funded Institutions

Most of the funded program are conducted by universities. During the first 4-year implementation of the Joint Fund, 52 programs were carried out by 15 institutions. Southwest Jiaotong University undertook 19 programs; followed by Beijing Jiaotong University with 10 programs, and Central

South University with 8 programs.

According to the statistics of number of cooperation, it is widely participated by other cooperative institutions in the funded programs by the Joint Fund. Most of the cooperation occur between university and university; only a few occur with transportation enterprises.

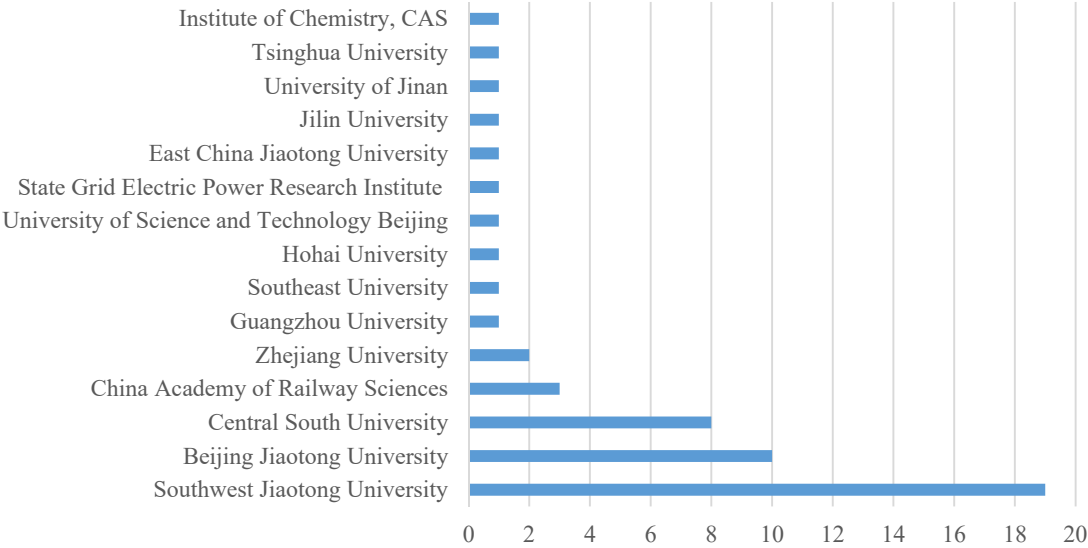


Fig. 3 Funded Institutions by the Joint Fund  
 Data source: NSFC website <https://isisn.nsf.gov.cn/egrantindex/funcindex/prjsearch-list>

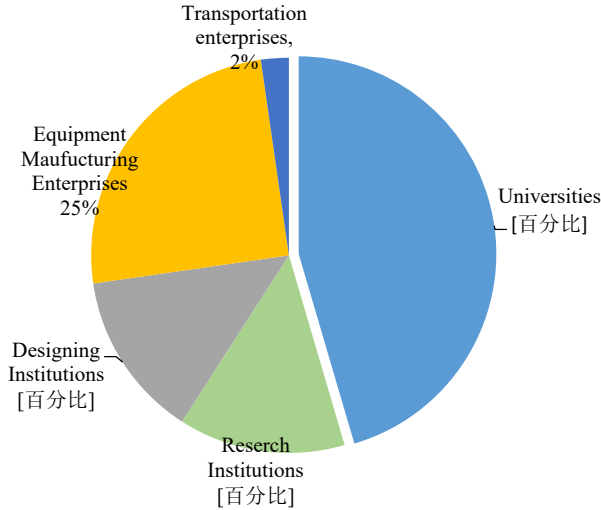


Fig. 4 Cooperative Institution Proportion  
Data Source: NSFC website

<https://isisn.nsf.gov.cn/egrantindex/funcindex/prjsearch-list>

#### IV. THE ESTABLISHMENT OF PERFORMANCE EVALUATION SYSTEM OF THE JOINT FUND

As part of NSFC, the performance evaluation of the Joint fund is complementary the whole performance evaluation of NSFC from the perspective of in program type. General speaking, most of the performance evaluation methods of the Joint fund are categorized as retrospective evaluation[11], whose main purpose is to acknowledge the output of funded programs. However, NSFC performance evaluation takes the comprehensive planning and the organization evaluation as the core targets, closely tied with resource allocation[1]; it is not simply equivalent to review and evaluate of the funded programs and their achievements, or to review single project collectively.

It is demanded that a feasible criteria system should be applied to evaluate the performance of the Joint Fund, driven by the government, the public and the NSFC committee itself. In accordance with Joint Fund’s closely connection with the industrial sector, the Paper categorizes and analyzes detailed content in three dimensions, in order to establish the criteria system for performance evaluation of Joint Fund based on NSFC framework with references to relevant studies and researchers at home and abroad[3][5][6][9].

