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Review on Reform of Research Evaluation in Past Decade

Fang XU
Institutes of Science and Development, Chinese Academy of Sciences, Beijing 100190, China School of Public Policy and Management, University of Chinese Academy of Sciences, Beijing 100049, China,
xufang@casisd.cn

See next page for additional authors

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Abstract

Over the past decade, there have been many scientific and technological evaluation reform documents and great efforts represented by "Three Evaluations" and breaking "Four Only", which have achieved good results but the gap is still huge. This reform has better eliminated the surface problems such as unreasonable evaluation quantity, frequency, and index in the "Three Evaluations". The reform has been initiated in the reward system, talent plan, and project fund management, but is still halfway. The reform of scientific and technological evaluation has not yet achieved a fundamental improvement in the value orientation of guiding scientific researchers to pursue excellence from the bottom, and the problem of new evaluation approach remains to be solved.

Keywords

research evaluation; reform; “Three Evaluations”; breaking “Four Only”

Authors

Fang XU and Xiaoxuan LI

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XU Fang[1], LI Xiaoxuan[2]

1. Institutes of Science and Development, Chinese Academy of Sciences, Beijing 100190, China;
2. School of Public Policy and Management, University of Chinese Academy of Sciences, Beijing 100049, China

Abstract: Over the past decade, there have been many scientific and technological evaluation reform documents and great efforts represented by "Three Evaluations" and breaking "Four Only", which have achieved good results while the gap is still huge. This reform has eliminated the surface problems such as unreasonable evaluation quantity, frequency, and index in the "Three Evaluations". The reform has been initiated in the reward system, talent program, and research fund management, but is still halfway. The reform of scientific and technological evaluation has not yet achieved a fundamental improvement in the value orientation of guiding scientific researchers to pursue excellence from the bottom, and the problems of new evaluation approach remain to be solved. **DOI:** 10.16418/j.issn.1000-3045.20220418001-en

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Research evaluation has been a hot topic in the reform of scientific and technological system for a long time. The past decade has witnessed the greatest efforts in the reform of research evaluation in China, and a number of policy documents and measures have been introduced for the reform of "Three Evaluations" ① and "Four Only" ② (or "Five Only" ③). The reform is mainly carried out in the following two aspects. (1) Reform of research evaluation methods, namely abolishing the mechanical and quantitative evaluation methods relying only on papers, rewards, labels, projects and other aspects, which is called direct research evaluation reform in this paper. (2) Reform of management system issues that have an important impact on the value orientation of scientific researchers and the research evaluation methods, involving the reward system, talent program, and research fund management. In fact, the reform of management system involves breaking the reward only, label only and project only in "Four Only", and are called research evaluation-related field reforms in this paper. This paper reviewed and summarized from two aspects: direct reform of research evaluation and reform of research evaluation-related fields.

It should be noted that the broad sense of research evaluation involves both scientific research and technology. This paper focuses on the research at universities and research institutions, mainly involving scientific research evaluation.

1 Direct reform of research evaluation

Over the past decade, the government reformed the research evaluation from two aspects: "reduction" and breaking "Only". Breaking the "Four Only" or "Five Only", is of great social influence and high popularity. "Reduction", namely reducing the times or frequency of research evaluation, is a major event of research evaluation reform and yet is less known than breaking "Only". Universities, research institutions, and funding agencies have actively explored the methods for research evaluation and achieved certain progress.

1.1 "Reduction" reform

There are diverse problems in research evaluation, one of which is that the evaluation is excessive and complicated, especially in the early 12th Five-Year Plan period. On the one hand, with the continuous increase of national input in science and technology, research funds are mainly used to support research projects, which increased evaluation activities such as project evaluation, mid-term evaluation, and

① Opinions on Deepening the Reform of Project, Talent and Institution Evaluations (ZBF [2018] No. 37).
② Notice of the Ministry of Science and Technology, Ministry of Education, Ministry of Human Resources and Social Security, Chinese Academy of Sciences and Chinese Academy of Engineering on Launching a Special Action of Clearing "Paper Only, Title Only, Education Background Only and Reward Only" (GKFZ [2018] No. 210).
③ Notice of the General Office of the Ministry of Education on Launching a Special Action of Clearing "Paper Only, Label Only, Title Only, Education Background Only, and Reward Only" (JJTH [2018] No. 110).

