

RESEARCH ON SCIENCE & TECHNOLOGY INNOVATION OF MULTI-CAMPUS UNIVERSITIES IN CHINA

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Abstract

In the last decade the higher education reform in China has made great progress. Multi-campus universities result from the reform of higher education. 'Science & technology innovation of multi-campus universities' has emerged as a new approach in innovation studies. This paper points out that: The innovation achievements of science & technology from multi-campus universities have placed a very important role in the national innovation system of our country. However, in the process of science & technology innovation, these universities, established through consolidation and reorganization, will meet many new challenges and as well as opportunities, such as the difficulties of amalgamations among subjects, conflicts of different cultures among campuses in multi-campus universities, and the difficulties of the integrations of the resources among campuses in multi-campus universities as well. The article focuses on how to improve the construction of science & technology innovation system. And it goes a further to puts forward that we should carry out system innovation started by subject construction, in order to promote the amalgamations among subjects; supported by the constructions of research platform, project and personnel. At last it concludes that only by doing so can the system reforming in science & technology administration be profound continuously, and the mechanism of science & technology administration be innovated constantly.

1. INTRODUCTION

Since 1990's, many Chinese universities have been keen on establishing new campuses. Their purposes are enhancing competitiveness by expanding dimensions, so as to get in tune with the rapid development of domestic society, economy and science and technology (S&T). During the process of rearranging the composition and construction of Chinese universities, guided by the policy of 'co-construction, arrangement, co-operation and combination', there have been over 900 universities merged or reorganized throughout the country, in which 597 universities have been reformed into 267 new universities.[1] Quite a number of multi-campus universities have been built with enormous campuses and complete disciplines, including liberal arts, science, engineering, agriculture, medicine and

so on. They have not only accelerated the growth of Chinese higher education, but also promoted the realization of its Three Major Functions: talents cultivation, scientific research and social service. Therefore, the emergence of such universities is more necessary for the development of themselves and even more necessary for their adaptation to the development of the society. The outside conformations of multi-campus universities are various because of their different ways of production. Most of them were formed through combination and rebuilding, there also were building and expanding and creating and virtual. As to their inside constructions, some divide their campuses by discipline groups, some by grades and also others by mixed methods. In general, compared with single-campus universities, although multi-campus ones enjoy their huge dimensions, abundant resources and grand and novel historical missions, they still subject to many new opportunities as well as new challenges in S&T innovation.

University holds a very important function in knowledge production, proliferation and dissemination, acting as the 1st executive main body in the national knowledge innovation system and one of the inner components of the national innovation system. In order to follow the trend of multi-campus university, it is of especial necessity and urgency to search for the construction patterns of S&T innovation system in multi-campus universities, in accordance with their characteristics.

2. Opportunities and Challenges in S&T Innovation of Multi-campus University

S&T innovation can be defined as the production of new knowledge or new outcome that can promote the development of human society or the evolution of human living patterns, which is created from available S&T knowledge or outcomes.[2] In April 2004, a documentation named “Some Advise on Making Full Use of the S&T Innovation Function of University” was brought out by Ministries of Science & Technology and Education coherently, and then followed by the “Project on S&T Innovation in University” set out by Ministry of Education .

A multi-campus university established by combination can hold many characteristics, such as enormous dimensions, complete disciplines and concentrated talents; and obtain a strong capability in S&T innovation, so that it can play an important role in the national S&T innovation system. It is especial the case for famous universities. Through combination and co-construction, those outstanding ones are experiencing a process of becoming the top-grade research universities in China, even the 1st-class ones in the world. Now, they are ready to play a leading role in both knowledge and technology innovation, and hold the balance in the national S&T innovation system. Such universities as Beijing University, Wuhan University, Jilin University, Fudan University, Shandong University, Huazhong University of S&T, Wuhan University of Science & Engineering, Middle-Southern University, Sichuan University, are largely different with the former single-campus ones. We cannot deny that multi-campus universities do hold quite some advantages in S&T innovation over those single-campus ones, but they will also have to cope with several new problems. So it is the opportunity accompanied with challenge.

