Could the home institution do better? Application of symbiosis theory in the science foundation community

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ABSTRACT: When symbiosis theory is transplanted from biology to other fields, the application is quite successful and proves that this theory is universal. Similarly, individual researchers, R&D foundations and home institutions or universities, which are the researchers' employers can form a *science foundation community*. In such a community, each part is extraordinarily eager to provide any necessary assistance to help the others, and the mutual benefits cause mutual progress for all members of the community. On the basis of the current working experience, this article presents a discussion of how home institution could play a better role in managing a science foundation, considering that project applications and fund arrangements have soared during the past few years. If the four strategic principles presented in this article are appropriately implemented, it would lead to positive management outcomes in the future.

INTRODUCTION

Applying for R&D funds to undertake scientific projects is a universal activity for researchers. Various foundations appeal to researchers to apply for funds. Meanwhile, the home institution or university, which is the researcher's employer is eager to provide any necessary assistance to help the researchers to obtain the funds. Accordingly, these elements form themselves into a *science foundation community.*

BACKGROUND AND LITERATURE REVIEW

The National Natural Science Fund Committee of the Sixth Committee of the Fourth Plenary Session has presented the overall arrangement of the Twelfth Five-year Development Plan of the National Natural Science Foundation of China (NSFC). The NSFC will *focus more on basis, focus more on frontier, focus more on the strategic direction of talent, and further optimise funding model, and implement the original innovation strategy, the innovative talent strategy, the opening cooperation strategy, the innovative environmental strategy and the excellent management strategy*.

The home institution is an important part of science fund management team, as it is the connecting bridge between the NSFC and the majority of scientific researchers, which serves a communication role, and plays an important role of providing ties and bridges. This article has been written based on a background of sustained high growth in the number of the National Natural Science Foundation funding applications during the *Twelfth Five-year* period, combined with the current science fund management practices. The article presents analysis and discussion on how to further develop the work functions of scientific fund management in the home institution, focusing on development direction in scientific fund management in the home institution as well.

Industrial symbiosis (IS) engages communities of co-located companies in a cooperative management of material and energy flows [1]. Some researchers view these economic activities along with their associated partners (suppliers, customers, government agencies, etc) and the natural environment in which they operate to be complex adaptive systems. For example, industrial eco-parks organised around agricultural products and the pulp and paper industries are relevant areas of application for this filed [2].

Another example has been provided by H.S. Park, who described the Korean national policies and developmental activities of this vision that drive the global trend of innovation by converting existing industrial parks to eco-industrial parks through inter-industry waste, energy and material exchange in Ulsan Industrial complexes, which are the primary and supportive components of the Ulsan EIP pilot project [3]. It is quite obvious that the symbiosis is transplanted and applied universally in other fields. Without any doubt, it would be of significance to implement the symbiosis concept in the science foundation community.

ANALYSIS OF THE HOME INSTITUTION SUPPORTING ROLE AND IMPORTANT STATUS

- Application number and size of the fast growth:

In the annual report of the National Natural Science Fund Committee on government affairs, statistics on application projects and institutions in the past three years, have been presented and are summarised in Table 1 [4]. On one hand, new applications added to existing fund project applications increased significantly as evidenced by the project supporting institutions' situation analysis. On the other hand, some scientific research institutions are growing rapidly. In this background, there are several challenges in light of so many applications, relying on the existing science fund management strategy.

Table 1: Statistics of projects and institutions in past 3 years.

Year	2011	2012	2013
Projects applications	153,800	177,000	161,888
Project admissions	34,836	38,441	38,920
Applications by institution	1,985	2,188	2,223
Admissions by institution	1,350	1,420	1,489

- Diverse roles and significant responsibilities of the home institution:

The 55th Shuangqing Forum meeting of the National Natural Science Foundation Committee presented a concept of Science Foundation Community [5]. The home institution that *...is not only attributed to the management service system of two major systems, but also has a close relationship with the expert system*, is an important part of this community. As an important force of the Science Foundation Community, the home institution will combine the decentralised, independent fund management staff with disciplinary evaluation experts closely together [6].