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Corresponding author: LI Xiaoxuan, E-mail: xiaoxuan@casisd.cn

concluding project evaluation. On the other hand, due to the low proportion of service fees for postgraduates and personnel fees for scientific researchers in the funds for research projects, scientific researchers tend to compete for every project they see, being either to be evaluated or to evaluate others. Meanwhile, evaluation is often used instead of management in the research management departments, and the management of documentary and sci-tech archives is also ranked based on evaluation. As a result, scientific researchers find it difficult to devote themselves to research and sometimes may complain.

In view of the problems mentioned above, twelve organizations, such as the Organization Department of the CPC Central Committee, the Publicity Department of the CPC Central Committee, the Ministry of Science and Technology (MOST), the Ministry of Education (MOE), the Chinese Academy of China (CAS), and the National Natural Science Foundation of China (NSFC), worked together to improve the evaluations of talent, projects and institutions (hereinafter referred to as "Three Evaluations"), and to carry out research evaluation "reduction" reform in 2013 [1]. The relevant organizations sorted out all the evaluation items as required to identify those to be retained, merged or canceled. The activity lasted for a year and a half, when a total of 37 items were canceled, 41 reduced by merger, and 20 delegated to lower levels, realizing an overall reduction rate of 29%. For example, the NSFC did not conduct mid-term inspection for the projects with the duration of less than three years, and combined the financial examination of cost reimbursable project acceptance with that of professional project acceptance. In addition, the "reduction" reform organizations explored solutions to duplicate project proposal and approval. For example, the Department of Management Sciences of the NSFC enhanced coordination with the National Social Science Found to limit items in retrieval to avoid repeated funding. The Publicity Department of the CPC Central Committee agreed with other departments, such as the MOE, that the applicant of the NSFC should not apply for the research project of humanities and social sciences supported by MOE during the same period.

Moreover, these 12 organizations discussed setting up the "no evaluation month (quarter)" for research evaluation each year, trying to ensure that scientific researchers can focus on research for about half a year without being disturbed by the evaluation work. That is, they will neither be evaluated nor evaluate others. However, this measure has not been implemented so far. Despite being innovative, this measure is extremely complex and difficult to be implemented.

In general, the "reduction" reform has reduced the total times and frequency of research evaluation. Nevertheless, since the relationship between research management works (such as the ratio of stable support to project competition) remains unclear, the management of research projects is still rigid. In other words, the total times and frequency of research evaluation can be further reduced, and the environment in which researchers fail to concentrate on research has not been fundamentally changed.

1.2 Reform of breaking "Only"

Quantitative evaluation based on SCI papers was introduced to China in the 1990s and has been gradually employed in the evaluation of research projects, talents, institutions with its conciseness and objectivity [2]. At first, the quantitative evaluation played a role in improving the quantity and quality of China's research output and the international academic exchange capacity. However, the increasing reliance on quantitative evaluation gave birth to a variety of problems. The research evaluation began to focus only on the number of publications, number of citations, and impact factor of the journals regardless of research quality. The phenomenon of evaluation based only on the title, education background, reward, and label is increasingly serious, which arouses concerns from the government, the scientific and technological community, and society [3–5].