2.1 Advantages in S&T Innovation of Multi-campus Universities Maturity in disciplines

Since most multi-campus universities are made up of several former independent ones through combination and co-construction, the basic conditions of S&T innovation can be obtained by the maturity and comprehensiveness in families of disciplines. The reason is that the maturity in disciplines will be beneficial in searching for new point of growth among existing disciplines and giving birth to new cross disciplines. Furthermore, the completeness of disciplines and extensive S&T intercommunion activities could also provide space and chance for S&T innovation. The innovation pattern having been always followed is taking the key disciplines, like science, liberal arts, engineering and medicine, as breaches to accelerate the cross and syncretism among disciplines, so as to build new point of growth. And at the mean while, the combinations between science and engineering, liberal arts and science, medicine and engineering and medicine and science can enhance the overall strength of a university as well. Let's take Jilin University as the first example. It is a key comprehensive university with 115 undergraduate, 234 graduate, 140 doctoral majors and 17 mobile postdoctoral centers, whose disciplines cover liberal arts, science, medicine, engineering, management and so on. Then let's see Zhejiang University: it has 11 discipline groups, including philosophy, economy, law, education, liberal arts, history, science, engineering, agriculture, medicine and management, in which there are 24 national key disciplines. In general, there are 110 undergraduate, 264 graduate, 181 doctoral majors and 39 mobile postdoctoral centers in it. Thus, it can be concluded that a multi-campus university can obtain many evident advantages in S&T innovation, due to its maturity in disciplines and wide range in scientific research and S&T service.

(1) Wide range in S&T services

Since a multi-campus university can get some advantages in social capital, its S&T service has the trend of diversification. Social capital is "a series of identification relationships founded by a single person or an organization (on broad sense) in one community, with inner and outer objects through long-term communication, co-operation and mutual benefit; as well as the historical traditions, value orientations, beliefs and behavioral normal forms lying beneath those relationships." [3] A university is no more than an organization, so it also has a broad relationship network connected with other social parts. Thus, the corresponding social capital can be created from it, too. A multi-campus university can have numerous inner organizations, due to the feature of multiple campuses. The complexity and diversity within them will bring more networks on social relationships, and its productivity on social capital will surely be increased and variegated. Moreover, the social capital related to teachers and students can also be enhanced greatly. If the former parts of some multi-campus university were belonged to different government ministries or economic sectors, then its serving scale tends to be enlarged, which means to serve various of ministries, trades and areas simultaneously. The new Jilin University is composed by Jilin University, Jilin University of Industry, Baiqiu Medical University, Changchun University of Science & Technology and Changchun Post College, while the above five are governed by the Ministries of Education, Public Health, Land and National Resources, and Information Industry separately. Consequently, the serving fields

of the new one have been expanded dramatically in number and scope. Now it is responsible for the needs from not only one, but also numerous trades; not only in Jilin Province, but also throughout the country. It is the diversity in subjects that a multi-campus university services, that brings it with new opportunities and space in S&T innovation.

(2) Benefit for cultivation of innovation talents

It can be said that the advantage of a multi-campus university in S&T innovation owes a great deal to its convenience in the cultivation of innovation talents. After all, the talented persons act as a vital and indispensable element in S&T innovation. And the qualifications to talents have been renovated continuously. The reasons are not only that the new frontier branches of science and cross disciplines have emerged by the growth of cross and syncretism processes in disciplines; but also that many resolutions in social production or social lives would rely on various knowledge and abilities. That means, a college student should not only grasp enough expertise and special skills, but also received extensive cultural training, and even obtain quite strong innovation abilities. Despite of a competitive capability or successful experience in some place, a single-discipline college still may fall back in the competitions of cross and syncretism in disciplines, feel reluctant in the cultivation of talents with integrated qualifications and at last feel hard to keep pace with the social development. While a multi-campus university can make best use of its advantages of maturity in disciplines, attractiveness in teachers groups and influence in academic atmosphere, as the primary conditions in the incubation of compound and innovation talents.

2.2 Challenges in the S&T innovation of Multi-campus University

(1) Difficult in discipline syncretism

In multi-campus universities, having various families of disciplines is an advantage in S&T innovation, but it's not always the case. The large number of disciplines may also distract the limited resources and cause to rebuild at a low level. Taking the advantages of multi-discipline depends on several conditions, including the effective syncretism between disciplines, the congregation of the scientific research resources and the improvement of innovation capability. Generally, there are two types of syncretism between disciplines, the one is tangible syncretism, called 'Hard Syncretism', and the other is intangible syncretism, called "Soft Syncretism". The syncretism in "hard" aspects of disciplines from each campus, such as facilities, assets, faculties, and financial affairs are comparatively easier than that in 'soft' ones like the connotation development or the research directions of disciplines. Although some multi-campus universities have adjusted their discipline constructions when established, there are still some vital problems unsolved: the concrete configurations between disciplines is hard to process, the growing directions of disciplines have not been focused accurately, the construction of cross-disciplines are far from enough, some disciplines are reconstructed on a lower level, and the research scales of some disciplines are still narrow. All the above phenomena still exist now. A single discipline or a college is still invested by some universities as a main body or unit, but the investment to the cross-disciplines that cross the colleges or departments has not been paid enough emphasis. Moreover, each discipline continues to develop separately. And