On one hand, funding applications come from different home institutions; on the other hand, evaluation experts accept the organisation and management of these institutions as well. Relying on these specific individuals, the home institutions can achieve their functions within the Science Foundation Community. In the meanwhile, under the guidance and support of the Fund Committee, the home institution provides some management services, such as coordination and so on, and has become an important pillar of the NSFC. Simply captured: *...the home institutions give full play to the role of bridges and bonds linking the NSFC, the fund applicants and fund reviewers with people that get funded and other scientific and technological workers* [7].

ANALYSIS OF THE HOME INSTITUTION - DISCUSSION AND SOLUTION

- Developing advocacy work on research integrity, striving to put early warning in the prevention of academic corruption:

Currently, the amount and level of research funding has become an important indicator for many research units to assess work performance and conduct performance evaluation among researchers, and some units undertake a quantitative assessment of the amount of funds and on whether the level of the projects is national, provincial or prefectural. The amount of research funding or projects has been more and more associated with the research groups' benefits and individual interests, especially for researchers at some units. If one fails to get funding for a variety of projects, it will not be possible to carry out the usual research work and there will also be some implications in personal income and living standards. Therefore, the outcome of project applications has had an impact on researchers' status and earnings.

In the meanwhile, in current scientific and technological circles, there exists a more serious phenomenon that is the abuse of power and focus on self-interest. The Advisory Project Group of Chinese Science and Technology System and Policy which belongs to the Faculty of Chinese Academy of Science presented an issue *...on the value orientation of research activities that are full of excessive interests* [8]. The project's decision and capital allocation may be determined by a few people and such situations still exist. This can cause problems to some researchers, in that they do not have time to study scientific problems or undertake academic work, due to spending too much time trying to curry favour with leaders and asking the right sector for the funds becomes their top priority. Some people hunt for research funding, so they can hire students or young teachers to work for them. To some extent, they become *research contractors*. It not only makes researchers spend more working time and energy on non-research activities, but also contributes to an unhealthy academic atmosphere and can lead to academic corruption.

Although the National Natural Science Fund Committee has done quite well in dealing with corruption, according to the notice of the Oversight Committee of the NSFC, there are still a lot of applicants who do not take appropriate measures in the process of project application. In order to get approval, they provide inaccurate or wrong information, and the phenomenon of reporting projects, which have already been approved for funding also occurs sometimes. On one hand, it is a very important and very honourable thing for both the applicants and home institutions to get approval from the

Science Foundation; on the other hand, it will also lead to extremely adverse effects on the home institutions' reputation, when misbehaviour of project applicants is revealed during investigations. The home institution is the first hurdle for preventing misconduct. For example, if project team members provide false personal information, the applicants will no longer be eligible to apply. Such things can be avoided through carefully conducted, formal examination of applications by the institution. And, it is necessary to carry out research ethics education work; especially, researchers should develop an awareness of scientific research integrity of young researchers, postgraduates and others who currently take part in research projects. A certain degree of academic corruption and misconduct can be prevented through the conduct of scientific ethics training.

- Creating a comfortable academic environment under national macro policy:

A supporting institution provides researchers with an independent innovation platform to promote scientific research personnel to undertake funded projects. Innovative scientific research has a direct impact on society. In general, a supporting institution should guarantee hardware and other supporting structures for a science fund project. But, basic research work has the characteristics of strong uncertainty and needs to wait for a long time to present tangible outcomes. Due to multidimensional academic engagements, there is a serious shortage of scientific research personnel to conduct research, as academics have to spend a lot of time to deal with all kinds of inspections, appraisals and other non-research activities. An article by a scientific researcher outlines this situation: *I only spend 1/3 of my time doing research, although my days are busy, but in a week, it is rare to be able to sit quietly to read the literature, undertake experiments or write an article. About one-third of the time is needed to apply for the project, a third of the time to deal with all kinds of chores, and the real time spent on scientific research is another one-third* [9].

This also seems to reflect the current situation of scientific research workers, who in order to finish work on time, have to, at the start of project, draw some research conclusions not fully documented and formed, or in order to ensure some specific scientific research results, often follow unreliable directions and finish up with a fast post. From the macro level of national science and technology perspective, this negatively affects progress in general, and impacts on scientific and technological achievements. So, although China has one of the world's top science and technology human resources, and the total number of SCI papers published in this country has been among the world's top, it still cannot answer *the most profound scientific questions* posed by Qian Xuesen, the greatest scientist in China, it is unable to produce world-class masters, and many key technologies and core technologies remain disciplined by others. The high technology manufacture system demands all kinds of technical solutions that have high external dependency, and China is still the world's factory, whose long-term development of national economy could be potentially threatened.