In view of this problem, the General Office of the CPC Central Committee and the General Office of the State Council issued the Opinions on Deepening the Reform of Project, Talent and Institution Evaluations (hereinafter referred to as the "Three Evaluations" document) in 2018. The MOST then took actions by Launching a Special Action of Clearing "Paper Only, Title Only, Education Only and Reward Only" (hereinafter referred to as breaking "Four Only"). The MOE further added "Label Only", increasing breaking "Four Only" to breaking "Five Only". Thus, the reform of breaking "Only" in research evaluation was kicked off nationwide. On the one hand, the relevant departments and organizations canceled some unreasonable requirements of "Four Only" in evaluation systems or regulations at all levels according to the reform documents and cleared the restrictive, vetoing, and threshold indexes reflecting "Four Only". On the other hand, departments, institutions, and universities began to explore research evaluation methods conforming to the law of research innovation. In 2020, the MOST issued the Several Measures to Break "Paper Only" in Research Evaluation (Trial) (GKFJ [2020] No. 37) and, jointly with the MOE, issued the Several Opinions on Standardizing the Use of SCI Paper Indexes in Colleges and Universities and Establishing Correct Evaluation Orientation (JKJ [2020] No. 2), advocating to implement the representative work mechanism, which is a good evaluation approach. In 2021, the General Office of the State Council issued the Guiding Opinions on Improving the Mechanism for the Evaluation of Scientific and Technological Achievements (GBF [2021] No. 26) for achievement evaluation reform, requiring that the evaluated achievements include not only the papers published on journals, but also the innovation level, the transformation and application performance and the actual contributions to economic and social development of these achievements, namely the evaluation emphasizing the impact.

In a general view, the reforms of "Three Evaluations" and breaking "Four Only" have been accepted by the scientific and technological community. We conducted a questionnaire survey of 1 140 researchers conducted in 2019. The survey showed that 81% of the respondents agreed with the reforms and 72% believed that the "Three Evaluations" reform hit the problems in China's research evaluation and was pertinent to some extent [6]. However, breaking "Only" does not involve "building". Many researchers question based on what will their work be evaluated instead of papers or projects. They are worried about the greater impact of human relationship on the evaluation due to the lack of objective criteria. The issue of fairness of peer review [7] has not been well solved in China, while it is associated with scientific culture, research level, and research management system and cannot be solved only by breaking "Only".

1.3 Practical exploration of "leading wildebeest"

We have discussed the role of "leading wildebeest" in research evaluation reform in three articles since 2017 [8–10], believing that the advanced research institutions at the academic center should take the lead in the reform of research evaluation. This is actually the application of stratification theory of science [11] in research evaluation, i.e., the theory of stratified evaluation. Some leading research institutions have made practical explorations in research evaluation reform.

In 2018, the NSFC began to optimize the peer review mechanism of research project evaluation based on "Responsibility, Credibility, Contribution" (RCC) [12]. By establishing the credit record system of experts, the RCC evaluation mechanism defines the responsible and irresponsible evaluation behaviors of experts, and explores the positive evaluation methods for contributions of experts while standardizing their evaluation behaviors. Over three years of the pilot, the RCC mechanism has demonstrated a positive role in standardizing the expert evaluation behavior and helping applicants improve the research quality. A survey showed that more than 75% of the respondents believed that the experts gave more serious evaluation and submitted the opinions more timely, and more than 80% thought that the comments were more detailed after the trial of the RCC mechanism [13].

In terms of talent evaluation, a number of well-known universities in China, such as Peking University and Tsinghua University, adopted tenure-track to reform the employment system. For example, the researchers at Tsinghua University can apply for tenure after 5–6 years of tenure-track investigation, and thus be included in the permanent faculty ④. The top peers from around the world evaluate the applicants' research direction, research achievements, potential for further development, and position in the evaluator's institution through anonymous communication. The evaluation is mainly qualitative, with the number of publications as a reference. Eventually, the appointment of tenure-track personnel is decided through collective vote by the academic committee and all the tenure professors in the faculty based on the results of the anonymous communication.

After more than 20 years of endeavor, the CAS has rolled out a path of breaking "Four Only" based on quality evaluation from quantity evaluation, and formed a CAS Model for institution evaluation [9]. Quality evaluation of the CAS is mainly based on the major outcomes. The major outcome-oriented evaluation system [14], also known as the "1-3-5" evaluation system ⑤, was proposed in 2012, including "two links and one basis". The "two links" refer to the expert evaluation link (international evaluation should be adopted once available) and the acceptance evaluation link (focusing on the major output targets). "One basis" means that the annually monitored key indexes of the institute are taken as the basis of the two evaluation links. The "1-3-5" evaluation system delegates more power to the institutes so that researchers can concentrate on research instead of striving for papers, projects and other indexes, thus facilitating the major achievement output of the institute. It should be noted that the institute evaluation is an important management tool of the CAS, which will be constantly improved with the adjustment of CAS's development strategy.