the personnel, training and financial systems always far from have been combined together, according to the requirements of discipline syncretism. Some universities have established a series of cross-discipline research centers in order to impel the cross combinations between disciplines. But actually some centers have not been performed effectively. And some concrete mechanisms on discipline cross still have not been established. Historical practice showed that, any hit discoveries and breakthroughs in S&T realm, each progress in any part of the society and the emergence of any new industry, the above matters are all closely related to the innovation outcomes in some disciplines or the growth of the syncretism between disciplines. If a multi-campus university cannot carry out the concrete syncretism of disciplines, it still cannot get the effects of "1+1>2" and cannot break through in S&T innovation, no matter how many disciplines it has.

(2) Conflicts between Campus Cultures

Campus culture is the supreme goal, value criterion, basic faith and behavioral norm, which is formed in the long-term operation a school and obeyed by all teachers and students.[4] In a university, it is the result of long-term accumulation of ideas, spirit, custom and traditional culture. And it is the 'soul' of university organism in the whole operating period. The academic atmosphere, academic tradition and the system culture are the main characteristic of the campus culture. Before combination, each university usually has its own history, and because of the differences in operation tradition, discipline construction and management style. And each one may have formed its own peculiar campus culture gradually. Sometimes, the difference can be obvious enough to block the combination of a multi-campus university. There always exists large gaps in campus culture between science & technology university and literary & science university, between single-discipline university and multi-discipline university, between long-history university and short-history university, among the university belonging to different government Ministries, between formal university and open university, especially between the medical university or arts university and the rest of ordinary vocational universities. After combination, it appears a brand-new challenge in how to reintegrate the operation spirit, operation style, academic tradition, administration style of the former parts into one, which can not be seen in the former single-campus universities.

Because of the culture conflict and excluding between campuses, the talents concentration, resource integration and discipline syncretism in a multi-campus university have been hindered, and will affect the co-operations in the important items, then the innovation capability of the university as a whole.[5] Thus, a multi-campus university should promote the syncretism and coordinate the relationships between commonness and individuality, inheritance and innovation of different campus culture to avoid the cultural conflict while take complete advantage of the radiation effects of campus culture.

(3) The Obstructed Integration of Resources

After the multi-campus university was formed, the resources in each campus, including campus construction, equipments, laboratories, and documents and references materials, etc, have been integrated roughly. But for the distraction of campus, those resources can hardly be shared efficiently; moreover, each campus may have formed its own custom and

benefit consciousness, so it is quite difficult to integrate the resources. A single discipline or department usually has the intention of considering its own benefit firstly, and taking “small but entire” as a guidance in the constructions of disciplines and bases. Under the effect of the “small but entire” concept, all kinds of resources have been formed into distracted and inherent subordination relations in each college and function department. Thus, the using extensions of resources are extremely limited. And the sharing mechanisms of resources are obstructed, so that the resources cannot be used efficiently, which leads to the spare and waste of resources at a big scale. For example, Some researchers have no items to do, but own some superior equipment; meanwhile, some others have a lot of research missions, but they have no necessary equipment. If every research team wants to have its own “small but entire” equipments group, it will cause the massive repetitions purchase and great waste of the limited resources. If the resources in a university cannot be shared, and the limited resources cannot be integrated efficiently, the education standard, research capability and social service function will be affected, and its S&T innovation strength will also be obstructed.

3. The Construction of the S&T Innovation System in Multi-campus Universities

The former S&T innovation systems in a set of multi-campus universities that were newly founded in combination, now need to be reconstructed, because most of them can no longer fit for the requests of new situations. The construction of the S&T innovation system in a multi-campus university should follow the programs and targets of the national S&T innovation system. During this process, the construction of disciplines should be taken as a breach. And the construction of supporting systems, formed by the research platforms, the research programs and the talented teams etc, should be taken as vital problems. In order to make important breakthroughs in the S&T innovation, we still need to carry on the reform in S&T administration system profoundly and continuously, so as to foster beneficial atmosphere for innovation or establishing new businesses.