In May 2011, at the Third National Basic Research Work Conference held in Beijing, member of the Political Bureau of the CPC Central Committee, state councillor Liy Yandong, and Vice-chairman of the CPPCC National Committee, Minister of Science and Technology, Wan Gang, reported that: *...to deepen the reform of the science and technology system, it is necessary to create a good environment on the basis of research and development. To build the basis of liberal studies academic environment*, [it is necessary] *to advocate courageous questions, challenge traditional schools of thought, create an atmosphere of discussion, improve and perfect the evaluation method of science and technology* [10].

At the same time, the progress of science and technology of the People's Republic of China law article 56 pronounced that that *the state shall encourage scientific and technological personnel free exploration, having the courage to take risks. Original records can prove risk exploratory of strong, high science and technology research and development project of the science and technology personnel has fulfilled diligently obligations but still cannot complete the project, give tolerance* [10].

Figure 1: The overall performance of institutions.

The annual overall performance of institutions is illustrated in Figure 1. A supporting institution should cooperate with national macro policy and law, internally build academic atmosphere, actively create conditions to promote the

exchange of different academic schools of thought, accept collision, not blindly pursue scientific research achievement or one-sided pursuit of quantity. It should prevent the quick buck attitude and short-term gain philosophy, support integral science fund project contracts that include a great concentration of scientific research and exploration.

FINDING AND IMPLICATION

- Respecting the dedication in the management of funds from administration, and improving the incentive mechanism of the science fund administration team:

National Natural Science Fund Ordinance, a total of 43, including 17 items, and 44 bureaus involved in supporting institutions, in the organisation and planning, application and evaluation, funding and implementation, monitoring and management and other scientific fund important management aspects. They put forward specific requirements for the supporting institution that stresses the important position of the supporting institution in the science fund management process in accordance with the law. However, at supporting institutions, specific administrative transactions are completed by management workers.

The National Natural Science Foundation of China with the good public praise of fair and equitable assessment of the project, has a good reputation in the scientific and academic circles, and enjoys high prestige. Therefore, scientific research personnel in each research institute should pay more attention to the National Natural Science Foundation of China. The enormous enthusiasm to apply for project funds has resulted in a high number of applications submitted to the National Natural Science Foundation of China, and this number is still increasing. But supporting institutions have less staff for scientific research management and, in addition, there are issues to be addressed in relation to other entities, including national social science fund projects, local natural funds, the Ministry of Education, Ministry of Science and Technology projects and other ministries' projects, and all kinds of horizontal topic of management work, etc.

According to the requirements of the National Natural Science Fund Ordinance, supporting institutions should carefully examine and verify the materials or reports submitted by applicants and ensure the authenticity of the submitted materials, rapidly increasing year by year. The application materials of the National Natural Science Fund pose a great challenge to supporting institutions' science fund management staff. Since the number of applications soared, the problems that management staff have to deal with in the process of fund declaration have increased; science fund managers tend to become more focused on the process of scientific fund application and are required to proved explanation and assist, all of which is time-consuming.

Due to the nature of the project fund approval process in relation to the applicant and supporting institution, once the funds are approved, all the kudos for securing the funds go to the applicant's research team, while the scientific fund management work remains in the shadow, and it is not recognised for its contribution to the overall success. A supporting institution should attach great importance to the dedication of science fund management workers behind the main scene, ensure the effective incentive mechanism, care about them from the perspective of their work and life, build a business-minded, hard-working spirited management team for the cause of securing appropriate science funds. This approach is illustrated in Figure 2.