2 Reform of research evaluation-related fields

Breaking "Only" is not just a problem faced by the scientific community or just a reform in research evaluation methods. Paper only, reward only, and label only to be broken involve the reward system, talent program, and research fund management, which are value-oriented batons.

2.1 Reward system

The national sci-tech reward system has undergone many reforms [15]. In 2017, the General Office of the State Council issued the Plan on Deepening the Reform of Sci-tech Reward System ⑥. According to the spirit of the Plan, the following measures are developed to reform the review of national science and technology awards. (1) Optimizing the reward evaluation criteria and reducing the papers and monographs required by the National Natural Science Award from no more than 20 to no more than 8 ⑦. (2) Reducing the awarding items of National Natural Science Award, National Technological

④ Department of Physics, Tsinghua University. Tenure-track system activates the faculty. (2011-11-11). https://www.tsinghua.edu.cn/info/1808/73111.htm.
⑤ "1" means one positioning, "3" means three major breakthroughs, and "5" means five key cultivation directions
⑥ Notice of the General Office of the State Council on issuing the Plan on Deepening the Reform of Sci-tech Reward System (GBH [2017] No. 55).
⑦ Three national awards for science and technology are constantly reduced and the recommendation system plays a key role. (2018-01-08). https://baijiahao.baidu.com/s?id=1588975262855163039&wfr=spider&for=pc.

Invention Award, and National Science and Technology Progress Award (hereinafter referred to as the "three awards") from no more than 400 to no more than 300. (3) Changing the recommendation system and application system into nomination system.

On the whole, the reform of national sci-tech reward system in 2017 has been accepted by all sectors of the society, while opinions of the scientific and technological community have persisted [16,17]. In 2020, the issuance of the three awards was postponed to 2021, and no award was issued in 2021. This is a major signal of further reform of the national sci-tech reward system and indicates that the reform of the national sci-tech reward system remains to be carried out.

A major reason for the unsound reform of the national sci-tech reward system lies in the unclear positioning of scientific and technology awards in China. As the highest award in science, the national science and technology award represents the greatest honor in research, and thus the number of international science and technology awards is generally controlled for selection of the best. For example, the National Medal of Science issues about 10 medals every year. According to the Plan on Deepening the Reform of Sci-tech Reward System released in 2017, nearly 300 awarding items of the three awards are issued every year (including the first and the second prizes). This rewarding is essentially an evaluation of the advanced: the first prize for "excellent" and the second prize for "good". This was reasonable when China was weak in science and technology in the past. However, China has made great progress in science and technology and is emphasizing original and innovative achievements in key technologies, which makes it necessary to restore the original positioning of reward evaluation. Truly original works are rare, and too many awards may lead to awards of varying quality, which affects not only the honor and justice of national science and technology awards but also the orientation toward originality.

The Plan on Deepening the Reform of Sci-tech Reward System issued in 2017 mentioned that we should encourage the sound development of science and technology awards set up by non-governmental sectors, which is a good policy. Social awards should be added in time if the three national awards for science and technology reduce awarding items. At present, social awards have been improved to some extent and yet are not sufficiently encouraged. With many constraints, these awards are much less influential.

2.2 Talent program

In 2010, the State Council issued the Outline of the National Medium- and Long-term Program for Talent Development (2010–2020), identifying 12 major talent programs organized and implemented at the national level. Following this, talent program has become an important part of the work of governments and institutions at all levels to attract talents and display political achievements. According to incomplete statistics, there are more than 20 talent programs at the national level and more than 200 nationwide. In the past decade, the Outstanding Youth Program established by the NSFC in 2012, the Youth Top-notch Talent Program set up by the Organization Department of the CPC Central Committee in 2012, and the Youth Changjiang Scholars funded by the MOE in 2015 have been considered the goals by novice researchers.