3.1 Construction of Disciplines as a Breach

A discipline is a basic unit for talents development, a performance domain for S&T outcomes and also a carrier for the S&T innovation. Since a discipline is a basic element in the university, the main talents and resources in a university are attached to them, and then the main-stream culture of the university is also rooted from them. So a multi-campus university should take the construction of disciplines as a breach in the construction of S&T innovation system. According to the needs of knowledge-based economy and S&T innovation, we should firstly clarify the trends of dividing, while crossing, penetrating and comprehending continuously in disciplines during the modern S&T development. Then we should integrate the structure of disciplines by reorganizing the ‘small but entire’ ones, renovating the traditional ones, supporting the new developing ones and the frontier or crossed ones, corresponding the relationships among the key, supporting and related ones, in order to establish a scientific and rational discipline structure with features and advantages that can insure a harmonious and sustainable development of numerous disciplines.[5]

(1) Integrating the disciplines by programming the orientations

An outstanding problem lies in the discipline composition of many multi-campus universities is the excessiveness, decentralization and mismatch of disciplines. It can be ultimately ascribed to the unordered developments among disciplines. A prescription to this is to draw up a scientific and rational program on the orientations of all disciplines, so an effective integration of disciplines in a university can be guaranteed. The successful experience from top-grade universities in the world has proved that, in general, a scientific and rational program on the development of disciplines should satisfy the following conditions: a broad and profound domain of basic disciplines, obvious dominance in applied disciplines, a higher level of humanities and social studies, the leading disciplines with definite and outstanding functions. All of the above can facilitate the cross and penetration among the disciplines.

According to this standard, firstly, we should clarify the status quo of disciplines in each campus, including the research direction, study strength and resource allocation of each discipline. Secondly, we should divide the disciplines by properties into three major groups: the basic, the applied and the technical disciplines. Then we can decide the leading disciplines in each group by the demands of social development and the trends and features in contemporary S&T progress. Thirdly, let leading disciplines take the lead, we can compose some groups with the three types of disciplines from every campus, conforming to the inherent laws and actual situations of each discipline and establish the relationships of supporting and stimulating between the groups. Consequently, all disciplines in a multi-campus university would become an organic system in which each discipline could have an appropriate position and sufficient developing space. So the contradiction resulted from the one-way adjustments on disciplines can be avoided, which is advantageous to the harmonious development of every discipline.

(2). Promoting the cross and syncretism among disciplines by system innovation

In a multi-campus university, the numerous disciplines seemed to have been integrated into an organic community theoretically. But in fact, separate disciplines can't merge into an integral whole spontaneously. Because it is limited by the differences in discipline tradition and culture, the profit consciousness, the traditional habits, attitudes and beliefs of the faculties. To change such situation, the supervisor in a multi-campus university has to regulate his strategy. He should put system innovation into the original discipline structure. For example, teaching, the research and the producing once were organized by departments or college. Now, he should take the discipline groups to be responsible for the establishment of colleges and the arrangement of teaching, while leave the research and production to project seminars or research centers. Such reform measures can clear up the obstacles among original disciplines drastically, and promote the cross and syncretism between disciplines. Thereafter, the S&T innovation capability of a multi-campus university can surely be enhanced, in the processes of expanding the new developing disciplines while consolidating the traditional ones. As to this aspect, a great number of operating techniques are worthwhile for us to learn from, in many famous American universities, such as Harvard University, Stanford University, Pennsylvania University and Columbia

University. Generally, they all share a common ground of a powerful arts & science college, concentrating on graduate in basic disciplines and undergraduate education; as well as several specialty colleges like medical, engineering, agriculture, law, commerce, and normal college, providing only graduate education. In addition, they have established cross-discipline research centers in great quantities, in order to carry on the research and train the graduates under cross-discipline conditions. In this system, a teacher can belong to a college and a research center simultaneously, keeping the flexibility in ascription. Which will benefit the syncretism of disciplines greatly. [6]

3.2 Scientific Research Platform, Research Project and Talents Group Construction as Props

Many multi-campus universities own numerous research platforms, which include organized scientific research bases, creative laboratories (centers), cross-department and cross-discipline research centers and the fictional research institutes (centers). The research bases, key laboratories, research centers and wild-field stations etc., are major contents of ability construction in research development, which is directly related to the level and the scale of S&T innovation, discipline growth, talents attraction and achievements commercialization. Therefore, research bases construction is the foundation of the S&T innovation system construction. Without first-class research bases, S&T innovation can not maintain the sustainable development and top-grade fruits will be difficult to achieve. During the construction period the research bases, we should make use of its advantage and specialty, and pay attention to correct research orientation, cross-discipline syncretism extensive social S&T resources and powers recruit. Through scientific research institution rebuilding, the cross-discipline research centers and cross-school, cross-district scientific research unity could be set up and multi-discipline, multi-technique scientific research institution with strong ability will be formed. And the sharing of base resources and maximization of innovation effectiveness can be achieved by following the principle: open, move, compete, and cooperate.