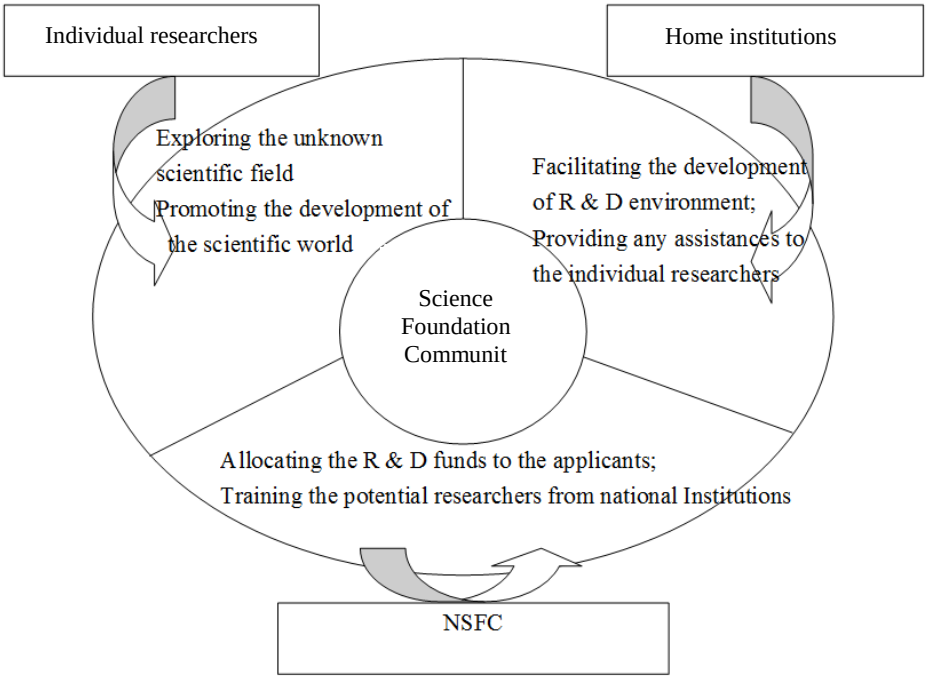

Figure 2: The symbiosis diagram in the *Science Foundation Community*.

- Improving the existing communication network operation mechanism, building an exemplary role for institutions to attract more funds:

According to the provisions of the National Natural Science Foundation management - work regional liaison network regulations, the main task of the liaison network *…reflects the views and suggestions by supporting institutions and researchers for the work of the National Natural Science Foundation. In order to provide consulting services for researchers at supporting institution to apply for natural science funds, and project management support fund management work must be carried out that will also facilitate exchange of experiences, theoretical research and business training* [11]. Obviously, communication networks provide a valuable communication platform for various individual institution, promote exchanges and contacts between the Foundation, the supporting institution, and between various supporting institutions.

Currently, the operating mechanism of the liaison network includes: annual meetings of the Fund Committee and network units, management of conferences, promotion and arrangement of national natural science funds. Within the liaison network supporting institutions conduct a management meeting every two years to strengthen relations and communication, and also organise seminars and training activities, which are high priority. *In the way of organisation and coordination, the important characteristic of communication network management model is the coordinating role of informal relationships (rely on personal relationships) in the informal organisation* [12]. So, it can create conditions for the use of microblogging, on-line video and other modern information technology to support unit managers in liaison actively with scientific research departments and other supporting institutions to share management experience, resolve management problems, master new information and new ways of speeding up management work and improving the quality of management.

According to recent statistics of the National Natural Science Foundation, some supporting institutions submitted on the surface over thousand applications [13], while others only one item. Obviously, there are great differences in the approach of these two kinds of supporting institutions' fund management units. In order to help other supporting institutions to improve, it is necessary to investigate the management practice of supporting institutions with a large amount of applications, to understand how to prepare submissions efficiently and effectively, and how to create a positive work atmosphere conducive to processing a huge volume of work.

CONCLUSIONS

When symbiosis theory is transplanted from biology to other fields, its application is quite universal. Similarly, individual researchers, R&D foundations and home institutions or universities, which are the researchers' employers can form a science foundation community. After all, the NSFC should pay more attention to the supporting institution science fund management team, and strengthen communication between science fund project management staff at all levels, the supporting institution and the Science Foundation.

In such a science foundation community, its various parts should be eager to provide all the necessary assistance to help each other. The home institution should carry out the promotion of scientific research produced ethically, ensure that there is no academic corruption, create a good academic environment, improve science fund management workers' incentive mechanism, promote the implementation of excellent management strategy, unite the fund administration to work together to achieve the national development goal under the guide of symbiosis theory in future.

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