The implementation of talent programs, on the one hand, has mobilized the enthusiasm of researchers and institutions, and, on the other hand, resulted in the emergence of label orientation and comparing phenomena, which make researchers hard to concentrate on research. The scientific and technological community calls for greater coordination ⑧, and even cancellation of talent programs. In 2019, the Organization Department of the CPC Central Committee proposed a series of reform measures in the Solidly Promoting the Optimization and Integration Work of Talent Program. The reform measures included reducing the talent programs, avoiding repeated funding in the same period and so on. Well-intentioned though they are, these measures are implemented less well at the ministerial level. (1) In terms of the types of talent programs, talent programs of other departments except a few departments such as the Ministry of Finance, are basically retained. (2) The number of researchers in need of funding has not been decreased, and yet that in a few talent programs has increased. (3) The mutual exclusion measure only plays a partial role and there is a lack of systematic reform measures.

Generally, talent programs act as an incentive for young researchers standing out. However, for the overall environment where researchers can focus on research, such talent programs formed by government departments through "patching" have caused an increasingly negative impact and are not conducive to the fostering of research spirit. The motivation of research talents should depend on the sound talent market mechanism. That is, the value of talents should be measured by the talent market rather than the government endorsement based on talent programs.

2.3 Research fund management

The problems of research fund management [18,19] include the insufficient service fees and personnel fees, rigid management of research funds, and imbalance between competitive funds and stable support. Focusing on these problems, the central government and the Ministry of Finance have made fruitful efforts in the reform of research fund management in recent years.

The Several Opinions of the State Council on Improving and Strengthening Administration of Scientific Research Projects and Funds Supported by Central Finance (GF [2014] No. 11) released in 2014 proposed that we should define the

⑧ Recommendations of CPPCC members in the autonomous region: streamline and integrate the talent programs in our region. (2021-08-13). http://www.nxzx.gov.cn/zxgz/tagz/202108/t20210813_424496.html.

range of expenditures directly related to research project, and adjust the range of service fees by including the social insurance subsidies for temporary employees of the project into the service fees. According to the document, the service fees are included in direct funds and the control over the proportion is completely abandoned. Before issuance of the document, the total proportion of service fees and personnel fees in project funds was generally controlled within 15%. Because of this limitation, researchers had to seek funds to pay the service fees and even strive for unnecessary projects to replenish the service fees. After the document was released, researchers immediately relaxed safe in the knowledge that they had the funding for postgraduates, post-doctors and other personnel. In 2016, the General Office of the CPC Central Committee and the General Office of the State Council issued the Several Opinions on Further Improving the Administration Policies of Scientific Research Projects and Funds Supported by Central Finance (ZBF [2016] No. 50), setting indirect expenses in general project funds at 13%–20% without restricting the proportion of performance income of researchers in indirect expenses. In 2018, the Notice of the State Council about Several Measures for Optimizing the Management of Scientific Research and Improving Scientific Research Performance (GF [2018] No. 25) put forward that the proportion of indirect funds can be further adjusted according to the actual situation for mathematics and other pure theoretical basic research projects. The above documents released in 2016 and 2018 have greatly mitigated the insufficient salaries of researchers. In addition, the document released in 2016 broke the restriction between accounts in the use of funds and delegated the fund budget adjustment right to the responsible research institution, thus greatly simplifying the procedures for fund budgeting and use and saving time.

In general, the reform measures to abandon the control over research fund have been accepted by researchers and improved the environment where researchers can focus on research. However, these measures have not been fully implemented in some aspects. Specifically, (1) research institutions do not well take the responsibility after the right delegation by the government; (2) these measures introduced by the government are not in smooth coordination with inspection, auditing and other standards.