In addition, the fictional research institute (center) also can be established during the period of the platform construction, for example, Shanghai Education Committee establishes E-research institute facing to local universities. Schools could also set up the cross-discipline research institution that is a fictional organization beyond the foundational department and college and directly led by the president. The research personnel who declare the important project of national class can take the items to research institute (center) enjoy the good treatment during the process of carrying on project research, and also must accept the work test and complete the suited mission at the same time. Through setting up the mechanism, the present tie (the tie of the work) of the relatively rigid personnel mechanism can be solved, and research team organization that can gather and spread inside is shaped according to the vital research items. At last, with the help of the advantages from various different disciplines, research organs is operated at a higher level of university and discipline groups, and have top level breakthroughs in some significant science questions.

Talent group construction is the core contents of the S&T innovation system construction. It needs much attention not only on bring up the excellent and top-notch talent, but also on the construction of the talents structure and steps brigade, in order to form the top-grade level innovation groups, S&T expansion teams and S&T entrepreneur troops. The leader group of academic community is be figured by fetching in quite a lot elites in their self-educated realms and cultivating an group of academy leaders with significant influence at home and abroad. As to those S&T youth talents who have already made great contribution in the field, should enjoy the superior polices, including the incumbency call, treatment and life etc. At the same time, the university should develop the atmosphere which to attract talents by the development of program and its future, gathers talents with advantageous conditions, encourages talents with the excellent environment and policies, so that the current talents can be used well, top-notch talents can be retained, usher talents needed urgently can be ushered, spare talents can be trained.

During S&T innovation spiral rising process, the talented persons in the field are trained by practicing some vital research projects and by taking a part in the concrete innovation activities. It partly create excellent environment for the innovation consciousness and abilities cultivation of the talent, and provide the effective driving mechanism, which can stir up a creative desire of and energy of the talented person. Therefore, multi-campus university can't produce high quality research findings unless the following were to be carried out. The national standard is the direction striving to. Some research groups should be organized, based on taking the advantageous discipline as the group leader, and many discipline crossing. And some vital or series project should be researched around research direction and research target. To moderate rationally the relation of horizontal and lengthways of the research direction, the universities, based on plan as a whole and overall layout, need regulate the proportional structure of the foundation research, application study and techniques development according to the plan. In conclusion, the talented person is the research corpus, the item is the research to rely on, and the base is the battlefield of the research.. Therefore, the talented person, the base and the project are three vital supporting conditions of S&T innovation. In order to create the marking achievement, the university should gather the creative groups based on condensing discipline direction and constructing research platform.

3.3. Ensured by Innovation in S&T Administration System and Operation Mechanism

Concerning multitudes families of disciplines, complicate S&T mechanism and extensive project, and in the construction process of S&T innovation system, multi-campus should improve traditional administration system and method by introducing the new one to initiate S&T administration innovation. All these above are based on the idea that talents, achievements and benefits are benefit from good administration.

Firstly, the S&T administration organization systems of campus and college (department) should be perfected so as to fully arouse the enthusiasm of the college (department) and research institute (centre);a new operation mechanism should be established, including setting up project mechanism directed by market, open and fair project bid mechanism, the

mechanism of dynamic scientific and technological funds and project management , and test mechanism for work load of scientific research.

Secondly, the combination mechanism involving production, teaching and research should be set up, which establish the cooperation between university and enterprise. It gives play to each advantage of university and enterprise, disposes the three of basic research, application study and developing research rationally, and form overall arrangement of basic research orientation, application study base, developing study industrialization. It also set up university S&T campus, which makes producing, teaching and research combine firmly, and achieve benign and inter-dynamic interaction to improve together.

Thirdly, to build the good policy environment for S&T innovation, the encouragement and tied mechanism of S&T innovation should be set up and perfected, and present science and technology appraise mechanism and talents appraise mechanism also be reformed; all kinds of positive factors were to be fully aroused, a variety of latent energy in S&T innovation were to be excavated through setting up various kinds of reward mechanisms; To the behavior unfavorable to S&T innovation, they are also to be restrained and standardized by the form of system .

Fourthly, the university should strengthen the talent team construction of S&T management by establishing service consciousness so as to change service method. To organize and coordinate all the resources in the multi-campus and carry on S&T innovation, the S&T administrators with service consciousness should hold the key of different S&T information market in time by changing the passive administration style into the initiative one.

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