##### A. Strategic positioning analysis

Strategic positioning analysis evaluates the consistency between the fund and the strategy plan; assesses the strategic demand of the establishment of the Joint Fund for basic science research under the background of high-speed railway development in China; and systematically analyzed the strategic functions of the Joint Fund in improving railway scientific innovation and fund structure.

##### B. Results and influences evaluation

Results and influences evaluation includes the review of output and outcome. The output evaluation focuses on the standards of papers and patents from the funded programs; while the outcome evaluation focuses on the effects of the Joint Fund on following perspectives: high-speed railway construction, equipment manufacturing, operation and management, transportation security and talent cultivation.

##### C. Organization management performance evaluation

Organization management performance evaluation reviews the implementation procedures and organization management during the operation of the Joint Fund.

Based on the principals above, the performance evaluation system of the Joint Fund is as follows:

TABLE 2 THE PERFORMANCE EVALUATION SYSTEM OF THE JOINT FUND

Principal	Key point	Primary Criteria
1 Consistency	1.1 Strategic Positioning	1.1.1 Strategic demand for basic science research due to the high-speed railway development
		1.1.2 Improving Railway Scientific Innovation System
		1.1.3 Improving NSFC Funding Structure
2 Effect	2.1 Output	2.1.1 papers and books
		2.1.2 patents and standards
	2.2 Outcome	2.2.1 Contribution to high-speed railway cutting edge technology
		2.2.2 Supporting effects on high-speed railway construction
		2.2.3 Supporting effects on equipment manufacturing
2.3 Talent Cultivation	2.2.4 Supporting effects on operation and management	
	2.2.5 Supporting effects on transportation security	
	2.3.1 Youth talent cultivation	
3 Organization management	3.1 Funding Procedures	2.3.2 Elite and leading talent cultivation
		2.3.3 Innovative team cultivation
		3.1.1 Prudence of guidance formulation
		3.1.2 Justifiability of reviewing procedure
		3.1.3 Effectiveness on progress management
		3.1.4 Discretion on result evaluation

## V. DATA RESOURCE AND EVALUATION METHODOLOGY

The data resources and major methodologies are as follows:

Literature research: Data and proofs are researched from existing documents and literature including relevant policies and plans of science and technology development, national and regional performance evaluation standards, 12th five-year national science and technology development plan of railway, annual project guidance of Joint Fund, project application forms and annual progress reports of funded projects, etc.

Seminar and survey: Seminars and surveys have been held regarding 44 funded projects, to systematically identify the progress and results of these projects, and collect project managers' suggestions and advises on the management of the Joint Fund. Besides, the evaluation team conducts interviews with the management team in supportive institutions, to seek their advice on the development of Joint Fund.

Questionnaire: Peer expert questionnaire and project team questionnaire are designed and distributed. 11 expert questionnaires are recycled out of 21 submitted, the recycling rate is 52.4%; 33 project team questionnaires are recycled out of 44 submitted, the recycling rate is 75%.

Expert consultancy: Experts in performance evaluation field are invited to discuss the preliminary report. And final reports are finalized in accordance with the advice and feedbacks of experts.

## VI. PRELIMINARY EVALUATION CONCLUSIONS

The performance evaluation on science research programs is highly policy-oriented, where the criteria could affect the evaluation results directly; therefore the diversity of different program types shall be considered when setting the criteria system. NSFC focuses on funding basic sciences, emphasizing the standards of the output and talent cultivation; while driven by the industry, the Joint Fund highlights the evaluation of outcomes in high-speed railway industry.

The paper establishes the Joint Fund's performance evaluation framework "Evaluation topics—Key issues—Evidences"; adapts research methods as text analysis, questionnaire research, and site survey; and provides the evidence chain to support three evaluation topics. It is concluded that the Hi-speed Railway Joint Fund is established in accordance with the national strategy to develop hi-speed railway; obtains progressive results in last

five years; and is well-organized under the close cooperation between NSFC and China Railway.

Specific issues are identified during the evaluation. For instance, the actual results are not ideal of industry-university-research collaboration in most of the funded project; the communication mechanism among project cooperation sides as well as among project teams are not well developed.

The paper believes the Hi-speed Railway Joint Fund shall further to develop the industry-university-research collaboration; to enhance the cooperation with enterprises, to promote the combination between science theory research and practices; to encourage universities and research institutions to apply the Joint Fund together; to provide related experiment terms and facilities; to improve the cooperation with out-of-railway system institutions to insist the direction to attract and coordinate social science resources.

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