The reform of research fund management has promoted that research evaluation. (1) It has reduced some researchers' motive to compete for every project and corrected the value orientation on project application. Researchers do not need to apply too many projects since the problems of service fees and personnel fees in project funds have been solved. (2) The right value orientation of researchers has, to a certain extent, weakened the tendency of "Project Only" in research evaluation. For example, some research institutions have weakened the practice of taking the projects supported by the USFC as the threshold for awarding a professional title. However, the following new case is worth noting. In 2018, the introduction of the Opinions of the CPC Central Committee and the State Council on Comprehensively Implementing Budget Performance Management (ZF [2018] No. 34) could be a good thing. However, there are some problems in implementation. Some departments or institutions transform performance evaluation that should be directed at macro management into repeated evaluation of gross-roots research institutions and research projects, increasing the burden of researchers.

3 Conclusions and suggestions

The past decade has witnessed the greatest efforts in research evaluation reform and the most documents introduced since the reform and opening-up. This is attributed to two reasons. On the one hand, China has developed from following other countries to keeping pace with and even being ahead of other countries in science and technology, and thus the research evaluation system needs to be changed. On the other hand, research evaluation problems have existed for a long time and are increasingly urgent to be solved. In general, the reform over the past decade has achieved notable results, while the gap is still wide. The reform has eliminated the surface problems such as unreasonable evaluation quantity, frequency, and index in the "Three Evaluations"; the reform has been initiated in the reward system, talent program, and research fund management, but is still halfway; and the reform of scientific and technological evaluation has not yet achieved a fundamental improvement in the value orientation of guiding scientific researchers to pursue excellence from the bottom, and the new evaluation approach remains to be established.

3.1 Performance and experience

(1) The research evaluation reform represented by "reduction" and breaking "Only" has achieved good results and been praised by researchers. In the "reduction" reform, 29% of the evaluation items have been reduced. In the breaking "Only" reform, a large number of unreasonable quantification criteria for evaluation indexes have been eliminated and the representative work system has been accepted. These reform measures are consistent with international research evaluation reforms such as the San Francisco Declaration on Research Assessment [⑨] and stronger.

(2) A number of leading research institutions have shown their initiative and enthusiasm in the reform, demonstrating good models. For example, funding institutions (e.g., the NSFC), universities (e.g., Peking University and Tsinghua University), and research institutions (e.g., the CAS) have explored new evaluation methods that are in line with

⑨ DORA. The San Francisco Declaration on Research Assessment. [2022-04-19]. https://sfdora.org.

international methods in the project, talent, and institution evaluations.

(3) Progress has been achieved in the reform of research evaluation-related fields such as the reward system, talent program, and research fund management, and the value orientation has been corrected to some extent. Great efforts have been made in the reform of research fund management, and researchers have given positive comments. Efforts are being made to reduce the national awards in science and technology, and yet the reform has not been fully completed. The talent program reform has achieved preliminary progress in limiting the number of "labels" of a single researcher, but the efforts are inadequate.

(4) This round of reform is mainly driven by government policies, with a clear and well-arranged policy system. ① A clear policy system. The reform is conducted on "Three Evaluations" by means of "reduction" and breaking "Only". Breaking "Only" involves not only evaluation indexes but also the reward system, talent program, and project fund management. ② A well-arranged policy system. Under the guidance of Opinions on Deepening the Reform of Project, Talent and Institution Evaluations, the relevant organizations such as the MOST immediately developed the action plans for breaking "Only" and other supporting documents, forming policy synergy.

3.2 Problems

(1) An effective research evaluation governance system has not yet been formed. The problems of research evaluation need to be jointly solved by stakeholders, the tasks and responsibilities of which need to be clarified. This round of reform mainly focuses on government policies. However, the tasks and responsibilities of the government and relevant stakeholders, such as funding agencies, research institutions, researchers, publishers, and scientific and technological associations, are unclear. The responsibilities and tasks should have been first determined in the reform. From the perspective of the governance system, the principal reasons for the failure to form an effective research evaluation governance system include the unclear role of the government in the management of research evaluation, the unclear way of delegating power with the maturity of the scientific community, and the unclear way of promoting the self-reliance and self-improvement of the scientific community.

(2) The role played by the scientific community is insufficient. This problem can be considered an extension of the above one, which is reflected in three aspects. ① This round of reform is mainly promoted by the government. Welcomed by the scientific community, the reform is only passively implemented without giving full play to the initiative of the scientific community. As a result, the scientific community does not make new standards until the government has broken "Only". ② The stratified evaluation theory is not fully embodied, since many research institutions have published only a few SCI papers or applied for a few NSFC projects, and have not entered the stage of breaking "Only". ③ The government has implemented unified management and not fully delegated power, while the "leading wildebeest" research institutions dare not make new standards.

(3) Insufficient attention has been paid to the evaluation methods for new research paradigms such as integrated research. The emerging fourth-paradigm, interdisciplinary, data-driven research can be classified as the integrated research paradigm [20]. Compared with the traditional research, integrated research focuses more on problems and discipline crossing, which is a huge challenge for the entire scientific community including China's. Attention to this kind of research is insufficient in China. Research and practice are needed to figure out how to transit from traditional evaluation to evaluation under the more open, more dynamic and thus more complex integrated research paradigm.

There are still a number of issues facing China's research evaluation, such as the fairness of peer review, specialty of evaluation methods, and scientificity of evaluation management (such as preventing disorderly release of the ranking). These issues are associated with other factors, such as scientific culture, research integrity, and research level, being worthy of attention.

3.3 Suggestions

The reform of research evaluation is a long-term process and will still be the focus of China's reform of scientific and technological system. To this end, we put forward four suggestions.

(1) Building a healthy research environment and insisting on breaking "Only". The government should further implement the reform of simplification and decentralization. The specific measures include reducing talent programs supported by central ministries and commissions to fully realize employers' autonomy of personnel placement; clarifying that the three awards are not tools for the selection of the advanced and encouraging non-governmental sectors to set up awards; coordinating policy standards of inspection, auditing and other aspects to implement the reform of research fund management.

(2) Maintaining the achievements in the reduction reform of research evaluation. It is suggested to accurately implement the comprehensive budget performance management and improve the macro system and mechanism of science and technology management through budget performance evaluation to avoid repeated evaluation on grass-roots research institutions and researchers.

(3) Adopting stratified evaluation. Research institutions of different types and at different levels should be encouraged to explore their own evaluation methods. Leading research institutions should be encouraged to undertake the task of pilot exploration and make new standards to play their role as a "leading wildebeest".

(4) Innovating the research evaluation methods following the trend of scientific and technological development. Efforts

should be made to develop the evaluation methods for the new research paradigms such as integrated research, as well as the emerging fields such as big data, so as to strive for a preemptive opportunity in the world.

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XU Fang, Deputy Director of Evaluation Center of Chinese Academy of Sciences, Associate Professor of Institutes of Science and Development, Chinese Academy of Sciences (CAS). Her main research interests are S&T management and evaluation, S&T policy, etc., and she is mainly responsible for the institute evaluation of Chinese Academy of Sciences. In the past five years, Dr. Xu has completed more than 20 tasks entrusted by the Ministry of Science and Technology (MOST), Ministry of Finance (MOF), National Natural Science Foundation of China (NSFC), CAS, and so on. She has published more than 40 papers in European Journal of Operational Research, Omega, Science Research Management and other high-level journals. E-mail: xufang@casisd.cn

LI Xiaoxuan, corresponding author, Director of the Evaluation Center of Chinese Academy of Sciences (CAS), Professor and Doctoral Supervisor of Institutes of Science and Development, CAS. Member of the expert group of non-party people for policy suggestions, the United Front Work Department of the CPC Central Committee, and Member of Beijing Committee of the Chinese People's Political Consultative Conference. His research focuses on scientific research management, including research evaluation, human resource management, and research funding management. In recent years, he has mainly undertaken important scientific research projects from CAS, the National Development and Reform Commission, the Ministry of Finance, the Ministry of Science and Technology, National Natural Science Foundation of China, and so on. He has published many papers in domestic and international journals in management innovation and evaluation area. E-mail: xiaoxuan@casisd.cn

